QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

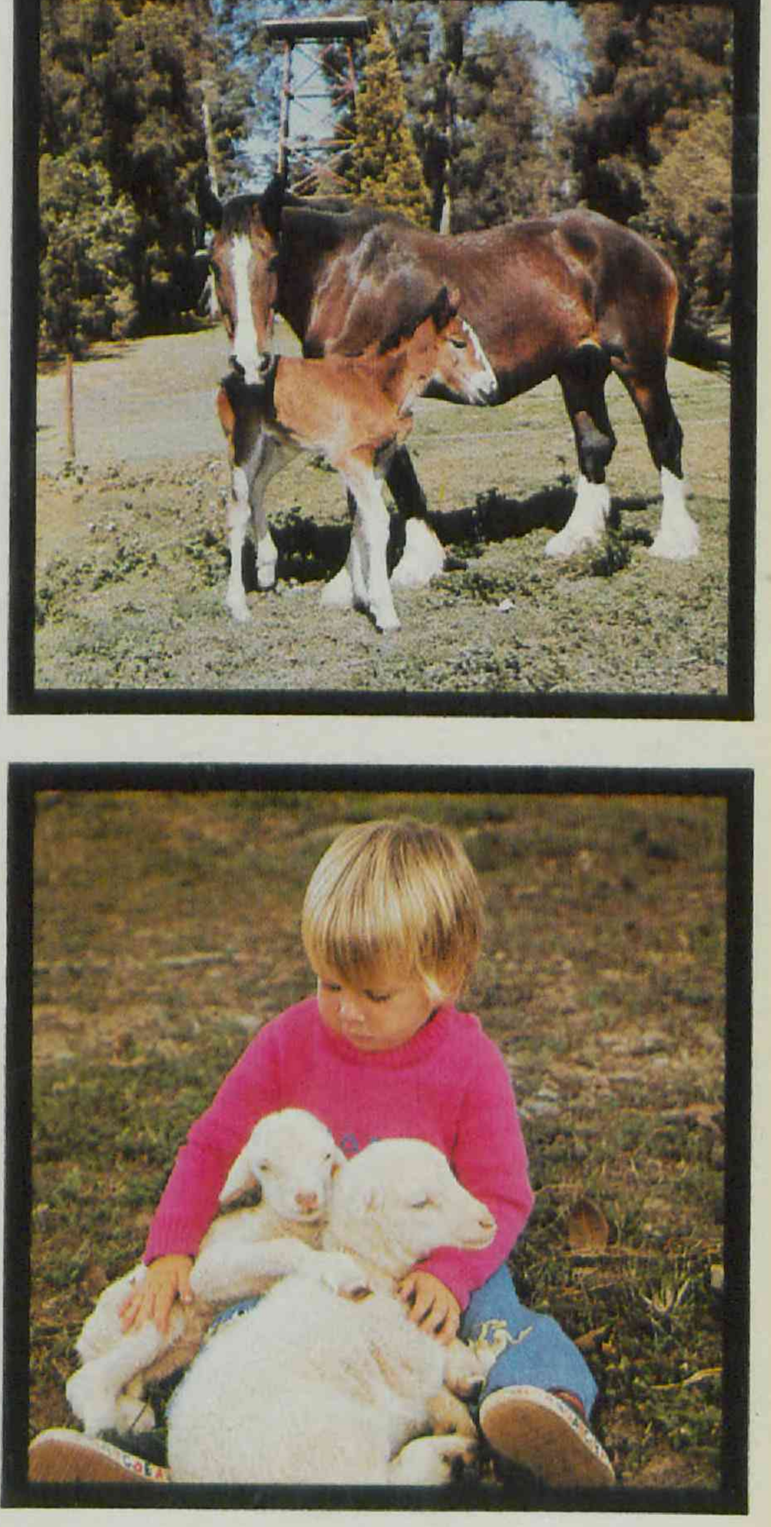






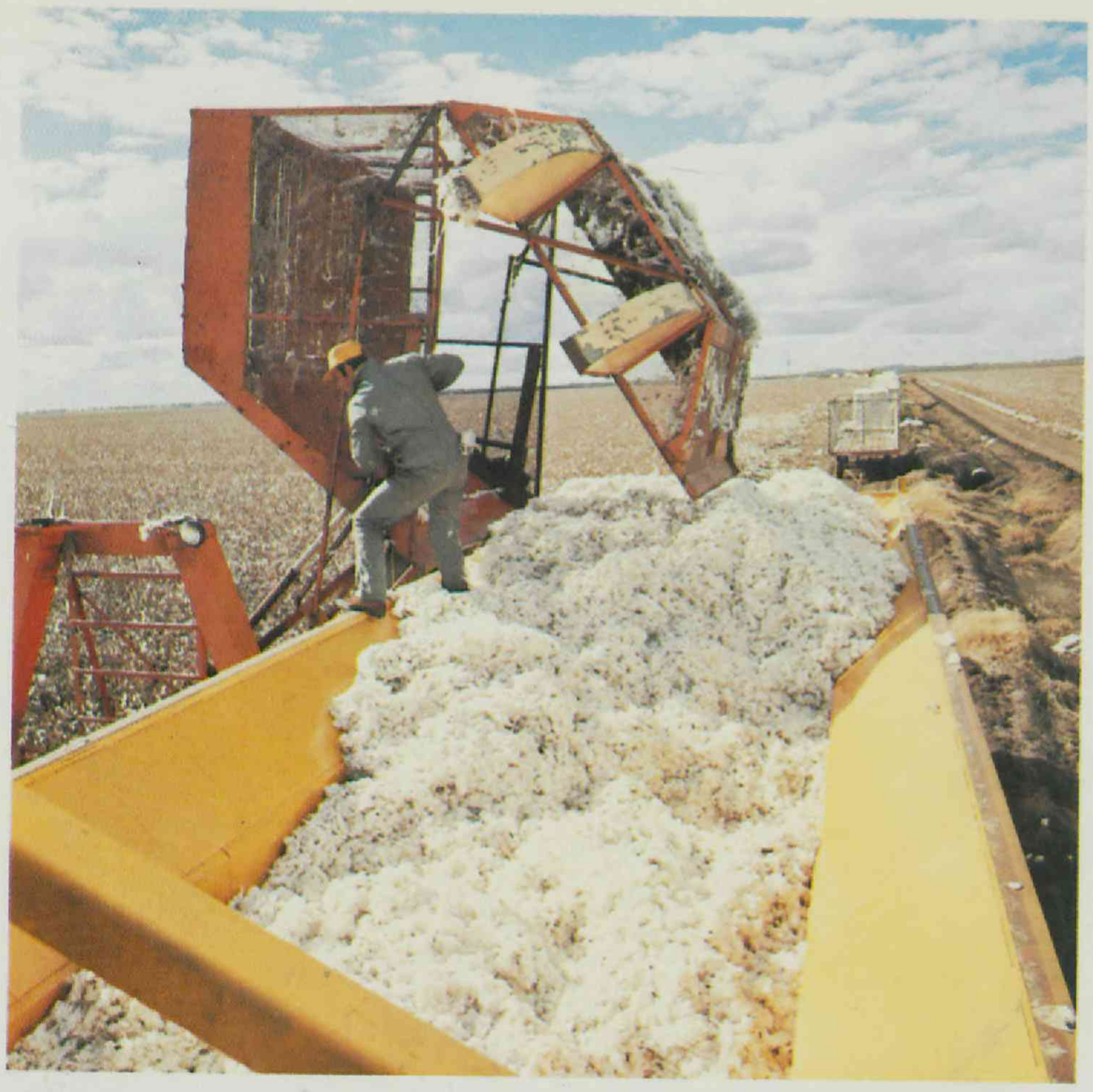






Annual Report 1979-1980

Presented to Parliament by Command



Filling a module-maker direct from a cotton picking machine in the Emerald Irrigation Area. With a production of 26 000 bales, Emerald is now second only to St. George (27 500 bales) as a cotton growing district in Queensland.



Department of Primary Industries officer Mr Keith Bodman (right) inspects a cauliflower crop in the Lockyer Valley. The Lockyer has become Queensland's biggest producer of crucifers, with broccoli, cabbage and cauliflower the main crops.



Using a cone planter for accurate placement of seed in experimental plots. This machine, designed by Department of Primary Industries engineers, speeds up planting time by at least 10 times.

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QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

Annual Report 1979–80

Presented to Parliament by Command

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Organization of the Department

as at 30 June 1980

MINISTER FOR PRIMARY INDUSTRIES ..	Hon. V. B. Sullivan, M.L.A.
DIVISION OF ADMINISTRATION—	
Director-General and Under Secretary	E. O. Burns, B.Com., F.A.S.A.
Deputy Director-General	G. I. Alexander, B.V.Sc., M.S., Ph.D.
Chief Advisory Officer (Administration) ..	N. F. Fox, B.Agr.Sc.
Assistant Under Secretary	J. D. Reardon, A.A.U.Q., A.A.S.A.
Assistant to the Director-General	W. F. Y. Mawson, B.Econ., H.D.A.
Accountant	—
Executive Officer, Research Stations Section	B. A. T. Rodda, B.Agr.Sc., Dip.Agric.Ext.
Executive Officer, Extension Services Section	J. Gibb, B.V.Sc., Dip.Agric.Ext.
General Manager, Agricultural Bank ..	A. Dellit, A.A.S.A.
Director, Information and Extension Training Branch	M. D. Littmann, M.Sc.
Director, Biometry Branch	C. P. Hamilton, M.Agr.Sc., B.Econ., Q.D.A.H.
Chairman, Rural Reconstruction Board ..	W. F. Y. Mawson, B.Econ., H.D.A.
DIVISION OF ANIMAL INDUSTRY—	
Director of the Division	J. W. Ryley, B.V.Sc., F.A.C.V.Sc.;
Deputy Directors	B. A. Woolcock, B.V.Sc.; L. Laws, M.V.Sc.
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Husbandry Research Branch	R. J. W. Gartner, B.Sc. (Director)
Pathology Branch	W. T. K. Hall, M.V.Sc. (Director)
Beef Cattle Husbandry Branch	M. R. E. Durand, M.R.C.V.S. (Director)
Veterinary Services Branch	S. G. Knott, B.V.Sc. (Director)
Sheep and Wool Branch	P. S. Hopkins, M.V.Sc., Ph.D. (Director)
Slaughtering and Meat Inspection Branch ..	B. Parkinson, B.V.Sc. (Director)
Pig and Poultry Branch	F. N. J. Milne, B.Sc. (Director)
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Deputy Director	G. G. Crittall, Dip.Ind.Chem., A.R.A.C.I.
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Field Services Branch	J. G. Miller, B.Agr.Sc., Dip.Bus.Admin., Q.D.D.M. (Director)
Research Branch	Ailsa J. Gillies, M.Sc.App.(Med.) (Director)
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Director	A. Hegarty, B.Sc., Q.D.A.
Deputy Director	H. W. Pauli, B.Agr.Sc., B.E.(Civil)
Development Planning Branch	N. M. Dawson, M.Agr.Sc. (Director)
Soil Conservation Branch	H. S. Briggs, M.Agr.Sc. (Director)
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Marketing Services Branch	W. Kidston, B.Com., A.A.S.A. (Director)
Standards Branch	W. V. Mungomery, B.Agr.Sc. (Director)
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Deputy Director	G. S. Purss, M.Agr.Sc.
Agriculture Branch	J. K. Leslie, Ph.D., B.Agr.Sc. (Director)
Horticulture Branch	N. S. Kruger, M.Sc. (Director)
Agricultural Chemical Laboratory Branch ..	B. J. Crack, B.Sc., M.S., A.A.C.I. (Director)
Botany Branch	R. W. Johnson, M.Sc., Ph.D. (Director)
Entomology Branch	T. Passlow, M.Agr.Sc. (Director)
Plant Pathology Branch	R. C. Colbran, M.Agr.Sc., Ph.D. (Director)

Queensland Department of Primary Industries

Annual Report 1979–80

To the Honourable the Minister for Primary Industries

Sir,

My report for the year ended 30 June 1980 shows that the generally healthy position which Queensland's rural economy exhibited in 1978–79 continued during 1979–80.

The gross value of rural production increased by approximately 11·7% to an estimated $2,466m in 1979-80.

This increase was due principally to the increase in the pastoral sector from $910m to $1 091m, sugar-cane from $383m to $527m and an increase in the gross value of horticultural industries from $147m to $159m. However, the gross value of principal grains declined from $371m to $245m, mainly because of reduced wheat and barley harvests.

The figure below shows the gross value on a proportional basis. As can be seen, the greatest relative changes were in sugar (up from 17·2% in 1978-79 to 20·1% in 1979-80), pastoral (up from 42·6% to 45%), and principal grains (down from 14·7% to 9·8%).

Weather conditions

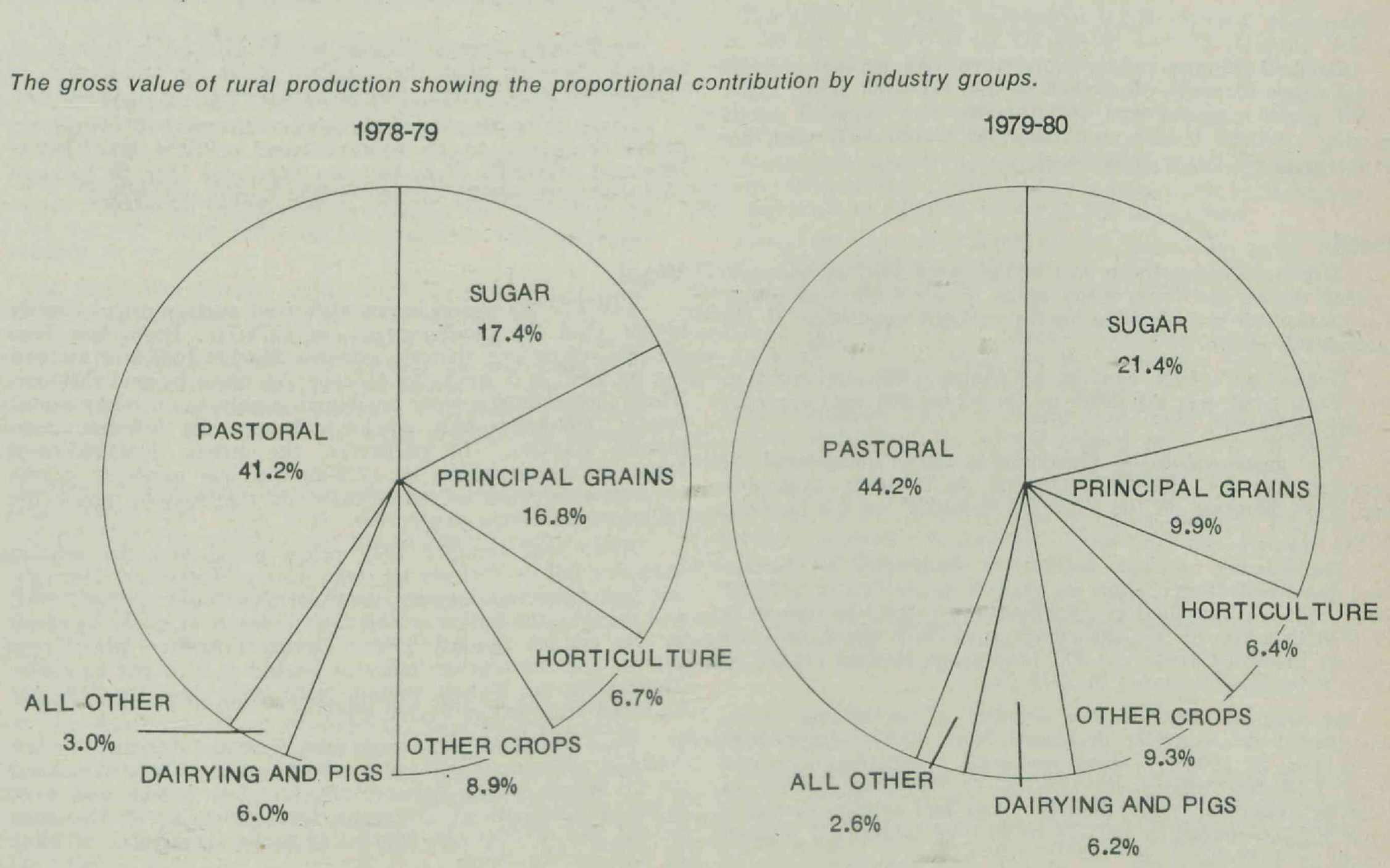
With the exception of the South Coast, Curtis and Warrego districts where below average rainfall was recorded, all east coast and southern border districts of the State recorded above average rainfall during June 1979. However, in July this was true only for the North Coast Herbert and the Central Coast East districts. Throughout the remainder of the State rainfall was light and patchy. Frequent frosts were experienced over the inland areas of the State.

The lack of rain continued during August with all districts reporting below-average falls. This resulted in a deterioration in winter crop prospects with below-average crop yields being expected. During September 1979, patchy rain fell over most southern areas of the State with only spasmodic coastal showers recorded in the tropical areas. A high fire danger then existed throughout the State. The dry conditions favoured winter crop harvesting but delayed land preparation and early plantings of 1979–80 summer crops. Above-average rainfalls were generally received over the south-east quarter of the State and the Upper Western district during November. Elsewhere rainfall was below average.

Rainfall during December, due almost entirely to thunderstorm activity, was low with only the North Coast Herbert district recording above-average falls. Most of the south-east and tropical coastal districts recorded falls of about 50% of average with falls well below average in remaining districts. Over the Christmas-New Year period much of the tropics benefited from fair to good rains bringing welcome relief from the very hot and dry conditions. Tropical Cyclone 'Paul' brought heavy to flood rains to the North and Central Coasts and widespread falls to the Carpentaria districts.

During February, Tropical Cyclones 'Simon' and 'Ruth' brought gales and extensive rainfall to coastal areas. With the exception of the Upper Carpentaria and Central Highlands and Lowlands rainfall totals declined rapidly away from the coast. In general, about average rainfall was received in the tropical areas of the State during March but in the south, the below-average rainfall pattern, which was well established from the beginning of the year, continued.

The gross value of rural production showing the proportional contribution by industry groups.



Early in May 1980, widespread good falls over virtually all of the grain growing areas turned a very poor winter crop outlook into a much brighter picture. Heavy sowings of wheat, barley and oilseed crops are now expected, but follow-up rains will be needed to ensure successful crops.

General pastoral conditions which remained favourable for much of 1978–79 have displayed their characteristic fluctuations this year. Rain has been scattered and, apart from the late autumn falls, hot and dry conditions prevailing in inland areas have resulted in drought conditions over significant areas of the State.

As at 31 May 1980, the shires of Balonne, Bendemere, Blackall, Booringa, Inglewood, Millmerran, Murilla, Murweh, Paroo, Quilpie, Tambo, Tara, Waggamba, Warroo, and parts of the Bulloo, Bungil, and Chinchilla Shires had been declared as drought areas.

Pastures and fodder crops

In most of the far south-western grazing region, drought conditions, low surface water supplies and a poor body of pasture feed prevailed. The body of feed available to stock from both native and sown pastures in the coastal and sub-coastal regions remained variable in both quantity and quality as a result of the scattered nature of the rainfall.

Irrigated lucerne growth was fair-to-good in most districts although hot, dry weather caused some checks in growth and some stands were invaded by grass. Lucerne aphids did not cause any serious problems but some spraying was necessary to control limited outbreaks.



Round hay bales appeared for the first time in the 1980 drought, replacing the long-established rectangular bales.

Dryland summer fodder crops were fully utilized and did not produce regrowth other than in rain favoured areas. Many failed grain sorghum and millet crops also supplied useful grazing. Winter fodder crop plantings, particularly oats, are expected to be larger than usual.

Beef

Although the northern part of the State received adequate rainfall during the year, many areas in the south and south-west were still experiencing severe drought conditions at the end of the period.

Queensland's beef herd at 31 March 1980, estimated at 10 137 000 head, was 3% down on the 10 462 000 head recorded a year earlier.

The gross value of Queensland cattle slaughtered or exported live for 1979-80, estimated at $916·9m, showed a significant increase on the $760·5m recorded for the previous year.

The number of cattle and calves slaughtered in Queensland increased from 3·15m in 1977-78 to 3·30m in 1978-79. Beef and veal production increased from 594 600 tonnes in 1977-78 to a record 662 200 tonnes in 1978-79. Beef and veal exports increased from 271 500 tonnes net shipped weight in 1977-78 to 325 700 tonnes in 1978-79.

By way of contrast, the number of cattle and calves slaughtered in Australia decreased from 12.97m in 1977-78 to 11·35m in 1978-79. Beef and veal production decreased from 2 183 800 tonnes in 1977-78 to 2 017 900 tonnes in 1978-79. However, Australian beef and veal exports increased from 757 700 tonnes in 1977-78 to 813 700 tonnes net shipped weight in 1978-79.

Liveweight auction prices continued to rise until early 1980. In January, a record 115c per kg liveweight was paid for some prime trade bullocks at Gracemere while a record 108c per kg was paid for lot fed steers at Cannon Hill in February. In March, prices fell dramatically with top prices at Cannon Hill for steers and bullocks declining to around 70c per kg in April. However, prices had firmed again by the end of the year with some prime steers attracting top bids of 92·6c per kg at Cannon Hill.

Major reasons for the price declines were: (1) the weakened United States demand resulting from plentiful supplies of pork and poultry meats and prevailing economic conditions; and (2) the forced marketing of cattle because of drought conditions in the south and south-west of the State causing an excess of supply in relation to demand.

The Queensland Meat Industry Organization and Marketing Authority continued its carcass classification trial at the Bundaberg Public Abattoir and commenced another trial at Kilcoy during the year.

The Authority launched its Livestock Market Reporting Services (L.M.R.S.) on 3 March 1980 with reports on cattle, sheep and lambs from Cannon Hill, Toowoomba, Dalby and Gracemere saleyards. It is expected that the service will be extended to the Townsville and Charters Towers saleyards later in 1980. This service in Queensland is compatible with similar services in New South Wales and Victoria and as a result, it will now be easier to make comparisons between the States.

On December 30, United States' President Carter signed into law the Ullman Bill. The law known as 'The Meat Import Act of 1979' replaced the Meat Import Law. Under the Act, total imports of quota meat into the United States were to be restricted to a trigger point of 756 600 tonnes. Australia's share was expected to be 388 100 tonnes.

However, because the United States estimated that the total quantity of quota meat available from supplying countries in 1980 would amount to only 748 400 tonnes, no import restrictions were applied in the 1980 part of the period. Following this announcement, the Australian Meat and Livestock Corporation suspended, for an indefinite period, the entitlement scheme which had operated for Australian exporters of beef and veal to the United States.

The Australian Meat and Livestock Corporation conducted a survey in June 1979 of 2 000 cattle producers throughout Australia. The prime purpose of the survey was to measure the direction and anticipated rate of change in the Australian beef cattle breeding herd. Results of the survey indicated that the national herd for 1979-80 should increase by 9% and by another 3% in the 2 years to June 1982. However, the drought which has occurred in many areas of Australia since the survey has altered these expectations considerably.

Sheep

The number of sheep and lambs slaughtered in Queensland decreased from 1·480m head in 1977-78 to 1·442m head in 1978-79. Mutton and lamb production in Queensland increased from 25 915 tonnes in 1977-78 to 26 528 tonnes in 1978–79.

Preliminary figures released by the Australian Bureau of Statistics showed that the number of sheep and lambs in Queensland at 31 March 1980 decreased by 8·5% to 12 443 000.

Lamb prices fluctuated throughout the period. However, prices continued on an upward trend. Prime lamb prices increased markedly from between 141c and 154c to between 182c and 258c per kg dressed weight during the period.

Wool

The 1979-80 season began with wool auction prices slightly higher than the closing prices in 1978-79. From late September, prices rose sharply, with the Market Indicator increasing by 12% in 3 weeks to 414c per kg clean by mid October. These developments were attributed largely to currency movements, depleted supply stocks and generally buoyant commodity markets. In particular, the strong demand from Japan at the beginning of 1979-80 was due partly to efforts to secure supplies of wool early in the season, given the falling value of the yen.

After mid October 1979 prices eased and the Market Indicator fell to 379c per kg clean during November. Throughout December and January, the Australian wool market firmed and the Market Indicator rose 34c to reach 413c per kg clean by the end of January 1980. During February, prices rose sharply and the market indicator peaked at 433c per kg clean. These were the highest auction prices paid since the 519c per kg clean recorded in March 1973.

Wool auctions were seriously disrupted by an 11-week strike by storemen employed by wool brokers. The strike ended on 21 March 1980. Sales resumed in late March and wool prices declined in all categories throughout April. However, by the end of May the Market Indicator again rose to close at 407c per kg clean.



Crossing cucurbit species in a programme aimed at breeding resistance to watermelon mosaic virus into zucchini.

The Australian Wool Corporation announced a record profit of $24·1m for 1978-79. This was the Corporation's first profit since the introduction of the floor price in 1974 and the highest since the wool reserve prices scheme commenced in 1970.

The first objective measurement wool sale trials were held in Adelaide during February. The new method uses additional objective measurements of staple length, clean colour and a calibrated appraisal of staple strength together with the normal data for fibre diameter, yield and vegetable matter.

The Federal Government announced in July that the minimum floor price for the 1979-80 season would be 318c per kg clean for the Market Indicator. This represented an increase of 20c over last season's floor price. The Government also indicated that the floor price scheme would be continued in 1980-81 at a level not less than 318c per clean kg.

The Australian Wool Production Forecasting Committee estimated Australian shorn wool production for 1979-80 to be 662·2m kg with dead fellmongered and skin wool expected to produce 69·5m kg.

The Australian Bureau of Statistics reported that Queensland's wool production in 1978-79 at 63·8m kg was 8% above the previous year's production of 59·3m kg. Queensland wool production in 1978-79 realized an estimated gross value of $127·4m, which was $20·5m above the value of the production from the previous season. Preliminary estimates indicate a value of $139·5m for all wool produced in Queensland in 1979-80.

During 1978-79, eight auction sales were held in Brisbane. A total of 311 838 bales was sold at an average price per kg of 205·51c, which was the highest average price obtained in recent years.

The number of sheep and lambs shorn increased from 12·9m in 1977-78 to 13·7m in 1978-79. The average fleece weight increased from 4·20 kg in 1977-78 to 4·32 kg in 1978-79.

Because of strong demand in the first half of the 1979-80 season the Australian Wool Corporation became a net seller of wool. Corporation stocks fell to an estimated 118 000 bales at the end of February 1980. After resumption of sales in March following the wool strike, the Corporation had to intervene heavily to restrain the price downturn and become a net buyer. Corporation stocks at the end of May were 225 000 bales.

The United Graziers' Association Sheep and Wool Committee, which represents nearly 90% of the State's wool growers, announced that it favoured the elimination of Brisbane as an auction centre.

Warwick Woollen Mills expected its new mill would be operational around August-September 1980.

Pigs

The number of pigs slaughtered in Queensland decreased from 747 000 in 1977-78 to 721 000 in 1978-79. Despite this reduction, pigmeat production increased from 42 410 tonnes in 1977-78 to 43 030 tonnes in 1978-79. This increase in pigmeat production reflected the continuing trend of slaughtering pigs at heavier weights.

Preliminary figures released by the Australian Bureau of Statistics showed that Queensland's pig population at 31 March 1980 increased to 522 000, up by 35 000 in the year.

From the commencement of the period to early September, prime baconers continued to attract a first advance payment of $1.44 per kg hot dressed weight. During September payments declined to $1.36 per kg. This payment continued until the end of March 1980 when first advance payments fell by 5c to $1.31 per kg. A further reduction of 5c kg also occurred during mid April.

The continued trend of rising feed costs and declining pig prices throughout the period caused producers to maintain a cautious attitude towards any herd expansion.

The number of pigs slaughtered in Australia decreased slightly from 3·7m in 1977-78 to 3·6m in 1978-79. Pigmeat production dropped fractionally from 199 080 tonnes in 1977-78 to 198 562 tonnes in 1978-79.

The Federal Primary Industry Minister, Mr. Nixon, approved special export meat provisions during the year to enable a wild pig and kangaroo processing industry to be established at Goondiwindi.

Poultry meat

Chicken slaughterings in Queensland increased by 13·8% on 1977-78 figures to 28·4m. Queensland chicken slaughterings represent 14·9% of total Australian slaughterings. Total Australian poultry slaughterings increased by 9·3% in 1978-79 to 191·0m, compared with 174·7m in 1977-78.

Dairying

Following a recovery in production during 1978-79, whole-milk produced for all purposes fell during 1979-80 due mainly to worsening drought. Partly as a result of the decline in milk availability, Queensland's butter output is estimated at about 3 500 tonnes compared with 5 651 tonnes in the previous year. Similarly, cheese production fell from 12 125 tonnes in 1978-79 to an estimated 10 700 tonnes in 1979-80.

The export markets for most manufactured products have continued to exhibit some strength with the Japanese cheese market remaining very buoyant. The completion of the Multilateral Trade Negotiations (M.T.N.) and accession to the new International Dairy Agreement will result in further trade benefits to the dairy industry. The first export in 8 years of Australian cheese to the E.E.C. took place during the year as a result of the M.T.N. discussions.

Although Commonwealth marketing arrangements for prescribed manufactured products continued during 1979-80, the system took a different form compared with the previous year. Underwriting of prescribed products continued but the production ceilings which applied for butter in 1977-78 were removed so that in effect all production was underwritten.

MILK ENTITLEMENTS. The Queensland Milk Entitlements Committee continued its programme aimed at distributing market milk entitlements to below-average processors during the year. A total of about 65 000 L of market milk entitlements had been reallocated to the end of May by the Committee. State Government assistance for the scheme now totals $3·6m in loan funds to enable eligible processors to purchase surrendered entitlements.

During the 1979-80 period adjustments with respect to market milk entitlements among processors in south-east Queensland were continued by the Milk Entitlements Committee under the terms of the *Milk Supply Act* 1978-79.

Since the commencement of the milk acquisition and redistribution scheme in June 1978, a total of 57 817 L of market milk entitlements has been acquired from 310 drop-outs among the 15 market milk processors in the region. This milk has been distributed to the 12 processors who were below 60% in the 1977-78 production year. No market milk has been reallocated to producers supplying Metropolitan Milk Producers' Co-op. Assn. Ltd., the Suncoast Milk Producers' Co-op. Assn. Ltd., and the South Coast Co-op. Dairy Assn. Ltd.

A total of $1,394,388.50 was expended in reimbursing drop-out producers for milk entitlements during the period. The Committee made this milk available to processors at a purchase price of $50 per litre.

In addition to this redistribution of drop-out milk, a quantity of 7 064 L of milk was acquired through a growth in the market and this was distributed to the same 12 processors free of charge. It is expected that, by October 1980, all 15 processors will be processing 44·2% and above of total milk as market milk within their franchise milk districts approved under the Milk Supply Act.

Egg industry

The egg industry stabilization scheme continues to have a most important influence on the industry's outlook with a continuation of the matching of egg production to demand. Due to the effectiveness of this scheme, it is expected that returns to egg producers will continue to keep pace with general inflation levels.

It has been generally accepted within the industry that a seasonal quota reduction will occur during the high production period from August to January. A temporary 8% quota cut was applied in all areas of Queensland from July-August 1979 to December-January 1980. The Hen Quota Committee has announced an 8·5% cut in south-east Queensland and 4% elsewhere for the forthcoming August 1980 to January 1981 period. In addition, the quota cuts and reinstatements in south-east Queensland are to be staggered to reduce peaking of demand for hatchery and abattoir facilities.

A controlled transfer of quota scheme has continued to operate. This gives producers the ability to dispose of their quotas separately from the land and enables certain smaller producers to increase their quotas to more economic levels.

It is estimated that egg production in 1979-80 will be 1% below 1978-79. Egg sales by The South Queensland Egg Marketing Board (trading as Sunny Queen Egg Farms) are estimated to be 6% above those for 1978-79. Sales by The Central Queensland Egg Marketing Board are estimated to be 11% above those of 1978-79.

A $2·5 m redevelopment of The Egg Marketing Board's facilities at Red Hill, Brisbane, was completed during the year. The new egg handling facilities are among the most modern in Australia.

Grain crops

During 1979-80, dry conditions were experienced in almost all grain producing districts. The result was reduced yields from winter crops and reduced plantings of summer crops.

Wheat

Queensland's wheat production in 1979-80 is estimated to be 850 000 tonnes from a planting of some 754 000 hectares. Although this planting was slightly higher than last season's, the extremely dry conditions pushed production down by some 57% from the record 1978-79 harvest.

The relative distribution of receivals at State Wheat Board depots by grades in 1979-80 (with 1978-79 figures shown for comparison) was as follows:

Classification	Percentage	
	1979–80	1978–79
Prime Hard	24·9	6·4
No. 1 Hard	24·8	22·2
Australian Standard White ..	37·4	29·0
No. 2 Hard	1·0	7·9
General Purpose	10·2	33·6
Seed	1·7	0·9
TOTAL	100·0	100·0

The export market for Australian wheat remained strong throughout the season. From a record peak on 25 June 1979 of $174 per tonne F.O.R. for shipment in November 1979, the Australian Wheat Board's Asking Price for Australian Standard White wheat remained around $150 per tonne for the remainder of 1979-80.

Exports of Australian wheat this season are expected to reach 13·5 m t compared with 11·525 m t in 1978-79. The Australian Wheat Board expects to clear all major stocks of wheat except some in New South Wales.

Growers' returns from the 1979-80 crop are expected to be in excess of $120 per tonne, port basis.

Barley

Production from the 1979-80 barley crop was forecast at 324 000 tonnes from a sowing of 205 000 hectares. This compares with a record 583 321 t from 232 462 ha in 1978-79. The reduction was due principally to the less favourable climatic conditions in 1979-80 compared with the excellent conditions of the previous season. Continued dry weather forced the abandonment of approximately 7 000 ha before harvesting.

Receivals by The Barley Marketing Board totalled 235 353 t with exports of 156 353 t. The following Table shows Board receivals by relative grade for the 1979-80 season (with 1978-79 figures for comparison):

Grade	Percentage	
	1979–80	1978–79
Malting	56·3	24·5
Manufacturing	25·9	49·5
Feed	15·8	24·6
Seed	2·0	1·4
TOTAL	100·0	100·0

The quality of the crop was excellent, despite the adverse growing conditions. An indication of the quality is that 56·3% of Board receivals were classified as Malting grade, compared with 24·5% in the previous season.

Growers delivering to the Board were paid a first advance of $82 per tonne on all classifications. This compares with $50 per tonne in 1978-79. The higher rate of first advance is due principally to excellent sales prospects for the 1979-80 intake.

Grain sorghum

Grain sorghum production in 1979-80 was estimated at 700 000 tonnes from 326 000 hectares. This compared with 712 908 t from 279 961 ha in 1978-79.

Because of the reduced crop in southern Queensland and increased demand for stockfeed, the Queensland Grain-growers' Association has available for export 200 000 t compared with 250 000 t in 1979.

The Central Queensland Grain Sorghum Marketing Board has estimated that receivals in 1979-80 could reach 240 000 t of which 200 000 t will be exported. Last season 190 000 t were exported from receivals of 200 000 t.

Maize

From estimated sowings of 34 500 hectares maize production in 1979-80 was estimated at 95 000 tonnes. In 1978-79, 34 122 ha produced 111 101 t. Production on the Atherton Tableland is expected to be about 25 000 t, well above last year's 17 000 t.

Returns to growers this season are expected to increase due to improved export market prices.

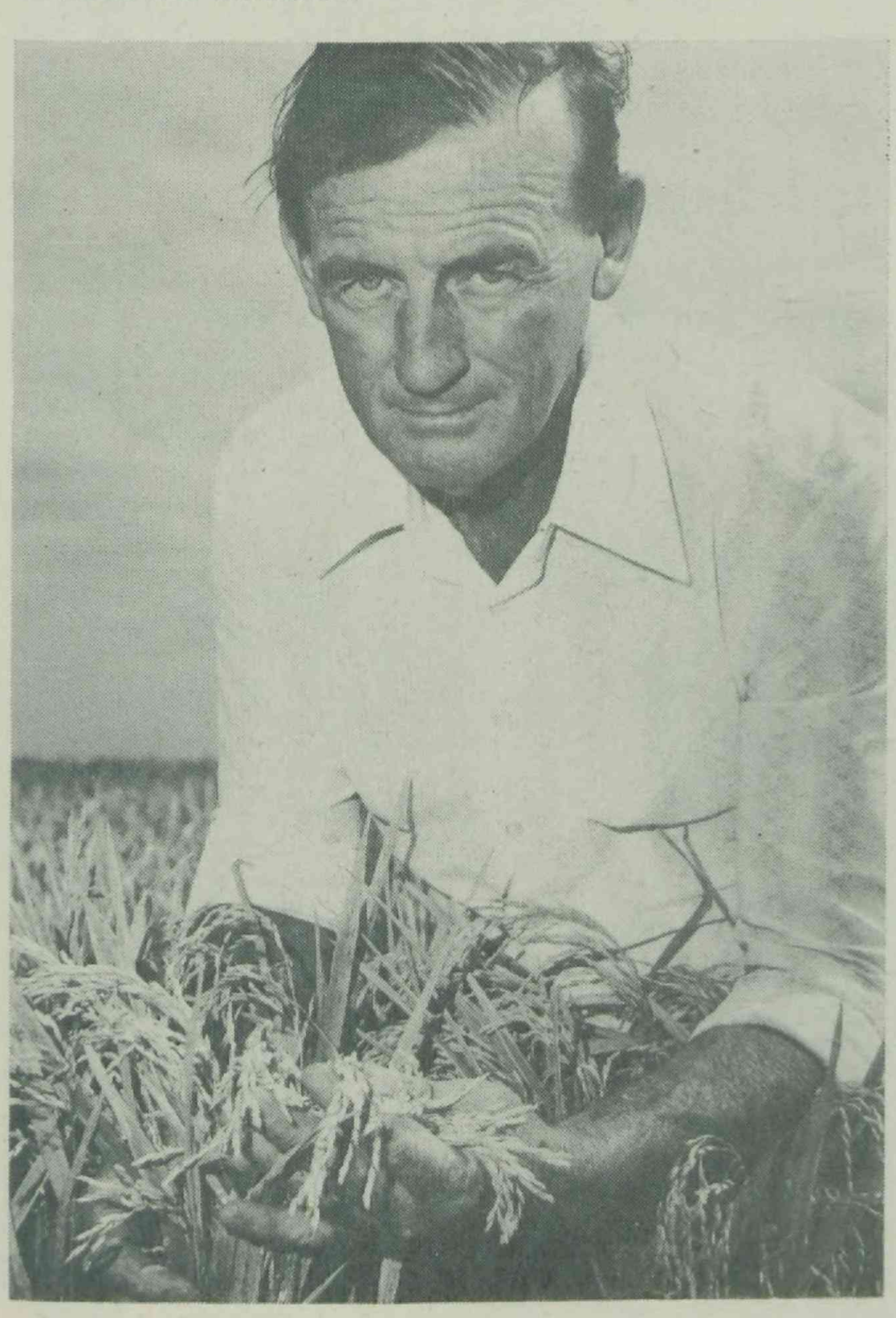
Rice

The rice industry continued its expansion in 1979-80 with further land being cropped under rice in both the Burdekin and the Mareeba districts. Under north Queensland conditions, two rice crops a year were feasible. The 1979 winter rice harvest produced 6 190 tonnes compared with 6 302 t in 1978. The 1979 summer harvest was a record with an intake of 14 730 t. This represented an increase of 63% on the 1979 summer harvest which was the previous record harvest.

An area of 1 605 ha was sown to rice for the 1979 winter harvest compared with 1 441 ha in 1978. For the record 1979 summer harvest, 2 510 ha were sown compared with 1 884 ha for the previous summer harvest. Weather conditions were generally favourable except for the concluding periods of each harvest.

First advance payments made to growers by The Rice Marketing Board were $110 per tonne for the 1979 winter harvest and $100 for the 1979 summer harvest.

The north Queensland rice industry places emphasis on quality as Mr M. C. Finlay, Adviser in Agriculture at Ayr, points out. New developments in rice agronomy and improved varieties promise a sound future for the Burdekin and Mareeba rice industries.



The rice industry is actively seeking export markets for the Queensland product which is recognized as being of high quality. The long grained rice varieties grown in Queensland, known as Bluebonnet and Starbonnet, are in demand on export markets and generally attract a premium price.

Because of the increased production and improved export market prospects the level of the annual Queensland rice quota has been increased from 23 500 t paddy to 30 000 t paddy. The increase is effective from 1 March 1980 and covers the 1980 winter and summer harvests.

Oilseeds

Because of the general lack of planting rains in the Central Queensland Highlands, production of safflower in 1979-80 is estimated at 5 400 tonnes from 9 500 hectares. This compares poorly with the 1978-79 crop which produced 32 619 t from 38 137 ha. Returns to growers in 1979-80 are expected to average about $200 per tonne delivered processors' plants compared with $180 per tonne in 1978-79.

Production of linseed in 1979-80 is estimated at 4 500 t from 5 500 ha, compared with 3 911 t from 3 266 ha in 1978-79. Returns to growers for 1979-80 are expected to approximate $220 per tonne delivered processors' plants compared with $195 per tonne in 1978-79.

Sunflower production in 1979-80 is estimated at 110 000 t compared with 121 611 t in 1978-79. The area planted is estimated at 165 000 ha compared with 161 823 ha in 1978-79. Returns to growers are expected to approximate $240 per tonne delivered processors' plants compared with $230 per tonne in 1978-79.

Production of soybeans in 1979-80 is estimated at 58 500 t from 39 000 ha compared with 65 185 t from 36 430 ha in 1978-79. Returns to growers are expected to be below the 1978-79 record level of $250 per tonne delivered processors' plants.

Other crops

Sugar

The 1979 sugar season was one of contrasts. Heavy rain in north Queensland early in the year caused severe erosion and some crop damage which reduced production in some areas. On the other hand, the crop was drought-affected around Bundaberg, Isis and Maryborough. Overall, the 1979 season can be considered as an improvement over that of the previous year.

At the completion of harvesting, the restrictions imposed under the International Sugar Agreement (I.S.A.) resulted in an estimated standover of 1·3 m tonnes of cane left in fields. Two areas, Burdekin and Central regions, accounted for about 77% of all standover cane in 1979.

A total of 19·858 m t of cane was milled in Queensland during 1979 from which 2·81 m t of 94 net titre (n.t.) sugar were produced. In the previous year 20·136 m t of cane produced 2·75 m t of 94 n.t. sugar.

The 1979 productivity values were 77·77 t of cane and 10·99 t of 94 n.t. sugar per hectare. The corresponding values in 1978 were 84·38 t of cane and 11·52 t of 94 n.t. sugar per ha.

The weighted average c.c.s. content in the 1979-80 season was 13·92 which was 0·45 units or 3·3% above the figure of the previous year.

In Australia, total cane harvested for crushing reached 21·1 m t which produced 2·96 m t of 94 n.t. sugar. This result was well below the 1977 record of 23·5 m t of cane and 3·3 m t of 94 n.t. sugar.

Exports during 1979 remained virtually unchanged compared with 1978 at about 1·89 m t. Japan maintained its position as our largest export market, accounting for almost 750 000 t during the year.

A combination of factors, including production shortfalls, the prospect of consumption exceeding production and a high level of speculative activity, led to a significant price increase during the year. As a result, all I.S.A. quotas were suspended on 11 January 1980 and by the end of February the price had risen to U.S. 21c per pound at which point all special stocks were released. This effectively removed the last measure of control over the international sugar trade.

Subsequently a special session of the I.S.A. re-negotiated all 'trigger point' prices and confirmed a decision to implement the stock financing provisions of the I.S.A. However, no agreement could be reached on new export quotas and, as such, quotas for the next 3 years will depend on the I.S.A. formula which is related to previous export performance.

Although prices have continued to fluctuate, they remain at relatively high levels and the prospects for the short term seem encouraging.

Peanuts

The area planted to peanuts in Queensland for the 1980 season was estimated at 33 500 ha. This is about 3 000 ha or 8% less than the record of 36 601 ha in 1979. Compared with the record peanut area in 1979, a significant decline in peanut plantings occurred in southern Queensland in 1980, with the South Burnett and the Upper Burnett Districts accounting for most of the decrease.

A reduction in plantings of between 12% and 15% was estimated for these districts. In southern Queensland, competition from grain sorghum and soybeans, combined with the high cost of producing peanuts, diverted land use away from peanuts.

Contrary to the overall trend in southern Queensland, this season's planting estimate for north Queensland was 6 500 ha, about 35% up on the previous season's level.

Early projections were for a near-record peanut crop this season, but hot and dry weather conditions extending throughout most of the growing period adversely affected yields in most peanut producing areas, especially southern Queensland. Reflecting this decline in yields, production of peanuts in Queensland for the 1980 season was estimated at about 45 000 t, nut-in-shell, compared with the record of 61 464 t harvested in 1979.

Production in north Queensland, however, was forecast at between 12 000 and 14 000 t. If realized, this record production in north Queensland would represent an increase of between 33 and 55% on the previous peak of 9 028 t in 1979. On the basis of these forecasts, receivals of peanuts by The Peanut Marketing Board during the 1980 season are likely to total 38 000 t, nut-in-shell, compared with the record 53 000 t delivered in 1979.

On the Australian market, sales commitments during this season were equivalent to about 90% of the total receivals, leaving the remainder of the intake for export to established overseas markets, especially New Zealand, the United Kingdom and Asian countries.

Average returns to growers declined during the 1979 season to 36·8c per kg compared with about 40c per kg in 1978. For the 1980 season, growers have received a first advance payment of 30c per kg compared with 26·5c per kg in 1979. In reaction to strengthened prices for peanuts on the Australian market during 1980, average returns to growers could increase moderately for the 1980 season. This increased return to growers could be a major factor in promoting a substantial expansion of peanut plantings in the 1981 season.

Navy beans

Plantings of navy beans in the 1979 season amounted to 4 800 ha which were considerably down on the record plantings of over 10 000 ha in 1978. However, the crop produced 4 794 t with an average yield of 1 000 kg per ha, the highest average yield on record.

As a result of poor seasonal conditions, the 1980 crop is expected to yield only about 1 200 t from 4 500 planted ha.

Returns to growers for the 1979 season are expected to equal the 42·25c per kg received by growers for the 1978 crop.

Cotton

A second consecutive record production of cotton was recorded in Queensland with the crop for the 1980 season forecast at 83 000 bales, compared with the previous peak of 58 958 bales in 1979. The increased production is attributable mainly to an expansion of cotton plantings in all major cotton producing regions of Queensland, particularly the Emerald Irrigation Area.

In all regions except for the Dawson-Callide district, yields have been normal to above average, with crops benefiting from generally favourable growing conditions. In the Dawson-Callide district, yields were reduced by adverse seasonal conditions.

Reflecting generally good weather conditions and successful pest control measures, the cotton crop in the Emerald Irrigation Area increased to 22 000 bales this season compared with the 17 133 bales harvested in 1979. Further substantial increases in cotton production are projected for the region as more land comes into production with the development of the irrigation project. In fact, with the completion of the irrigation scheme in the early 1980s, cotton production in the area is projected at 37 000 bales annually or nearly 70% above the current season's level.

A new record in cotton production is also expected in southern Queensland, with increases occurring both on the Darling Downs and in the St. George district. Cotton production on the Darling Downs is estimated at 17 500 bales or about 8 900 bales more than in 1979. The crop in the St. George district is estimated at 26 500 bales or 61% more than in 1979.

Market prospects for 1980-81 indicate that sales of Queensland-grown cotton on the Australian market will total about 18 000 bales, compared with 15 000 bales in 1979.

Queensland's cotton exports have expanded substantially in keeping with production increases. Exports of cotton from Queensland this season are projected at 65 000 bales or nearly 21 000 bales more than in 1979. Nearly 52 000 bales or more than one-half of the crop had been contracted forward by the end of May 1980, with most of the export business with Asian countries, especially Japan.

World cotton prices strengthened during the first half of 1979-80 in response to a keen international demand for cotton. Prices have been particularly strong on the Asian cotton market. The Liverpool C.I.F. Index for Strict Middling 1 1/16 inch cotton increased from an August 1979 average of U.S. 77·50c per lb. (Aust. 162·26c per kg) to an average in December of U.S. 82·80c per lb. (Aust. 174·98c per kg). The Index during January, 1980 was U.S. 91·60c per lb (Aust. 182·86c per kg) nearly 21% above the previous year's level.

A high-yielding cotton crop in the Emerald Irrigation Area.



Reflecting prospects for record world cotton consumption, reduced exports by several major cotton producing countries and increased commodity speculation, the increase in cotton prices continued into early February. However, prices declined slightly throughout the remainder of February. This downward trend in prices was caused mainly by a significant liquidation of speculative cotton holdings on the New York Futures Market.

Since then, a wait-and-see attitude on the part of cotton buyers, who want to assess more carefully production and consumption prospects for the 1980-81 world cotton season, has exerted pressure on world cotton prices. Thus, the Index has declined from U.S. 94·25c per lb (Aust. 205·03c per kg) on 28 March 1980 to U.S. 89·10c per lb. (Aust 189·24c per kg) early in May 1980.

On the basis of the current trend in world cotton prices, however, the gross revenue for the 1980 cotton crop in Queensland is estimated at about $35m. Average returns to growers in 1980-81 are expected to be about $350 per bale, compared with $276 per bale in 1979-80.

Ginger

Production of ginger from the 1979 crop totalled 5 205 tonnes from 150 hectares. This represents a significant recovery from the previous season's weather-reduced output of 3 570 t from 125 ha.

The area planted for the 1980 crop increased to 214 ha and, as a result, production is expected to rise to around 7 300 tonnes.

A new ginger processing factory at Yandina was officially opened in April 1980. The new factory is expected to increase the processing capacity of the Buderim Ginger Growers' Co-operative Association by about 60%.

Domestic and export sales of ginger products exhibited strong growth in 1979 and this trend is expected to continue in 1980.

Fruit and vegetables

The intake of pineapples for processing during 1979 totalled a record 115 250 tonnes compared with the previous year's total of 88 855 t. Unfortunately, the 1979 summer crop was late in maturing and therefore not available for disposal in some of the best selling months of the year. Nevertheless gross salary payments by the Golden Circle Cannery reached record levels.

A research project at Bundaberg is aimed at mechanizing the production of fresh market tomatoes.



Extremely dry weather at a critical growth period reduced the size of the 1980 apple crop. Apple production from this year's crop is estimated at 1·4m cases compared with a pick of 2·0m cases last season.

The Australian apple and pear industry was the subject of an Industries Assistance Commission Inquiry during the year. The Inquiry was concerned with the question of whether export stabilization assistance should continue beyond the 1980 season. In November 1979, the Commission released a draft report of its findings which recommended that the export stabilization scheme be replaced by export underwriting arrangements. Following public hearings on the draft report, a final report was forwarded to the Federal Government but, as yet, the Government has not announced its decision on the Commission's recommendations.

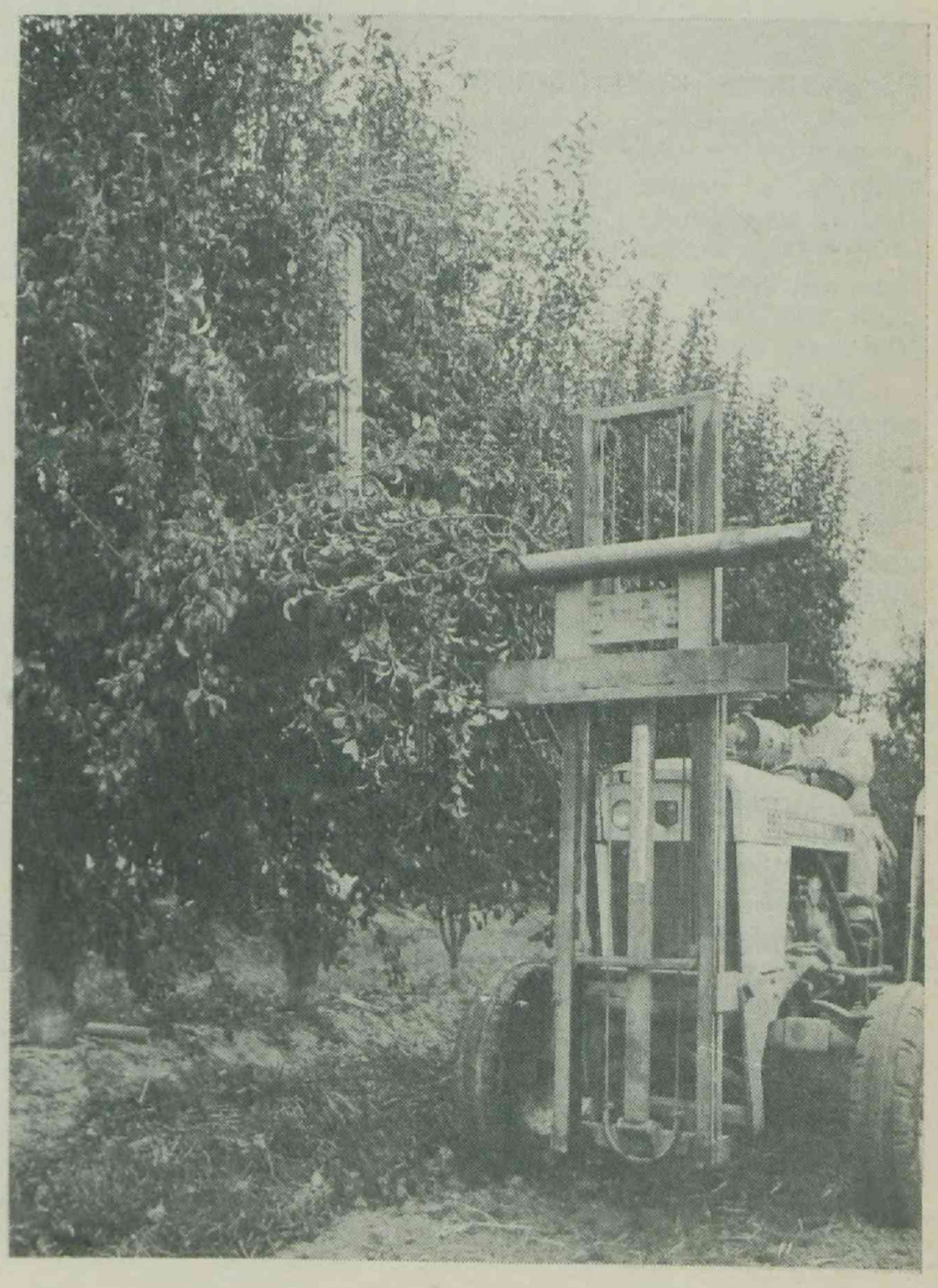
Heavy produce growers voted in favour of joining the Vegetable Sectional Group Committee of the Committee of Direction of Fruit Marketing in a poll conducted in November 1979. Appropriate amendments were made to The Fruit Marketing Organisation Acts in the first session of Parliament in 1980. Integration of heavy produce growers into the Vegetable Sectional Group Committee will enable the interests of the industry to be more effectively promoted.

Officers of the Department were involved in a number of major studies during the year. Following a request which emanated from the 1979 Burdekin Conference held at Ayr, a working party consisting of officers of the Departments of Primary Industries and Commercial and Industrial Development was formed in February 1980 to investigate the horticultural potential of the north Queensland region with particular reference to future developments in the Burdekin district. The working party is expected to complete its report within the coming year.

In October 1979, representatives of the banana industry approached the Department with the proposal that an investigation be conducted into the feasibility of establishing a banana production forecasting system in Queensland. As a result of this approach, a Banana Forecasting Committee consisting of Departmental officers and an officer of the Committee of Direction of Fruit Marketing was formed. The Committee's final report will be available by the end of 1980.

Two important issues concerning trade in fruit and vegetable products arose during the year. In September 1979, the Federal Government received formal advices from the Government of Papua New Guinea that it was considering placing a complete ban on the imports of a wide range of fresh vegetable products.

Mechanical pruning of apple trees may prove another labour-saving practice for apple growers.



As the Queensland vegetable industry would have been significantly affected by such a move, the Department made representations to the Federal Government on this matter. Following numerous meetings between representatives of the Australian and Papua New Guinea Governments, it was decided in April 1980 that the ban would not be implemented.

The Department continued to be represented at meetings of the National Vegetable Panel during the year. The Panel continues to closely monitor the vegetable processing industry in Australia.

The current review by Commonwealth officials into the New Zealand Australia Free Trade Agreement (N.A.F.T.A.) will have important implications for Queensland fruit and vegetable growers. This Department will closely monitor the moves to develop closer economic ties with New Zealand.

Tobacco

Sales of tobacco leaf during the 1979 Queensland selling season amounted to 8 198 461 kg at an average price of 367·5c per kg and a gross value of $30·1m. This compares with 7 579 537 kg sold in 1978 for a gross value of $27·2m and an average price of 358·4c per kg.

The level of the Australian marketing quota for the 1980 selling season was set at 15·1m kg which represented a decrease of 1·3% on the previous season's quota. This has resulted in Queensland's quota being reduced from 8·2m to 8·1m kg. However, the minimum average reserve price for the 1980 selling season has been increased to 406c per kg compared with 377c per kg in 1979.

Both the quota level and price movements are reviewed each year, the former in accordance with movements in consumption and manufacturers' stockholdings and the latter with reference to farmers' costs of production. There is continuing concern in the industry regarding future quota levels as consumption of tobacco products has failed to show any increase over recent years. The concern is particularly relevant as the level of usage of Australian leaf in domestic manufacture is limited to 57% at the present time.

Administration Division

During 1979-80, a major investigation was made into all areas of Departmental operations. This has been part of a long-range plan to provide an appropriate management system to effectively plan, co-ordinate and monitor revenue, expenditure and results achieved in terms of specified objectives.

The primary functions of the Department have been determined as falling within four major areas: administration, research, service and regulatory, and extension.

Activities and projects have been classified into sub-programmes and then grouped into programmes within these areas. Aims and objectives have been established for each sub-programme together with a general description of the activity and the personnel involved, including nomination of officers responsible for management of the various sub-programmes.

Programme management

The Department is co-operating with both the Department of the Public Service Board and the Treasury in the areas of programme management, and accountability and financial control respectively. Because of the complex responsibilities of the Department of Primary Industries, some considerable time will elapse before the adjustments involved in these concepts are fully incorporated into Departmental operations. However, significant progress is being made.

Based on the existing situation in 1979, an investigation revealed 83 discrete areas of activity in the Department. These are defined as sub-programmes which can be logically aggregated into a number of programmes.

As identified, sub-programmes represent a functional unit and as such may cut across the existing structure of Branches and Divisions.

Steps are being taken to convert to an accounting system based on sub-programmes rather than on Branches. It is expected that this will lead to improved financial costing and control and also provide for better assessment of funding over the life of the projects within the sub-programme.

Internal investigation groups were established to examine and review the identified sub-programmes. Such review groups were composed of staff not involved in the implementation of the sub-programmes which they were required to examine.

In their reports, the review teams recommended some staff adjustments. Longer-term manpower plans, based on these recommendations, are currently under consideration.

Establishing the management accounting and other general information systems to give effect to the provisions of the Financial Administration and Audit Act 1977-78 requires a number of major development phases. The activities of this Department are varied and conducted by a variety of professional and technical disciplines at centres dispersed throughout the State. They are funded through several Treasury Funds, some of which are financed by the Commonwealth, others by industry grants and yet others by general revenue collected.

Internal audit

A direct and important effect of the Financial Administration and Audit Act has been the appointment of two internal auditors who are providing information of a supervisory and managerial nature.

Management accounting

It is quite apparent that mangement needs for current, reliable information on which to base its decisions can be met only by the use of computer-based systems. This is a common problem now faced by a number of large Departments. Senior staff of my Department have been actively engaged on an inter-departmental committee assessing possible approaches which may be taken in this regard.

Some of the concepts within the programme-based management proposal are being adopted by the Administration Division in 1980-81. However, present accounting equipment is a major constraining factor.

Transactions recorded in the Trust and Special Fund were subject to a review in 1978-79. As a result of this review, there was some restructuring of the Department of Primary Industries Special Standing Fund and of Trust Funds recording expenditure from the Commonwealth Industry Grants. Details of these are tabulated in the report of the Administration Division.

Animal Industry Division

The year under review, while presenting difficulties due to diminishing resources and severe drought in southern districts, was one of progress in many areas. The highlights of these achievements are outlined in the following paragraphs.

Pastoral industries

The major achievement of the year was undoubtedly the declaration of the brucellosis provisionally free area in northern Queensland. This milestone in a most ambitious undertaking reflects the dedication of officers, and their success in involving the grazing, livestock selling and livestock processing industries. The brucellosis programme made good progress in other areas in spite of drought conditions in southern Queensland, and some 70% of herds have now been assessed. Extensions to the eradication areas were achieved. All of the State, with the exception of an area of the lower Channel country, was under eradication at the end of the period. More than 2 million laboratory tests were carried out as part of the eradication programme. There was a sharp increase in the bacteriological examinations made as part of the associated epidemiological investigations in infected herds.

Two lysosomal storage diseases have been diagnosed previously in Queensland namely mannosidosis in Angus and Angus-derived breeds and toxicity due to *Swainsona luteola* in cattle, sheep and horses. The disease is characterized clinically by staggering, inco-ordination and muscle tremors. These signs are the result of damage to nerve cells in the brain and spinal cord by the abnormal accumulation of compounds due to the lack of specific enzymes. In *Swainsona* poisoning the enzyme is destroyed by the plant toxin and in mannosidosis the enzyme is lacking due to the genetic defect.

A national programme to eliminate carriers of the gene responsible for the enzyme deficiency in mannosidosis has commenced with the support of the Angus Society. A disease similar to mannosidosis, but due to the deficiency of a different enzyme and probably genetic in origin, has been investigated in three Brahman herds. The extent of the disease in the Brahman breed is being established by a random survey of high grade Brahman bulls at slaughter.

To the present the diagnosis of enzootic bovine leucosis (EBL) has been made by haematological examination of blood. Recently, the causative virus was isolated at the Animal Research Institute, Yeerongpilly. This should facilitate the development of serological methods of diagnosis allowing for better definition of the distribution of the disease and assisting in its control.

The capacity of parasites to reach a state of equilibrium with chemicals used against them was again well illustrated during the year. A new strain of resistant cattle ticks, *Bophilus microplus* was detected and is a cause for some concern. The strain shows a high level of resistance to the new group of acaricides, the amidines. Initially, a serious decline in efficacy was shown when those compounds were used at concentrations marginally below recommended strength. More recent investigations, however, have revealed a strain of ticks from a Rockhampton district property which has a high degree of resistance to these compounds.

Field reports in recent months suggest that a pyrethroid resistant strain of buffalo fly has emerged on the Central Coast.

Strains of *Haemonchus contortus,* the barber's pole worm of sheep and goats, have been tested and found resistant to all the broad spectrum drenches registered and available for use in this State. Fortunately, two narrow spectrum products are still effective against this strain. Resistance of the sheep blowfly to organophosphorus compounds continues to limit the duration of their effectiveness.

Interest in electric fencing is still widespread and extension officers have continued to provide advice to enable producers to install fences. In a recent development, staff are investigating electrification of the dingo barrier fence in conjunction with the Stock Routes and Rural Lands Protection Board. If successful, this would greatly reduce the capital cost of upgrading the fence.

A successful discussion series on beef cattle selection has been held in Toowoomba with guest speakers from the Animal Genetics and Breeding Unit, Armidale. An average of 15 producers had attended eight consecutive monthly meetings. Evaluation during the next year will concentrate on how the attitudes of these producers have been changed. A follow-up series is planned.

During the year, in collaboration with the Queensland Meat Industry Organization and Marketing Authority, a series of trials was conducted to investigate the desirability of retaining the present 'dry' curfew system at liveweight selling centres. Results to date would suggest that the present curfew produces artificial liveweight differences between groups of animals with similar carcass weights because of pre-curfew treatment. Allowing stock access to water until post-sale weighing would minimize these differences.

A further series of trials has highlighted the magnitude of liveweight and carcass losses suffered by cattle between mustering and slaughter. It seems that these losses could be as much as 5% of carcass weight. Since many cattle in Queensland spend a considerable time between mustering and slaughter, the loss to the producer, processor and nation as a whole is substantial. As an adjunct to this work, the importance of allowing cattle access to water between arrival at the abattoir and slaughter became apparent. Carcass weight of bullocks was increased by 4% when watered for 3 hours after a long rail journey.

The results of the research programme on the biological control of fly strike have shown that some sheep are biologically resistant and others are susceptible to blowfly strike. An insight into the physiological mechanisms underlying these qualities has been obtained and a method of orally controlling the spread of myiasis developed.

Resistant and susceptible sheep have for many years been categorized on the basis of fleece and conformation characters. The current work has studied the extent to which sheep can spontaneously withstand a larval challenge by initiating their own biological remission. It seems likely that a susceptible animal summons an anaphylatic response to challenge which in turn facilitates the spread of the lesion. The heritability of these characters is currently under investigation.

Blowfly larvae feed on serum exudates. A series of *in vitro* sero-cultures has identified a compound which is capable of interfering with larval development. This compound is non toxic to sheep, and *in vivo* studies have shown that oral administration will provide a measure of blowfly control. This technique could herald a new approach to blowfly control if practical evaluations prove successful in the presence of natural challenge.

Successful attempts to induce biologically changes in fibre diameter have enabled marked progress to be made in the wool harvesting programme. A steroid compound which possesses potent catagenic (shedding) properties in sheep, has produced a single injection treatment which facilitates harvesting. Graded doses of the catagenic steroid can be used to crutch or shear the animals biologically.

The Sheep and Wool Branch has adopted an action plan designed to foster the development of an overseas marketing system for Queensland sheep. Central and north-western Queensland supports a sheep industry which has no reliable market for its end product, the adult sheep. This situation has a profound effect on the viability of the industry in this State. There are more than 6 million sheep in this region, of which very few are sold as cast-for-age stock. Their productivity (wool and lambs) is low after they attain 7 years of age.

Because of the age structure of the flocks, approximately one-third of the sheep in the area are poor producers. Selling these sheep routinely at 7 years of age would markedly improve the profitability of the industry. South-East Asia seems a logical market outlet for these sheep because of its communities' requirements for lean mutton and because of its geographical proximity to outlet ports.

A trial consignment of bone-in mutton carcasses produced at the Sheep Field Research Station, Toorak, is due to be shipped to Singapore in the near future. Other research and development efforts undertaken by the Branch have been designed to assist in getting trial consignments of live sheep into South-East Asia. Consumer reaction will obviously be an important determinant of the future viability of the marketing exercise.

Field studies in northern and southern Queensland have in recent years shown that the supplementation of nitrogen to pregnant and lactating sheep is beneficial in reducing the effect of adverse seasonal conditions. The economic and practical impact of the finding can be best exploited under field conditions by providing urea in the sheep's drinking water. A urea dispenser which provides regular and compulsory intake of urea in water was developed at the Toorak Research Station and is now commercially available.

The results of all individual research projects undertaken at Toorak Research Station in recent years have been collated and developed into a comprehensive extension programme to the sheep industry. This programme is aimed at improving the overall productivity of flocks in the semi-arid tropics. The extension exercise commenced with the Toorak Open Day and subsequently included the presentation of comprehensive audio-visual and poster displays at all the major agricultural and pastoral shows and the State Sheep Show at Roma. A follow-up effort designed to circulate management calendars to individual producers is currently in progress.



During the drought in south Queensland, many graziers fed urea through the drinking water. The method illustrated is through the 'Toorak' dispenser. Other methods included 'bombing' tanks and reticulation systems and a variety of dispensers. A mixture of urea and sulphate of ammonia was used in preference to urea alone.

After several years, investigation work has been completed on the isolation, purification and structural characterization of the toxin of sunflower daisy (*Wedelia asperima*) which has been responsible for serious losses of sheep in north-west Queensland. The structure of the toxin was elucidated by staff at the Australian National University on purified material supplied by the Animal Research Institute. The toxin is related to a group of toxins present in the plant *Atractylis guminifera.* At the Animal Research Institute, preliminary experiments based on indications of this relationship suggested that the toxin had an inhibitory effect on tumours in rats. Further work on this possible beneficial effect on the toxin is continuing at the Institute in collaboration with the Queensland University and the Chester Beaty Cancer Institute in England.

The toxicity of crofton weed, *Eupatorium adenophorum* for horses has been confirmed, the flowering plants presenting the greatest danger. This has been a problem particularly in the Albert Shire for many years. The condition is characterized by severe lung damage, affected horses showing signs of respiratory failure culminating in sudden death.

The significance of oxalates in tropical grasses in the development of oesteodystrophia fibrosa, 'big head' in horses was established and practical means of preventing and alleviating the condition in the field were developed and successfully applied.

Intensive animal industries

In a further move towards establishing industry-based groups, a pig and poultry specialist diagnostic and research group was established within the Animal Research Institute. It is being regarded within the Institute as a prototype of industry-oriented multidiscipline teams investigating problems arising in food and fibre producing animals. Already the pig and poultry group has established a better identity with the industries it services.

Fatty liver and kidney syndrome (FLKS) is a disease of young chickens partly characterized by pale liver and kidneys indicative of high tissue fat content in birds at post mortem. The disease is conclusively diagnosed by definition of changes in the spectrum of liver fatty acids in affected birds. FLKS has occurred sporadically in southern States but had not been conclusively identified in flocks in Queensland. During the year, the accurate typing of the biochemical characteristics of FLKS resulted in the first conclusive diagnosis of the disease in a flock in Queensland. This was further confirmed by the immediate and rapid repsonse of the diseased flock to biotin supplementation.

As part of the comprehensive extension programme to the poultry industries, staff of the Poultry Section have organized producer discussion groups in the major poultry producing areas of the State: the Darlings Downs, near north Coast, Townsville, Cairns and Atherton. Meetings are held bimonthly. The programme content is by producer request and the meetings are organized by Departmental staff. The discussion groups are well received by producers and have proved effective in defining industry problems and efficient in implementation of remedies. The groups have been instrumental in improved information flow among producers.

A most successful Field Day was held on the 29 August 1979 to celebrate the inaugration of the Pig Research Centre, Wacol. The theme of the day was 'Research for the pig producer' and the attendance of 150 was representative of the pig industry and associated industries.

Quarantine and exotic diseases

The report by the Senate Committee on National Resources on the adequacy of quarantine services made a number of important recommendations of vital concern to Queensland. These recommendations are at present under consideration by the Commonwealth Government. One matter of concern is the importation of aquarium fish. Representations have been made to the Commonwealth to introduce more effective controls over this trade.

Big advances in relationship to the screw-worm fly surveillance were made with the appointment of a specialist Veterinary Quarantine Officer to Cairns in early January. This officer's duties include surveillance and monitoring of northern Queensland and the islands of the Torres Strait for this serious parasite and other exotic diseases. Education of the residents of the region on exotic diseases, their economic consequences and their detection is an important part of his duties.

The monitoring programme involves a comprehensive trapping campaign for screw-worm flies using an attractive lure. A secondary aspect will be a dog population and disease control programme of the area involving speying and distemper vaccination clinics. This work is aimed at making the early detection and control of a potential rabies outbreak a less difficult task.

The importance with which screw-worm fly is viewed is further indicated by the fact that Veterinary Officer Mr J. Walthall is currently in the U.S.A. for a 6-month study of the epidemiology and control of the fly.

In the field of exotic disease, a simulated Newcastle Disease outbreak exercise was held in the Brisbane area. This increased staff expertise and pointed out areas where modification of procedures was required. Two senior officers attended an exotic animal disease emergency seminar held at the Australian Counter Disaster College which provided invaluable experience in this field. It was the first such seminar in Australia bringing together all the agencies which would be involved in a major exotic disease episode.

Meat inspection and meat quality

The Committee of Enquiry set up by the Commonwealth Government to investigate meat inspection in Australia recommended the establishment of an Australian Meat Inspection Service (AMIS) which would be responsible for the employment of all meat inspectors in Australia. The recommendations are still under consideration by the Commonwealth and States.

The proposal by a large developer to establish a meat market similar to those existing in Melbourne and Sydney progressed to a further stage during the year. As the proposal conflicted with existing regulatory requirements for butchers' shops, discussions were held with all interested parties to study the implications of the proposal, particularly the impact on standards of conventional butchers' shops. Following the necessary amendments to the Meat Industry Regulations, construction of the retail meat market commenced at Mount Gravatt, Brisbane.

For the first time in Australia, commercial use is being made of electrical stimulation as a means of tenderizing beef. Sixteen rectal probes are in use and an automatic stimulation unit has been installed at Kilcoy abattoir.

A new system of identification of electrically stimulated meat with green brands has been planned in consultation with the Kilcoy management and is to be adopted. Two other innovations are to be assessed: the branding of individual cuts in the boning room and the grading of carcasses by management. Both these innovations will be supervised and monitored by Slaughtering and Meat Inspection Branch inspectors.

Facilities and staff

Additional facilities for the Biochemistry Laboratory provided by the recently completed building programme include a discrete radio-isotype laboratory complex. This laboratory is now functioning at the Animal Research Institute, Yeerongpilly. It is capable of counting both beta and gamma emitting isotypes together with ^{14}C- or ^{3}H- labelled compounds through Gas Chromatograph/Gas Proportional Counter. Considerable investigations have been carried out to adapt commercially available human-oriented radioimmunoassay kits for animal parameters.

In a year of few senior staff changes, Mr R. J. W. Gartner was appointed Director of Husbandry Research Branch.

Chemical residues in animal products

Statutory limits for pesticide residues in agricultural products are set among other things to the lowest amount consistent with good agricultural practice. They are thus quality control standards by which good agricultural practice can be assessed.

Animal products, including meat, require special attention, and to this end the Department of Primary Industries is undertaking a monitoring programme. The essential features of this are an annual quota of 7 000 samples of fat taken from identifiable cattle at selected meat works, examination of the samples at the laboratory of the Animal Research Institute for 17 significant pesticides and the follow-up visits by veterinary field staff to producers presenting cattle with significant residues.

Visits are made in all cases where analysis reveals residues above half the statutory limit. Officers provide advice and assistance or apply sanctions including movement restrictions depending on the source and nature of the pesticide exposure.

The standard of quality control is indicated by a 99% compliance as revealed by examination of 8 400 samples from more than 4 000 properties in the 12 months to 31 March 1980. On a property basis, violations against persistent organochlorine pesticides were 1·6% and against organo-phosphorus compounds 1·7%.

A similar series of analyses was undertaken on a range of milks and dairy products processed throughout Queensland. Where above maximum residue limits (MRL) are obtained, follow-up visits are made to the producer or processor with traceback to individual properties.

A total of 491 samples of milk and other products was analysed from 25 factories. This includes 268 samples supplied to the Commonwealth Department of Primary Industry. For all residues, the level of compliance was 99%. The only significant levels of contamination occurred with dieldrin. Special traceback investigations were undertaken on four properties.

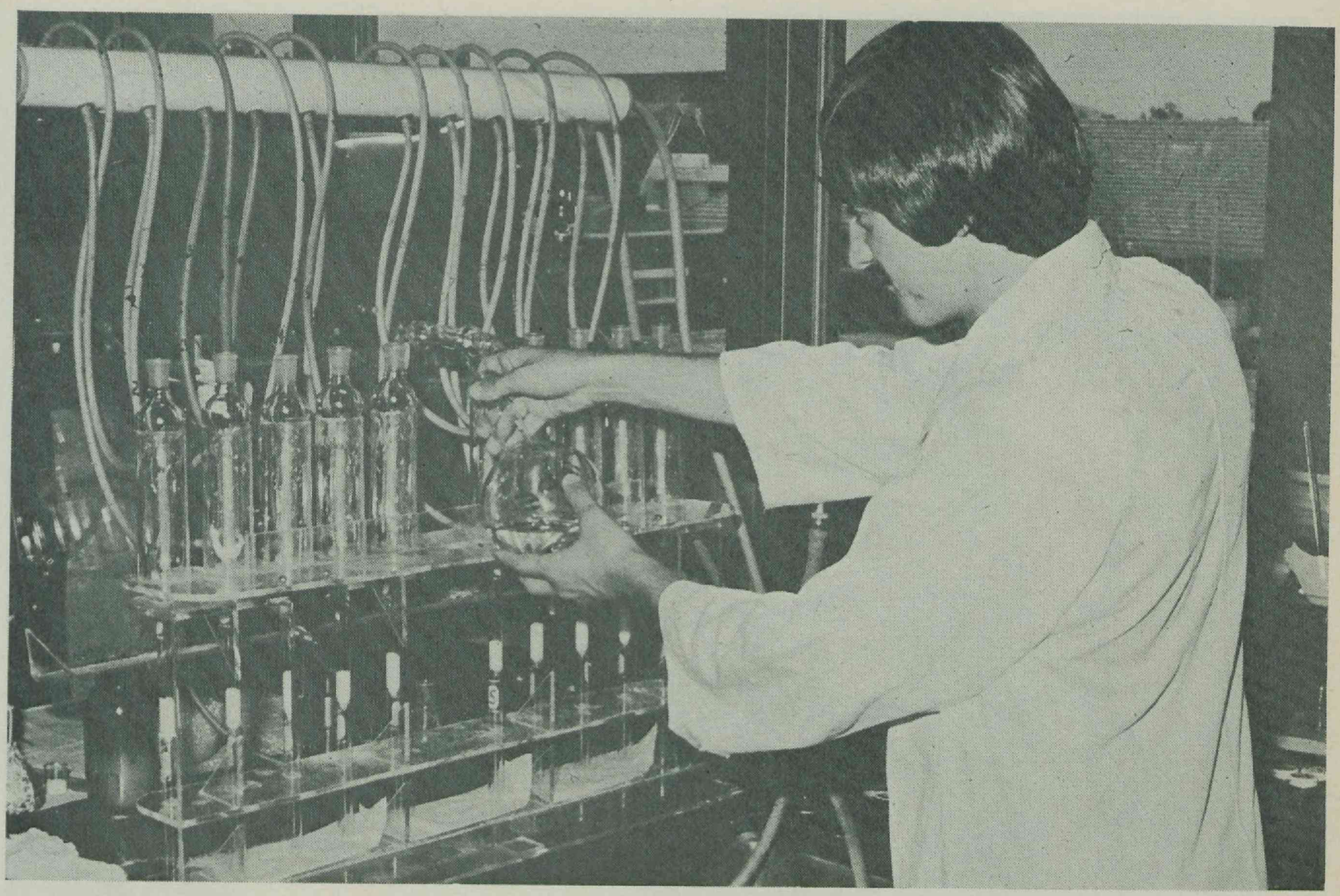
The Inter-departmental Committee on Chemical Contaminants in Foods, with representatives from the Departments of Primary Industries, Health, Lands, Forestry, Commercial and Industrial Development and the Queensland Fisheries Service met regularly during the year. The problem of chemical residues in animal tissues was one of the problems considered.

This standard of quality control derives from policies of phasing out biologically persistent chemicals where substitutes are available, and from the statutory prohibition of their use on animals, their environs and their feedstuffs. While progress in the reduction of pesticide levels in food of animal origin has been satisfactory, some problems still remain to be overcome.

Animal welfare

Animal welfare has always been a major concern of the Division of Animal Industry, and research into and extension of improved husbandry methods are major tasks of the Division.

During this year, the subject of the welfare of intensively-housed pigs and poultry has been a focus of attention. Minority groups have used the press and the electronic media to express their views that intensive animal production methods are cruel.



Extracting pesticide residues from a fat sample is a sophisticated and expensive process in the pesticide monitoring programme.

Officers of Pig and Poultry Branch are concerned at the often emotional and misinformed views put forward, and have taken the role of over-viewing the situation at an objective, scientific level. Meetings have been held with minority groups, the media and producer organizations.

Australian and overseas research related to animal welfare, particularly in the field of animal behaviour, is monitored. One officer of Pig and Poultry Branch is engaged in research into poultry behaviour.

The Australian Branch of the World Poultry Science Association (W.P.S.A.) has formed a standing committee on poultry welfare and the animal ethologist of my Department is a representative on this committee.

Based on codes prepared in Queensland and New South Wales, a National Code of Practice for Poultry Welfare in Australia is being developed. The Queensland code, prepared by Departmental staff and representatives of the poultry industry, was distributed to Queensland egg producers and broiler growers. A similar national code for the welfare of pigs is being developed.

During the year, attention was also focused on the deaths of cattle during transport for slaughter. In association with the Queensland Meat Industry Organization and Marketing Authority, staff of the Department continues to investigate many aspects including the causes and prevention of deaths in cattle travelling long distances to slaughter.

Plant Industry Division

Biological control of insect pests and diseases of plants has advanced very rapidly in the last decade. Research within the Division has developed the factors of genetic resistance, native and introduced insect parasites and soft chemicals into integrated management systems which offer effective control and substantial economies as well as reductions in the use of hard chemicals.

A unique achievement has been the combined use of two introduced species of *Typhlodromus* and the native predator *Stethorus* to control mites in deciduous fruit trees without resort to acaricides. Wide distribution of these predators is planned for 1980-81.

White wax and circular black scales in citrus have been controlled by parasite releases, and release of the wasp parasite *Aphytis* in conjunction with modified insecticide usage has given a high level of red scale control with a 95% reduction in insecticide costs during 1979-80 commercial trial.

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Grain sorghum breeders have now incorporated sorghum midge resistance into the female as well as the male parents of hybrid sorghum. Commercial hybrids with effective resistance are undergoing pre-release evaluation.

Useful resistance to *Heliothis* in both soybean and cotton has been identified, and resistance breeding programmes in both crops have been accelerated to augment the gains already achieved with integrated pest management in the cotton crop.

New varieties of tobacco (ZZ100) and tomato (Scorpio) resistant to bacterial wilt (*Pseudomonas*) have been released. Grower adoption of ZZ100 in north Queensland has been prompt to the extent that it is expected to be the major variety planted in 1980.

New diseases

Root rots of soybean and chickpeas caused by the fungus *Phytophthora megasperma* have caused substantial losses in some crops on the Darling Downs and research programmes to develop resistant cultivars have already begun.

In the Bowen district, a new race of the fusarium wilt fungus is spreading in tomatoes, and control of this disease by chemical and cultural methods and through cultivar resistance is receiving high priority.

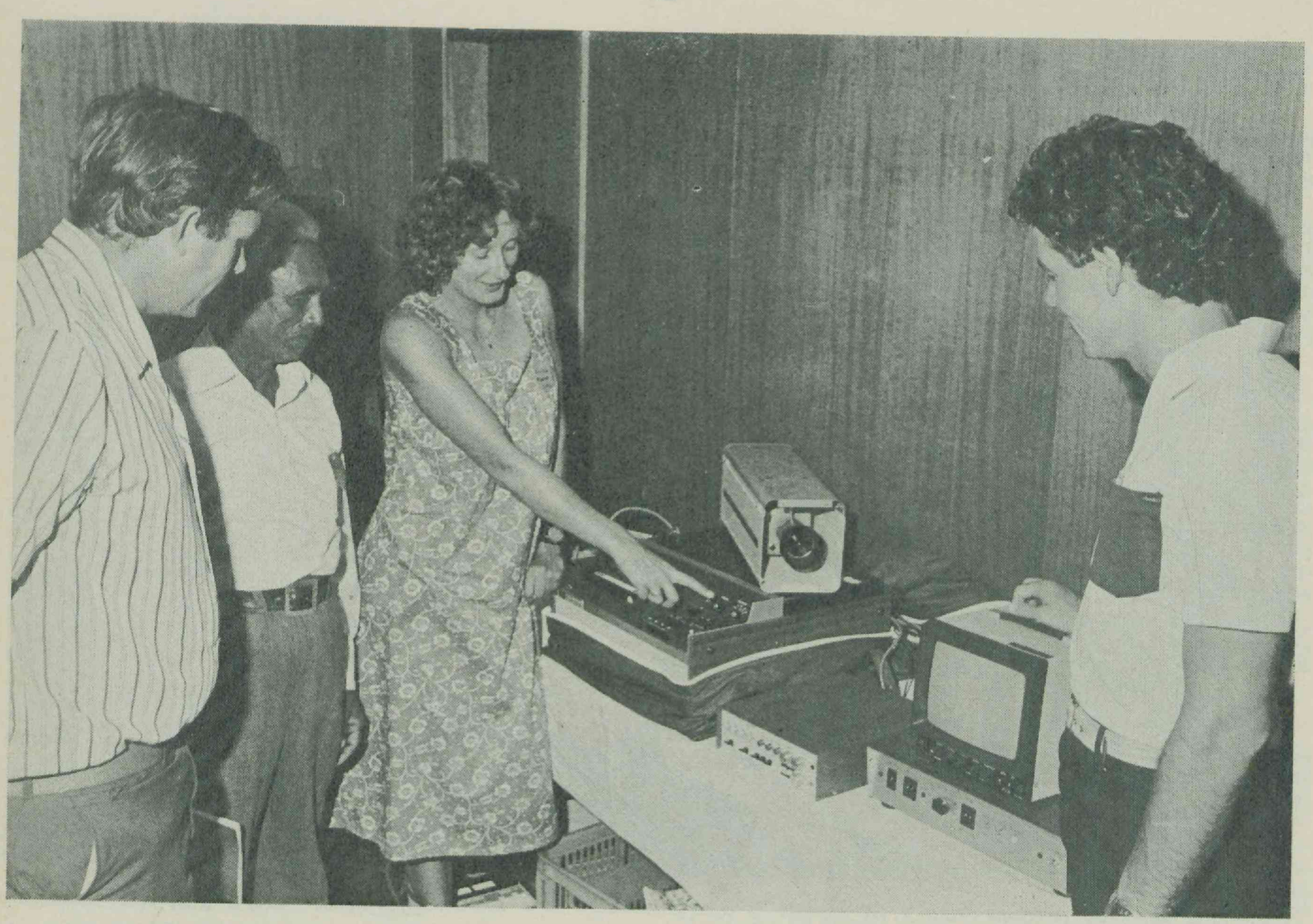
Wildfire in tobacco (*Pseudomonas tabaci*) caused severe damage for the first time in the Mareeba-Dimbulah area necessitating investigation of chemical control methods.

A devastating dieback of grey mangroves, particularly in the Gladstone area, is being investigated. Present evidence suggests it is carried by an undescribed species of *Phytophthora* and studies have been directed at understanding the effects of environmental changes on this disease.

International co-operation has enabled screening of sorghum lines for downy mildew resistance, a disease which is devastating in South-East Asia. Immunity already exists in the sorghum line QL3 released by the Department some years ago and another immune line which is agronomically superior to QL3 is to be released in the near future. These actions should provide security for the Australian sorghum industry should downy mildew enter this country.

Soil fertility

Complex mineral deficiencies on black earths of the Darling Downs known as the long-fallow disorder are yielding to microbiological research by the Queensland Wheat Research Institute.



Dr Linda Murphy, Ethologist, Poultry Section, demonstrates video equipment used for recording chicken behaviour to broiler growers attending last year's Poultry Information Exchange.

Previous work had shown that deficiencies of zinc, phosphorus, potassium and manganese were aggravated by fallowing and affected by cultural operations and crop sequences.

Recent work has shown that populations of root lesion nematodes reach very high levels in the second wheat crop following long-fallows. Concurrently, the populations of natural parasites of this nematode fall to low levels. These nematodes debilitate the roots of wheat causing plants to develop mineral deficiencies.

Soil fumigants and non-volatile insecticide-nematicides have controlled the nematodes and associated mineral disorders.

Pasture species for the tropics

As a result of joint studies with C.S.I.R.O., two new *Stylosanthes* cultivars were approved for release by the Queensland Herbage Plant Liaison Committee in August 1979.

Fitzroy, a cultivar of *S. scabra*, while susceptible to anthracnose (*Collectotrichum gleosporioides*) in high rainfall districts has proved unaffected south of latitude 22°S, and even north of this west of the 750 mm isohyet. Fitzroy is earlier maturing and heavier seeding, less stemmy and more leafy and slightly more frost tolerant than the earlier-released cultivar Seca. Fitzroy will allow the advantages of *S. scabra* to be exploited in extensive pasture areas in central Queensland.

The other release was *S. guianensis* cv. Graham, an earlier flowering and heavier seeding type which will allow *S. guianensis* to be used farther south and in drier country than previously. It will also replace cv. Schofield which has succumbed to anthracnose in higher rainfall districts.

Interstate and overseas studies

The wide ranging technology employed in the Division requires an emphasis on post-graduate study. Officers who participated in such study included: M. C. Cox (U.S.A.); D. L. George (U.S.A.); E. J. Gilbert (Canada); J. A. G. Irwin (U.S.A.); D. J. Martin (U.S.A.); C. P Miller (New Zealand); A. J. Pressland (Armidale); J. R. Syme (U.K.); P. H. Twine (U.S.A.); L. J. Wade (Perth); A. A. Webb (Canberra).

Overseas study tours were made by: G. S. Purss (U.S.A., U.K.); R. C. Colbran (U.S.A., Canada, Europe); R. Barke (U.S.A.); J. B. Watkins (U.S.A.); R. Shorter (U.S.A., India); L. J. Wade (India) and K. J. Middleton (U.S.A).

Other officers went overseas as consultants. These included: R. L. Dodman (South Africa); K. B. McRae (Fiji); B. Watson (Western Samoa); I. F. Beale (Brazil); D. Hawton (Burma); R. G. Henzell (Papua New Guinea) and J. M. Hopkinson (India).

Land Utilisation Division

The Soil Conservation Act was amended during the year. The amendments are aimed at increasing the efficiency of administration of soil conservation activites and increasing the involvement of landholders and local communities in project planning. The amendments to the Act are summarized below—

- The Soil Conservation Authority has been reconstituted from a corporation sole (Director-General of Primary Industries) to a body corporate comprising: Director-General, Department of Primary Industries; Director, Division of Land Utilisation, Department of Primary Industries; Director of Soil Conservation, Department of Primary Industries; Commissioner, Queensland Water Resources Commission.
- Section 47 (24) of the Local Government Act can now be applied, on the recommendation of the Soil Conservation Authority, in Areas of Soil Erosion Hazard, Project Areas and Soil Conservation Districts. Previously, such application was totally prohibited.
- The Soil Conservation Authority is now required to consult, where possible during the preparation of a Project Plan, with all persons or bodies likely to be affected by the Plan.
- The inspection period for advertised Project Plans (and Soil Conservation Schemes) has been changed from 3 months to a minimum of 30 days.
- The Soil Conservation Authority is required to advise each objector to an advertised Project Plan of its determination on his objection before submitting the Plan to Governor-in-Council for approval.



Kerman navy beans under furrow irrigation in the Burdekin. Irrigation methods change and low-maintenance plastic piping has replaced head-ditches. Holes cut to coincide with row spacing have variable outlets inserted to control the rate of water flow.

- A procedure has been introduced for landholders to appeal against the Authority's determination on objections to a Project Plan, before the Plan is submitted to Governor-in-Council for approval. Appeals are to be heard by a three-person panel, two members of which shall be Advisory Group Committee members.
- Local Authorities and other statutory authorities are now authorized to undertake and maintain 'community works' in accordance with Section 58 Agreements with the Soil Conservation Authority.
- The Minister is now authorized to appoint 'a person or persons' to hear grievances against Section 71 Soil Conservation Orders issued by the Authority instead of 'a person'. Similarly, the Authority is now authorized to appoint 'a person or persons' to hear grievances against a Section 67 Notice issued by a Trust.

Commonwealth Grants Commission

The Commonwealth Grants Commission advises the Commonwealth Government on—

- Special grants to claimant States to enable them to perform their functions at a level comparable with the standard States of New South Wales and Victoria.
- The proportion that each State should receive of the 39·87% of personal income tax collections available for general revenue assistance to the States under the new Federalism arrangements. (Queensland currently receives 17·5% of this tax pool. By comparison, Queensland has 15·5% of the population.)

Officers of the Division of Land Utilisation made major contributions during the year to submissions on Agriculture and Soil Conservation for the special grants claim and for the Six States Relativities Review. The submissions were prepared on the basis of a formula developed by the Commission to show relative cost disabilities per unit serviced.

For agriculture, the proposed number of units was determined from both the number of farms and gross value of agricultural production. For soil conservation, the estimated capital cost of works required was used as a measure of unit services, the costs for each State being taken from the main report of the Commonwealth-States Collaborative Soil Conservation Study 1975–77.

The greater relative dispersion of Queensland farms and the greater range of environments to be serviced were assessed as disability factors. The factors were based on an analysis of the 176 000 farms in the six States. Locations for 176 centres were used so that each was representative of 1 000 farms.

A climate classification was then done for the 176 centres to group them into 15 localized research environments. Of the 15, nine were represented in Queensland and of these four, representing 35% of Queensland farms, were tropical environments unique to Queensland. These data were then combined with an economies of scale function derived for crop research to show the higher research costs per farm in Queensland.

Sugar industry expansion

The Central Sugar Cane Prices Board will hear submissions from industry organizations, mills and mill suppliers' committees in Brisbane commencing on 15 July 1980.

The Board has been requested to institute an urgent inquiry into the necessity, scope and manner of expansion in the productive capacity of the sugar industry taking into account—

i. That the increase in productive capacity of the industry should be moderate having regard to marketing information as to the prospects of reasonably assured markets for Australian sugar in 1981 and subsequent seasons.

ii. That any decision in this matter should not affect the possibility of further adjustments in productive capacity of the industry should the circumstances change in the future.

iii. A careful consideration of the productive capacity and economic viability of lands currently assigned and of all potentially assignable lands.

iv. The ability of the industry's milling capacity to accommodate any increase in production proposed by the Board.

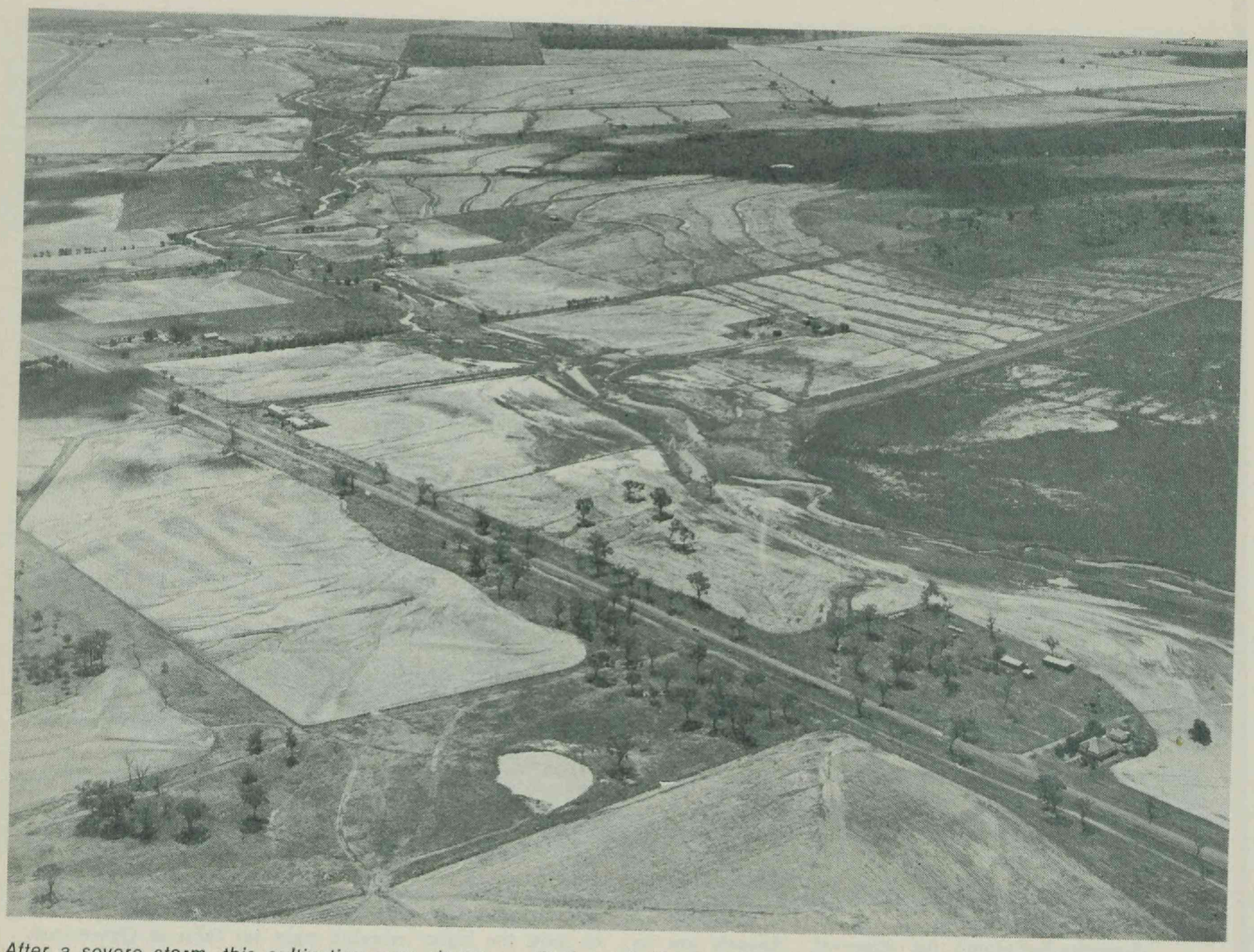
v. That the interests of those producers who are unwilling or unable to participate in any expansion are not unduly prejudiced.

vi. That, as on previous occasions, in its distribution of any increase granted, the Board is to have regard to the willingness of existing producers in the first instance to accept the risks involved and to fulfil the obligations entailed, due weight being given to customary considerations such as equity and economic farmsize.

vii. Any other factor which the Board considers relevant in the light of the above.

Agricultural engineering

A five-member Agricultural Equipment Advisory Committee was set up in October 1979 to provide a forum for producers, manufacturers and dealers to discuss disputes over farm equipment performance. The Executive Engineer, Engineering Services Section, is the Committee's Executive Officer. The Committee comprises representatives from the Tractor and Machinery Association of Australia, the Queensland Graingrowers' Association, Queensland Farm Machinery Dealers' Association and the Council of Agriculture.



After a severe storm, this cultivation area shows: a silted creek (flowing from lower right to upper left); a valley floor that is subject to erosion, siltation, flooding and frequent changes in creekbed location; unprotected sloping areas of cultivation that have been subject to severe sheet and rill erosion (foreground, left); and sloping cultivation areas that have been partially protected by contour banks.

The rapidly growing demand for agricultural engineering advice in country centres has resulted in the appointment of an Extension Engineer to Atherton in far north Queensland, and approval has been given for an Extension Engineering position in the Dawson-Callide area of central Queensland. Both positions have resulted from a growing awareness of the need for the extension of engineering technology to the farming community.

Mr I. Grevis-James, an Agricultural Engineer, has been granted 18 months' study leave at the Oklahoma State University, U.S.A., to undertake a Masters Degree in Farm Machinery Management. He is participating in a field research programme to study the management of tractors and implement operation in wheat farming. This project is specifically aimed at collecting data and developing techniques that will minimize liquid fuel consumption in wheat farming.

Mr C. D. Macrae, a specialist Engineer associated with the intensive pig and poultry livestock industries, visited research institutions, universities and field centres in New Zealand for the purpose of examining techniques for waste management; environmental control for pig production, layer and broiler housing; functional and structural design of farm buildings; and automatic stock feed processing and distribution systems.

Energy considerations

The energy crisis has stimulated new interest throughout Australia in the production of liquid fuels from renewable resources derived from plant biomass. Various organizations and universities are investigating fuel alcohol production from sugar-cane, cassava, sugar-beet and cereals.

To provide a 10% ethanol blend in all gasolines sold in Queensland, a production of 225 000 kilolitres of ethyl alcohol would be required. This is about three times the current production of ethyl alcohol in Queensland, all of which is produced by the fermentation of molasses.

If this were to come from sugar-cane, some 40 000 hectares of land would be required to produce the extra 225 000 kilolitres of ethanol per year.

A Sugar Industry Consultative Committee has been formed to study all aspects of alcohol production from sugar-cane. The committee will consider, from an overall industry point of view, possible organization structures which would enable alcohol and sugar to be produced in the most effective and compatible manner.

As a member of the committee, the Director, Development Planning Branch, has been involved in assessing the availability of suitable un-assigned land for ethanol production.

Preliminary comparisons with alternative methods of producing alcohol show that ethyl alcohol from sugar-cane cannot compete on an economic basis with large-scale plants producing methanol from coal, because of the high cost of sugar-cane. It has been estimated that growers could expect to receive only about half of the return they would get for sugar production for cane diverted to ethyl alcohol production.

Research and development activities relating to the conservation of energy in primary tillage operations have been promoted by the Engineering Services Section of the Department of Primary Industries. Investigations into reduced tillage, related specifically to the heavy black clay soil used for cereal production in south-east and central Queensland, are aimed at reducing the energy inputs associated with crop production. Associated studies into tractor and implement matching also have the objective of energy conservation.

Research and development studies directed specifically to the production of energy crops for liquid fuel production are major activities in Agriculture Branch. Agronomic studies associated with the production of cassava for either liquid fuels or as starch are being undertaken at suitable frost-free locations in north Queensland, central Queensland and at Coolum in south-east Queensland. The commercial production of starch from cassava is being undertaken at Yandaran, north of Bundaberg.

Land resource studies to identify areas of land in central Queensland, north Queensland and the Peninsula suitable for the production of energy crops have been completed.

Interest in the production of liquid fuels on the farm has been stimulated by the Federal Government's proposal to allocate 42 experimental, farm ethanol production licences in Australia. To date, nine licences have been issued to Queensland.

Dairy Division

The Dairy Produce Act was proclaimed in November 1979. Assent had been given previously in June 1978. The new Regulations under this Act were gazetted on 14 June 1980. The old legislation has been clarified and up-dated and the new Act and Regulations provide a valuable framework to assist the dairy industry from farm to consumer.

A new Artificial Breeding of Stock Act was assented to in December 1979 but has not yet been proclaimed. Regulations under this Act are being prepared.

Artificial breeding

The first attempts at artificial breeding in Queensland were made at Rocklea in 1955 and so 1980 marks the Silver Jubilee of this activity in Queensland. One of the most notable achievements in that time has been the development of the A.F.S. (Australian Friesian Sahiwal) breed to provide tick-resistant dairy animals. This programme now has more than 100 milking animals in commercial herds.

The proving of dairy bulls in co-operation with N.S.W. commercial herds has now been extended to encompass both Jersey and A.I.S. breeds.

South-east Queensland Research Station

Properties have been purchased to provide a research station in south-east Queensland. This station will allow investigations into feeding and husbandry practices and will be particularly relevant to the 80% of Queensland dairy farmers now located in south-east Queensland. This is a major step forward and will provide avenues for a wide range of pasture studies and field investigations.

Staff

As a consequence of a reassessment of Divisional work priorities and in response to a directive from the Public Service Board, four staff positions were declared redundant. One of these members resigned and the other three were absorbed in the Division through vacancies.

Interstate dairy produce

Butter and cheese have been shipped in bulk to Queensland from southern States for some time, and packed by Queensland processors for local distribution.

This year, two other interstate activities occurred for the first time. Murray Goulburn Co-operative Company Limited began marketing retail packages of butter under its own brand, and will also be introducing other products into Queensland.

Two tanker loads of milk were received from Victoria to provide sufficient milk to meet the manufacturing requirements of one processor. This highlights the shortage of manufacture milk at that time, although this was only for a short period.

Milk production and utilization

Despite the drought and the reduced number of dairy farmers, total milk production for 1979-80 was 538m L, which was only 4·5% less than 1978-79 where favourable conditions prevailed but 4% more than the previous year 1977-78.

Cheese production has been maintained and butter production, as expected, has decreased to less than 4 000 tonnes. Sales of modified milk have almost trebled, while cream sales have shown a 60% increase.

Research Stations Section

Regional research stations have continued to play a vital role in applied research and demonstration work of State and regional significance.

The Ayr station was visited by a large group of Mackay-Rockhampton dairy farmers who were seeking the practical results of clover or clover-ryegrass management, as well as results of fertilizer regimes. It is believed that the increased area of temperate pastures sown in 1980 and the return to the 'old' recommended rates of fertilizer usage stem from such visits.

In studies on the economics of pasture production, the use of the disc mower speeded up the work. It was vastly superior to slashing and to forage harvesting with the back open, and was a little better than mowing with the mower-conditioner.

There may still well be a requirement for lower cost establishment procedures which, at this station, have varied from merely slashing and burning and broadcasting to slashing, burning, ripping, double discing and rotary hoeing before broadcasting.

Highlights of the year at Biloela were a successful lucerne field day in August 1979 and a discussion evening on lucerne management with Dr V. Marble, of the U.S.A. This was of particular interest in view of the use here of the U.S.A. aphid resistant lucerne varieties.

Winter-active lucernes have become popular in the Dawson-Callide area because high levels of production can be achieved during the winter months when the demand for hay is strong. There are strong indications that winter-active lucernes have been overcut in the first winter with a corresponding reduction in long-term production and plant population. Accordingly, a time-of-cutting trial planned to begin in 1980 will attempt to identify the best management strategies for locally-adapted lucerne varieties.

At Brigalow Research Station, near Theodore, a trial has been initiated to assess the value of leucaena (a tree legume) as a protein supplement for finishing 2-year-old steers grazing improved pastures during the autumn-winter period. The leucaena was sown in December 1978 in 4 m rows, and the inter-row area sown to grass in Febraury 1979.

The leucaena survived the dry 1979 year and established well. The leucaena will be allowed to grow to tree form (3 m high) before grazing.

The grazing trial will commence in December 1980 and the cattle will have access to the leucaena supplement until March 1981.

A livestock project is to breed up from a Hereford base to a herd of high grade Simmental cattle to represent the large European breed type in this environment. Both productive and reproductive performance of these cattle will be evaluated under the environmental conditions representative of central Queensland at Brigalow Research Station. The relative performance of the various grades will also be assessed.

The first calves in this programme were born in the interval September to December 1979. The mean birthweight of the Herefords was 32 kg. This compares with a mean birthweight of 29, 33 and 36 kg as the Simmental component increased from $\frac{1}{4}$ to $\frac{1}{2}$ to $\frac{3}{4}$ respectively.

In another project, Hereford and first-cross (F_1) Africander-Hereford weaner steers grazed improved grass pasture in a common group. At 40 months of age in March 1980, the 38 Hereford steers weighed 473 kg compared with 541 kg for the F_1 Africander-Herefcrd steers, a difference of 68 kg. The post-weaning daily gains for the Hereford and F_1 Africander-Hereford steers were 0·33 and 0·39 kg per head per day, At slaughter, the crossbred steer carcasses were 48 kg heavier than the Herefords.

At Gatton, it has been demonstrated that seed potatoes can be produced successfully in south-east Queensland and a recommendation was made for the establishment of a seed potato certification scheme in Queensland.

Such a scheme would be of benefit to producers of the seed, users, and to the Queensland economy generally. The main advantages would be availability of seed potatoes from Queensland producers at times of the year when supplies are not available from southern producers, reduced transport costs and freedom from certain diseases.

Some progress has been made in the pumpkin project. Although the understanding and possible elimination of 'bone' was the original objective of an investigation, it has been found possible, by selection, to achieve increased yield and improved fruit type. These results should benefit the industry. The secret of 'bone', however, remains almost as elusive as ever.

The evaluation of an accidental Queensland Blue x Lockyer Pink cross has given encouraging results. The population is still segregating for a wide range of characteristics but there is a reasonably high percentage of desirable fruit types.

It is possible that an acceptable variety could be obtained by the end of 1981. In comparison with Queensland Blue, this variety would be earlier in maturing, have an orange skin, have easier peeling qualities, good flesh colour including freedom from 'bone', and resistance to sunburn. Storage properties may not be as good as those of Queensland Blue.

Weather conditions hampered field trial work at Hermitage, near Warwick. Materials and components were purchased for a new four-row cone planter which was built in the station workshop. The significance of this machine is that four row plots, comprising two datum rows flanked by a guard row on each side, can now be sown in one operation. Other features of this machine are the installation of individual belted cones for each row and the provision of water injection and insecticide application equipment.

The Atherton Tableland maize industry continues to benefit from the maize breeding work on the Kairi station. The recently-released QK690 and QK694 cultivars form 60% of the current season's plantings on the Tableland. The remaining 40% of seed sold is made up of older Kairi releases, QK217, 231 and 489.

In dairy cattle work, the optimum rate for nitrogen-fertilized tropical grass pasture (Gatton panic) was determined from a 3-year grazing study. The optimum stocking rate was determined as 2·5 cows per ha at a fertilizer level of 400 kg N per ha per year with maintenance superphosphate (250 kg per ha) and potash (50 kg per ha). At this stocking rate, Friesian cows produced 3 100 kg of milk with 3·7% butterfat and 8·45% solids-not-fat without any energy or protein supplements. This is the average production of supplemented cows on the Atherton Tableland, so there are still big advances to be made in production per cow.

This experiment also recorded world record milk production per hectare for any experiment on dryland tropical pasture—9 600 L at 3·5 cows per ha.

Milk yield of early lactation cows was increased by 10% through the use of a coarse salt supplement (NaCl). Cows grazing tropical grass-legume pastures on the Atherton Tableland receive approximately only half their sodium (Na) requirements from pasture and water sources. Tinaroo glycine was found to be particularly low in Na (0·01%), while Gatton panic averaged only (0·07%) Na. Cows require 0·15% Na in their diet and the deficit may be corrected through a supplement available to them in the milking bails. This response to Na is the first recorded experiment for dairy cows in Australia.

At the J. Bjelke-Petersen station, Kingaroy, work is continuing on the role of stubbles in Burnett farming systems.

Forty-four farmers, predominantly from the Central Burnett, inspected two farms where stubble mulching is being evaluated on a commercial basis. During late 1979, 63 farmers attended six farm walks to view the results of winter cereals which had been drilled into summer crop stubble.

On two pilot farms, a conservation cropping system gave good yields in spite of adverse rainfall and expected weed problems did not appear. Run-off under conditions of surface retention of stubble was found to be much less than under stubble incorporation.

For weed control, a locally-developed wick weeder has provided a cheap method where weeds are taller than the crop. This could significantly reduce the amount of chipping necessary in peanut crops.

Navy beans and soybeans again proved unreliable under adverse weather conditions. Modern maize and sorghum varieties exhibited much better drought tolerance.

At Millaroo, a successful field day was held in conjunction with the Lower Burdekin Rice Growers' Consultative Committee. The field day covered rice varietal work, red rice control, Starbonnet pure seed, starch crops in the nursery area and laser levelling techniques.

The major item of new equipment purchased was the 'Hege' rice plot harvester which was imported from Germany in March. The machine should allow a greater number of experimental rice varieties to be handled each year, thus accelerating the rice programme of the future.

At South Johnstone, studies on centro (*Centrosema pubescens*) survival with grazed guinea grass showed that the life of individual plants is short, and stolon-produced plants are more important in maintaining the legume population than regeneration from seed. This mixture is one of the most important on the far north tropical coast.

A planting density and time-to-maturity trial with tea, now 8 years old, continues to show no disadvantage from early plucking, and outyielded conventionally-managed tea by 300 kg per ha. With age, the differences between planting densities have narrowed.

The multiplication of new legume seed stocks is an important aspect of work at Walkamin Research Station.

Following the release of the Graham and Fitzroy stylo cultivars, 400 kg of certified seed were distributed to 34 seed producers for supervised commercial increase. Seed increase continued with established stands of Archer axillaris *Stylo viscosa* CPI34904, Graham and Fitzroy stylos and with Riversdale and Makueni guinea grasses.

New plantings were established of some 10 *Stylo scabra* and 11 *Stylosanthes guianensis* lines, Safari white clover and a small number of grasses for the dry tropics.

Peanut research is concentrated in the more rapidly expanding production areas around Dimbulah and Mount Garnet.

The efficiency of servicing station and district peanut trials has been greatly increased since specialized peanut harvesting equipment and a means of transporting it from centre to centre have been obtained. The equipment consists of a peanut planter, a puller, a thresher and a grader-sheller.

The work involves varietal testing a large number of Virginia Bunch and Spanish types, plant breeding, disease control and nutrition.



Evaluating the effect on wine quality of grape variety and producing district.

Acknowledgements

The Department is involved in collaborative studies with other Government agencies and wishes to acknowledge their co-operation. During the past year, these have included co-operative projects with the New South Wales Department of Agriculture, Commonwealth Scientific and Industrial Research Organization, Commonwealth Department of Housing and Construction, Bureau of Sugar Experiment Stations, Department of Lands, Co-ordinator-General's Department, Water Resources Commission and Department of Local Government.

A helpful degree of co-operation has been received from various Commonwealth Departments including Trade and Resources, Foreign Affairs and Primary Industry.

The co-operation of universities and other educational institutions is acknowledged and appreciated.

Acknowledgement is made to the many organizations and private firms that contributed funds towards projects and research activities during the year. The Commonwealth Government has again provided support through the Commonwealth Extension Services Grant and Commonwealth Rural Industry Grants, in addition to national disease eradication programmes.

To the primary producers who have co-operated in the many and varied field trials conducted during the year, I take this opportunity to express appreciation for the use of their facilities and resources. Field trials are a well-nigh indispensable link in the chain from research to commercial practice and the producers involved provide a service to others in the industry.

The technical sections that follow my report are necessarily restricted in the amount of data that can be presented. Persons seeking greater detail are invited to contact the appropriate Branch of the Department.

Yours faithfully,

E. O. BURNS
Director-General

Division of Administration

ADMINISTRATION Division comprises the Administrative and Accounting Services of the Department and also the Technical Support Services: Information and Extension Training Branch, Research Stations Section, Extension Services Section and Biometry Branch.

Central Administrative and Accounting Services

Staff establishment in the Central Administrative and Accounting Services at 1 July 1980 compared with the previous year is shown in the following table:—

——	As at 1–7–79	As at 1–7–80
Ministerial Staff	5	6
Departmental Directorate and Internal Audit	7	7
Brisbane Administration and Records	60	55
Commercial, Despatch and Stores ..	14	13
Country Support Staff	106	108
Accounting and Finance	63	65
TOTAL	255	254

In addition, clerical staff is employed in the other Divisions of the Department and provides a range of support services for a variety of purposes. Comments on activity in these Divisions are given in other sections of this report.

General overview

During 1979 80, a major investigation was made into all areas of Departmental operations. This has been part of a long-range plan to provide an appropriate management system to effectively plan, co-ordinate and monitor revenue, expenditure and results achieved in terms of specified objectives.

The primary functions of the Department have been determined as falling within four major areas—

Administration
Research
Service and regulatory
Extension

Within these areas, activities and projects have been classified into sub-programmes and then grouped into programmes. Aims and objectives have been established for each sub-programme together with a general description of activity and personnel involved including nomination of officers responsible for management of the various sub-programmes.

Establishing the management accounting and other general information systems to give effect to the provisions of the Financial Administration and Audit Act 1977-78 requires a number of major development phases. The activities of this Department are varied and conducted by a variety of professional and technical disciplines at centres dispersed throughout the State. They are funded through a variety of Treasury Funds, some of which are financed by the Commonwealth, others by industry grants and yet others by general revenue collected.

It is quite apparent that management needs for current reliable information on which to base its decisions can only be met by the use of computer based systems. This is a common problem now faced by a number of large departments. Senior staff of the Department have been actively engaged on an interdepartmental committee assessing possible approaches which may be taken in this regard.

Some of the concepts within the programme based management proposal are being adopted by the Administration Division in 1980-81. However, present accounting equipment is a major constraining factor.

Concurrent with the development of administrative concepts, three committees of appropriately qualified and experienced officers have been appointed to investigate the other three major functional areas of Research, Extension and Service, and Regulatory. Preliminary reports have been received and further investigation is now being undertaken to examine in detail the chemical analytical services and extension staffing.

Departmental staff

The approved permanent salaried staff establishment of the Department for 1979-80 compared with the previous year is shown below—

——	As at 1–7–78	As at 1–7–79	As at 1–7–80
Consolidated Revenue Fund	1 660	2 317*	2 321†
Trust and Special Funds ..	786	287	286
Commonwealth Funded ..	341	131	132
TOTAL	2 787	2 735	2 739

* Includes 147 Commonwealth–State joint funded positions.
† Includes 151 Commonwealth–State joint-funded positions.

The Stock Fund was closed from 1 July 1979 and 512 positions formerly included under Trust and Special Funds are now shown under Consolidated Revenue Fund. This action was necessary because of a High Court decision which ruled the stock assessment invalid. Declining Commonwealth support in certain areas of research and extension also necessitated the financing of a number of previously Commonwealth funded positions from Consolidated Revenue Fund.

During 1979-80, activity of the joint Commonwealth-State Bovine Tuberculosis and Brucellosis Eradication Programme was recorded in the State Consolidated Revenue Fund.

During the 1979 academic year, 304 officers were undertaking approved study courses ranging from Senior to Doctor of Philosophy. Of these, 68 officers completed their courses. Approval granted for courses commencing in 1980 and for course amendments total 66.

Comments on in-house management and administrative development training programmes are given in the Information and Extension Training Section of this Report.

A total of 24 staff resigned or retired during 1979-80 after attaining 60 years of age. Officers who retired after more than 25 years' service were—Messrs G. H. Allen, Executive Officer, Research Stations Section; W. Haylett, District Adviser, Field Services Branch; J. J. Hedges, Inspector, Veterinary Services Branch; E. H. Hooker, District Inspector, Veterinary Services Branch; E. T. Lindsey, Senior Farm Hand, Animal Research Institute, Yeerongpilly; Miss I. B. Mair, Laboratory Attendant, Agricultural Chemistry Branch; Messrs W. Pont, Senior Pathologist, Plant Pathology Branch; V. J. Wagner, Assistant Director (Agronomy), Agriculture Branch; L. E. Walter, District Inspector, Veterinary Services Branch; Miss U. V. Webster, Stenographer, Dairy Research Branch.

Senior staff promoted to positions outside the Department included Mr E. R. G. White, who was Assistant Under Secretary now Deputy Chairman of the Sugar Board, and Mr T. J. Beckmann formerly Director, Agricultural Chemical Laboratory, now Director of the Government Chemical Laboratory in the Department of Health.

Accommodation

Erection of an Office-Laboratory Building at Ayr to accommodate the Department's major research facility serving the Townsville-Burdekin District was completed and occupied in 1980. This has solved the problems of overcrowding and fragmentation of staff as experienced in accommodation in the Court House and in rented premises.

The only major project under construction at present is Stage II of the Office-Laboratory Complex at Mareeba. Completion of this building will enable Mareeba administrative regulatory and extension staff to be accommodated at the complex.

Rising costs of building construction and a significant decrease in available funding have necessitated deferral of the provision of much needed facilities required for the ongoing support of the rural sector.

Finance

During 1979-80, the operations of the Department were under considerable restraint due to staff ceiling and funding limitations imposed through Commonwealth and State Government policies and industry economics.

This Department serves diverse and widely spread rural industries throughout the State. It is essential that many of the services offered by the Department be provided as geographically close as possible to the areas serviced. A number of new or expanded centres in country areas has been developed over recent years. Maintenance and operation of such centres in remote areas is a costly but justified exercise. Fuel costs, which represent a major cost of field staff, have been subject to cost increases far higher than the general inflation index. The effect on existing funds has been significant.

Natural disasters again placed heavy demands on finances. Administration of the joint Commonwealth-State Disaster Assistance Scheme inspections and processing of payments were met wholly from Departmental funds. Actual assistance payments made by this Department and subject to cost sharing arrangements amounted to $1,644,553 compared with $2,373,659 in 1978-79.

Departmental expenditure from the Consolidated Renvue Fund as compared with the previous year is shown in the following table—

Vote Sub-Division	1978–79	1979–80
	$	$
PAYMENTS AUTHORISED BY SPECIAL ACTS		
Grant in Aid of the Banana Industry Fund	34,980	70,048
DEPARTMENT OF PRIMARY INDUSTRIES		
Salaries	21,328,355	32,798,332
Contingencies	20,017,601	17,162,026
TOTAL	$41,380,936	$50,030,406

Salaries paid from Consolidated Revenue Fund in 1979-80 included $1,495,895 on account of the Bovine Brucellosis and Tuberculosis Eradication Campaign and $7,169,859 on account of administration of the Stock Acts. These activities were previously financed through the Trust and Special Funds. The balance of the increased costs represents award increases.

Lower contingency expenditure in 1979-80 resulted from reduced acaricide subsidy payments of $220,813 (1978-79 $906,877) and bluetongue control expenditure of $56,060 (1978-79 $345,183) excluding payroll tax, administrative overheads and superannuation subsidy. The supplementary grant to the Stock Fund in 1978-79 was $9,236,205 and assisted in financing salaries through that fund amounting to $6,405,390. As indicated above, these salaries were met from Consolidated Revenue Fund in 1979-80. The balance of the grant which would have been paid in 1979-80 was applied to meet direct from Consolidated Revenue Fund those general contingency costs previously met from the Stock Fund.

During 1978-79, the State contribution to the joint Commonwealth-State Bovine Brucellosis and Tuberculosis Eradication Programme was met from Consolidated Revenue Fund and amounted to $792,000. Certain indirect costs were also met direct from the Consolidated Renevue Fund. To facilitate accounting for total costs, all programme costs were met direct from Consolidated Revenue Fund in 1979-80. General direct operating costs were $3,725,818 while compensation payments were $631,333. Indirect costs and charges were being assessed at the time of preparing this report. Commonwealth contributions are now paid to the Consolidated Revenue Fund.

Transactions recorded in the Trust and Special Fund were subject to a review in 1978-79. As a result of this review, there was a some restructuring of the Department of Primary Industries Special Standing Fund and of Trust Funds recording expenditure from the Commonwealth Rural Industry Grants.

Trust and Special Fund	1978–79*	1979–80
	$	$
Department of Primary Industries Special Standing Fund	3,357,856	4,295,887
Banana Industry Fund	62,259	224,161
Commonwealth Agricultural Extension Services Fund	1,929,395	1,379,257
Commonwealth Poultry Industry Assistance Fund	1,399,040	2,634,584
Commonwealth Quarantine and Export Inspections Fund	1,752,714	2,096,694
Commonwealth Rural Industry Grants Fund	1,476,183	2,066,587
Commonwealth Soil Conservation Fund	70,964	..
Dairy Pasture Subsidy Fund	45,344	..
Meat Inspection Account	2,172,572	2,374,051
Poultry Industry Fund	454,864	530,910
Stock Compensation and Stock Improvement Fund	10,461	11,980
Stock Fund	9,849,985	285,972†
Sugar Cane Prices Fund	1,188,574	1,182,600
Swine Compensation Fund	9,301	11,793
TOTAL .. .. .. $	23,779,512	17,094,476‡

* The figures shown above for 1978–79 have been adjusted to give the comparable values for expenditure in 1979–80.

† Transfer of Balance of Fund to Consolidated Revenue Fund.

‡ $133,602 being transfers of balances following restructuring of some trust funds.

Technical Support Services

Research Stations Section

RESEARCH Stations Section operates 11 Stations and provides facilities for research projects to be conducted on these Stations and on certain commercial properties in the surrounding districts.

The Section operates stations at: Hermitage, via Warwick; Gatton; Kingaroy; Coolum; Biloela; Brigalow, via Theodore; Ayr; Millaroo, via Ayr; South Johnstone; Walkamin; and Kairi.

Administration

A Research Stations Board recommends Departmental policy on the broad objectives of research programmes requiring use of the Section's facilities and resources. The Board, made up of the Deputy-Director General and the Directors of each of the five Divisions, met on nine occasions to consider programmes and policies.

One of these meetings was held at Gatton Research Station to permit detailed evaluation of research needs in the Lockyer and Fassifern Valleys.

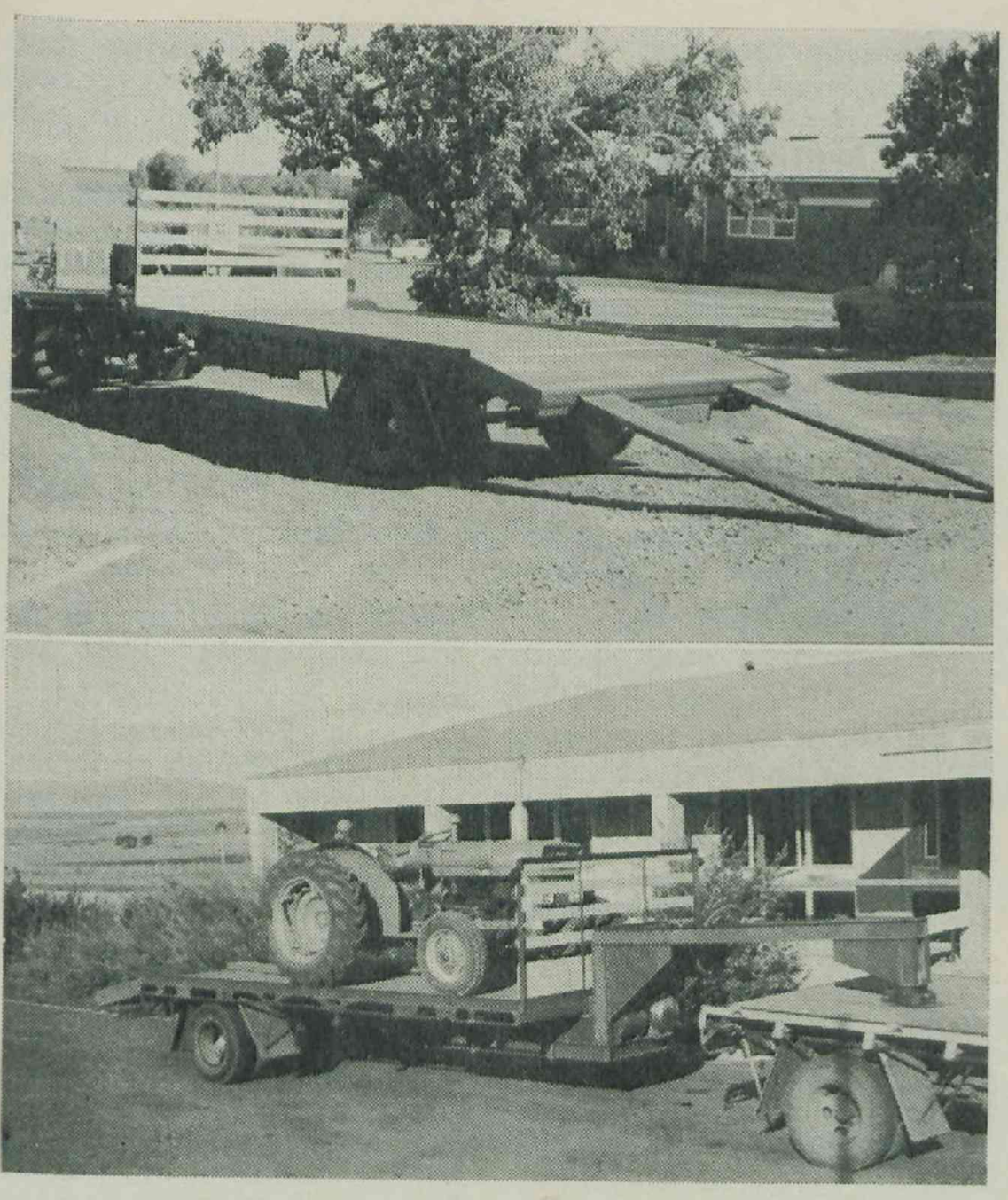
Each Station has its own Reviewing Committee which is responsible for examining proposals submitted for inclusion in the Station's research programme. The Committee is required to allot priorities to individual project proposals so that the Station's resources and facilities can be used effectively. The role of Committees in allocating priorities has become extremely important as the effects of inflation continue to restrict the number of projects which can be undertaken.

Industry Consultative Committees continued to provide valuable assistance to the Station Committees at Hermitage, Kingaroy, Biloela, Brigalow and Kairi. These Consultative Committees include progressive, influential primary producers whose practical, commercially-oriented opinions made a significant impact on the direction of many research projects.

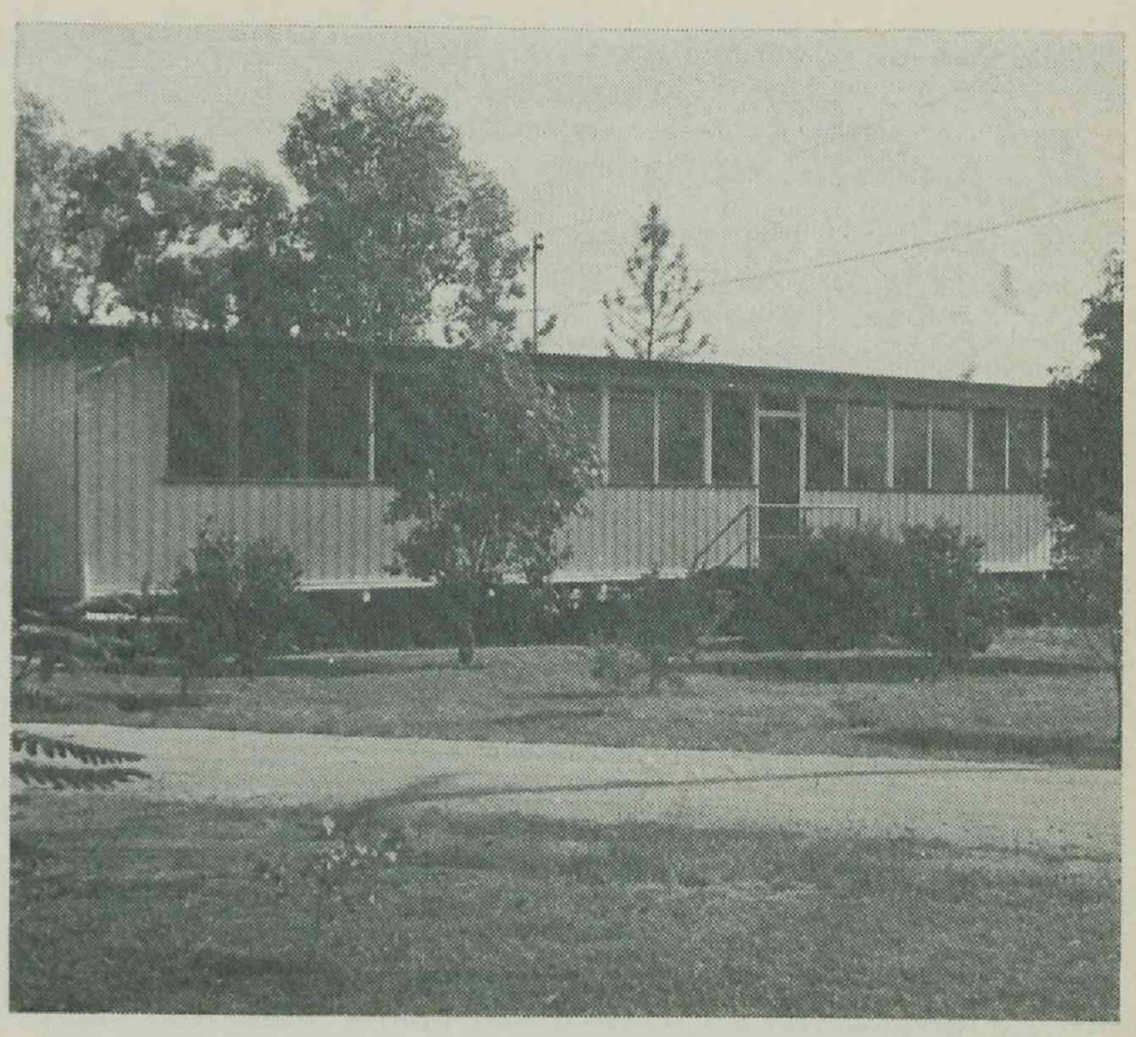
Notable events

Mr G. H. Allen retired as Executive Officer, a position he had held since the establishment of the Section in 1962. Mr B. A. T. Rodda, formerly Principal Extension Officer, Extension Services Section, was appointed Executive Officer.

Numbers of visitors to Stations increased markedly. This trend may be expected to continue as producers become more dependent upon technological advances for their own economic viability. To cater for the interests of producers and of other parties, field days, meetings, workshops, discussion groups and detailed inspections of specific trials were organized.



Off-station trials call for much moving of equipment. Hermitage Research Station services trials located as far as 500 km from base. The trailer was designed for safe and rapid loading and transport was built by Hermitage staff in the station workshop. The tractor is quickly bolted to the trailer chassis and does not need to be tied down.



This building now provides office and laboratory facilities at Walkamin Research Station. It was previously used at Parada.

Highlights of these activities were—

- The visit by dairy farmers from Mackay and Rockhampton areas to Ayr Research Station to inspect irrigated clover and ryegrass grazing trials.
- A lucerne field day at Biloela and discussions led by Dr V. Marble, a visiting expert from the U.S.A., on lucerne management.
- An oilseed workshop at Hermitage which attracted delegates from Universities in Queensland and New South Wales and from the New South Wales Department of Agriculture.
- A field day at Kairi for dairy farmers interested in the effects of nitrogen on dryland grass pastures and the use of salt supplementation.
- A stubble-mulching field day at Kingaroy.
- The range of projects with varieties, weed control, seed production and land preparation techniques studied by rice growers at the Millaroo field day.
- The enthusiastic acceptance of the principles of pasture management by beef producers who attended field days at the South Johnstone sub-station, Utchee Creek, and companion trials at Tully River and at East Palmerston.

Extended facilities

Economic stringencies severely limited opportunities for development.

The Works Department arranged construction of a plunge dip at Utchee Creek and a controlled-environment plant growth-chamber at Hermitage. Kairi's irrigation potential was further developed by Works Department projects.

Commonwealth grants permitted the purchase of planters at Hermitage, Kairi and at Kingaroy; a truck to service trials in the district covered from Hermitage; grain trailer and drying bins at Kairi; grain bulk handling facilities at Kingaroy; and a rice harvester at Millaroo.

Industry funds were used to acquire specialized peanut handling equipment at Walkamin and a large trailer at Hermitage.

Planning was completed on a number of major works scheduled for construction in 1980-81. These include—

- One new dam and the significant extension of an existing stock-watering dam at Brigalow.
- Improved water supply and reticulation for irrigation and for domestic use at Hermitage.
- Equipping a new bore and irrigation-water reticulation at Gatton.
- A rotary dairy at Kairi.
- A peanut-handling shed at Kingaroy.
- New buildings to permit expansion of pig research at Biloela.

Planning was also well advanced in acquiring additional land at Kingaroy to cater for the expanded peanut breeding programme.

Achievements

Results of particular research projects are included in Divisional contributions to this report. Among the more significant results arising from work supported by the section were:—

- Five sorghum hybrids based on sugarcane mosaic virus resistant materials from the Hermitage breeding programme were commercially available during the 1979-80 season.
- Midge-resistant sorghum hybrids being developed by workers at Biloela and Hermitage are nearing commercially acceptable standards.
- Soybean variety trials at a range of sites serviced from Hermitage have proven conclusively the suitability of particular varieties in specific localities.
- Barley breeding at Hermitage has produced several lines which have outyielded Clipper by 20% and which lodge less, resist mildew better and display quality equal to Clipper.
- There is potential for the development in south-east Queensland of a seed potato certification scheme.
- Pumpkin growers stand to benefit from an evaluation at Gatton of an accidental 'Queensland Blue' x 'Lockyer Pink' cross. There may be an acceptable variety obtained within 2 years. Although it would not store as well as 'Queensland Blue', the new variety would be earlier maturing, orange skinned, easy peeling, good flesh-colour, free from 'bone' and resistant to sunburn.
- Chipping of weeds in peanuts may be lessened by the development at Kingaroy of a wick-weeder for the control of tall weeds such as Anoda weed.
- Sorghum at Kingaroy gave better results with ammoniated forms of phosphorus than with the application of comparable amounts of nitrogen and phosphorus as urea and superphosphate respectively.
- Variations have been detected at Kingaroy in the susceptibility of soybeans to insect attack.
- While undamaged Red Spanish peanuts subjected to moisture stress are less susceptible to invasion by *Aspergillus flavus* than intact pods of Virginia Bunch, the damaged pods of both varieties are equally vulnerable.
- Some herbicides used commercially to control weeds in wheat have been shown in Biloela trials to adversely affect wheat yields.

- Addition of nitrogen depressed wheat yields under the very dry conditions experienced on shallow duplex soils at Brigalow while spectacular responses followed the application of phosphorus.
- At Brigalow, birthweights of Hereford calves averaged 32 kg compared with 36 kg for calves with a ¾ Simmental component. At 200 days, this gap had widened greatly with Herefords averaging 153 kg compared with 191 kg for the ¾ Simmentals.
- Calving difficulties in Herefords can be inherited.
- Growing dairy cattle on an adequate protein diet can gain weight just as rapidly when supplemented with molasses as they do when the extra energy is provided as grain.
- Starbonnet still performs better on the Burdekin than other available rice varieties.
- Cassava yields at Coolum, Millaroo and South Johnstone continue to impress.
- Studies on centro at South Johnstone indicate that, in a mixed centro-guinea grass pasture, survival of centro depends on stolon-produced plants rather than regeneration from seed.
- 'Maturity bronzing' of bananas at South Johnstone continues to provide a challenge. No cause has yet been established and no relationship with insects or with nutrition has been discovered.
- All maize varieties now grown on the Atherton Tableland are Kairi-bred. Most popular are QK690 and QK694. Considerable progress is being made towards the commercial release of high-yielding midmaturing hybrids.
- Friesian cows at Kairi, given free access to a maize-silage and meatmeal mix, produced 16·6 kg milk per day during midlacation while similar cows on a restricted maize-silage intake produced only 14·4 kg per day.
- Stem-borers continue to be the major economically unsolved problem of rice growers in the Mareeba area.
- Walkamin continues to demonstrate its importance to the pasture seed industry and *Stylosanthes* lines still attract most attention.
- Bureau of Sugar Experiment Stations workers were delighted to find that all sugar-cane varieties planted at Walkamin flowered, with 68% flowering freely. This will give tremendous impetus to sugar-cane variety development in Queensland because breeders had previously been frustrated by their inability to get many breeding lines to flower in the coastal cane-growing areas.



These Stylosanthes scabra *plots have made excellent growth in their first season at Walkamin Research Station.*

Information and Extension Training Branch

PRINCIPAL functions of Information and Extension Training Branch are— (1) to disseminate agricultural information to the community, with special emphasis on the rural sector; (2) to conduct training activities to develop Departmental staff in both management skills and extension methods; and (3) to provide photographic, art, duplicating, publishing and library services for the Department.

The Information Section of the Branch broke new ground during the year by greatly enlarging its dissemination of agricultural information. This has been achieved by providing feature pages in *Queensland Country Life* in addition to the other material published.

The *Queensland Country Life* features have been a co-operative effort by Information Branch journalists, Agriculture Branch staff and the newspaper.

Although the principal target is again the rural sector, information of interest to the whole community is being provided.

The Training Section continued the emphasis on management development training, bringing to 220 the number of senior staff trained in management skills. Training in extension methods was given to extension workers.

Training and Information Sections co-operated in holding writing workshops for both extension and regulatory staff.

Organization and staff

Total staff of the Branch stood at 67 on 31 May 1980. Of these, eight were officers of Public Relations, Government News and Information Services, Premier's Department; 15 were librarians; and one was a printer from the Government Printing Office.

Information section

EDITORIAL. Six issues of the *Queensland Agricultural Journal* were published during the year. This magazine remains the Department's principal extension publication, mainly because of its versatility. It publishes in the one issue text, line drawings, half tones and colour reproductions.

Circulation remains about 10 000, made up of primary producers, private and public companies, libraries, educational institutions and the public. The strong overseas demand for the journal shows no signs of slackening.

In the last 12 months, 96 major articles were published. These covered such diverse topics as wheat growing, feeding dairy cattle, pastures, fencing and native plants.

Editorial staff co-operated with Branches in editing and producing 153 Farmnotes and 65 Refnotes during the 12 months.

Since the Farmnote series began in September 1977, more than 400 topics have been covered. Most of the topics that readily lend themselves to Farmnote presentation have now been covered and the rate of new accessions is slowing down. On the other hand, the call for reprints of existing titles is increasing. Almost 50 were reprinted in the year under review and heavier reprinting is forecast for 1980-81.

These leaflets have proved the most economical means yet employed by the Department of conveying written information to producers. However, where a Farmnote consists of more than one sheet, collating and stapling delays may destroy its timeliness, especially where numbers in excess of 500 are required.

Editorial staff was involved, with Branches, in producing 'for sale' books for use by farmers. The title *Weeds of Queensland* was released during the year and the title *Handbook of Ferns and Fern Allies in Queensland* was at an advanced stage of publication. Other books scheduled for printing deal with insect pests in Queensland, insect pests of the macadamia, seed contaminants, dairy cattle research techniques and vegetables in the home garden.

A further volume of *Wildflowers of South-eastern Queensland* is scheduled for release in 1980-81.

Responsibility for allotting ISSN and ISBN library numbers for all Departmental publications has been taken over by the editorial section.

The editorial section also had major commitments in publishing the Department's Annual Report to Parliament, and in providing speech and background notes and special articles for the Governor and State Ministers in various Departments as well as the Department of Primary Industries.

PRESS. The weekly bulletin of press items issued to all provincial and metropolitan newspapers continues to be a success. This bulletin is circulated to 96 press outlets each week and agricultural news appears regularly in most of these.

Newspaper coverage was greatly expanded during the year by the arrangement to publish feature pages of agricultural information in *Queensland Country Life* each week.

This is a real success as the Department's research findings are brought to the notice of a readership in excess of 30 000.

RADIO. The main radio output of the Branch is a weekly 15-minute programme made up of four short topical interviews. The programme is syndicated to 17 regional radio stations.

Officers from Marketing Services Branch recorded a weekly 3-minute item on market intelligence for the A.B.C. Country Hour. Radio items on Near North Coast extension programmes were supplied to stations at Nambour, Gympie and Maryborough as required.

Practical training in the use of radio in extension work was given at the Department's staff training workshop.

REGIONAL INFORMATION. Regional Information Officers at Toowoomba and Rockhampton continued to supply agricultural information to the media in those districts on a full-time basis.

The three regions in the south-eastern corner of the State—East Moreton, West Moreton and the Near North Coast—were given media support, part-time, from journalists based at Head Office.

Regional information supported the Department's extension programmes in those areas served.

TELEVISION. Television coverage has not expanded at the expected rate. This is mainly because of the restricted requirements of the channels which are broadcasting to a predominantly urban audience. The concentrated effort to provide newspaper coverage has contributed to the slower expansion through the diversion of staff to the newspaper work.

ART. In 1979-80, the Art Section handled 247 requests for art work for publication through the Department's in-plant duplicating service or the Government Printing Office. Some single requests involved the preparation of as many as 37 separate pieces of artwork.

As well as training its own staff, the Department is involved in training overseas visitors in the use of radio to convey agricultural research information to farmers. This is particularly important in some developing countries where the illiteracy rate is high. Here, D.P.I. radio officer Ron Powell interviews Mr Baikoro Sillah, of Gambia.

The two Commercial Art Assistants have managed to keep pace with the Department's demands and also to handle displays for major conferences.

The appointment of the Department's first display artist in the previous year has been fully vindicated. The Department's 1979 R.N.A. display was judged its most successful ever and its appeal was such that it was hired by a large commercial chain store as the nucleus of its Christmas children's display.

In addition, the display artist has prepared displays at four district shows. Four special displays for anniversaries and jubilees have been prepared, as well as six career displays.

IN-PLANT DUPLICATING. Pressure from Branches for large-scale duplicating has continued to increase. A careful check on productivity during the year has shown that the maximum capacity of the duplicating operation, with the present staff and equipment, is 35 000 printed pages a day. This capacity is achieved except at times of staff shortage through sick and recreation leave.

Demands from Branches for duplicating consistently exceed this figure, frequently reaching 60 000 printed pages a day. The result is a permanent backlog fluctuating between 300 000 and 500 000 printed pages.

Production in 1979-80 exceeded 9m printed pages, all of which were printed in-house. The 1978-79 requirement of 12m printed pages was met by employing the Government Printing Office to do the excess.

The return of the Clerk (Agricultural Extension) to supervisory duties in the Duplicating Room should give an accurate costing of the duplicating operation.

Photography

Photographic services were provided during the year and covered black and white and colour photography, enlarging, murals, audio-visual displays, and cinematography.

During the year, the cost of photographic materials increased sharply. Manufacturers' figures show an average increase in excess of 75% with some special lines going up more than 110%.

These increases have made black and white materials as expensive as colour. It is now the practice to use colour in place of black and white in all display work, and this has led to improved displays with a more professional appearance. While the cost of materials is no higher for the colour work, production is slower as colour is far more labour-intensive than black and white.

Field work almost doubled during the year with the number of exposures increasing from 10 000 to 19 500. Increases were also recorded in processing (30%) and murals (100%).

The shooting of cine film more than doubled during the year—from 2 750 m to 5 790 m. At present, eight films are at various stages of production. Cinematography is also a labour-intensive undertaking: each minute of on-screen film takes about 40 hours to make.

Major projects completed during the year included photographs of seeds for Standards Branch, fruit varieties for Horticulture Branch, special prints for Entomology Branch and the Isis film for Soil Conservation Branch.

The number of audio-visual displays prepared during the year showed an increase but a considerably greater demand is expected in the coming year.

Training

MANAGEMENT DEVELOPMENT. The Training Section continued its series of Management Development courses by holding an additional three courses during the year. This brings to 220 the number of senior staff who have now attended these courses.

This activity has been followed up by a series of short workshops for officers needing more information on particular topics. These topics include such areas as managing time, role specification, setting objectives and extension and report writing.

As a result of the total management programme, Central Administration has reported an improvement in organizational communications.

OTHER TRAINING. One 2-week Extension Methods School was held for extension workers and separate 1-week Communication Courses were held for regulatory and research staff.

Four writing workshops were held for extension workers. These were co-operative efforts with both Training and Publications staff contributing specialized inputs.

A.V. equipment loan service

The audio-visual loans service was re-organized during the year. A C.E.S.G. grant of $1,000 was used to replace and upgrade equipment held at Head Office for issue on loan to regions close to Brisbane.

A special Treasury allocation of $12,000 granted in the previous year was used to replace obsolete and unserviceable equipment in country centres. This has reduced the cost of freighting equipment to distant centres and increased the efficiency of the service.

Library

The library service continued to expand and develop during the year.

FAR NORTHERN REGION. The position of librarian for the Far Northern Region was filled in September 1979. Since this appointment, a large portion of the Region's books and journals have been gathered into a central collection at Mareeba. This collection will form the nucleus of the Regional Library.

In addition, more than half the books in the Region have been catalogued and a Union Catalogue of all holdings in the Region has been established.

ON-LINE SEARCHING. After Reference staff had attended training sessions, several on-line-searches were completed. A talk describing the possibilities and economics of on-line searching was given to Branch Directors in October 1979, and the service was publicized in the Library List.

Since then, 20 requests for searches have been completed.

STATISTICS. The statistics of library operations are—Central Library: accessions (books and journals) 1917; loans 5 362; inter library loans, lent 918, borrowed 2 125; contents pages circulated 26 867; articles copied from contents pages 7 702; bibliographies (including computer searches) 56; books catalogued 2 094; pages photo-copied 128 930. Branch libraries: loans 7 731; inter library loans, lent 1 064, borrowed 2 266; bibliographies (including computer searches) 45.

Biometry Branch

THE purpose of Biometry Branch is to provide biometrical and data processing services to the Department.

Both services involve a major commitment to using computer facilities. Logically therefore both services have come under the jurisdiction of one administrative unit, Biometry Branch. This arrangement facilitates conduct of activities pertaining to the whole Department in addition to those activities which service the needs of particular Sections or Branches.

Biometrical services

Biometrical services which constitute one of the Department's research work programmes comprised five separate activities during 1979-80. These activities were the provision of biometrical consulting services, the development of statistical computer programmes, the conduct of biometrical training activities, the undertaking of system research and the decentralization of biometrical services. A sixth activity started late in the year when biometricians initiated several new research projects.

DECENTRALIZATION OF BIOMETRICAL SERVICES. The activity of decentralizing the Branch to provide closer contact between biometricians and research-extension officers was completed late in the year with transfer of two biometricians and a cadet (technician) to Rockhampton. Appointment of a replacement biometrician in October 1979 enabled this unit to be fully staffed.

The Branch now has units of two or more biometricians with technical support at each of Toowoomba, Townsville and Rockhampton.

Biometrical services in south-east Queensland continued to be provided by biometricians located at Brisbane. These officers make regular visits each week to the major laboratory complexes in the metropolitan area and occasional visits to centres outside Brisbane.

BIOMETRICAL CONSULTING SERVICES. A consulting service to research and extension officers is provided by biometricians who advise on experimental designs, analyses and interpretation. Although analysis of data accounts for the major component of time, biometricians reported that an increasing amount of time was being taken up with consulting on experimental designs. This change is attributed, in part, to the success of the inservice training programme which has enabled more research officers to undertake their own analyses.

Experimental designs. During 1979-80, a total of 395 new research projects was submitted to the Branch for comment on the experimental designs. While this represented a 9% reduction on that of the previous year, there was considerable variation from region to region, for example, on the Darling Downs there was an increase of 40% compared with reductions in all other regions. The numbers of projects submitted for appraisal are given in Table 1.

Data analysis. The 616 data sets submitted for analysis during 1979-80 were almost the same as for the previous year (621). The number of analyses completed fell by 3% to 610 which allowed a further small reduction in the carryover (29%) of data sets submitted. Details of work undertaken by the Branch are summarized in Table 1.

TABLE 1

SUMMARY OF BIOMETRICAL WORK: 1979-80

—	Projects approved	Data submissions	Analyses completed	Analyses outstanding
North Queensland ..	114	159	156	37
Central Queensland	52	27	34	26
Darling Downs ..	114	175	163	23
South-east Queensland	125	255	257	87
TOTAL ..	405	616	610	173

An easing of the work load in north Queensland and on the Darling Downs, and strengthening of the central Queensland unit with an extra biometrician appear to be satisfying client needs in country centres. Regionally based biometricians, this year, found time to pursue further some aspects of biometrics in addition to the analytical service normally given to research staff. Biometricians located at Brisbane, however, still remain fully committed to servicing client needs and have been unable to contribute as much to other Branch activities as when the unit was fully staffed.

Non parametric statistical tests were used to determine preferences by the beetle *Pteropetalaeus darlengensis* Carter for particular soil moisture and temperature levels. Pairs of beetles were introduced to each of five treatment levels in polythene tubes and allowed to move freely along the tubes to preferred treatments. The Kolmogorov-Smirnov test was used to show that the distribution of beetles along the tubes was not uniform. Preferences were shown for soil moisture levels of 28%.

Regional cotton and peanut trials were analysed and interpreted with aid of a suite of programmes developed at the University of Queensland. Input and output routines for the programmes were improved in adaptations by Biometry Branch for use on the C.S.I.R.O. computer network. The cotton trials involved 32 different environments (four in New South Wales, four in Queensland, all over 4 years) as part of the Australian Cotton Cultivar Trials. The peanut trials were adjuncts to peanut breeding work near Kingaroy. The same programmes are expected to be used to analyse genotype by environment effects in other crops in the near future.

Coefficients of variation were drastically reduced using square root transformations on counts of plant numbers in three replicated factorial designed trials near Mackay. These trials aimed at evaluating possible ways of rejuvenating heavily stocked grass-legume (Siratro) pastures.

Certain genetic components of variance were estimated for each of three groups of sorghum breeding lines (F_1 lines, half-sibs and full-sibs). Each group was planted with 169 entries in intermixed 13×13 triple lattice designs at three locations, two on the Darling Downs and one in central Queensland. Various 'across site' analyses were determined for each group after the initial series of individual lattice analyses, including covariance analysis.

Different methods of estimating seed germination of Cucurbitaceae were compared as a contribution to the Germination Committee of the International Seed Testing Association. The results were intended to guide standardization of germination testing world-wide. The data, which were received from Australia and many overseas seed testing centres, proved to be badly balanced in the statistical sense with considerable lack of conformity as to use of 'standard' testing procedures. Data showing excessive variability from two centres were rejected from the analyses. Overall results were inconclusive as tests giving highest germination rates were found to vary from species to species.

The programme RGSP was used to prepare 136 tables from a survey of quota egg producers aimed at providing information for policy decisions and extension programmes affecting the egg industry. The size of the data set and the answers to some of the 260 questions meant considerable experience in computer file handling and use of RGSP was essential. Edited output from the programme was also held on file to produce microfiche copies of the tables for inclusion in the final report and, therefore, to save an enormous amount of typing effort.

Statistical interpretation. Interpretative abilities of biometricians were demonstrated by their co-authorship of 16 papers contributed to scientific journals and presentation of papers to three technical conferences-meetings during the year.

The Branch was also asked to referee 33 manuscripts before their publication to ensure that high standards of statistical methodology are maintained.

TRAINING IN BIOMETRICAL METHODS. The Branch training activity can be divided into two components: external, for training given to officers in other Branches; and internal, for Branch staff.

External training. The year 1979-80 saw completion of a training programme extending over 6 years with considerable financial support from the Commonwealth Extension Services Grant. The year ended with a review of the training programme, the results of which are still being assessed.

Two workshops were conducted for Departmental officers to demonstrate the use of a number of statistical programmes available on the C.S.I.R.O. computer network. This series has now equipped more than 170 officers with sufficient knowledge to be able to use the programmes as required.

A third workshop was conducted at Townsville late in the year for agrostologists. This workshop aimed at enabling agrostologists to analyse data gathered during visual estimation of pasture productivity.

Internal training. Biometricians maintain and improve their technical competence by attending recognized tertiary courses; by participating in a range of seminars, conferences and workshops; and through personal reading of technical literature.

Five biometricians continued tertiary studies for post graduate or second degrees, one of the group completing his Master of Scientific Studies degree at the end of 1979.

Technical conferences attended by biometricians included a symposium on regression analysis (Sydney), Development of BLUP routines (Armidale), 'Agriculture Capricornia' (Rockhampton) and the Jubilee Conference of the C.S.I.R.O. Division of Mathematics and Statistics (Adelaide).

Technical support staff from Toowoomba, Rockhampton and Townsville met in Townsville to examine their roles in the Branch and to exchange technical information relevant to their respective roles.

DEVELOPMENT OF STATISTICAL PROGRAMMES. All statistical programmes are to be shifted from the SYSTEM set disc storage to the Department's USER subset disc storage early in the new year 1980-81. This should substantially reduce storage costs and will allow other programmes to be held permanently on file. Minor changes to control cards will be necessary for programme access but users will be advised promptly and will have a short period to make necessary changes before the shift is made permanent.

Several programmes were written to process data associated with the Broad Resources Appraisal Survey based on Toowoomba. In this, current and potential land use statistics are being estimated for 3 279 individual mapping units arranged within 114 shires in 10 regions. Apart from initial checking programmes to detect errors in coding, a programme was needed to adjust current estimates to agree with more reliable figures from the Australian Bureau of Statistics.

Several programmes were converted and modified for investigation of genotype-environment effects through the C.S.I.R.O. computer network. These programmes were originally written in the Department of Agriculture for processing on the University of Queensland's PDP10 computer. Documentation is being prepared and will be available early in 1980-81.

SYSTEMS RESEARCH. Participation in bio-economic systems research was largely confined to modelling lamb and wool production for a sheep breeding flock in north-west Queensland. A computer model based on the daily utilization of energy, selected amino acids and glucose showed reasonable agreement between simulated values and field measurements of wool growth in grazing experiments at Julia Creek and Charleville.

The model developed for wool growth was manipulated in an attempt to explain differences in wool growth of non-pregnant sheep in both environments. Simulations suggested that lower wool growth at Julia Creek could be explained by reduced per head intake of forage with at times a lower organic matter digestibility and nitrogen content.

This systems research was used to redirect some research activity, particularly the direction of work at 'Toorak' Field Research Station, Julia Creek.

BIOMETRICAL RESEARCH. In past years, pursuit of formal education was the only avenue open to biometricians to continue to develop their technical potential and to expand their expertise. Due to pressure of work, biometricians were unable to extend methodological investigations which were essential for processing research data to the stage where the methodology could be documented. Work pressure eased sufficiently during 1979-80 for the possibility of pursuing biometrical research to be encouraged.

Biometricians were requested to submit outlines of projects which they wished to undertake. Nine projects were approved and one was deferred for consideration as a joint exercise involving several biometricians.

Reports from projects will take the form of articles for technical journals or technical bulletins published by Biometry Branch. The first publications are expected during 1980-81.

E.D.P. services

Provision of electronic data processing (EDP) services is a relatively new work programme within the Department's administration area of endeavour. The main activities within the programme are the development of computerized systems for processing management and accounting data, the development of skills in computer programming and system analysis among Departmental officers, and the acquisition, location, operation and maintenance of data processing and computer equipment.

The year 1979-80 saw consolidation of the programme by appointment of three programmers to Biometry Branch to complete a training and recruitment programme extending over 3 years. Each activitiy is reported upon separately.

SYSTEMS DEVELOPMENT. Several computerized systems are in various stages of development. The most noteworthy project is that of developing a computer-based financial accounting system. During the past year, a comprehensive report on existing Departmental procedures for manually handling Sundry Debtors was completed. Development of a computer system was delayed, however, pending the investigation and evaluation by officers of the State Government Computer Centre and the Department of the Public Service Board of commercially available computer packages which might be useable for government accounting processes.

Purchase of a commercial package would remove the need to develop an 'in-house' accounting system and achieve standardization of accounting practices throughout the Public Service.

Implementation of the Plant and Inventory Recording System (PIQUIP) progressed to the input of raw data and data validation for the past 3 years, and creation of the initial master file.

Several systems are now in use or well advanced in development as a result of 'on-job' training for inexperienced staff. Technical skills were improved and simultaneously with development of useful application systems for user clients. Systems included in this category were—

ACDC—a system of registration of operators, equipment and chemicals approved for commercial application of herbicides.

LIBRA—a system of recording bibliographic data and information usage.

DPISPS—a system of recording data noted in Stock Permits.

Some maintenance activity is required for these systems as users seek alterations and enhancements, particularly in the LIBRA system.

DATA PROCESSING TRAINING. Formal training of staff in EDP Section continued throughout the year. Courses attended at the State Government Computer Centre included—

1100 Basic Concepts

1100 Executive Control Language

Basic and Advanced Cobol Programming

Symbolic Stream Generator

Filetab

Two officers in the Section attended a 5-day seminar entitled 'Tools and Techniques for Systems Development' in Sydney to round off previous training in Structured Analysis and Design. Emphasis in this seminar was on integrating the various techniques in the real-world environment rather than on the techniques themselves.

DATA PROCESSING DOCUMENTATION STANDARDS. The Manual of Documentation Standards for EDP activity was completed and distributed within the Department during 1979-80. Procedures for developing amendments to systems were added to the initial manual with some other minor amendments late in the year.

Implementation of the Standards is an integral part of developing accounting systems within the Department. The Accounting Manual refers specifically to requirements relating to documentation of EDP systems and associated clerical procedures. These requirements are satisfied by the procedures outlined in the Standards.

COMPUTER HARDWARE FACILITIES. All Departmental centres in the metropolitan area have been connected by Telecom data transmission lines to the State Government Computer Centre. This will enable officers at each centre to utilize the Department's management information and accounting systems as required and when relevant components are fully implemented. At the same time, technical users have the opportunity to transfer their data processing activity to the Centre rather than to C.S.I.R.O. or the University.

Heavy dependence on C.S.I.R.O. for technical data processing by research officers necessitated enhancement of the Department's facilities connected to the C.S.I.R.O. computer network. Equipment purchased late in 1978-79 was installed progressively during the past year.

The Branch Director was heavily committed to negotiating approvals for acquisition of hardware and software for the Computer Operated Brands Recording and Acquisitions (COBRA) system for the Livestock Brands Office. Equipment and software to the value of $150,000 is being supplied during 1979-80. A second stage including the bulk of the software estimated to cost an additional $100,00 will be negotiated early in the new financial year.

For the second successive year, no additional equipment was purchased for location in country centres. Attention was given to the possibility of introducing micro-computer systems to country centres based on experience gained with Apple II micro-computers used in the COBRA system. A submission was forwarded to the Department of the Public Service Board for purchase of an initial Apple II for evaluation by the biometricians.

The need is to determine the capacity of the micro-computer to handle existing biometry statistical programmes and to adapt, modify or develop programmes which can be used generally. The intention is to develop a suite of acceptable statistical programmes for use by Departmental officers before micro-computers are widely installed. This will circumvent many of the difficulties which arose from proliferation of incompatible programmable calculators in the past.

COMPUTER EQUIPMENT OPERATIONS. Data processing activity during 1979-80 was running at levels similar to those in 1978-79.

Data preparation services were provided by three operators in Brisbane who also operate and maintain the biometry computing equipment in Mineral House. During the past year, 1 052 separate data sets were prepared onto punched cards.

No new large data sets similar to the AEHIS data base were received for preparation during the year. However, the work load of entering data onto computer files is being dispersed. Additional operators were trained at the State Government Computer Centre to use the GCS data entry system. Experience of the Biometry Branch operators is that use of the GCS system is considerably faster (by a factor of 1·5 to 2·0) than time taken to punch data onto cards.

The Branch reports with regret the untimely death of Dr Jocelyn Tommerup who gave valuable service to the Branch and the Department during her career.

Extension Services Section

STAFF of Extension Services Section are responsible for co-ordinating the extension activities of Departmental officers. They pay particular attention to extension activities involving groups of officers interested in assisting primary producers to overcome their problems in an organized purposeful manner.

Nine officers are stationed in eight of the extension regions of Queensland and two officers form an 'Extension Evaluation Unit' at Brisbane.

Several activities occurring during the year under review are worthy of comment—

- There has been a trend from 'district' towards the 'industry' system for organizing extension planning operations. In July 1979 a report on 'Extension Programming' was presented by Mr E. Dexter from the Extension Evaluation Unit of the United Kingdom Ministry of Agriculture, Fisheries and Food. This report recommended that in future all extension planning should be based around 'industry groups'.

  In several regions, the responsibilities of the District Extension Committees have now been altered so that 'industry groups' are responsible for planning extension activities according to the local needs of the various industries. In some regions, industry groups are working as sub-committees of the District Extension Committees but in others, the District Extension Committees have disbanded.

  Where industry groups have been functioning for some time, the staff concerned have been able to focus more keenly on the problems of local producers. In some instances, they have actively involved some producers in their planning procedures.

- A two-man extension evaluation team has been operating for approximately 12 months. One of the unit's major undertakings has involved a 'Situation Appraisal' of the passionfruit industry in the Nambour area. This work gave local Departmental officers new insights into the problems facing the industry in that area and into the various techniques which can be used to assist in determining the extension needs of an industry. Passionfruit growers in the Nambour area were actively involved in several phases of this situation appraisal.

  As a result of the study, some special extension projects have been undertaken and others are planned.

- Another major activity of the extension evaluation team has been to carry out several surveys of attitudes to beef carcass classification. These surveys have been carried out in conjunction with a beef carcass classification trial at an abattoir near Brisbane. Beef producers and meat retailers who trade with that abattoir have been involved.

  The information obtained has enabled the unit to establish benchmarks that will assist a comprehensive trial evaluation in 1981. The information has also provided a basis for planning extension programmes for both groups of clients. Preliminary reports on the initial surveys have been prepared.

- In his report, Mr Dexter also commented on the need for more involvement by primary producers and industry representatives in the planning of extension activities. This subject was discussed in depth at a workshop attended by senior staff at Toowoomba in May 1980 and some general agreement was obtained on procedures to be adopted.

  It is expected that a number of attempts to improve this aspect of programme planning will be undertaken in the near future.

- The involvement of staff of the section in training and development activities has continued at an increased level. During the year, one officer commenced a course for a master's degree in extension at the University of Melbourne and another officer is attending a post-graduate management course at the Queensland Institute of Technology on a full-time basis. A third officer is completing this post-graduate course on a part-time basis after attending the Institute on a full-time basis in 1979.

- Some of the extension activities that have been carried out in the past few years are now giving encouraging results. Items worthy of note are—

  1. Many more cattlemen in ticky areas are now culling cattle that carry high tick numbers. This is one aspect of the Department's integrated tick control programme for the control of cattle tick through breeding for tick resistance and confining the use of chemicals to a strategic basis.

  2. There has been a continued increase in the number of cool stores and forced air cooling rooms for horticultural produce. This is linked with extension projects aimed at improving the quality of produce by precooling before sending it to market. The net benefits of this programme accrue to both producers and consumers.

  3. As tobacco growers changed to the new systemic fungicide to control blue mould, they had to change some of their husbandry practices. Extension activities assisted them to do this and it is now considered that virtually 100% of tobacco growers are making effective use of the new systemic fungicide.

  4. More drying plants for both cereal grains and peanuts are being installed in both south and north Queensland. Advice from the Department's engineers has ensured that the machines now being installed are those most suitable for this purpose.

  5. The programme to reduce iodine levels in market milk has been successful. The main tasks were to make producers aware of the situation and to monitor their progress in overcoming and achieving the relevant standards for this quality product.

  6. The number of dairymen and beef producers who have been trained by Departmental officers to carry out artificial insemination on their own stock continues to increase. This will have considerable impact on the future use of A.I. in Queensland and in the maintenance of the genetic quality of our cattle herds.

Division of Animal Industry

THE Division of Animal Industry is made up of eight Branches. The five field Branches are: Veterinary Services Branch, Slaughtering and Meat Inspection Branch, Beef Cattle Husbandry Branch, Sheep and Wool Branch, Pig and Poultry Branch. The other three Branches are Pathology, Biochemistry and Husbandry Research Branches which constitute Animal Research Institute and the regional laboratories at Oonoonba (Townsville) and Rockhampton.

The activities and responsibilities of the eight Branches are directed towards the achievement of the following Divisional objectives—

- To promote efficient commercial production of food and fibres from animals, without damage to the environment.
- To provide a service to producers for developing and maintaining healthy herds and flocks.
- To ensure that meat is supplied to the community in an hygienic state and to promote improvement in the quality of animal products.
- To ensure that only disease-free animals are used for human consumption.
- To eradicate or economically control animal diseases.
- To prevent the entry and exit of animal diseases into or from Queensland.
- To ensure adequate technical and management training of staff for performance of functions.
- To provide animal identification services to the livestock industries.

Division suffered some contraction in staff and financial resources while endeavouring to maintain services at a level at least equal to that of previous years. The increasing cost of these services in a climate of financial stringency has led to reviews of the services provided during the year and to the identification of low priority areas of operation. Resources allocated to these areas have in some cases already been reduced, but it is clear that some such low priority services will have to be phased out over the next few years. Others will have to be greatly reduced in scope. The position is exacerbated by the general contraction in the value of funds provided from industry for research and from the Commonwealth for extension services.

There were few changes in senior staff during the year. Mr R. J. W. Gartner was appointed Director of Husbandry Research Branch. Dr L. L. Callow, Chief Protozoologist and research leader at the Wacol Tick Fever Research Centre, resigned to take up an appointment at the Queensland Agricultural College, Lawes.

Amendments to legislation

ACTS. A series of amendments to the *Stock Act* 1915–1979 was given assent in December, 1979. The changes included the addition of 'insect' under the definition of 'animal' to provide for inclusion of the apiary industry. For similar reasons, the definition of 'animal product' and 'biological preparations' was expanded to include products of bees. A definition of 'animal pathogen' was included, and relevant sections amended to enable controls to be exercised on disease-causing agents in the State. The definition of 'Chief Inspector' was amended to clarify the position relating to persons who occupy this position while the Director Veterinary Services is absent. Some diseases which were not previously listed were included in the definitions of 'disease' and 'notifiable disease', to update these areas. The term 'inoculate' was expanded, and provision was made in the definition of 'laboratory' to cater for parasites and toxic materials.

Quarantine provisions were amended to provide tighter control of movements of stock, and to relate disease to stock in an area. Changes were made to the sections relating to stock permits and waybills, to clarify the responsibility of owners, make provision for concessional permits for horse owners who regularly travel to equestrian events, and to require permits to be presented to authorized persons on demand.

To facilitate compulsory testing for disease, Section 25 was strengthened to allow the Minister to authorize an Inspector to order an owner to install a holding facility after other alternatives have been fully explored. A further amendment to Section 25 strengthened the powers of inspectors to question persons who are suspected of having relevant information.

Section 25A was amended to overcome anomalies in respect of veterinary practitioners who service the national brucellosis and tuberculosis eradication scheme, and to provide for travelling stock to be moved to an available facility for testing for these diseases. Provision is also made for indemnity of Authorized Veterinary Surgeons and for preventing owners from removing animals which gave suspicious reactions to testing. Associated with this programme is the need to tighten controls on the use of vaccines which could cause difficulty in interpreting tests. This is provided for under an amendment to Section 26 (2).

The offences section of the Act was amended to include provision for the amendments to the sections relating to stock permits, and to create an offence relating to false information being given by applicants for stock health certificates. In addition, provision was made for the recovery of costs for work done following failure to comply with an order of an inspector, in cases where testing is necessary.

Another amendment clearly indicates the right of police officers to institute proceeding for any breach of the Act which comes within the compass of their powers. This change is contained in Section 30 (1).

Under Section 31, reference is now made to the Code of Good Manufacturing Practice of the National Biological Standards Laboratory, which becomes the standard relating to laboratories and ancilliary facilities.

The Schedule relating to the subject matter for Regulations was expanded to include provision for powers for control in relation to animal pathogens, a framework in relation to disease eradication programmes, and the activities of laboratories in relation to parasites and toxic substances.

The Brands Act 1915–1978 was amended to include a definition of 'sell', set a maximum size for spay marks, tidy up the Directory provisions, include colour for sheep brands, allow re-issue of earmarks with the consent of the previous owner, allow an employee to brand, update the evidence provisions, allow a refund of unused fees, and to introduce compulsory pig branding.

REGULATIONS: ORDERS-IN-COUNCIL: NOTIFICATIONS. Regulations under the Foot-and-Mouth Disease Expenses and Compensation Fund Act 1958–1969 were amended to widen the definition of 'disease' to include all the exotic diseases covered by the Commonwealth-States cost-sharing agreement, and to tighten the provisions of several existing regulations.

Regulation 66A of the Stock Regulations of 1935 was amended to increase the compensation payable for cattle affected with and destroyed because of tuberculosis and brucellosis. Regulations under the Brands Act were amended to provide pig brand application forms and certificates.

The Meat Industry Regulations 1973 were amended to provide a maximum of 80 000 poultry to be processed at a Class 2 poultry slaughterhouse per month where an approved chain system is installed: for a retail market and a Class 5 butcher's shop; for prohibition of the use of certain products in the manufacture of prescribed or minced meats; and for an increase in prescribed fees.

Orders-in-Council were promulgated to declare additional chemical residues to be a 'disease' for the purpose of the Stock Act; prohibit the introduction of swine or carcasses or products of swine from Tasmania and to revoke the prohibition; revoke the Queensland bovine tuberculosis infected area; and revoke the assessment on suppliers to the Nanango Dairy Factory for the veterinary mileage scheme.

Notifications were gazetted to declare a bovine tuberculosis provisionally free area in southern Queensland; alter the boundaries of the tuberculosis protected and infected areas; declare a bovine brucellosis provisionally free area in north Queensland and associated amendments to the protected area; and define new interstate movement conditions in respect to bovine brucellosis.

Animal identification

COMPUTERIZATION OF BRANDS. Tenders for a Computer Operated Brands Recording and Acquisition (COBRA) System were let in January 1980, and equipment delivery commenced in May. The computer consists of a Honeywell level 6 computer with 512 K bytes of main memory and twin 256 MB discdrives. The terminals will be Apple II micro computers each with 48 KB memory, $5\frac{1}{4}$ in. (133·35/mm) discdrives and associated printers and video screens. System installation and programme development have commenced and will, subject to availability of funds, continue through 1980-81. The computer offers a whole new concept in Brands record keeping and recovery and will enable fast and accurate searching of records dating back to 1872.

CATTLE EARMARK AND SHEEP DISTRICTS. A 2-year project to convert old cattle earmark and sheep district boundaries to accurate maps was finalized during the year. The various boundary descriptions were written in 1916 and amended over the intervening years. Consequently they had become difficult to relate to modern maps. The project involved tracing the old boundaries from the original Government Gazettes and placing them together on a set of large modern maps. Once this was done, these master maps were gazetted as the legal record. Maps with the districts overprinted were produced and forwarded to all country centres.

REGISTRATION. Brand registrations and transfers continue to show a steady increase. Horse and cattle and sheep brand registrations totalled 3 156 (2 573 in 1978-79) transfers 2 768 (2 057) and alterations 923 (501).

PIG BRANDING. Although compulsory sale branding of pigs of a live-weight more than 30 kg and above was provided for in the December 1979 Brands Act Amendment, the section has not been proclaimed. It is not proposed to introduce the system until September 1980 to allow time for administrative details to be finalized and for a public education programme. The current voluntary pig brands registration scheme will be replaced by a new system with procedures similar to the current Brands system in respect to application and administration.

CATTLE IDENTIFICATION. Property registration and tail tagging of slaughter cattle provided under the Cattle Identification Regulations has been invaluable, not only in brucellosis and tuberculosis traceback, but also in the identification of the origin of cattle in other programmes including the chemical residues monitoring survey.

Tail tag surveys at meatworks revealed a variable loss of tags. The loss rate varied with saleyard and meatworks but, as the result of follow-up extension, the loss rate of Queensland wrap-around tags has been reduced to acceptable levels. The rate of loss of N.S.W. ratchet tags is considerably higher.

Problems with observance of the Regulations were encountered with introduction of untagged cattle from interstate and with boxing of untagged and tagged consignments as the result of spelling en route to meatworks. Both problem areas were largely resolved during the year.

The green tail tag identification of 'slaughter only' cattle originating from tuberculosis-infected herds has reduced the risk of mis-direction of such cattle from immediate slaughter. Consideration has been given to extending this form of identification to herds classed as suspect for tuberculosis.

Animal quarantine and exotic diseases

COMMITTEE OF INQUIRY. During the year, the Senate Committee of Inquiry into the Adequacy of Quarantine reported to the Commonwealth Government. A number of recommendations for change and for strengthening quarantine was made by the Committee. Some of these have already been implemented, while others require decision at Commonwealth Government level. The Committee supported continuance of the existing arrangements where the States undertake animal and plant quarantine on behalf of the Commonwealth.

SURVEILLANCE IN NORTH QUEENSLAND. During the year a Veterinary Officer, who will be working full-time on animal quarantine duties in Cape York Peninsula and the Torres Strait Islands, was appointed to Cairns. He will be supervising the screw worm fly monitoring programme, undertaking spaying programmes of dogs and cats in the Torres Straits and Bamaga as an aid to population control, carrying out distemper vaccination programmes to eliminate the confusion caused between the nervous form of this disease and rabies and organizing educational programmes on exotic disease.

Plans are well in hand to begin a screw worm monitoring programme in the area using an attractant lure 'swormlure' to attract and trap flies. It is planned to undertake monthly monitoring on Saibai Island, Boigu Island, Bamaga and Prince of Wales Island with 3-monthly surveying on Darnley, Murray, Yorke, Yam, Sue, Badu, Moa, Thursday and Horn Islands and at Heathlands and Weipa. The traps are built, but delays have been caused by difficulty in obtaining some ingredients of the 'swormlure' and in making arrangements for delivery of 'swormlure' which cannot be carried by air at present.

The Divisional Veterinary Officer, Cairns, a Veterinary Officer from the Oonoonba Veterinary Laboratories and the Veterinary Officer from Cairns on full-time quarantine duties visited P.N.G. to obtain first hand experience with old world screw worm flies, to discuss the C.S.I.R.O. research programme on screw worm flies in that country and to learn to identify the flies which are very simliar to other species present in the north.

Mr J. Walthall, Veterinary Officer (Exotic Diseases), left in April to spend 6 months in U.S.A. and Mexico working in the screw worm eradication programme. Funds for this work were provided by the Australian Bureau of Animal Health.

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The surveillance programme continued throughout the year with officers from this Division travelling on some of the flights and sea surveillance trips as well as undertaking land surveillance visits through the Peninsula. During these land visits, the opportunity is taken to recruit local inhabitants to assist voluntarily with the major task of attempting to maintain effective quarantine surveillance in this particularly vulnerable area.

ILLEGAL IMPORTS. During the year, the powers of search were used on two occasions relating to the suspected introduction of illegal imports. One was related to the seizure of eggs from an incoming passenger at Sydney Airport, but no illegal imports were found on the property. The other was associated with the illegal importation of Asseel eggs from the U.S.A. by Parcels Post at a coastal town which allowed evidence to be obtained for prosecution. The powers of search which were introduced into the Quarantine Act in 1979 by the Commonwealth Government will provide significant assistance in detection of quarantine irregularities.

ANIMAL IMPORTS. During the year, 331 dogs and 290 cats were imported from New Zealand. These animals are not required to undergo quarantine. A total of 129 dogs was imported from the United Kingdom (61), Papua New Guinea (56), Hawaii (7), Fiji (4), and Norfolk Island (1). Cats were also imported from Papua New Guinea (11) and Fiji (1). Dogs from the United Kingdom are required to undergo 90 days' quarantine at Lytton Quarantine Station while dogs and cats from the Pacific region must undergo 9 months' quarantine.

MEAT. Fresh meat could be imported only from New Zealand but during the year, the Commonwealth Government approved protocols for the importation of fresh beef from U.S.A. and Canada. Canned beef is a permitted import from any country provided it is accompanied by prescribed documentation in regard to health and cooking temperature.

During the year, the following importations were made through Queensland ports: U.S.A. (40 tonnes), Canada (1 965 kg), U.K. (92 286 kg), New Zealand (10 689 kg), Taiwan (1 275 kg), Germany (452 kg) and Pago Pago (62 200 kg).

CHEESE. A total of 239·28 tonnes of cheese was imported from Norway, Denmark, Switzerland, Germany, Austria, France, Sweden, Netherlands, Finland, Italy, U.K. and U.S.A.

LIVE FISH. A total of 2·8 million fish in 206 consignments was inspected and 374 prohibited fish seized and destroyed. This Division made a major contribution to a Working Party appointed to examine procedures and protocols for the importation of fish and treatment of water imported with the fish. The recommendations of the Working Party will be introduced as soon as the necessary arrangements for certification are made with exporting countries and suitable facilities are provided at or near the airport for inspection, water treatment and replacement.

INSPECTIONS AND SEIZURES. A total of 2 193 commercial overseas aircraft which carried 188 093 passengers was serviced during the year. At parcel post, 1 723 parcels were inspected resulting in 229 seizures. In terms of shipping, 342 cargo vessels including 28 with bonds for ships pets, 23 yachts and 17 passenger vessels disembarking 4 853 passengers were serviced. A total of 804 pairs of shoes of people returning from foot and mouth countries was treated during the year.

The total seizures for the year were in excess of 1 500 items covering a large range of prohibited and potentially infectious materials.

FOREIGN FISHING VESSELS. Clam boats again presented a problem this year at Cairns and Mackay with four vessels being captured. The policy of destruction of all quarantinable material, confiscation of the catch and vessel and prosecution of the master and crew was vigorously implemented. While this policy has reduced the number of vessels operating, the rewards are still sufficiently high to encourage illegal clam fishing.

PREPAREDNESS FOR EXOTIC DISEASES. A simulated exotic Newcastle disease exercise was held in November 1979 in the Brisbane area. The basic objective of the exercise was to ascertain how effectively the establishment of a headquarters could be organized in the face of an exotic disease. Officers involved in this exercise varied in their previous experience. The exercise also involved many people in the poultry industry and from other Government Services.

Following the exercise, all facets of the exercise, including establishment of local headquarters, State Emergency Service involvement, traceback and surveillance, slaughtering and disinfection and administration including the shortcomings, were examined closely by the officers of the Branches involved. There is no doubt that valuable lessons were learnt. This will add to the considerable expertise acquired in previous eradication exercises.

Two senior staff members attended an exotic diseases seminar at the Australian Counter Disaster College at Mt. Macedon, Victoria. Participants came from a full range of agencies from States and the Commonwealth likely to be involved in major exotic disease episodes.

Late in the period covered by the report, discussions were held with the Commonwealth Department of Health, the Australian Bureau of Animal Health, the State Departments of Lands, Aboriginal and Islanders' Advancement and the National Parks and Wildlife Service in relation to the development of a proposal for a stock-free zone in Cape York Peninsula. There was general agreement on the overall concept of the proposal as a means of reducing the risks of incursion of exotic animal diseases, but detailed feasibility studies are required on a number of aspects of the proposal.

Other matters under consideration in northern areas include control or removal of some feral animal species from strategic Torres Strait Islands, improvement of housing and management of cattle and pigs, and identification of pigs and dogs. The Commonwealth Department of Health in consultation with this Department is giving consideration to a quarantine zone in the Torres Strait region and the formation of a Torres Strait Quarantine Conference involving Island Chairmen and appropriate Commonwealth and State Government Departments.

LICENSING AND CONTROL OF PIGGERIES. Provisions were introduced into the Stock Act and Regulations some 4 to 5 years ago to control the feeding of untreated animal matter to pigs. These were designed to prevent transmission of diseases to animals should feedstuffs containing viruses of exotic diseases illegally enter Australia. Similar requirements have been introduced in all States.

All piggeries have been kept under regular surveillance during the year to ensure that the requirements were being observed. Initially, some violations were detected by Inspectors but illegal practices in most instances ceased following extension efforts. Two persons in the Townsville area were convicted for feeding animal matter to swine. The disposal of scraps from hospitals, cafes, boarding schools, and service establishments was kept under supervision.

Processed animal matter, that is, animal matter reduced to meat-meal or like product by an approved dry rendering process, may be fed to swine on any premises. Treated animal matter, that is, animal matter which has been submitted to an approved heating process may be fed to swine in piggeries licensed as piggeries under the above regulations and to swine on premises registered as slaughter-houses or poultry slaughter-houses or knackers' yards under the *Meat Industry Act* 1965–1977. Six piggeries located at Maleny, Gordonvale, Biggenden, Granville, Kuttabul and Warwick have been registered under these regulations.

Livestock exports

During the year, the following stock and poultry were exported from Queensland ports: cattle (18 885), sheep (272), horses (77), dogs (451), cats (161), day-old chickens (90 150), birds (84), fish (1 688) and bees (17 597). In addition 54 848 doses of semen and 102 600 eggs were exported.

In recent months, strict conditions for the export of live horses were drawn up by the Australian Bureau of Animal Health in consultation with Chief Veterinary Officers of all States and are now being implemented. These should allow horses to enjoy better travelling conditions and permit them to arrive in good health at the country of destination. These conditions require a veterinarian or a groom to travel with each significant consignment and their reports will be used to amend conditions should they not prove adequate for the welfare of the horses.

Fauna and feral animals

DEER. The disease status of red deer in south-east Queensland was monitored. The National Parks and Wildlife Service has agreed to the programme, which involves sampling deer running in State forests. Autopsies were conducted on animals injured during trapping operations.

The results of the survey indicate that the prevalence of worm burdens is low. The only intestinal parasites seen were gastric worms that were related on morphological grounds to *Ostertagia* sp. Lungworms are present in deer on some properties. Tissues from a red deer hind contained unidentified larval parasite migration tracts in the liver.

Infestations of *Boophilus microplus* were higher in the wetter areas. Deer on one property carried Mt. Alford strain ticks.

Culturing of selected lymph nodes revealed the presence of a typical *Mycobacterium* sp. Although, this could interfere with correct interpretations of the tuberculin test, it is fortunate that the habitat of red deer does not include any known TB infected properties.

KANGAROOS. Melioidosis is a disease which is occasionally seen in slaughtered pigs in north Queensland. The causal organism is capable of affecting a wide range of animals, including man, and it is very difficult to treat. The recent diagnosis of melioidosis in two tree kangaroos held by the National Parks and Wildlife Service in Townsville shows that one species of our unique native animals is also susceptible to this condition.

FERAL PIG SURVEY—BRUCELLOSIS A serological survey for brucellosis of feral pigs being slaughtered for the export game meat trade was conducted. Of 962 sera examined, eight sera involving pigs from the Shires of Taroom, Belyando and Livingstone were positive.

This survey was followed by a more detailed examination of feral pigs from the Taroom Shire. Serum, spleen, iliac lymph node and uterus were collected from a total of 30 pigs in four consignments. Three of the 30 were serologically positive, but neither *Brucella suis* nor *Br. abortus* was cultured from the positives or a selection of serologically negative animals.

Environmental studies

CHEMICAL RESIDUES. Veterinary Services, Biochemistry and Slaughtering and Meat Inspection Branches are involved in a project which commenced in March 1978 and was designed to monitor the organochlorine and organophosphate pesticide residues in cattle slaughtered in Queensland. The project is supported by the industry through the Australian Meat Research Committee. It aims at assisting the industry to meet the quality control standards implicit in the statutory limits for pesticide residues, which are set on a basis of good agricultural practice. Industry support will continue for another year to permit further investigation of problems which have become evident in the course of the survey.

During the year 8 400 samples from 4 211 properties were analysed. Of these 99·26% of samples (98·4% of properties) and 99·2% of samples (98·3% of properties) complied with standards in respect to organochlorine and organophosphorus resides respectively.

The control, traceback and extension aspects of this project are carried out by officers of Veterinary Services Branch. Traceback investigations have revealed both licit and illicit sources of contamination. Quarantine restrictions are imposed where illicit sources are involved or where the owner has been careless in the licit use of chemicals on crops or for other purposes closely associated with animal production.

In the pesticide monitoring programme, a State Meat Inspector collects a carcass fat sample for analysis.



The major source of organochlorine residues has been revealed to originate from the licit use of dieldrin and BHC in certain crops with which cattle production is closely associated. Appropriate action has been taken to define these problems more precisely and to minimize animal product residues resulting from such licit uses. Organophosphate residues arise exclusively from the use of overstrength dips or dipping at short intervals too close to slaughter.

A major extension programme has been developed with the objective of educating producers on the methods of avoiding unacceptable chemical residues in animal products. This involves low key extension methods comprising group seminars, follow-up property visits in the case of over-strength dips, a programme to discourage illegal use of dieldrin in the sheep industry, and more responsible licit use of chemicals in white ant control and cropping associated with animal production.

The use of pesticides in the pig industry was investigated by means of a random survey of slaughter pigs originating from piggeries in south and central Queensland. Data on 319 fat samples from 221 identified piggeries, disclosed 10 (4·5%) properties having residues in excess of statutory limits. The results indicate no overt misuse of these chemicals, the levels obtained being marginally above limits set to accommodate bioaccumulation of background levels of these pervasive chemicals. In the case of dieldrin residues, the need to control termites is not recognized in the statutory limit of 0·2 mg per kg. No organophosphorus residues were detected although selected organophosphorus insecticides may be used for ectoparasite control in pigs.

A similar random survey of chemicals residues in poultry products has been commenced.

A project to examine the interaction of pig products with modern packaging materials has been supported by funds from Australian Pig Industry Research Committee. A major computerized literature search of the interaction of packaging and food, water and blood is nearing completion. Methods have been developed to estimate phthalate plasticisers in fat and they have been tentatively identified in tissues.

Development of facilities

The Division of Animal Industry has continuing major and minor building programmes to replace old laboratory and animal facilities which can no longer be operated efficiently to accommodate changes resulting from scientific advancement and to provide new facilities to accommodate changes in emphasis of its diverse programmes.

The two major development programmes are the rebuilding of the Animal Research Institute, Yeerongpilly, and the relocation of the units at the Animal Husbandry Research Farm, Rocklea. In the past several years, new facilities have been provided at the Animal Research Institute for Biochemistry and Husbandry Research Branches. The most recently commissioned facility at the Institute was a discrete radioisotope laboratory complex with laboratory animal as well as laboratory accommodation. It is operated by the Biochemistry Branch. Its equipment is capable of counting both beta and gamma emitting isotopes together with 14C– or 3H–labelled compounds through Gas Chromatograph-Gas Proportional Counter. The Packard Instrument Company 2260 Liquid scintillation counter provides data reduction in a number of modes via an inbuilt microprocessor system. A Canon SX-320 data processor has been interfaced with a Packard Instrument Company 5230 Gamma scintillation spectrophotometer and provides a wide range of data reduction especially in terms of Radioimmunio Assay (RIA) techniques. This instrument is fitted with a 3¼ in. Sodium Iodide crystal to give excellent counting efficiency with isotopes to 2 MeV.

The next phases of the Animal Research Institute programme are the building of an administration-library complex, the updating of the animal facilities and a new laboratory for Pathology Branch and sewering of all laboratory and animal accommodation at the Institute. Plans for the administration-library building have been completed but work has not yet commenced. Work has commenced on a conventional poultry building to provide eggs for the poultry disease diagnostic services and on a medium security poultry building to provide specific pathogen-free chickens and eggs for poultry disease research and diagnostic programmes. Plans for a medium security large animal facility for transmission studies with infectious diseases are well advanced and initial planning of the Pathology laboratory has begun. The sewering of the Institute has reached the advanced planning stage.

The relocation of the cattle, poultry and pig testing facilities of the Animal Husbandry Research Farm, Rocklea, has become necessary from the urban sprawl in the Rocklea and surrounding areas exacerbating the flooding problems of an already flood-prone farm. The units will be resited on a site recently purchased in the Harrisville area or on other research stations presently located close to Brisbane.

In the minor development programme, the two mobile laboratories located at Toowoomba and Wandoan for testing in the brucellosis eradication campaign were relocated at the Charleville Pastoral Laboratory. This will give an improved brucellosis serological service to the south-western cattle areas. Plans have been completed for a new shearing shed at 'Toorak' Research Station to replace the old unserviceable shed. Funds have been provided from the Wool Research Trust Fund for a sheep shed at the Animal Research Institute to provide facilities for the escalated wool production research programme undertaken by Sheep and Wool Branch. Plans for the shed have been approved. Work has begun on providing goat metabolism facilities at the Wool Biology Laboratory as part of the mohair research programme.

A new shed annex to the metabolism building is under construction at the Animal Research Institute. Plans are well advanced for a new cattle building at the Tick Fever Research Centre, Wacol, to accommodate the cattle used in vaccine production under improved, more hygenic conditions. Plans are well advanced for extensions to the piggery at Biloela Research Station to accommodate those breeding pigs now being used in genetic studies at the Hermitage Research Station. On completion of these facilities, the piggery at the Hermitage Research Station will close.

Training programmes

To ensure a continuing improvement in the efficiency of operation of the extension, regulatory, research and service programmes of the Division, staff participation in management and technical training programmes was maintained at a reasonable level during the year. With the imposition of financial stringencies, it is becoming increasingly difficult to maintain satisfactory training programmes and to maintain balanced management and technical training. In this Division, where staff scattered throughout the State have constant contact with and give advice to the primary producers and have responsibility to ensure that products reaching consumers are of good quality and free of disease, it is important to maintain adequate training programmes to optimize the efficiency of the operation of staff and to improve their technical expertise.

Some of the senior staff of all Branches attended Management Development Courses conducted by Information and Extension Training Branch so that most senior staff of the Division have now had basic management training. Certain of these officers assisted Information and Extension Training Branch as co-trainers and trainers in Departmental management workshops. Several staff attended short specialised workshops which concentrated on one aspect (for example, team building, managing time, setting of objectives, writing, communication skills) of management training. Branches continued with their own in-service management development training of staff at all levels. To enhance staff development and to improve co-ordination of operations, the Division, late in the year, embarked on a role specification programme for all staff of the Division. An officer of Biochemistry Branch successfully completed a post-graduate course in management at the Queensland Institute of Technology and an Officer of Pig and Poultry Branch commenced the course.

Two officers completed post-graduate training in extension at the Queensland University leading to a Masters degree. Two officers successfully completed the Hawkesbury Graduate Diploma in Extension and a further two officers commenced the course. Three staff of the Division have commenced post-graduate technical courses at Universities. These courses include: sheep production at the University of New South Wales; Master of Science in Animal Production at the University of Reading, U.K.; and Master of Veterinary Science in Epidemiology, University of Melbourne.

Miss B. Donald, Microbiologist, Pathology Branch, completed a short study tour of institutes in the U.S.A. and Canada to update information on the diagnosis and epidemiology of tuberculosis. With finance provided by the Poultry Research Advisory Committee, Mr K. Reichmann, Biochemistry Branch, was able to undertake a short study tour of selected poultry research facilities in the U.K. while he was on a private visit to the country. Similarly, Mr D. Llewelyn, Beef Cattle Husbandry Branch, was financially supported to investigate cattle breeding techniques while on a private visit to New Zealand. Mr R. Gartner, Director, Husbandry Research Branch, completed a short study tour of New Zealand where he studied many aspects of deer production. Following presentation of papers as invited speakers at the Haemoprotozoan Seminar organized by the Wellcome Foundation in South Africa, Dr Callow and Mr Rogers, Pathology Branch, completed short study tours of that country. Mr Clague, Divisional Veterinary Officer, Cairns, and two other staff members from north Queensland familiarized themselves with the screw worm fly situation in Papua New Guinea during a short visit to that country. The presence of screw worm fly in Papua New Guinea poses a threat of incursions of this parasite into Australia. Messrs Wells and Langford, Assistant Directors Veterinary Services Branch, attended a short course on exotic diseases at Mt. Macedon, Victoria.



The expertise of Departmental staff is being used increasingly in foreign aid programmes. Mr R. J. Dalgliesh, of the Tick Fever Research Centre, is instructing a Costa Rican student in the technique of flagging pasture for ticks. Mr Dalgliesh was responsible for a training course on ticks and tick-borne diseases which was held in Venezuela.

During the year, Dr Callow and Mr R. J. Dalgliesh, Pathology Branch, undertook foreign aid projects on tick-borne diseases for FAO in Mozambique and Venezuela respectively. Mr G. Murphy, Biochemistry Branch, is presently on a 12 months consultancy for FAO in Uruguay. His task is to establish a comprehensive clinical biochemistry diagnostic centre.

An important method of improving the technical expertise of staff is the participation in intra and inter-branch workshops. Several Branches conducted workshops on a variety of topics. There was an escalation of Branch workshops during the year due to an extensive series of legal training workshops for Slaughtering and Meat Inspection and Veterinary Services Branches staff. The Veterinary Services Branch workshops in this area received considerable assistance from Mr A. Ernst who resumed duties in Beef Cattle Husbandry Branch after a year's secondment to Information and Extension Training Branch. Several staff of the Division also attended courses on computer appreciation organized at the State Government Computer Centre and others received training in statistics at the Queensland Institute of Technology.

Only a limited number of staff was able to present papers at interstate conferences, to undertake short interstate study tours or to attend short external courses. It is important that a reasonable level of training by these methods be maintained in future years.

Staff of the Division participated in two training courses for personnel from developing countries as part of this country's aid programme. The courses were held in Queensland. The first, for which Dr Callow was programme co-ordinator, was on ticks and tick-borne diseases and the second was on pig production.

An innovation during the year was a school for employees of pastoral houses. Staff of the Department had a major input into this school. As staff of pastoral houses often have first contact with primary producers, this school was important in developing liaison between agents and the Department.

Several prominent overseas scientists visited the Department during the year. These visits not only inform overseas people of Queensland's animal production and disease control programmes but also allow our staff to be informed of advances in overseas countries.

Cattle industry

Record high cattle prices, and a very severe drought in southern areas were the two features of the year.

The spectacular recovery in the beef market, which commenced during 1977 and gained momentum in June 1978, continued well into the year. Although there was a slackening in values in July-August, there was a subsequent strengthening trend with values peaking at record levels in January 1980 when yearlings, bullocks and cows realised 188, 175 and 162c per kg carcass weight respectively. This was approximately 12c per kg above the closing values of the previous year and 102, 70 and 82% respectively above the peak values of the 1973 beef year. However, the market became somewhat unstable during the second half of the year when values declined by about 40c per kg carcass weight in April and stabilized at around 140, 130 and 120c respectively for yearlings, bullocks and cows.

The store cattle market remained very sensitive to changes in slaughter cattle values throughout. The sudden down-turn in slaughter cattle values in July was accompanied by a drop of up to $100 per head in fattening-age store cattle. Values soared in the December-January period when slaughter cattle values peaked. However store prices fell to very low levels in March because of the lack of southern buyers, owing to drought conditions.

There was a marked swing towards grain fattening during the year. In a number of cases this was due to the necessity to finish cattle which had been started on crop and could not be finished because of crop failure. A lot of grain feeding was done in small-scale backyard feedlots or fed in the paddock as a supplement to failing crops. However, at the same time permanent feedlots on the Darling Downs operated to capacity.

The turnover in pastoral holdings, evident in the previous year, continued. There has been a strong demand for properties, particularly those combining pastoral and agricultural activities from southern buyers who are attracted to the comparatively lower land prices. This applied particularly to the Darling Downs.

Large numbers of stock were moved out of the droughted southern inland areas through forced sale or were sent on agistment into the central west and Dawson-Callide where reasonably favourable pastoral conditions prevailed. Agistment rates ranged from $1.50 to $3 per head per week. While this is a high rate, it was a good alternative to full hand-feeding on fodders which were in short supply and expensive. Many properties in the north-west, which continued to experience very dry conditions, were endeavouring to organize agistment for store cattle normally sent to the Channel Country for fattening, dry conditions having prevented the movement this year.

Beef industry statistics

Over the past 2 years, beef cattle numbers in Queensland fell by 1 million head. Before this, numbers had been building up and peaked at 11·1m head at March 1978. Provisional figures for March 1980 give Queensland 10·1m head—a decline of 9% over 2 years.

Breeder numbers have been declining from March 1976 to March 1979 but numbers increased by 0·7% during the past year. This confirms previous expectations that herd rebuilding was occurring as the female slaughter rate was down. However, the increase in breeder numbers is much lower than indicated in an AMLC Beef Industry Survey. The Beef Cattle Herd Monitoring Survey conducted by the AMLC in 1979 indicated that Queensland beef producers intended to increase breeder numbers by 8·8% for the 12-month period June 1979 to 1980. However, the survey was conducted during a period when the outlook for beef looked promising. Since then, export demand has declined, drought conditions have developed in most of the eastern States and prices have fallen. Obviously intentions have changed.

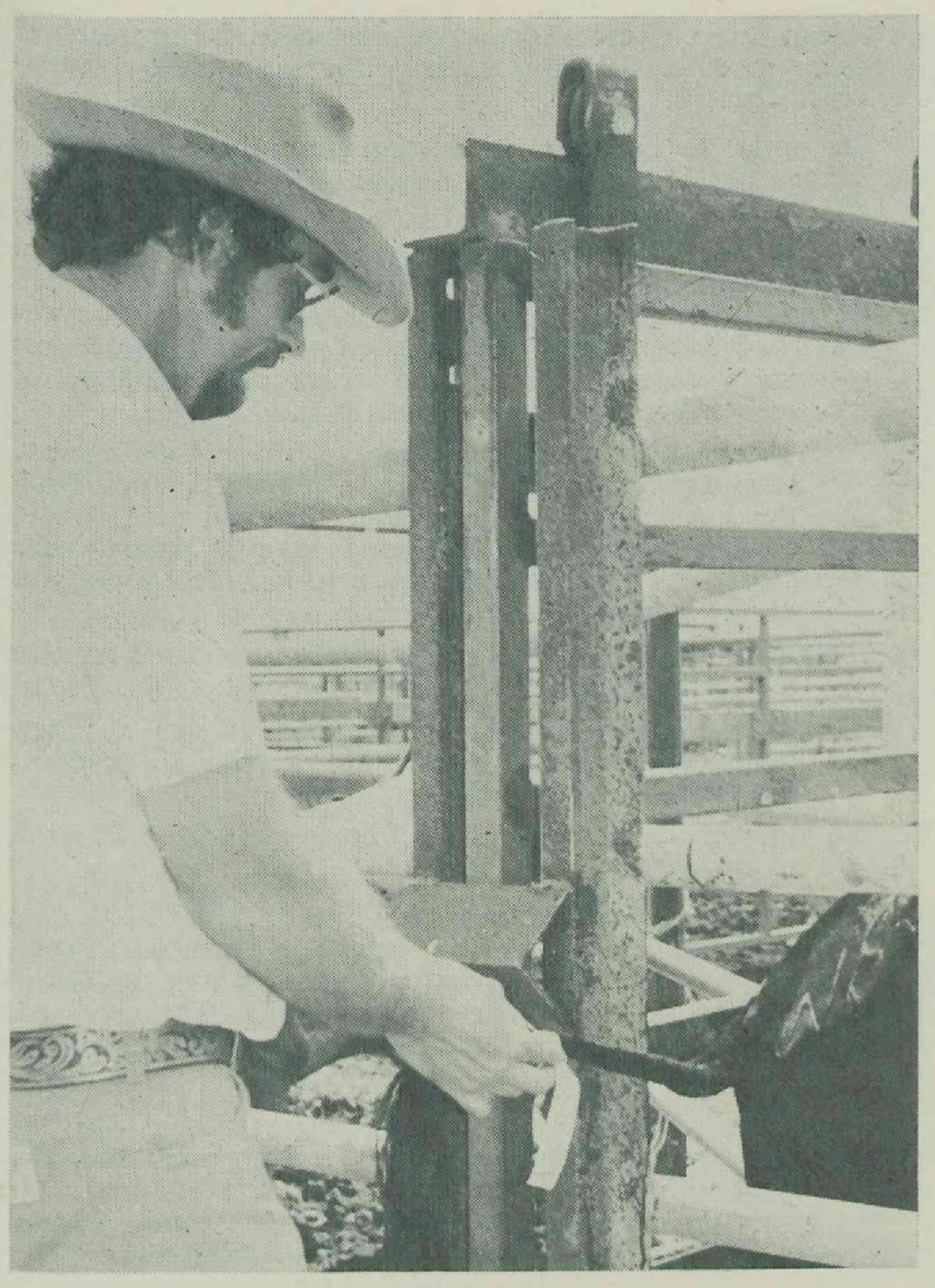
As indicated during the rapid expansion in cattle numbers from 1970 to 1976, an 8·8% increase could have been achieved if the intention were there. During the 6 years of rapid build-up in Queensland, breeder numbers increased by an average of 7% per annum. In one year it was as high as 13·5%.

During 1979, the slaughter rate eased back on the record achieved in 1978. Slaughterings were down 10% on 1978, due mainly to reduced female and calf slaughtering. During the first 4 months of 1980, the slaughter rate declined more markedly and was down 30% on the comparable period in 1979. The female slaughter rate decreased by 36%.

During 1979, more than 430 000 Queensland cattle crossed the border into other States, principally N.S.W. During the same period, approximately 120 000 cattle entered Queensland giving a net movement out of Queensland of 310 000 head. These movements are similar to the 1978 movements but considerably greater than the movements recorded during the years following the beef slump in 1974.

Beef Cattle Husbandry Branch has been engaged in the development of a data base for use on the three main beef cattle research stations. There is an immense amount of data that have been recorded but have never been used and are never likely to be used unless an efficient method of retrieval and analysis is devised. Consequently, officers in Rockhampton have developed a data base that is a modification of the data base used for the National Cattle Breeding Station.

Initially an attempt will be made to put Brigalow Research Station data onto the base. Subsequently data from Swan's Lagoon and Brian Pastures can also be recorded and stored in the same manner. Unfortunately, restriction of funds for equipment and computing costs may preclude any further development.



Positive cattle identification is essential for traceback in the brucellosis and tuberculosis eradication programmes, and for the identification of cattle in the insecticide monitoring programme. Tail tags correctly applied are an excellent method of cattle identification.

Brucellosis and tuberculosis eradication campaign

The eradication of brucellosis and tuberculosis progressed favourably during the year. Although the improvement in the tuberculosis picture is only marginal, many changes have taken place and the results should be seen over the next 2 or 3 years. It is expected that Queensland will achieve the initial target of provisional freedom for both diseases by 1983-84.

Total expenditure on the eradication campaigns for the financial year in Queensland was nearly $6·5m, with an additional $0·83m being paid to producers as compensation for the destruction of diseased animals. This represents an expenditure of $1.98 per unit of activity, Queensland being the most economical State.

BRUCELLOSIS. The first Queensland Provisionally Free area was declared. This consists of the veterinary divisions of Cairns and Townsville plus the shires of Carpentaria and Croydon. Although drought conditions have caused slower progress than expected in some areas, it is expected that the veterinary divisions of Toowoomba and Maryborough and four Shires in the Roma district will be declared provisionally free in the spring of 1980.

In April 1980, the whole of the State, with the exception of the Shire of Diamantina and the parts of Barcoo and Quilpie shires west of the Dingo Barrier fence, was brought under compulsory eradication. Extension of the eradication area during the year involved 27 Shires consisting of the veterinary division of Brisbane, the remaining five Shires in Rockhampton division, Bulloo Shire west of the Dingo Barrier fence, Boulia Shire and Mt. Isa City.

These extensions involved nearly 27% of Queensland herds and represent the last major declaration of eradication areas. A rapid increase in sample collection was anticipated and over 95 000 field samples were collected in Brisbane division alone during the quarter ending 31 March.

For the year to 31 May, more than 2 million blood samples were tested in Queensland laboratories. The fall in tests from a peak in mid 1978 related to the smaller number of Shires declared to be eradication areas.

The rate of progress is evident from the following table:—

Herd Status	1–7–78		1–7–79		30–6–80	
	No. of Herds	%	No. of Herds	%	No. of Herds	%
Not assessed	23 659	(59·6)	13 198	(36·6)	5 033	(15·3)
Suspect	2 944	(7·4)	2 099	(5·8)	915	(2·8)
Infected	1 457	(3·7)	1 329	(3·7)	1 067	(3·2)
Restricted	467	(1·2)	591	(1·6)	556	(1·7)
Provisionally clear	201	(0·5)	792	(2·2)	1 012	(3·07)
Tested negative	9 106	(22·9)	14 537	(40·3)	18 891	(57·4)
Monitored negative	946	(2·4)	1 511	(4·2)	2 642	(8·0)
Confirmed free	635	(1·6)	1 457	(4·0)	1 756	(5·3)
Accredited free	281	(0·7)	544	(1·5)	1 006	(3·06)
TOTAL	39 696		36 058		32 878	

During the year, the number of herds with a non-assessed status decreased from 13 198 to 5 033. The number remaining represents only 15% of Queensland's herds and indicates that the whole of the State will be eligible for 'provisionally free' status before the target date of 1984. At 30 June, the herd prevalence was 3·8% which represents a fall of 1·5% from the previous figure.

Apart from the sharp fall in non-assessed herds, the decrease in the number of infected herds, the increase in the number of accredited free herds, and the apparent fall in herd numbers are worthy of comment. The number of infected herds was effectively decreased by nearly 20% during the period. This decrease is to be expected as the bulk of infected herds have been located by traceback and the steady rate of decrease is expected to continue. The number of accredited free herds has nearly doubled during the year. When tail tags were initially introduced, many properties with few or no breeding cattle were allocated property numbers. Their gradual removal from computer files accounts for the bulk of the drop in herd numbers.

The use of vaccine continued at levels equivalent to those of the previous year. With the proposed declaration of large areas of the State to provisional freedom, conventional vaccine usage is expected to fall in future years.

At this point in the campaign, special attention is being paid to 'problem' herds. Such herds have failed to respond to repeated testing, have proved impossible to test completely or regularly, or involve owner co-operation which has been unsatisfactory. Such herds have an obvious potential to infect other herds, even though tight controls are maintained on cattle movements. Recent developments allowing taxation concessions for the owners of such herds who undertake partial or complete destocking as an approved programme are a major step forward in dealing with herds with difficult mustering problems.

The results of quarterly milk ring testing in Queensland dairy herds is most encouraging. The number of herds indicating a positive or suspect result in March 1980 was only 73 compared with 217 a year earlier. Similarly the number of dairy factories which had completely negative milk suppliers rose from four to 15.

A total of 576 335 meatworks blood samples was collected during the 9 months to March. The total represents a drop of 21% from the previous year over the same period. The lower figure can be attributed to a downturn in cattle slaughtering. The percentage blood collection figure from all available breeders stands at 84·4% for the 9-month period. Because of accounting procedures this figure is an under-estimate of the true collection rate.

Blood samples are now collected from 39 meatworks. Mt Isa and Tolga have been added to the list since last year. Two works collected more than 60 000 blood samples for the 9-month period (the busiest being Dinmore with 61 933. Fourteen works sampled in excess of 90% of all available eligible cattle. Staffing has been a problem mainly due to the Mareeba, Grantham and Pentland works operating a double shift for part of the year. It is difficult to make allowances for this type of operation and relief staff have frequently had to be drawn from meat inspection which has also had staff shortage problems.

Rose Bengal testing continues at a few works, but at a much reduced rate. The policy is that wherever possible testing should be done at one of the three tuberculosis-brucellosis laboratories.

A total of 3 066 brucellosis reactors was slaughtered at meatworks during the 9 months to 31 March. The significant increase in the proportion of reactors slaughtered at meatworks has resulted from a policy of using meatworks wherever possible due to the higher price now being commanded for beef.

During the year, the Toowoomba Rose Bengal testing caravan was moved to Charleville where a unit for both Rose Bengal and complement fixation tests was established. This will give an improved brucellosis service to the south-western cattle areas.

Brucellosis research was directed towards vaccines and vaccine responses. The serology of animals tested anamnestically with 45/20 has been studied in conjunction with C.S.I.R.O. in north-western Queensland. Initial results indicate that the anamnestic test is not as efficient as originally expected.

Adult Strain 19 vaccination is also being studied in actively infected herds. The use of this vaccine in adult animals has proved successful in a number of cases although in a few herds unsatisfactory side effects (abortions, loss of milk production, lameness) and persistent serological titres have posed problems. As a result of American studies and work by C.S.I.R.O., Strain 19 at a reduced dose rate (1/400) in adult animals is being investigated. Initial results of field trials indicate that the interference with serology post vaccination is minimal and the side effects compared with the normal dose are greatly reduced. Current indications are that this vaccine may eventually replace 45/20 and full dose Strain 19 in adult animals.

The indirect haemolysis test (IHLT) was introduced during the year following development of the test by the C.S.I.R.O. laboratory at Rockhampton. An investigation has indicated that immunization of cattle with tick fever vaccine that contains bovine red cells does not adversely affect the specificity of the IHLT. The results of both routine and research work will form the basis for evaluating the use of IHLT in the brucellosis eradication scheme. This test can be helpful in differentiating S19 vaccinal titres from true infection and has been introduced to all three Queensland laboratories so that it may be assessed.

A trial was conducted at three meatworks to determine the worth of collecting blood samples from 9-20 month old females and bulls. A total of 2 000 samples was collected and tested at the Yeerongpilly laboratory. The results showed several positives. As a result, it has now become policy to collect blood samples from all eligible females and bulls over 9 months of age.

TUBERCULOSIS. Tuberculosis eradication in Queensland has now reached a difficult and critical stage. The rate of progress is very slow, particularly when compared with brucellosis, whereas the cost to both producer and Department is high. A number of initiatives to deal with remote area problems has been undertaken by both State and Commonwealth Governments in consultation with industry and the outcome will be evaluated during 1980-81.

The eradication area for tuberculosis was expanded to include Mount Isa City and Boulia and Bulloo Shires while a large area in the south of the State was declared Provisionally Free. Both of these moves indicate that progress is being made, though slowly, and will help maintain enthusiasm through the difficult period now being encountered.

T.B. INFECTED PROPERTIES

Division	March 1978	March 1979	March 1980
Brisbane	1	1	6
Toowoomba	2	2	1
Roma	66	62	61
Maryborough	4	3	1
Rockhampton	55	54	46
Townsville	49	43	41
Cairns	14	19	18
Mount Isa	67	77	80
TOTAL	258	261	254

The above table indicates that the total number of infected herds has remained almost static over the past 3 years as the number of new infected herds being located is equalling the number of herds achieving clean status. The areas causing most concern are the far Western and Northern areas of the State where the lack of property improvements and high cost of mustering make disease eradication exceptionally difficult.

Many infected herds now have successful two-herd or segregation programmes. Clean, isolated groups should eventually breed sufficient numbers to replace the infected parent herd with clean cattle. Several properties destocked during the year as the improved cattle prices made destocking more economically rewarding.

In order to advance eradication several projects were undertaken during the year. The more significant were—

1. Visits to regional centres and several individual properties by Veterinary Services Branch and the Australian Bureau of Animal Health personnel in the Western and Northern areas of Queensland. The purpose was to define reasons for the poor progress made, assess areas of special need and assess the likelihood of successful eradication in the area.
2. A workshop at Mount Isa involving veterinary practitioners, Commonwealth personnel and Professor Francis from the University of Queensland. The purpose was to explore fully all aspects of eradication in the extensive areas with particular reference to technical aspects of of the tuberculosis test itself.
3. A meeting at Charleville with private practitioners to plan and prepare for increased eradication activity.
4. The placement of Department extension officers at Thargomindah and Birdsville to maximise producer co-operation.
5. The individual identification of all breeders in infected herds as an aid to eradication.

One major problem remaining is the difficulty of dealing with unmanaged cattle. These occur in National Parks, reserves and unworked properties particularly along the Dividing Range, and in Cape York and the Gulf. The economic and logistic problems in the removal of these cattle are a cause for great concern.

As foreshadowed in last year's report, there was an escalation of testing during the year. It is expected that this current level will be maintained.

—	Stock Tested	Herds Tested	Stock Positive	%
1979–80 ..	710 683	1 297	2 146	0·3%
1978–79 ..	529 658	1 089	1 885	0·2%
1977–78 ..	689 355	1 459	2 258	0·33%

For the 9-month period to March 1980, 1 552 526 cattle were slaughtered at Queensland meatworks. A total of 1 741 carcasses (0·11%) were tuberculosis-affected and 1 134 (0·7%) were condemned. This represents a slight increase in incidence in comparison with the previous period. Reactors are not included in these statistics. A new tail tag (green background with black lettering) was introduced during the year. Herds with a low prevalence (less than 0·2%) are allotted this tag to ensure that any lesioned animals discovered at abattoirs are subject to laboratory confirmation of the disease. Such information is necessary to ensure that no errors are made in diagnosis at such a critical stage in the property eradication programme.

Producers are now notified immediately by staff at the abattoir when a tuberculosis animal is discovered. This procedure has been introduced at producer organization request and avoids delays while awaiting laboratory confirmation and ensures rapid rectification of traceback errors should they occur.

The computerization of tuberculosis data will be introduced during 1980. This will greatly aid the maintaining of herd records and help in monitoring eradication programmes on individual properties.

Tuberculosis field research was confined to two areas. Investigation was made into the desensitization period resulting from 0·3 mg PPD tuberculin at Mount Isa in association with C.S.I.R.O. The results should be available early in 1981. The second investigation was into the practicability of reading TB tests at 48 instead of 96 hours. The results to date suggest that too many infected animals are missed by reading at 48 hours. Routine 72 hour reading will continue to be used.

A laboratory experiment investigating the lesions caused by the bacterial infection *Corynebacterium equi* in cattle has been completed. The importance of this infection is that it causes lesions that macroscopically cannot be differentiated from the milder lesions of tuberculosis. Even microscopically the differentiation is difficult. This emphasizes the need for bacteriological culture of suspected lesions particularly towards the end-point of an eradication programme.

Following a visit to U.S.A. and Canada by Miss B. Donald, Microbiologist, the techniques used in the tuberculosis laboratory at Yeerongpilly were reviewed and modifications made taking into account recent overseas developments. Isolates of *Mycobacteria* were identified for both South Australia and Northern Territory.

Ticks

Generally, tick activity for the year was low, undoubtedly the result of the widespread drought.

An outbreak of ticks in the usually tick-free area near Stamford occurred following a suspected illegal movement of cattle from the Atherton Tableland. Another outbreak in the tick-free area occurred near Isisford. An adjoining property across the Barcoo River was found to be infested also. Sixty-four properties in the once tick-free area south of the Mt. Isa-Hughenden railway line are known to be tick infested. Movement controls have been opposed strongly by graziers because of the inconvenience and costs. The situation is being investigated with a view to formulating a uniform control policy in the Mount Isa and Townsville Divisions.

The following numbers of properties in the normally tick-free area were quarantined because of tick (*Boophilus microplus*) infestation—

Division	Local Authority	Total
Toowoomba	Rosalie 13; Crows Nest 40; Jondaryan 7; Clifton 29; Cambooya 78; Allora 1 and Toowoomba City 4	172
Maryborough ..	Wondai 2; Nanango 30; Kingaroy 9; and Chinchilla 4 ..	45
Roma	—	16
Townsville	—	1
Rockhampton ..	—	3
	TOTAL	237

During the year the numbers of herds investigated for suspected acaricide resistance were—

Type Confirmed	Number	Progressive Total
Ridgelands	1	1 321
Biarra	45	2 513
Mount Alford	19	302
Gracemere	0	18
Tully	0	3
Mackay	3	152
Non-Resistant	10	1 926
TOTAL	78	6 235

Laboratory tests using packet tests conducted by C.S.I.R.O. Long Pocket Laboratory and the A.R.I., Yeerongpilly on tick samples from the field where control difficulty has been experienced, have indicated a low level of amidine resistance. However, trials using stall cattle artificially infested with these strains failed to show any control problem when the cattle were treated with amidine acaricides at the recommended strength.

Recent trials with artificially infested cattle have shown that, if the concentration of the medicament was reduced marginally below recommended levels, significant reduction in kill occurred with the suspect strains. However, further selection of these strains by amidine treatment did not increase the resistance factor. It appears that there is a cross resistance involved between the three amidines tested, namely amitraz, chlormethiuron and cymiazole. The field position is being monitored closely and producers are being advised to ensure that the chemicals are fully maintained at the strength recommended by the manufacturer.

Results of packet tests on ticks from a herd at Bajool indicated high resistance to amitraz and chlormethiuron. This is the first detection of marked resistance to chemicals of the amidine group. This result has been confirmed by spraying trials. Further dosage—mortality studies and documentation of the control failure in the field are being undertaken. The position is potentially serious and extension efforts have been directed towards instituting dipping programmes that would prolong the usefulness of the amidine group of acaricides for as long as possible.

A major component of the divisional extension programme has been the advocacy of tick-resistant, adapted, cattle for the infested central and southern areas of the State. In the Dawson-Callide, Burnett and the south-east areas which previously resisted this development, there was a noticeable change during the year. The programme has now entered a new phase in which extension activity has concentrated on ensuring that adapted cattle are now selected on adaptive traits and not on traditional concepts relating to British breeds. The emphasis has been on selection for tick resistance and reducing dependence on chemical tick control.

Selection of bulls on artificial infestation has been accepted by a number of owners, but we cannot pursue this vigorously because of the limitations on supply of tick larvae. In north Queensland, officers have undertaken trials and demonstrations on six properties on female selection. Where the low resistance females have been identified on the basis of paddock infestation and removed, dipping frequency has been dramatically reduced.

In association with the Droughtmaster Society, a new bull class has been created in the Townsville show. This requires entries to be tick-rated and performance tested in one location before showing.

Tick extension officers prepared numerous articles for newspapers and gave radio talks in support of policy regarding tick resistance, selection for tick resistance and minimal dipping. Field days were organized at properties where the results of breeding for tick resistance and dipping procedures were demonstrated.

Departmental dip moulds were used extensively in the State and at least 50 new dips were constructed during the year. Approximately 750 property contacts were made by the four tick extension officers during the year in connection with various aspects of the project.

A comprehensive investigation into the stirring of dips by mechanical pumps was undertaken by officers of Biochemistry Branch. Sludge pumps were originally examined and found to be ineffective. A high volume circulating pump was found to be adequate in stirring most types of dip. Trials were undertaken at Helidon, in the Brisbane Valley, Rocklea and Townsville resulting in the development of adequate techniques to provide effective stirring without the use of cattle. Three pumps have now been purchased and field trials will be undertaken by field staff of Veterinary Services Branch.

The dipping vat analysis service analysed 2 839 samples from vats. Only 12 acaricides were represented although the service has the capacity to estimate all registered products. The need for such a service is apparent as 40% of all samples were greater than 20% overstrength representing a waste of chemical and increasing the risk of residues in excess of statutory limits.

Experiments investigating the possible use of acrylic polymers as a depot for release of acaricides in the control of ticks have continued. Generally the results of two pen studies and one field trial indicate that the protection from the acaricide can be almost double if a polymer is used. However, although the results have been encouraging, it is considered that a more durable polymer is still needed to further extend the protection period. The work is supported by Australian Meat Research Committee funds.

At 'Swan's Lagoon' Research Station near Ayr, the effect of the cattle tick is being measured on the reproductive performance of Droughtmaster females (50% *Bos indicus*) and the growth of their progeny. Half the cows are dipped every 21 days and the others remained undipped.

At the end of the 1979 mating season, 93% of the undipped cows were pregnant and 83% of the dipped ones. Weaning rates in May 1980 were 86 and 69% respectively. This marked difference was due to the high incidence of perinatal and postnatal losses for the dipped cows. No prenatal losses occurred. At weaning, the undipped cows were in poorer condition and, as in previous years, they weaned lighter calves (148 *v* 166 kg). Animals which were not dipped before weaning have tended to compensate after weaning. At May 1980, the No. 8 dipped animals averaged 379 kg and undipped 362 kg, while the No. 9 progeny averaged 265 and 242 kg, respectively. It was necessary to survival feed the cows and calves for 10 days before the break in the season, but none died. During the past year, tick burdens have generally been light.

At 'Brian Pastures', dipping Sahiwal cross cattle every 3 weeks had no effect on liveweight performance. Between November 1977 and May 1978, the dipped animals gained 123 kg and undipped ones 124 kg. For the recent draft, gains were again similar. The highest tick count for untreated animals was 14·6 ticks per side, yet Hereford cows run as monitors in the same paddock had 61·8 ticks per side.

In two Ayr district herds, selection for tick resistance has so far been practicable for both breeding cows and bulls. One difficulty has been that nutritional stress upsets resistance patterns. In this environment, May and June seem to be the best months for selection because tick numbers are high and nutrition is adequate. There is a marked decrease in tick numbers in July.

There was a poor relationship between tick resistance and growth rate for bulls, indicating that these selection criteria should be considered independently. Lactating cows carried more ticks than non-lactating ones. Among the 571 Brahman crossbred cows assessed on one property in 1979, 45% were considered to have a high degree of resistance, 36% moderate and 19% low. The equivalent percentage among the cows with 50% or higher Brahman content were 52, 35 and 13% respectively.

On the other property the cows with a high degree of tick resistance were segregated and run as a group. These cows carried substantially fewer ticks than the moderate-low resistance group (40 *v* 277). However, paddock differences are thought to have contributed to the difference in body condition and pregnancy rate. Fifty-eight per cent of the replacement heifers and 46% of 2-year-old bulls available as potential sires had a high degree of resistance.

The role of colostral antibodies in immunity to ticks during calfhood is being investigated at the Tick Fever Research Centre, Wacol. In a preliminary experiment, calves born under tick-free conditions to dams from tick-free and tick-infested areas were infested with 1 g quantities of larval ticks six times during the 12 weeks after birth. Observations were made on total tick yields, tick weights and packed cell volumes (PCV) of infested calves. The two calves from exposed dams dropped 18 362 ticks, while the two from unexposed dams dropped 37 875. Depression of PCV was also greater in calves from non-exposed dams. There was no difference in average tick weights.

Tick fever

During the year 77 outbreaks of tick fever were investigated. Of these 56 were caused by *Babesia bovis*. The great majority of these outbreaks involved one or two sick animals. Notable losses included 12 deaths at Richmond, 5 head at Bundaberg and 6 in a herd near Townsville. Sickness due to *Babesia bigemina* was investigated in herds at Cryna, Goomeri (2), Rathdowney and Nanango. Outbreaks of anaplasmosis occurred in herds at Gunalda (10 sick out of 200), Oorindi (10 deaths out of 200), Rosewood, Eidsvold, Marburg, Gatton and Woodford.

The problem of tick fever in Queensland was exacerbated by prevailing drought conditions. Stock owners in some severely affected areas were forced to seek agistment for cattle, resulting in increased movement of susceptible stock into tick-infested areas. The situation was made worse by an acute shortage of specifics for treatment of tick fever during a period of several months. These circumstances underlined the value to the industry of a continuous supply of effective low-virulence tick fever vaccines.

A total of 814 915 doses of vaccine was supplied from the Tick Fever Research Centre, Wacol, during the year. This was an increase of 111 515 doses over that supplied last year, and may have resulted from the increased value of cattle, and the necessity to immunize susceptible cattle moved from drought stricken areas to tick-infested country on agistment. About 65% of the vaccine contained *Anaplasma centrale* as well as *B. bovis*. There was a small demand for *B. bigemina* either mixed with the other two organisms (3 778) or with *B. bovis* alone (266). *B. bigemina* vaccine was used to control isolated disease outbreaks due to this parasite or to protect valuable animals either entering the enzootic area within Queensland or being exported from Australia.

A project to determine the degree of resistance to *B. bovis* infection in various crossbred *Bos indicus* cattle was completed at 'Brian Pastures', Gayndah, during March. All treatment groups were inoculated intravenously with blood containing 107 *B. bovis* per mL, at a dose rate of 1 mL per 100 kg liveweight. Calculation of results was based on total temperature rise, parasitaemia and packed cell volume of the respective groups. Using these criteria the trial showed that of the cattle used, 50% Brahmans were most resistant to *B. bovis* infection, followed by 50% Africanders and finally Hereford.

In studies on tick fever epidemiology at Isis Junction, *B. bovis* IFA results proved erratic in 7/8 Sahiwal groups possibly because of the effect of breed resistance to the organism and the breed effects of suppressing tick numbers. A challenge apparently followed the boxing of all groups during drought conditions in December. By May this year, 15 of 25 calves were positive but results of tests were often equivocal for individual animals. In the 18 months old group 16 were positive out of 24. No *B. bovis* have been seen in smears from this group.

The majority of calves gave positive serological results for anaplasmosis but no organisms were seen in blood smears. The 18 months old group retained positive status but organisms were seen in this group originally.

Transmission of anaplasmosis to cattle by the brown dog tick (*Rhipicephalus sanguineus*) was confirmed at the Oonoonba Veterinary Laboratories. This is unlikely to be a common method of transmission but it is important to know that it can occur.

The major tick fever research effort occurs at the Tick Fever Research Centre, Wacol. Results of research projects during the year are outlined in the following paragraphs.

TESTING AND EXPORT OF FROZEN VACCINE. Further refinements were made to methods for the preparation and testing of frozen vaccine. In earlier experiments, blood containing *B. bovis*, *B. bigemina* and *A. centrale* was mixed before being frozen. Mixing the two babesias complicates infectivity tests which rely on the identification of the morphologically similar species in the blood of recipient cattle. Therefore, in preparing frozen vaccine by a modified method, the parasites were frozen separately. In practical vaccination the three parasites would be mixed after thawing and inoculated together.

Approximately 3 000 doses of trivalent vaccine were prepared for export. Testing of the vaccine before despatch showed it to be highly infective, even when diluted 1/50 before subcutaneous inoculation. The first consignment was to Trinidad and Tobago in October 1979, for use in dairy cattle imported from Canada. A second consignment was ordered and supplied in April 1980. Although no report on the use of the vaccine has been received, the order for the second consignment is encouraging evidence that the first was satisfactory.

RESISTANCE OF SAHIWAL CATTLE TO BABESIOSIS. A unique opportunity arose to test the resistance to babesiosis of a herd of 35 Sahiwal cattle. Groups of eight each of cows, heifers, calves aged 3 to 7 months and calves aged 1 week to 2 months, respectively, were challenged with unattenuated *B. bovis* and *B. bigemina*. Three aged cows formed an extra group of Sahiwals, and eight Herefords the same age as the heifers, were included in the challenge. Most of the Herefords developed potentially fatal *B. bovis* infections, and seven were treated. Reactions were much less severe in the Sahiwals, only two of the 35 being treated. An age difference in resistance of the Sahiwal cattle was seen, with the calves 3 to 7 months of age having milder reactions than all other age groups. This result and evidence from previous observations with *Bos taurus* cattle indicate that the safest age for cattle to be immunized naturally by tick infection, or vaccinated, is 3 to 7 months of age.

NEW CHEMOTHERAPEUTICS. The difficult situation regarding the cost and availability of tick fever specifics became worse during the year when amicarbilade ('Diampron') was withdrawn from the market. No suitable drug was available for a period of several months. Fortunately, sufficient experimental data were available to expedite the registration of the new formulation of imidocarb. This product, still with the trade name of 'Imizol', became available during the March quarter.

SUPPRESSION OF IMMUNITY TO TICKS BY IMIDOCARB. Imidocarb was used experimentally to suppress babesial infections in cattle being repeatedly infested with ticks. A disconcerting result was the establishment of lower than normal levels of acquired resistance to ticks in the cattle. The finding was confirmed by tests with three sets of identical twin calves. The practical implications of the finding may not be serious, especially if the drug is used for therapy of babesiosis and not for prophylaxis. However, there should be further testing of imidocarb and other parasiticidal drugs for immunological effects that are not dramatically obvious but nevertheless could be serious.

TICK ANTIGENS IN IMMUNE RESPONSES TO TICKS. Studies continued on the *in vitro* lymphocyte transformation test, using tick haemolymph to stimulate lymphocytes from cattle exposed to ticks. The use of leucocytes separated from other blood components rather than the whole blood culture previously used has greatly increased the sensitivity of the test. With this refinement, it was possible to obtain measurable stimulation with lymphocytes from about 50% of cattle up to 6 months after their last exposure to ticks. Previously, responses with whole blood cultures were obtained only when animals were actually tick-infested. Whether the degree of stimulation of lymphocytes correlates with acquired resistance to ticks has yet to be tested.

IN VITRO TESTING OF THE VIABILITY OF BABESIA. It was reported previously that an *in vitro* method for testing the viability of *Babesia* was being developed, using the incorporation by the parasites of radioactive hypoxanthine, a nucleic acid precursor, as a measure of vital function. The method is designed to measure the growth of parasites in culture media, or their residual viability after experimental treatments, without recourse to expensive infectivity assays in animals. More recently, the incorporation of labelled isoleucine, a protein precursor, was also studied. To obtain further evidence that the *in vitro* method compares favourably with infectivity assays, the effects of various chemicals on the viability of *Babesia* were assessed by both techniques. The chemicals including sodium fluoride, five babesicides, and the sedative drug 'Rompun', were tested at a range of concentrations and varying periods of incubation. Results obtained with both labelled compounds were satisfactory, although isoleucine incorporation may prove to be a better indicator of parasite viability over a wider range of experimental conditions. The development of this method is now almost complete and future work will largely involve its practical application.

DIFFERENCE IN VITALITY BETWEEN STRAINS OF TICKS. Differences between strains of *Boophilus microplus* ticks in their resistance to acaricides are widely recognized, but little is known about the development of different strains of the tick under similar conditions. In a series of experiments comparisons were made between the Yeerongpilly strain (A) and a

field composite strain (N). It was found that N strain ticks survived in greater numbers when released on cattle, and matured more slowly than A strain ticks. Also, mature female ticks of the N strain were heavier and laid more eggs than their A strain counterparts, and more of their eggs hatched. When larval ticks of the two strains were held in an incubator at 14°C and > 90% relative humidity, N strain larvae survived more than 4 weeks longer than A strain larvae.

The susceptibility of the two tick strains to infections with *Babesia bovis* was also found to be different. *B. bovis* parasites, ingested with blood by adult female ticks, developed more readily in the gut of N strain ticks, and infected a higher propotion of them and their larval progeny.

The final experiment in the series was designed to determine whether poor vitality of A strain ticks was due to their being more antigenic, thus provoking a more damaging immune response from host cattle. However, no difference in antigenicity between the strains was demonstrated. It seems likely that the A strain has lost vitality due to inbreeding during the many years that the strain has been maintained in the laboratory. The findings underline the need for caution in interpreting experimental results obtained with parasites maintained for long periods in the laboratory.

LOW PATHOGENICITY OF VACCINE STRAINS OF B. BOVIS FOR TICKS. The vaccine strains of *B. bovis* are maintained by repeated blood passage in splenectomized calves, a proceduce which reduces virulence of the parasites for normal cattle. Recent experiments indicate that repeated blood passaging also reduces the 'virulence' of *B. bovis* for ticks. The pathogenicity for ticks of two vaccine strains (C and K) attenuated by 28 to 33 passages in calves was compared repeatedly with that of the C strain in an unmodified, virulent state. The vaccine strains consistently infected more of the ticks, but killed a much lower proportion of them. Vaccine strain parasites seem to have lost a pathogenic quality which damages the gut cells of ticks. An intriguing possibility to be investigated is that *B. bovis* parasites damage bovine cells and tick cells by a common pathological mechanism which is modified or lost during repeated blood passage.

EFFECT OF COOL STORAGE ON INFECTION RATES IN LARVAL TICKS. It was reported previously that the development of *B. bovis* in unfed larval ticks was enhanced by storing the larvae for several weeks at 14°C. Because of the relevance of the finding to epidemiological studies, further observations were made with *B. bovis* and also with *B. bigemina.* This time, after the infected larvae had been stored at 14°C for up to 32 days, they were allowed to feed on calves before being examined. As before, the numbers of larvae in which parasites could be found increased after storage. The significance of the finding is twofold. First, it suggests that infected larvae exposed to about 1 month of cool weather are potentially more infective for cattle than those which find hosts soon after hatching. Second, true infection rates in larval ticks can be estimated only after the larvae have been held in cool storage for about 4 weeks.

VACCINE QUALITY. The diluent for tick fever vaccine contains 10% bovine serum in a balanced salt solution. The method used for filtration of serum is capable of removing bacteria but not viruses. As a precautionary measure, a method is being developed for inactivating viruses in large volumes of serum by heating at 56°C for 1 hour. Heated serum must be tested for its nutritional properties for *Babesia in vitro,* and one experiment has been completed. The rat parasite, *B. rodhaini,* was exposed to a balanced salt solution containing 10% rat serum which had been either untreated, or heated at 56°C for 0·5, 1, 3 or 6 hours. Residual parasite viability was tested in groups of CBA strain mice as well as by incorporation of labelled nucleic acid and amino acid precursors. The reconstituted vaccine was incubated at 37°C for 18 hours before inoculation of the mice. The results showed that heating the serum for up to 6 hours at 56°C had no apparent effect on its suitability as a diluent for *B. rodhaini.*

Buffalo fly

During December 1979, light infestations of buffalo fly were reported from the Brisbane Division. Moderate activity was reported from the central and northern coastal areas. However, increased activity was reported during late summer in the Brisbane and Maryborough divisions and in the northern sector of the Roma district despite the dry seasonal conditions. Demand for advice on treatment remains at a high level despite the uncertainty concerning the economics of treatment for this parasite.

Three synthetic pyrethrins, for example, fenvalerate, permethrin and cypermethrin, became available for buffalo fly control. Already there is field evidence to suggest that there are strains of buffalo fly present in central and northern coastal Queensland that are resistant to these chemicals. Investigations at Giru suggested that buffalo flies were resistant to permethrin while in the Mackay area resistance to fenvalerate has been demonstrated by field trials. In fact at Mackay fenvalerate selected out DDT resistant buffalo flies.

At 'Swan's Lagoon', a study is examining the effect of buffalo fly treatment every 3 weeks on the performance of steers and bullocks. Among the steers, treatment depressed weight gains over 10 to 12 months by 9 kg in 1977-78 and 11 kg in 1979-80. In 1978-79, treated steers responded by 15 kg. Treated bullocks gained more than untreated ones in each year, but responses were generally small (2, 19 and 5 kg). Steers carried fewer flies than bullocks, with light coloured animals attracting fewer than red or dark coloured ones. Peak fly numbers for bullocks were 340 in 1977-78, 396 in 1978-79 and 455 in 1979-80. The chemical used for treatment gave protection for 18 to 21 days during the dry season and 12 to 15 days during the wet season. Although the fly populations are considered to be lower than the average for northern Queensland, control of buffalo fly could not be justified on the results to date.

Internal parasites

Interest in the treatment of young cattle for helminth parasites is fairly widespread and treatment of weaners is common. The benefits of treatment are difficult to assess and often marginal, and no generally applicable strategy can be recommended.

Most anthelmintic trials suffer from the fact that treated and untreated animals graze together. This would tend to minimize the response to any treatment. A trial in south-east Queensland in co-operation with C.S.I.R.O., completed in 1979, showed a substantial response to regular 3-weekly treatment of young animals but the difference between treated and untreated animals was eroded during the year following treatment. Treated and untreated animals were grazing together.

A follow-up joint trial was commenced at Wivenhoe in September 1979 in which treated and untreated groups of weaners were kept separate and each treatment replicated three times. Despite the very dry conditions, treated Herefords gained 22 to 31 kg more than controls. Unfortunately the trial cattle had to be sold prematurely because of the drought.

A comparison of treatment of Murray Grey and Brahman X Murray Grey steers at Moura showed no statistically significant response to treatment over the whole period of the trial. A series of three trials was carried out near Mackay from 1977 to 1979. In one, there was no response at all to treatment, in two others there was some response but this was substantially eroded after treatment ceased. A small but significant response to the treatment of young cattle can easily be demonstrated but these benefits appear to be partly or wholly negated by the subsequent compensatory gain of untreated animals. These remarks apply to the routine treatment in the absence of clinical signs of helminthiasis.

Other diseases

Lysosomal storage diseases are a group of diseases which are usually characterized clinically by staggering, incoordination, muscle tremors etc. which are all signs indicating impaired function of the central nervous system. This impaired function is the result of storage of compounds, which are normally metabolized, within the cytoplasm of large neurones in the brain and spinal cord. The compounds are stored because the particular enzyme which assists their metabolism is lacking because of genetic defect or because it is destroyed by an ingested toxin.

The best known of these diseases affects Angus and Angus-derived cattle and is known as mannosidosis because it results from a deficiency of alpha-mannosidase. Programmes to eliminate carriers of the gene responsible for this deficiency are under way with the support of the breed society. Laboratory tests for Queensland cattle are carried out by the Veterinary Research Station at Glenfield in New South Wales.

Another one of these diseases has now been detected in the Brahman breed. The clinical signs and pathology are very similar to those of mannosidosis but in this case there is a deficiency of the enzyme alpha-glucosidase. The deficiency is probably genetic in origin. The extent of this condition within the Brahman breed is to be established by a random survey of high grade Brahman bulls at slaughter.

During the final quarter of 1979, ephemeral fever outbreaks were reported from all divisions but the prevalence was high in the Mt Isa division, the Croydon and Etheridge Shires and in the eastern coastal areas. The disease was active during January and February but prevalence decreased subsequently and in the early winter only isolated cases are being reported. Cattle up to 2½ years of age were affected mainly and the mortality rate was less than 1%. Outbreaks of ephemeral fever seem to be accepted as normal by stock owners because reports are not made as readily as they were formerly.

Outbreaks of enzootic bovine leucosis (EBL) were investigated in dairy herds at Pittsworth, Beaudesert (3), Rathdowney, Lawes and Grantham. Diagnosis by blood examination has been used for some years but is too expensive and not specific enough to be of use for survey purposes. There is a need to define the distribution of this infection in Queensland, particularly in beef cattle herds. To date most affected herds have been dairy cattle in south-east Queensland. EBL virus was isolated during the year and attempts are being made to produce enough antigen for the gel diffusion serological test. Bovine Syncytia Virus-like particles have been observed from some of the positive co-cultures under electronmicroscopy. Those cultures have been stored in liquid nitrogen for further investigation.

Enzootic bovine leucosis is considered to be associated with a C type virus and genetic susceptibility. The disease can be eradicated from a herd by identifying and culling all EBL virus carriers. Clinical lymphosarcoma has never been reproduced in cattle by inoculating them with blood, tumour tissue or C type virus suspensions. However, a feature of the virus is that tumours can be readily induced by inoculating such materials into sheep. The C type virus isolated from a herd affected by EBL is undergoing characterization.

One characteristic is the oncogenicity of this virus for sheep and to this end three groups of 10 sheep each have been inoculated with (1) EBL infected co-cultivated cell suspension, (2) EBL infected bovine lymphocyte culture suspension and (3) Uninfected foetal lamb cell suspension. The sheep are held in an isolation facility and will be bled and examined haematologically and by the agar gel diffusion test every 4 weeks. These sera should be useful in the development and evaluation of serological tests for EBL virus. All sheep will be autopsied when haematology or clinical signs indicated the development of tumours or at 3 years after inoculation.

Sera from the sentinel herds at Utchee Creek and Kairi together with those from cattle in other areas of Queensland are being tested for bluetongue in order to monitor the activity of bluetongue viruses. Virological examination of animals in the sentinel herds sero-converting to group tests failed to isolate bluetongue virus. However, repeated isolations of D'Aguilar virus were made.

The serious outbreak of infectious bovine rhinotracheitis in steers in a Dalby feedlot reported last year resulted in some 90% of the 1 300 steers becoming affected. The condition was more severe in young animals and the mortality rate was 2%. Newly introduced lots continued to become affected throughout the year. Permission was obtained to import a New Zealand vaccine for protective vaccination of introductions in order to contain the outbreak. Its use will be restricted.

Each of 48 IBR Serum Neutralization (SN) positive and negative sera was tested with unpurified IBR ELISA antigen. Nine out of 48 positive sera were unsuitable and 39 showed good positive reactions at a 1:40 dilution. Eight of the 48 negative sera were unsuitable and six gave positive reactions, the balance being negative. Overall reactions were quite good. The results suggested that the ELISA test is a more sensitive test system than the SN test.

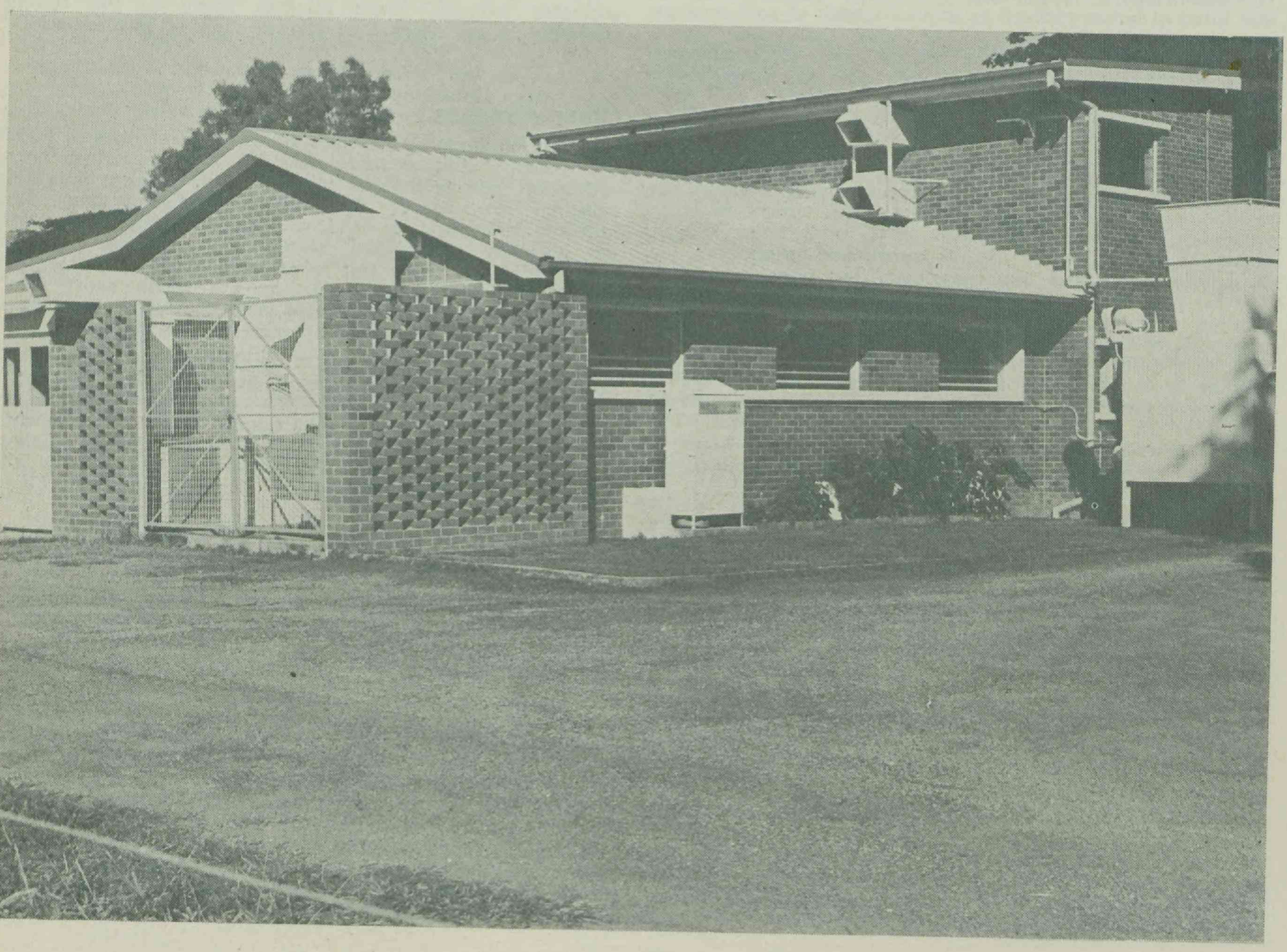
Three cows in a herd of 30 at Ropely died from a disease that was diagnosed subsequently as bovine malignant catarrh on histological grounds. One animal exhibited profuse pungent diarrhoea for the 8 weeks before death while another animal died following signs lasting 24 hours. Autopsy lesions included ulcerations of the mucosa of the oesophagus and small intestines, necrosis of the lymph nodes, inflammation of the coronets and ulcers of the buccal mucus membrane.

Outbreaks of blackleg were confirmed at Goondiwindi, Boonah, Toowoomba, Inverlaw, Gayndah, Gympie, Rathdowney and Pomona. The Rathdowney outbreak involved a 5 months old Jersey heifer which had been vaccinated against blackleg.

A leptospirosis vaccination trial was completed on a property at Biloela. Vaccination did not affect pregnancy date but reduced lactation failures in heifers by 8%. Lactation failure would denote either abortion or early calf death.

Salmonella typhimurium was responsible for causing the deaths of two Sindhi cows at Lawes. Mortalities due to salmonellosis were reported from Grantham, Gatton, Gumdale and at Woodhill where 10 calves died as a result of Group B *Salmonella* infection.

The isolation facility at Oonoonba Veterinary Laboratory, Townsville. This medium-security unit has been used for a variety of transmission tests. A notable use was bluetongue transmissions to pregnant sheep which demonstrated that the strain was only lowly pathogenic.



Vaccination against botulism with types C and D vaccines has been efficacious in controlling botulism in phosphorus deficient areas of central, northern and western Queensland. Now the few outbreaks reported occur in herds where vaccination has been discontinued through complacency.

Mastitis continues to cause economic loss in the dairy industry. Specific investigations showed that *Staphyloccus aureus* was again the most common cause of clinical cases. The majority of strains of *Staph. aureus* involved were resistant to penicillin. Other bacteria incriminated in the cause of outbreaks included *Streptococcus agalactia, Strep. uberis, E. coli, Klebsiella pneumoniae, Pseudomonas aeruginosa* and *Corynebacterium pyogenes.* Surveys of Darling Downs milk suppliers with bulk milk cell counts indicated a large number of herds had counts in the 500 000 to 1 000 000 cells per mL range. There is a continuing need for extension work in this area.

Chlamydia-type organisms have been isolated from samples obtained from 14-day-old calves at Kairi. The laboratory is investigating this organism as a possible cause of previously undiagnosed abortions frequently recorded from the Atherton Tableland.

The effect of inoculum density on subsequent re-isolation of *Campylobacter* from the campylobacter enrichment medium and *C. fetus* selective plates (CF plates) routinely used at the Institute was investigated. Five species of *Campylobacter* were used at two inoculum densities also with and without preputial washings from a bull free of *C. fetus.* The results indicated that preputial samples may need to contain relatively high numbers of viable *C. fetus* before a positive culture is obtained.

Reproduction

Despite the upturn in the beef market there was still a substantial number of females being sold for slaughter early in the year and there has been a continued interest in spaying. However, this interest has been directed more at learning to use the Biggers' spaying equipment rather than any interest in mass spaying of cattle. A trial carried out at Barcaldine of the effect of spaying on post-operative growth showed that the spayed animals gained less weight during the 255 days following the operation.

Reports from most districts suggest a substantial drop in calving rates during 1979-80, as a result of the dry conditions the previous year. Reproductive levels generally in Queensland are below those of more favoured regions and an increase in reproductive levels has always been held out as an opportunity for increasing production at little or no cost.

A herd simulation model, developed in Rockhampton in co-operation with C.S.I.R.O., has attempted to quantify the results of different reproductive levels. Where these are at least sufficient to provide heifer replacement and where cows are culled on failure to conceive, increases in reproductive rate have little or no impact on property income. The most significant factor affecting income is the survival rate of cows. The results of this simulation do not preclude the need to improve reproductive rates, particularly where cattle are turned off at a young age.

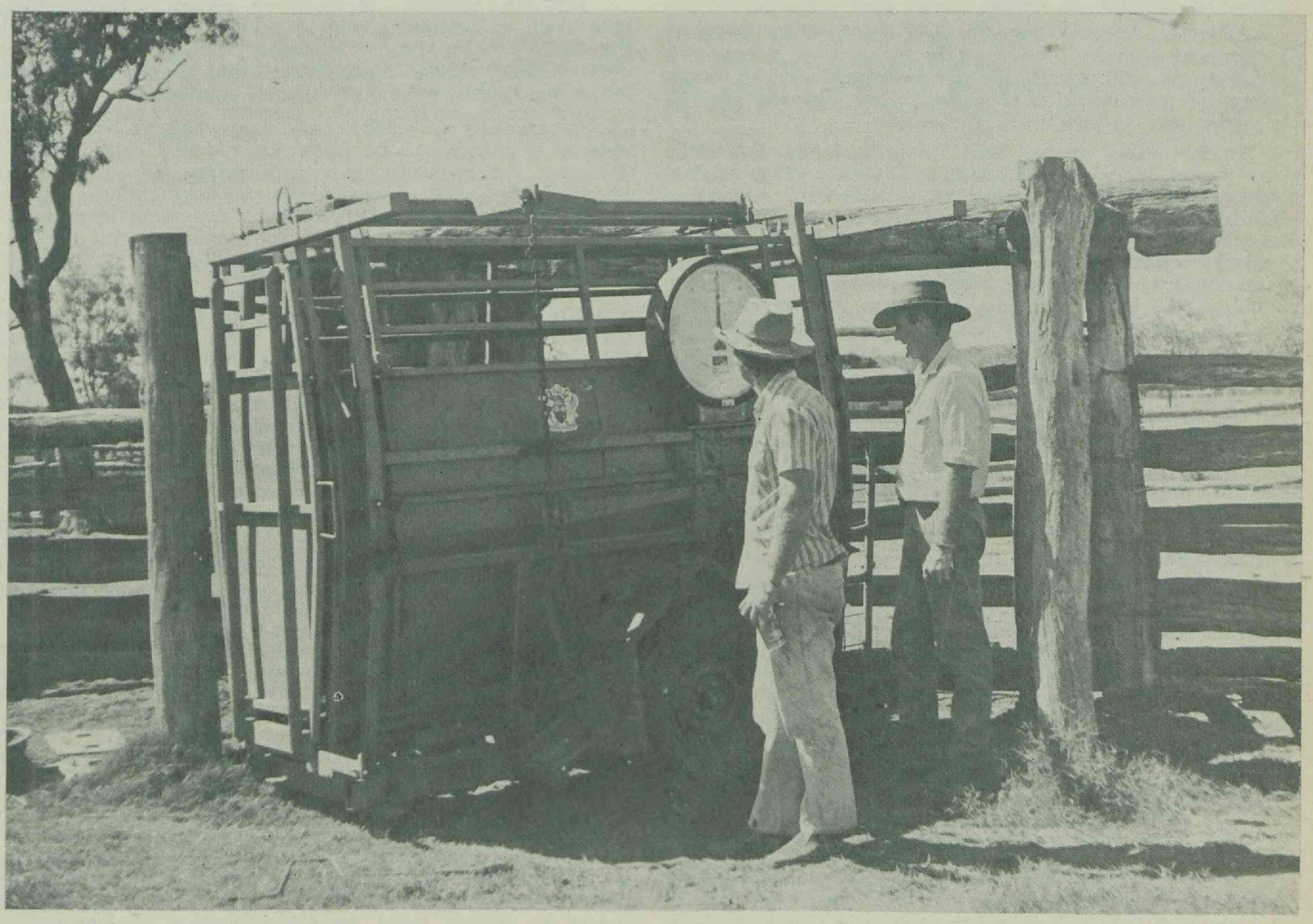
Weaning is regarded as one of the most important management practices contributing to increased breed survival and reproductive performance. Reluctance to wean early has been widespread because of concern at the effect on the calf. Early weaning certainly does give some setback to calf growth and studies at 'Swan's Lagoon' are measuring the long term effects of this practice.

An observation on a station in the lower Cape York Peninsula has provided valuable data on weaning and has been instrumental in convincing the owner of this and a number of other stations to implement appropriate weaning programmes. The main effect has been a marked improvement in breeder survival. Measurement of post weaning performance has demonstrated very little advantage to calves left on their dams until late spring as compared with those that were weaned in July.

More attention has recently been paid to reproductive capacity in bulls. The libido and serving capacity test developed by Dr Blockey in Victoria has aroused considerable interest. It has been introduced to a number of British breed studs on the Downs. The test, and modifications to it, have been tried at 'Swan's Lagoon' Research Station. It has not proved satisfactory with Zebu-cross bulls but further work is being done to see whether further modifications would improve it as a useful measure of libido and serving capacity.

Measurement of testicle size has also been advocated as a guide to sub-fertility in bulls. A survey based on the Warwick office is looking at variation in size in relation to season, age, and mating activity. At 'Swan's Lagoon', a more detailed study is being made in association with James Cook University. In this study, crossbred bulls are used and their age, growth rate and sperm production related to pattern of testicular growth.

Regular weighings of calves on a Cape York Peninsula property have convinced graziers that early weaning will not cause a permanent setback to growth. Early weaning will also reduce breeder losses and increase the calving rate.



The studies on dystocia are continuing in southern Queensland, based on the Brigalow Research Station and the Roma district. Previous work has indicated that there is a heritable component in susceptibility to dystocia and attempts are being made to build up two herds for comparative purposes, one of which will consist of progeny of cows that had to be assisted at their first calving. Difficulty has been experienced in identifying and purchasing these animals.

A simulation model has backed up an earlier study which demonstrated the marked economic advantage to yearling mating as opposed to mating at 2 years of age. There has, however, been some lack of data on the long term effect of yearling mating on a lifetime performance. There is a mass of data from research stations that could be very informative in this respect, but is generally inaccessible due to the great deal of time and effort that would be necessary for manual retrieval. A proposed data base for the three main beef research stations would be able to extract and examine such data if it could be implemented.

Nutrition

Extension staff in all districts have been inundated with enquiries concerning supplementary and drought feeding. During at least part of the year, drought or near drought conditions have been experienced in many districts. Fortunately cattle prices have been such that producers have been willing to feed supplements. The roller drum licker was again used in many areas.

However, there was also considerable interest in a much higher level of feeding and because of the late break at the end of last year there was widespread feeding of 'fortified' molasses. This is basically molasses containing 3 to 8% urea. In most cases, feeding was highly successful but in a few herds there were some mortalities. Although these were generally less than 2% nevertheless they appeared to be causing concern. A meeting of producers and staff was held at Ayr to discuss the use of fortified molasses. A research programme to meet some of the producers' concerns is being developed as a result.

In southern Queensland, the summer and autumn drought has been, in some areas, the most severe in producers' memories. One strategy has been to finish cattle in feedlots in order to destock. This has led to a tremendous demand for custom feeding, a demand that was in excess of the feedlotters' capacity to meet. It also resulted in many producers using grain to finish cattle on their own properties.

Earlier in the year, there had already been evidence of considerable increase in feedlotting stimulated by high beef prices and these two factors had led to a considerable increase in extension activity on intensive feeding. Seminars were held at Goondiwindi and at Moura and staff participated in a 2-day grain to beef workshop, sponsored by the Australian Lotfeeders' Association at Dalby.

PASTURES. Improvement of animal nutrition by the better management of native pastures or by introduction of improved pasture species still remains the one permanent solution to the problem of poor nutrition of grazing cattle. Several projects are under way to investigate this aspect.

An interesting residual trial from the initial Townsville stylo studies continues on 'Swan's Lagoon'. The original stocking rate fertilizer combinations introduced in December 1965 has been retained throughout the intervening period. The study is providing important data on pasture dynamics in this grass legume system. Long term data of this type are not available anywhere else in northern Australia. The legume continues to suffer anthracnose infestation, but there is little indication that this is having a serious deleterious effect.

Plot studies on the station indicated that the perennials *Stylosanthes hamata* cv Verano and *Stylosanthes scabra* cv Seca may be more desirable legumes than Townsville stylo. This results from their perennial nature, ability to produce shoots with light falls of rain, better ability to compete with grasses and resistance to anthracnose. A trial has been established to evaluate these legumes as additives to a native pasture sward and a Townsville stylo-native pasture sward. The legumes have been planted and animal measurements will commence this year.

An alternative legume which is showing promise in central Queensland is *Leucaena leucocephala*. This plant which has a browse shrub habit is planted as a separate sward. The area is ungrazed during the summer months and animals grazing native pastures are allowed access to the *Leucaena* as a nitrogen supplement during the winter-spring period. Results from 'Brian Pastures' indicate that animal performance is improved markedly by having access to the legume during this period. An observation has been commenced on a commercial property near Rockhampton to test the results in practice.

Over recent years, there has been increasing interest in the use of nitrogen-fertilized, irrigated, high-density ryegrass for beef production. High levels of beef production have been demonstrated in the Burnett region through high stocking rates and high indivilual animal gains.

The traditional winter fattening crop in southern Queensland is oats. Where irrigation is available, ryegrass provides a possible alternative feed source. The comparative production from these two crops was measured at Texas during 1979. The ryegrass pasture carried Hereford weaners at 8·6 beasts per hectare for 162 days and the mean weight gain was 1 kg per head per day. On oats at a stocking rate of 3·7 beasts per hectare, gains were 1·2 kg per head per day but the oats cut out after 131 days. Gross margins were $721 and $290 per hectare for ryegrass and oats, respectively.

High levels of production are possible on improved pastures, but the vast majority of stock produced in Queensland consume only native pasture. This constitutes our most abused and neglected resource. Fire is used widely as a management tool in native pastures to remove overburden to provide a green shoot, and to control regrowth, but there is little information on the effect on the pasture or animal performance. An experiment is under way at 'Swan's Lagoon' to study the effects of burning before and after the wet season on pasture and animal performance, presence of regrowth and the need for supplements. This a long-term study.

Pangola and setaria are commonly-used tropical grasses in improved pastures in Queensland. Animal production from pangola is generally higher than that achieved with setaria. The reason for this difference in productivity was investigated by Husbandry Research Branch staff using pastures harvested at similar digestibilities. Using the slaughter technique, preliminary results indicate the digested energy of pangola was utilized about 30% more efficiently than that of setaria.

Biochemistry Branch is participating in an investigation to define a recurring paresis and production drop in commercial herds grazing winer oats on the Darling Downs. Since in this season only a few animals were mildly affected in one of the two herds, any interpretation of results must be tentative. The mild outbreak followed frost damage to the oats, which appears to be the normal sequence of events. The majority of animals in this herd had blood inorganic phosphate concentrations below 3·5 mg per 100 mL at this time. Phosphate concentration in the milk fell from 84 mg per 100 mL to 67 mg per 100 mL while calcium concentration rose from 93 mg per 100 mL to 128 mg per 100 mL. The frost-damaged oats was nutritionally inadequate in protein (6·6% DM), calcium (1·6% DM), phosphorus (1·6% DM) and magnesium (1·3% DM). It may be the sudden drop in nutrition which precipitates the paresis and causes the production loss. Within 3 days, the oats had recovered with respect to all parameters except phosphorus which remained at the depressed level until sampling ceased 3 months later. Increased supplementation of diet at the time of frost damage and the regular provision of bone meal or dicalcium phosphate appears to offer possible protection from this condition.

INTENSIVE FEEDING. Research on cassava, a high yielding root crop, is continuing with a grant from Commonwealth Extension Services Grant. Preliminary results of comparisons between dried, chipped cassava tubers and sorghum grain, both fed as 90 : 10 diets with chaff, indicate equivalent growth rates.

Experiments with feed-grade rice, which is being developed as a crop in the Burdekin River delta, have continued following the generally poor performance of cattle fed a 90 : 10 feedlot diet. Digestibilities on these rations indicate the whole rolled paddy rice diet has a dry matter digestibility of 63·1% compared with 76·8% for a similar rolled sorghum grain diet. This would partly explain the poor performance in the feedlot.

The value of grain supplementation to promote the performance of early-weaned calves is being evaluated with 3 to 5-month-old Droughtmasters either being lot-fed or zero grazed on millet with or without grain supplements. Performance of the calves has generally been good and after 70 days most are in suitable condition for sale. Growth rates to date have averaged 0·75 kg per day for grazing calves, and 1 kg per day with a feed dry-matter conversion ratio of 4·6 for lot-fed calves.

SURVIVAL FEEDING. The cattle most at risk during drought are pregnant and lactating females. At the Rocklea Research farm, pregnant cows and heifers are being fed molasses-based diets at three intake levels for 180 days to determine the diets' suitability for survival feeding.

Results to date suggest that molasses is a suitable basis for survival feeding rations. However, the nitrogen source is important. Cottonseed meal was superior to urea and was equally cost-effective. Roughage appears not to be necessary in the diet. Initial body condition and the level of feeding have a large influence on survival time and viable calves were generally born when feed intake was about 6 kg per day.

NITROGEN SUPPLEMENTS. The emphasis in the research programme on nitrogen supplements has continued to concentrate on the role of combinations of urea and true protein. An experiment at 'Swan's Lagoon' aimed at comparing the effects of supplements of urea-sulphur and formaldehyde casein in various ratios on the utilization of low quality

roughage on growing steers. This pen study examined the effects of combination of nitrogen supplements on intake of native pasture hay and performance of steers in pens.

Preliminary results suggest that combinations of urea and protected protein give better results than either type of supplement alone. Unsupplemented Brahman-cross weaners lost 17 kg over the 60-day feeding period. A urea-sulphur supplement produced a 60% increase in roughage intake and eliminated any weight loss. Addition of a protected protein source as formaldehyde casein failed to increase intake further but produced a 7 kg liveweight gain. While the best performance was obtained with a combined urea-protected protein supplement, it is of interest that a urea supplement alone provided enough nitrogen for maintenance. Seventy-one per cent of the total liveweight response occurred with the addition of urea-sulphur only.

In a pen study at 'Swan's Lagoon' comparing the effects of supplements of energy and protected protein in several forms on the utilization of native pasture hay, intake by steers and the resultant liveweight performance are being measured. In this and another experiment, the effect of alkali treatment of hay on animal performance is being assessed.

GROWTH STIMULANTS. During the past year, zeranol, a growth promotant, was registered for use in steers in Queensland. This compound has been used widely in the United States and has been shown to increase weight gain by 10 to 15% and feed conversion by 8%. Where animal performance is poor, responses do not occur. Grazing studies in southern Australia and studies in feedlots in Queensland have produced similar liveweight responses.

A series of 10 grazing experiments was commenced in Queensland during the 1979-80 summer to measure possible responses under a range of nutritional regimes. Preliminary results from six north Queensland observations indicate that implanted animals gained about 12 to 18 kg more than control animals over 90 to 100 days. These responses are of the same order as those obtained in other environments. Every effort will be made to obtain carcass data where possible to determine to what extent the increased liveweight is reflected in increased carcass weight.

A second growth stimulant, monensin, is also under investigation. This is claimed to improve animal performance by altering fermentation patterns in the rumen resulting in more efficient usage of nutrients. Preliminary observations in pens on low quality roughage at 'Swan's Lagoon' showed a reduction in feed intake when monensin was fed. A study is currently under way under grazing conditions on native and improved pastures to determine reponses to the compound. The monensin is administered in the form of a capsule designed to release a certain dose of material each day. Preliminary data from native pastures suggest no response to monensin.

MINERAL SUPPLEMENTS. The role of various minerals in beef production in certain areas of the State is under investigation. Current trials are mainly involved with copper and cobalt. Despite low copper levels, treatment seldom elicits a productive response. With cobalt, a very marked response has been obtained in one area. Work during the year revolved around a programme to identify cobalt-deficient pastures and to ascertain the need for anthelmintic treatment in association with cobalt therapy.

A trial in the Taroom Shire compares the liveweight performance of untreated Hereford steers from weaning to 30 months with that of groups receiving copper supplements by injection or by Dewey's needles. The animals graze improved brigalow-vine scrub country on a commercial property near Wandoan. A second draft was introduced in September 1979. Untreated animals continued to show typical low copper status (liver 4 to 8 p.p.m.; serum 0.03 to 0.04 mg per 100 mL) while treatment with copper-calcium edetate at 12-weekly intervals or Dewey's copper oxide needles elevated blood and liver levels to normal values. Two-year-old animals have shown responses to copper therapy since January, but yearling cattle have shown no responses. Pasture analyses indicate seasonally low to very low copper levels, relatively high total sulphur levels and low copper: molybdenum ratios.

A similar result has been obtained at Brigalow Research Station with untreated animals showing typical low copper status. Treatment with injectable copper every 3 months failed to produce any liveweight response.

A study on a co-operator's property in Cape York Peninsula will compare performance of yearling steers receiving cobalt, anthelmintic or a combination of both, with that of untreated animals. Animals are grazing coastal plains country adjacent to Princess Charlotte Bay.

Effects of copper, cobalt, and anthelmintic treatment on the performance of steers and bullocks grazing native pastures on a commercial property in the Rockhampton district will be studied. Cattle have a history of poor performance. A similar trial with weaners on improved tropical pastures south of Mackay has been commenced.

Animals on a number of properties in the Torrens Creek area have a history of poor performance with significant mortalities. The effect of a calcium-phosphorus supplement on the performance of cattle and incidence of bone disorders will be studied. The animals will graze a native pasture paddock at Torrens Creek and a radioactive tracer technique will be used to identify animals consuming supplement.

The technique of rib biopsy is a satisfactory tool for establishing the phosphorus status of grazing cattle. Damage sustained to the twelfth rib at biopsy can adversely affect the value of future biopsies at or near the site on the same rib. This carry-over effect, possibly associated with bone healing, is influenced both by the degree of interference with the rib, and the time since previous biopsy. It was found that a period of 16 weeks between biopsies in cows and heifers is insufficient to eliminate this effect when samples are taken with a 14 mm trephine. A minimum period of 6 months between biopsies is recommended.

Yearling Simmental-Hereford steers were grazed on forage sorghum with and without a supplement of salt and sulphur and their performance was studied. Recent work in New South Wales had shown a 30% increase in liveweight gains with similar supplements for steers on forage sorghum. The sulphur acts as a detoxifying agent to hydrogen cyanide in the forage.

Over the 70-day grazing period at Brigalow there was no reponse to supplementation with mean gains being 0.8 kg per day. It is considered that nutrient levels on the forage were adequate eliminating any possibility of responses. A co-operative study is in progress near Goondiwindi in which the benefits of feeding sulphur to steers on forge sorghum in both the presence and the absence of the growth promotant, zeranol, are being investigated.

Genetic improvement and breed evaluation

The promotion of objective evaluation of breeding stock continues to be a main aim in extension and research programmes. The promotion of environmentally adapted and particularly tick resistant cattle has been a catalyst in furthering a wider acceptance of objectivity in selecting stock.

While enrolments in the National Beef Recording Scheme (NBRS) have largely remained unchanged during the past 12 months, the general interest in records of performance is increasing. This is seen in a wider use being made of performance records by bull buyers, an increasing demand for a tick rating on bulls, and the promotion of Sire Reference Scheme by two breed societies. There is also an increase in do-it-yourself performance recording and, in the Biloela-Rockhampton area, staff are assisting 18 property owners to record and select their own stock. The same sort of assistance has been given in other districts.

The Sire Reference Scheme being run by the Angus and Poll Hereford societies in association with the NBRS, began operating in 1979. To date, there have been no Queensland participants in the Angus scheme but five Queensland breeders took part in the Poll Hereford scheme. The aim of the scheme is to have 20 to 30 producers in each breed society co-operate to identify sires of special merit and accelerate genetic change among the co-operating herds. A sire reference scheme applies the acid test on those bulls participating in the scheme and is a big step for producers who are normally more concerned with subjective assessments.

A breeder discussion series was run in Toowoomba with the help of staff of the Animal Genetics and Breeding Unit, Armidale. About 30 producers have attended a series of eight meetings to discuss aspects of selection.

Bull-buying guides have been published in two districts. These list all the main bull sales and give an explanation of the concept of performance testing and rating. In north Queensland staff have been involved in identification, weighing and selection of 450 home-bred bulls for a major pastoral company.

On research stations and private properties, research activities related to genetic improvement continue to give a high priority to the evaluation of breeds in different environments. At 'Swan's Lagoon,' stabilized $\frac{1}{2}$ and $\frac{3}{4}$ Brahman and Sahiwal herds are being developed to determine genotype differences and to demonstrate the reponse to given selection procedures and to provide stock of known age and breeding for research programmes. Birth weight for No. 9 calves were similar for the F_2 $\frac{1}{2}$ and $\frac{3}{4}$ Brahman while the F_3 calves were generally lighter because they were from first-calf heifers. F_2 $\frac{1}{2}$ and $\frac{3}{4}$ Sahiwal tended to be lighter than the Brahmans. Data are being collected on pre-weaning and yearling growth rates but insufficient data are available to draw any conclusions at this stage. For the 1979 mating, the overall conception rate for all genotypes was 78% with maiden heifers at 91%. Low conception rates were recorded for all females rearing their first calf, with particularly low rates for high grade Brahman and Sahiwals.

At Brigalow Research Station, a high grade Simmental herd is being developed to assess performance traits under central Queensland conditions. During the grading up process, the various genotypes are being evaluated. Results to date show birth weight increasing as the Simmental component increases. An exception to this was the ¼ Simmental progeny which were lighter than straight Herefords. Dystocia and/or stillbirths were at a very low level for all genotypes. There were considerable differences in the average birth weights for different sires but for the AI sires there was some agreement between the Brigalow birth weights and the estimated breeding values published by the Simmental Society. The gestation periods for the half and three-quarter Simmental progeny are very similar at 282 days. However, there was considerable variation between sires in relation to gestation length.

In the second phase of the Simmental-Hereford cross-breeding project, Herefords are mated to F_1 Simmental-Hereford females and F_1 Simmental-Herefords sires are mated to Hereford females to produce ¾ Hereford ¼ Simmental progeny. The aim of this project is to determine the difference in performance of the same genotype progeny reared on either Hereford or Simmental-Hereford dams. To date, No. 9 calves reared on Simmental-Hereford dams have an advantage of 42 kg at weaning. At 15 months of age, from the pattern recorded for the No. 8 steers, where weight differences between the two groups increased in the post-weaning period.

In the Africander-Hereford cross-breeding project, the reproductive performance of F_1 Africander x Hereford females joined to Belmont Red bulls is being compared with contemporary Herefords. The second calving results show that, despite slightly heavier birth weights for crossbreds, they had fewer calving problems than the Herefords. In both genotypes, heifers mated to calve at 2 years of age did not perform as well as those heifers mated to calve at 3 years of age. On a property north-east of Cloncurry, Africander and Brahman cross genotypes are being compared on reproduction and growth rates. Results to date indicate a higher pregnancy rate for maiden Africander cross females but no clear picture emerges regarding pre-weaning performance. Some years favour Africander cross, others favour the Brahman cross. In post-weaning performance results for three calf crops tend to favour Africander cross progeny.

The Africander is also being evaluated at Charters Towers. The first mating was in February 1977 when ¾ Africander and high grade Brahman bull groups were mated to low grade Brahman crossbred females. To date three matings have occurred and two groups of weaners have been produced. Results show little difference in pregnancy rates but the rates favour the Brahman (76% *v* 67%). In yearling growth the performance of the No. 8 Brahman heifers is 15% better than Africander crosses. For the No. 9 calf crop, Brahman crosses also had higher weaning weights (164 *v* 153 kg at 200-day adjusted weights).

Belmont Red, Brahman and Santa Gertrudis genotypes are also being evaluated in the sub-coastal dry tropics at another Charters Towers property. The first mating commenced in January 1978 when Belmont Red, Brahman and Santa Gertrudis bulls were each mated to a composite group composed of equal proportions of high-Brahman, low-Brahman and Santa Gertrudis females. Over the 2-year period, conception rates are highest in the Santa Gertrudis bull group and the low-Brahman female genotype group. On pre-weaning performance, there was little difference between the performance of the Belmont Red and Santa Gertrudis progeny groups but Brahman weaners were lighter. Breed of dam had no influence on performance.

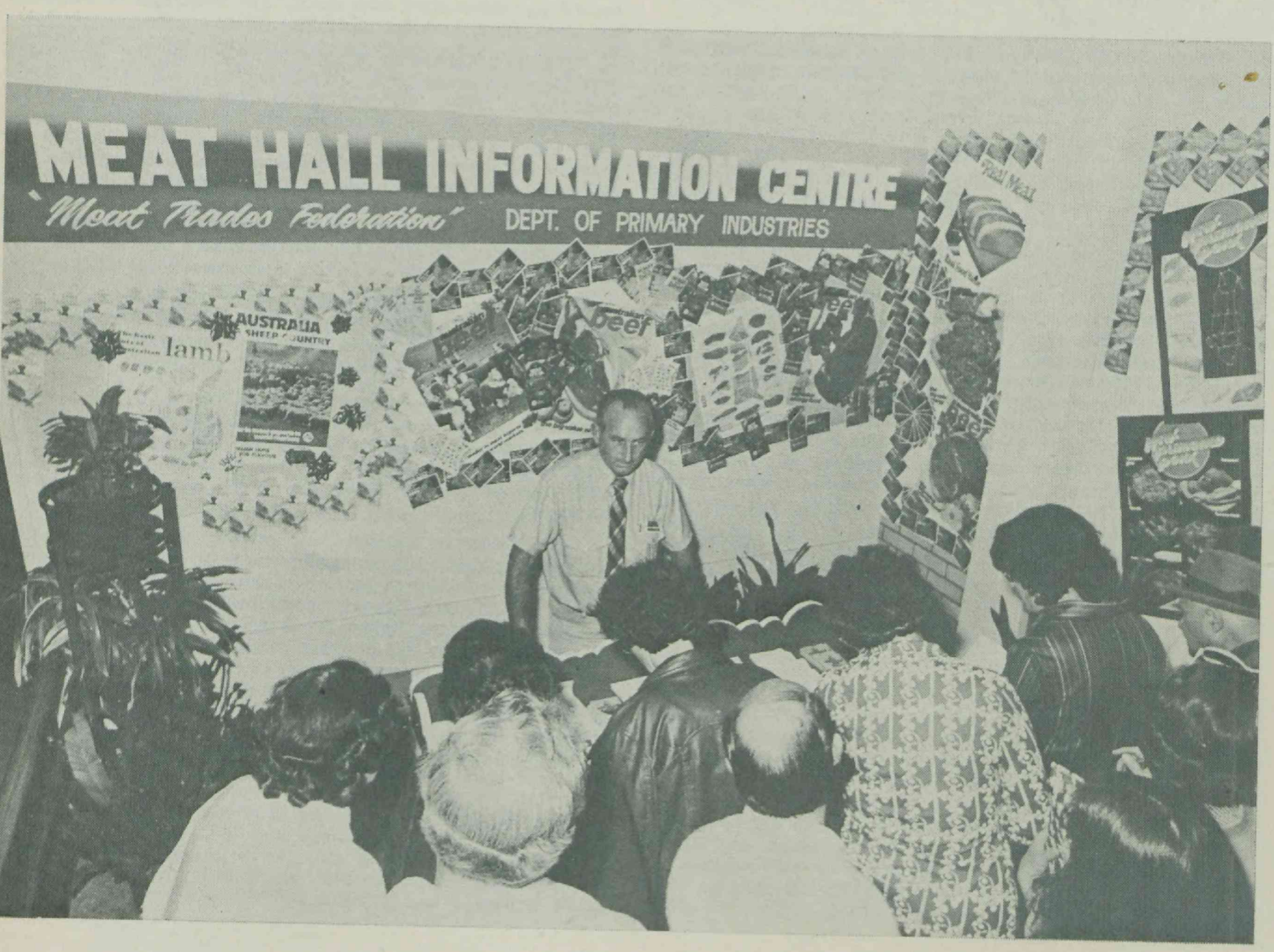
In association with James Cook University, a new co-operative project assessing Africander genotypes was commenced at 'Fletcherview' Research Station, Charters Towers, during 1979. Africander and Brahman bulls will be mated to Africander cross and Brahman cross females to determine breed differences, heterosis and estimated genetic parameters for important production traits.

In central Queensland, trials are comparing the effect of breed of bull on various production traits. On one property, Belmont Red, Droughtmaster, Brahman and Hereford bulls are being mated to cows of various genotypes. This is a long-term project that has already provided a considerable volume of important information.

A recent analysis of the influence of dam age on steers, showed that weight for age from weaning to sale is of importance in designing selection programmes. It was shown that dam age effects on liveweight and weight-for-age were highly significant at weaning, and at 12, 18 and 24 months of age, but not significant at older ages. The influence of dam age on weight and weight-for-age at 18 months, while significant, was small. It can be concluded from this that disregarding dam age adjustment at 18 months and older would not seriously reduce genetic gains when selecting for growth.

At Moura, European-infused Brahman crossbred bulls and Brahman bulls are being mated to Brahman breeders to compare the performance of European-infused Brahman cross progeny with high grade Brahman progeny. Limousin,

A busy State Meat Inspector, Mr Ken Crotty, of Ipswich, serving a section of the crowd at the Meat Information Centre at the R.N.A. Meat Hall in Brisbane.



Charolais and Chianina infusions are being assessed. Results to date indicate that breed of sire joined did not affect pregnancy rate. Breed of sire affected calf weight for age at a mean age of 82 days but not at 209 and 370 days. Chianina cross calves outperformed all others, with the growth of Limousin and Charolais cross calves being similar to that of the Brahmans.

The use of a Jersey component in beef production is being assessed at Oombabeer. The particular traits that a Jersey could contribute are milking ability, ease of calving, early sexual maturity and a degree of tick resistance. Africander bulls are being mated to a group of 40 Jersey cows and 40 Hereford cows. Data are being collected on reproduction, growth, carcass quality and tick resistance.

The effect of breed and age at first joining is being measured at Moura. The effect of mating Murray Grey and F_1 Brahman x Murray Grey at yearling versus 2 years is being assessed. Results to date indicate that there are significant breed differences in pre-joining weight and post-joining gain. At a pre-joining weight of 254 kg for F_1 Brahman cross and 241 kg for the Murray Grey, breed differences are not significant for pregnancy rate. However, the Murray Grey tended to conceive earlier in the season than the Brahman cross.

Growth rates of Droughtmaster, Brahman, Africander, Sahiwal and Shorthorn steers are being compared on Mitchell-Flinders grass in ticky and non-ticky country in the Julia Creek and Richmond areas. At Blackall, Santa Gertrudis and Belmont Red bulls are mated to Santa Gertrudis cross females to compare reproductive and growth performance. At weaning half the male progeny are transferred to Bauhinia Downs to assess performance in ticky country.

Transport and marketing

Mr W. J. A. Hall, an officer of Beef Cattle Husbandry Branch under the guidance of Dr. Longworth of the University of Queensland, and with the help of a Rural Credits Development grant, has been studying marketing costs and the relationship between cattle prices and marketing methods.

The trend towards liveweight selling continued and installation of liveweight facilities is being forced on any centre which wishes to retain its 'trade'. Scales were brought into use at Blackall, Wallumbilla, and Millmerran, and are being planned or constructed at Winton, Nebo, Emerald, and Bundaberg. Liveweight selling is still confined to slaughter stock, but some liveweight store sales are planned.

Roma saleyards, in May, had the largest recorded yarding for one day at any saleyard in Australia. A total of 9 393 was sold for $1,262,000. Total throughput for Roma for 11 months was 184 000 and is likely to exceed 200 000 for the year.

The Beef Cattle Husbandry officer at Dalby has been associated with the design and hopefully standardized installation of double deck unloading and loading facilities. It is essential that dimensions are standardized so that this type of facility can be used by all transports.

BRUISING. Research into the cause of bruising has ceased, except in association with other marketing-weight loss trials. Nevertheless officers have continued to emphasize ways of reducing bruising in their extension activities, in particular the need to dehorn young cattle. Some officers have observed an increase in the numbers of hornless cattle on offer at saleyards and a price premium for such pens. These trends have not yet been substantiated.

In conjunction with the Australian Meat and Livestock Corporation, Beef Cattle Husbandry Branch has produced a colourful leaflet on bruising titled 'Bruising costs money'. The leaflet has been distributed not only in Queensland but also by the AMLC in other States. The film of the same name is still in frequent demand, although one criticism by producers has been the lack of comment on bruising at abattoirs.

The Beef Cattle Husbandry officer at Dalby has been associated with a major cattle transporter in developing 'a low bruise crate'. The double-deck unloading facility installed at Dalby should also reduce bruising as well as speeding loading and unloading.

SALEYARD CURFEWS. Although the cost is substantial to install electronic scales and modify saleyard facilities for selling fat cattle on liveweight, many saleyard operators now want to adopt this method. The introduction of statutory fasting (curfew) periods with liveweight selling means that cattle must be yarded without feed and water for 10 to 12 hours before the commencement of the sale as well as during the sale. A survey over four sales between June and August 1979 at Dalby Saleyards showed that 56% of cattle did not have access to water between arrival and penning for sale. As a consequence, cattle were deprived of water for 13 to 55 hours before sale weighing. They were without feed for 14 to 77 hours.

The curfew aims at reducing the variation in gut fill and so dressing percentage between sale lots, but it was introduced without prior research. It can adversely affect returns to producers, is costly to operate and causes problems to saleyard operators and transporters.

Beef Cattle Husbandry Branch has undertaken, in collaboration with the Queensland Meat Industry Organization and Marketing Authority, a series of trials to re-assess the need for a curfew and examine alternative procedures for liveweight selling. This research indicates that the present curfew system does not achieve its objective, since substantial differences in liveweight and presumably gut fill can exist between groups of similar cattle which have fasted for various times. Such differences are exaggerated if some cattle have had access to water and others have not.

An alternative and better system would be to have water in the selling pens so that all cattle are on water but not feed from the commencement of the curfew period until sale weighing. In this way, the differences in liveweight between similar animals would be minimized and cattle would maintain weight during the sale. No animals would be dehydrated. Such a 'wet' curfew-sale system would also be more humane.

The investment in liveweight selling facilities makes it highly probable that stores will be sold on liveweight, with presumably the same curfew-sale procedures as for selling fat stock.

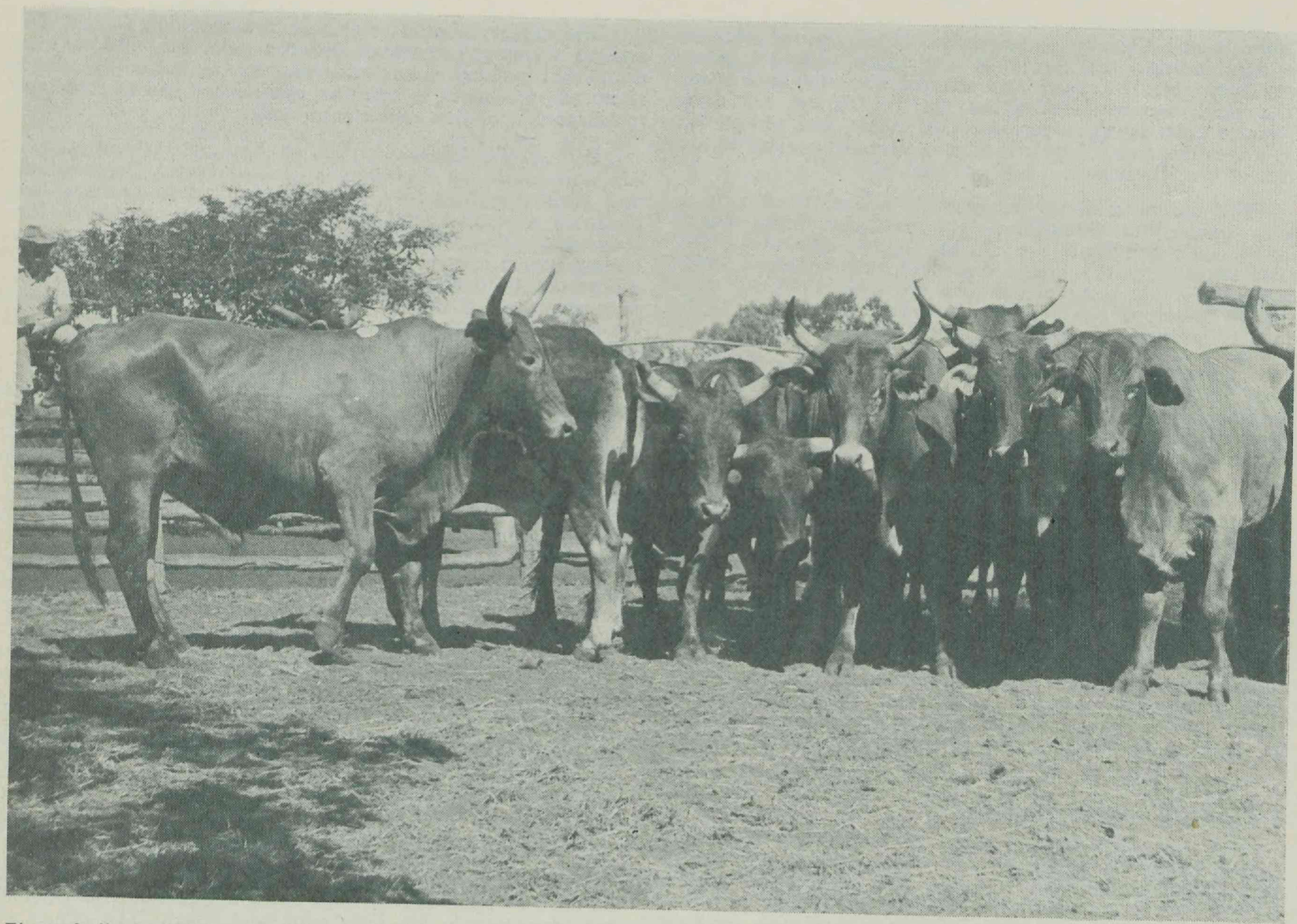
TRANSPORT. Weight loss during transport is inevitable. In addition, cattle often travel longer distances than may seem necessary. The supply of cattle relative to slaughtering capacity in a particular region can affect the direction of cattle movements, with the extra travelling reducing total beef production. This cost is increased by injury and deaths in transit plus freight costs. It is much less costly to transport cartoned meat than live animals, as well as being a more efficient way to use transport capacity.

Journey time has a greater effect on weight loss than the distance cattle travel, while the available evidence suggests that travel *per se* has little additional effect. The effects of distance and time were examined when two groups of cows were transported 460 and 2 055 km in July 1979, while a third group was held after 460 km and slaughtered at the same time as those transported the longer distance. Times from mustering to slaughter were 3, 8 and 8 days. The third group was deleted from a second, similar, experiment in October, when 2, 5 and 11 days elapsed between mustering and slaughter. On arrival at the various abattoirs, the cows had lost 9.4 to 13.4% of initial liveweight (437 kg). After 30 hours on water and feed, net losses were 6.9% for group II cows in the second experiment. The group II and III cows were both 2.2% lighter than the group I cows in the first experiment. The difference was 3.1% in the second experiment. Liver weight tended to decrease with time since mustering. Bruising was associated with factors other than distance travelled. Travel fatigue affected muscle pH, but values were not necessarily related to distance travelled.

Cattle become dehydrated in transit and unless they are watered before slaughter their carcass weights will be depressed substantially. After travelling from 'Tanbar', Windorah, to Brisbane, bullocks were watered (without feed) for 0, 3.5, 7, 28 and 32 hours and with feed for 32 hours before a 16-hour preslaughter fast. Rehydration increased carcass weight from 369 to 383 kg when bullocks were watered for 3·5 and 7 hours, 381 kg after 28 hours on water alone and 379 kg after 32 hours on water and feed. However, this increment was not maintained, presumably due to tissue catabolism. The carcasses of bullocks on water alone for 32 hours averaged 376 kg. The water content of fat-free muscle reflected the same patterns as carcass weight, although peaking at 78.16% for bullocks watered for 28 hours compared with 76.01% for those not offered water. Resting bullocks for 2 days rather than 1, reduced pH values from 5.64 to 5.57. This difference is of commercial significance.

The immediate priority of further research is to examine further the effects of method of sale, saleyard procedures and time since mustering on carcass weight and meat quality. Further study is warranted on the importance of rest and hydration of cattle at slaughter.

A total of 23 cattle including 7 recently dead, and 16 'downers' from 10 localities in Queensland was examined by veterinary officers on arrival at Cannon Hill. Trauma was the most significant cause of death. No evidence of infectious disease was detected. Clinical findings (neutrophilia, haemoconcentration and hypocalcaemia) were indicative of stress. The conclusions from the limited survey indicate that, to prevent stock losses, the time that cattle are travelled without rest, feed or water should be minimized. A limit of 24 hours' travel before stock are rested, fed and watered would reduce the numbers of dead and dying stock travelling on trains significantly. Ideally animals of different size should not be placed in the same wagon.



These bullocks from a property in north Queensland were used to test the effect of transport, watering and feeding on weight loss.

Extension

Interest in feedlotting has also stimulated a much greater interest in the use of Beef Cattle Futures as a hedge against falling prices. Several meetings have been held, in association with Economic Services Branch, to explain the operation of beef futures. At present it is believed that only a few cattle fatteners are actually using futures to hedge their returns.

Apart from the activities associated with the drought, there was also a general upsurge in enquiries on all matters relating to cattle husbandry. In one area this was reported as being associated with the many new property owners and with a movement of canegrowers into beef production. Established cattle owners have been concerned with developments such as yards, fencing and timber control. New owners have been interested in advice on overall property development.

Several extension officers have been involved in electric fencing developments and interest in this is still widespread. One leading producer at a field day on the Downs stated that in his opinion, it was the most important advance in property development in the last 15 years. Electrification of the barrier fence was being investigated at the request of the Department of Lands.

New, and hopefully more effective discussion groups have been established at several centres. A 2-day workshop at the Dalby Agricultural College was the basis for the formation of four district groups. In these four groups, and one at Gin Gin, Departmental officers serve the role of facilitator only and are not the principal prop to the group, which hopefully will be more self-sustaining than many in the past. In the Bowen district, producer liaison groups have been set up with a different objective, which is to try to ensure that extension and research are in keeping with producer needs.

Another new approach to servicing producers' needs is being tried in the Bundaberg district. Regular 'consultant clinics' are being held at centres away from the Beef Cattle Husbandry officer's headquarters. The dates of the 'clinics' are well advertised and producers appear to be taking advantage of this arrangement.

Staff have played a big role in the editing and production of district newsletters. Beef Cattle Husbandry officers edit or play a major role in the publication of the North Western Newsletter (Mount Isa), the Desert Digest (Barcaldine), Mulga Line (Charleville), Talking Point (Bundaberg), Borderline (Warwick), Western Downs Newsletter (Miles), Downs Cattle Husbandry Notes (Toowoomba), Rural News (Roma). Although very time-consuming, these newsletters do reach a large number of producers and are a useful and important extension activity.

In north Queensland close liaison has been established with three major pastoral companies which own a large proportion of the cattle in north Queensland. A series of four very successful field days was held in the remote areas of north-west Queensland to promote better contact between producers and departmental staff.

The cattle spaying extension project concluded this year. Its objectives were to teach graziers and Departmental extension officers a new and simple spaying technique, and to promote spaying of cattle as a means of herd improvement. Mr J. C. W. Biggers, District Inspector of Stock, who developed an automatic flank knife and ovary extractor for use in a simplified spaying operation, conducted a total of 50 spaying schools field days, and demonstrations. They were attended by 1 287 persons and 444 people associated with the cattle industry participated in learning the new technique.

More than 9 000 copies of explanatory articles were prepared by Departmental officers and distributed within the Australian beef cattle industry. Numerous radio interviews were broadcast and wide coverage of the technique given on ABC television programmes. As a result of Mr Bigger's ingenuity and extension efforts by Departmental officers, the cattle industry is conscious of the fact that it has at its disposal a spaying technique which is safe, simple, efficient and easy to perform.

A major extension effort by officers of Veterinary Services Branch has been directed towards promotion of the brucellosis and tuberculosis eradication programmes. In most regions the brucellosis aspects have been eminently successful if judged by the demand from producers for assessment of their herds.

Other major extension programmes relate to tick control and these are discussed more fully under that section of the report.

Sheep and goat industries

Rainfall in the sheep areas of the southern half of the State has been well below normal and this has resulted in widespread drought. Large numbers of sheep have been moved from south-western districts to agistment in the more favourable areas around Longreach and Blackall or have been sold. Supplementary feeding and the cutting of fodder trees such as mulga are widespread practices.

Research results obtained by Sheep and Wool Branch officers at the Charleville Pastoral Laboratory have been extensively used in the formulation of supplements to be fed to sheep consuming mulga. Many producers also supplemented their sheep with urea on the basis of information obtained from 'Toorak' Research Station experiments.

As a result of unseasonal drought conditions sheep numbers have declined; provisional estimates suggest that the State currently depastures 12·4 million head. Premature shearing has been a common practice in the drought-affected areas and wool cuts per head have been low.

Wool prices continued to remain above the floor price. The market indicator has ranged from 364 to 433c per kg with fluctuations around 400c per kg most common.

Blowfly activity in sheep throughout the State has been low because of the abnormally dry season.

Queensland's participation in sheep export markets has been limited. In an effort to rectify this, the Sheep and Wool Branch has undertaken a programme aimed at fostering the development of a market in South-east Asia for sheep from central and north-western regions of the State. As a result the Department of Trade, in conjunction with the Singapore Government, has called tenders for the supply of a trial shipment of bone-in mutton carcasses. It is hoped that this shipment may be the prelude to a new market outlet for Queensland sheep.

In conjunction with this programme, the Sheep and Wool Branch has mounted an extension programme to promote techniques which will increase the productivity of sheep in the semi-arid tropics of northern Queensland. This programme is based on the results of research projects undertaken at 'Toorak' Research Station in recent years. It commenced with an Open Day at 'Toorak' on 28 September, 1979 and has embraced mass media contributions, producer visits and a comprehensive audio-visual and poster display at all the major Agricultural and Pastoral Association Shows in central and northern Queensland and the State Sheep Show at Roma.

In co-operation with the Australian Wool Corporation and the Ithaca Technical College, a series of 2-day courses for the upgrading of professional wool classers' qualifications was held at strategic centres throughout the major sheep areas.

Wool harvesting

The objective of this research programme, which is partially funded by the Wool Research Trust Fund, is the development of an alternative method of harvesting wool in an effort to reduce or contain one of the major components of the annual cost of producing wool. The programme of wool harvesting research has been bi-directional—(a) research into chemical shearing has been aimed at developing a system of applying a depilatory solution to the skin of sheep, thus weakening the wool fibres sufficiently to allow the fleece to be readily removed mechanically; and (b) research into biological defleecing has investigated the factors controlling natural coat-shedding in animals so that controlled fleece shedding can be induced in Merino sheep.

In the chemical shearing programme, the wool-severance properties of various concentrations of calcium thioglycollate dissolved in a range of buffers (pH 10·5 to 12·5) and alkalis have been evaluated. A solution containing 3·6% calcium thioglycollate dissolved in a potassium chloride-sodium hydroxide buffer of pH 12 with 0·3% surfactant provided the optimum relationship between defleecing efficiency and the protective wool cover remaining on the sheep following harvesting. As little as 300 mL of this solution will theoretically defleece the average-sized sheep if suitable application techniques can be developed.

Experiments in application technology are being conducted in co-operation with the University of Melbourne, Civil Engineering Department. A prototype applicator has been produced by this group and will undergo testing on sheep in the near future. In conjunction with the Engineering Services Section of the Department, a 'maximum exposure' conveying race for sheep has been designed and will be constructed to enable practical evaluation of application methods.

Wool removal without fleece damage is a prerequisite for the commercial use of externally-applied depilatories. To this end, methods of fibre protection were also investigated. This exercise involves pretreatment of the 10 mm of the fleece closest to the skin with a protectant 3 to 4 weeks before harvesting. The unprotected wool grown immediately above skin level during this period then provides a site susceptible to dissolution by externally-applied chemicals. A solution of 6% formaldehyde buffered to pH 6, provided adequate protection of fibres against thioglycollate dissolution for a period of 21 days.

In the biological defleecing programme, a preliminary study into the effect of administering aminoglutethimide (which experimentally induces a pharmacological adrenalectomy) suggests that this drug delays the onset of the shedding cycle of rabbits. Follow-up work has examined the hypothesis that the adrenal gland produces a potent catagenic steroid which is normally responsible for inducing seasonal shedding in animals.



An experimental air nozzle being tested in the wool harvesting programme.

A range of synthetic analogues of cortisol has been screened for their ability to induce fibre shedding in sheep in an attempt to delineate the molecular configuration which has the highest activity. Results have shown that shedding can be induced using formulations containing a pregnane nucleus with a double bond between C1 and C2, a fluorine group on C9 and a hydroxyl or methyl group on C16. Optimum absorption rates and plasma levels of these steroids occur when they are in the microcystalline alcohol form. Further investigations of the effect of serial alterations to the molecular structure are in progress.

A series of experiments was conducted to study the mode of action of the corticosteroids in fibre shedding. Results suggest that glucose transport may be involved, as the intravenous infusion of glucose appeared to enhance the effect of corticosteroids and, conversely, the administration of chlorpropamide reduced the effect of low doses of corticosteroid.

Overseas markets for Queensland sheep

Central and north-western Queensland supports a sheep industry which has no reliable market for its end product—the adult sheep. This situation has a profound effect on the viability of the industry in this State. There are more than 6m sheep in this region, of which very few are sold as cast-for-age stock. Their productivity (wool and lambs) is low after they attain 7 years of age. In normal season, their annual mortality rates do not reach 50% until they are 11 years old. This means that, because of the age structure of the flocks, approximately one-third of the sheep in this area are poor producers. Selling these sheep routinely at 7 years of age would markedly improve the profitability of the industry.

The Sheep and Wool Branch has adopted an action plan designed to foster the development of an overseas marketing system for Queensland sheep. A trial consignment of bone-in mutton carcasses is due to be shipped to Singapore in the near future. Consumer reaction is likely to be an important determinant of the future viability of this exercise. The advantages of establishing such a market not only arise from the salvage value obtained from 7-year-old sheep off shears but also relate to concomitant husbandry procedures which could stem from the sale of these sheep. Changes in flock composition and flock structure would permit improvements in reproduction and wool production.

The Sheep and Wool Branch is therefore actively pursuing research and extension programmes designed to increase per head productivity and thereby combat the ever-increasing costs of production. These efforts can have a notable effect on industry viability in this region. The impact of their practical implementation would be enhanced if producers had a reliable market outlet for the cast-for-age sheep.

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Parasites

The research programmes to develop more efficient methods to control both external and internal parasites are supported by funds from the Wool Research Trust Fund.

The major external parasites of Queensland sheep (blowflies and lice) continue to be subjects of high priority research and extension activities.

The blowfly research effort has concentrated on developing ways of identifying sheep which have a natural biological resistance to challenge from *Lucillia cuprina* larvae. These larvae feed on the sheep's serum and some animals can initiate spontaneous remission through physiological mechanisms. The plasma profiles of resistant sheep clearly show increased levels of immunoglobulins, though attempts to confer immunity to sheep by vaccination procedures have not so far proved successful.

It seems likely that biological resistance to natural challenge may be associated with a reduced anaphylactic response. Studies of the heritability of resistance are in an early phase of development. The conduct of these trials has been assisted by the development of techniques to monitor the responses of sheep to a standard larval *L. cuprina* challenge.

Another aspect of the biological control of fly strike has involved the use of orally-administered non-toxic elements which are capable of reducing the severity of artificial strike. These studies give rise to speculation that oral measures used to control fly strike may one day herald a new approach to an old industry problem.

Research and extension efforts designed to provide producers with a more efficient system of insecticide application and a means of predicting blowfly activity in their flocks are in the process of being developed. Improvements in the technology of insecticide application and in ensuring the persistence of residues near skin level have also been extended to embrace lice control measures.

The Wiltshire Horn x Merino breeding programme aimed at developing a sheep with a fleece comparable with that of the Merino (M) in quantity and quality but less susceptible to blowfly strike by incorporation of some of the fleece shedding characteristics of the Wiltshire Horn (WH) continued during the year. In the evaluation of ½ M ½ WH, and ⅝ M ⅜ WH, and ¾ M ¼ WH sheep the degree of shedding seen increased with the proportion of WH in the sheep, while the fleece weight decreased with increasing proportions of WH (½ M ½ WH—2·12 kg, ⅝ M ⅜ WH = 2·6 kg, ¾ M ¼ WH = 3·16 kg). Most of the differences in fleece weight are in skirtings or bellies shed or retained by the various lines. Blowfly strike has been minimal in all crosses.

Wiltshire Horn x Merino half-bred ewes have been shown to be highly fertile. Ewes mated at Hermitage Research Station in 1979 produced 158% of lambs.

A survey to determine whether strains of *Haemonchus contortus* in Queensland are resistant to commonly-used anthelmintics commenced. Because of the drought conditions which prevailed in the major sheep areas of the State, most of the survey was conducted on the coastal strip. The presence of resistance was based on the results from (a) egg hatch assays for benzimidazole resistance and (b) pre and post-treatment egg counts for levamisole resistance. All resistant strains are being tested in worm-free sheep for confirmation of the field trial results.

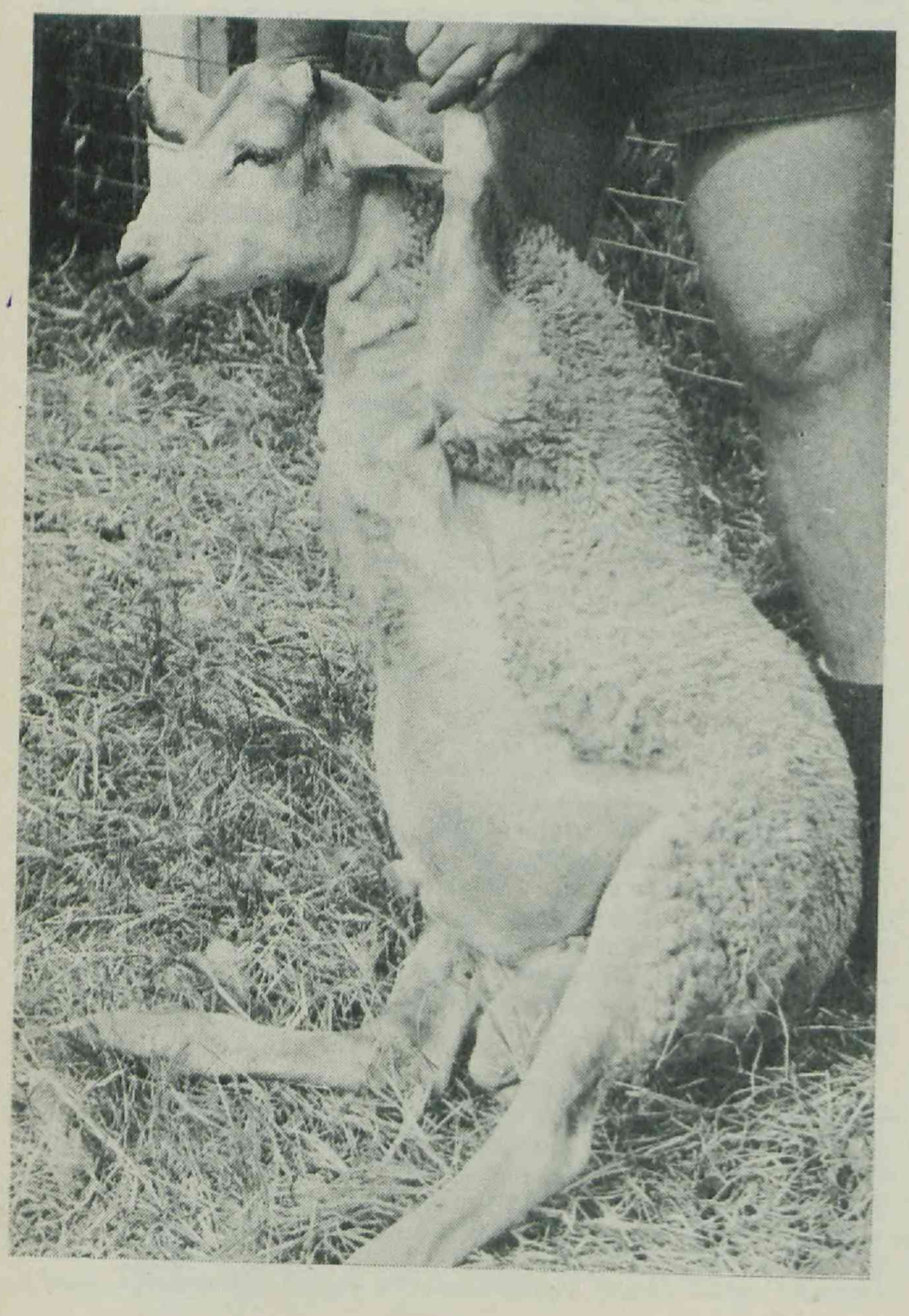
Of 23 properties surveyed, 17 were shown to have strains of *H. contortus* resistant to one or more of the benzimidazole group of anthelmintics. Of the 17 resistant strains, four were found to be resistant to levamisole also. The survey is to be continued in the major sheep-producing districts when seasonal conditions favour an increase in helminth populations. To prevent spread of resistant strains of *H. contortus* to the major sheep rearing areas of the State, sheep and goats from properties with resistant strains are subject to supervisory treatment for internal parasitism before movement west of the Great Dividing Range.

Following the apparent failure of levamisole to control infections of *H. contortus* in sheep at Lawes in south-east Queensland, a strain of this parasite was isolated at the Animal Research Institute, Yeerongpilly. This strain was used to infect sheep at Yeerongpilly and at Marrindale Research Station, Victoria, where four experiments to classify the resistance pattern of the parasite were carried out.

These experiments showed that the adult parasites of this strain were highly resistant to the recommended therapeutic dose rates of levamisole, morantel tartrate and thiabendacole. Other benzimidazole anthelmintics and also the organophosphorus compound, napthalophos were only moderately effective against the original isolate but rafoxanide, nitrozynil and phenothiazine were almost 100% effective.

Other highly effective chemicals were disophenol and closantel. After passaging the strain for four generations with both levamisole and albendazole, resistance to both napthalophos and the newer benzimidazole anthelmintics increased dramatically. This is the first report of a field strain of *H. contortus* exhibiting resistance to benzimidazole, non-benzimidazole and organophosphorus anthelmintics.

A lamb showing the wool shedding typical of ½ Merino ½ Wiltshire Horn Sheep. Studies with Wiltshire Horn x Merino sheep are being undertaken in the research programme on blowfly control.



Nutrition

The nutrition research programme is supported by funds from the Wool Research Trust Fund.

The benefits that can be obtained by urea supplementation to lambing ewes has now been demonstrated in southern as well as northern areas of the State. We are in a position to confidently advise producers to utilize this type of supplementation when the only form of nutrient available to lambing ewes is dry forage. A suitable urea dispenser is now commercially available. This adds the urea to drinking water and ensures regular and compulsory intake of the supplement. While the value of this form of supplementation for dry sheep has not yet been fully evaluated, pen studies have given encouraging results and further work is continuing.

Superior survival and growth rates in lambs and ewes have also been obtained by provision of natural protein supplements (cottonseed meal) to lambing ewes grazing dry pastures in south-western Queensland. However, while results were biologically significant, present costs would not make this form of supplementation economic.

Both the urea and the cottonseed meal supplementation work indicate that the protein and nitrogen content of available pastures limits reproduction capacity in western and northern Queensland. A further illustration of the value of protein was obtained in a pen study where birth weights and subsequent growth rates were higher in lambs whose dams were fed a high protein diet of ephemeral species (herbage) than in lambs whose dams were fed a low protein Flinders grass hay diet. This demonstrates the wisdom of utilizing paddocks with a mixed pasture containing ephemerals at lambing time.

Some final details of the study of nutritional factors limiting sheep productivity on southern Mitchell grass downs pastures are now available. Irrespective of the quality of the diet consumed during these experiments, both dry and pregnant ewes would have been able to obtain sufficient energy for their maintenance. It would have been impossible, however, for lactating ewes to consume sufficient forage to meet daily maintenance, wool growth and lactation requirements

During periods when sheep were eating dry Mitchell grass, nitrogen intake was well below that required to maintain normal rumen function. Other elements which appeared to be marginal or low in the diets when seasonal conditions were adverse were magnesium, zinc and copper.

The technique used for the conservation of Flinders grass hay in the north of the State has now been used for the production of Mitchell and buffel grass hay in the south. Further investigations will evaluate the worth of these forage sources as on-farm drought reserves.

The ingestion of tropical grasses high in oxalate content resulting in the development of osteodystrophia fibrosa in horses (monogastrics) from an interference with calcium and phosphorus metabolism has been established by staff of this Department. While it has been reported that sheep and cattle (ruminants) avoid the effects of oxalate on calcium availability by rapid degradation in the rumen, it was considered that, even if soluble oxalates are broken down, the other factors thought to be involved in negative mineral balances in horses, that is, a sub-maintenance calcium level and large calcium oxalate crystals (which would be more slowly degraded) could apply to ruminants.

Calcium, phosphorus and magnesium balance studies were done with sheep fed one of the tropical grasses high in oxalate content. The grasses fed were kikuyu, *Setaria sphacelata*. cvv. Narok, Kazungula, buffel grass and para grass. On a liveweight basis, balance figures obtained from horses and sheep were similar. All four grasses caused a negative balance for Ca and P, and kikuyu and buffel grass caused a negative balance for Mg. Work is continuing on the effects on mineral balances of supplementation with inorganic salts of calcium.

The potential for fat lamb production under different management systems was examined. Suffolk cross lambs grazing or zero-grazing oats were offered supplements of sorghum grain, cottonseed meal and monensin, a growth stimulant. Grazing lambs grew about 25% faster than zero-grazing lambs, the liveweight gain of unsupplemented lambs being about 0.18 kg per day. Carcass gain of the lambs was not affected by either grain intake or cottonseed meal supplementation, but the monensin (fed with the grain) proved to be very unpalatable and depressed intakes and performance.

Reproduction

Investigations supported by funds from the Wool Research Trust Fund have continued towards understanding factors contributing to peri-natal lamb deaths and to the poor growth rates of older lambs.

It is apparent from recent studies in water metabolism that lambs require more fluid in summer than tropical Merino ewes can provide in milk secretions. Therefore a supply of readily-available drinking water is required for the lambs.

Preliminary studies indicate that, under adverse seasonal conditions, a ewe's milk production is depressed by approximately 40% when it has only one functional teat. Survey data indicate that the incidence of teat damage in Queensland ewe flocks varies from 1 to 20%. The quantity of milk available to the lamb significantly influences its ability to survive and its growth rate. This, in some flocks at least, could contribute towards low reproduction rates particularly when ewes are on a poor plane of nutrition.

Higher milk yields and an associated increase in lamb survival and growth have been demonstrated in a South Australian strain of Merino ewes when compared with indigenous tropical Merinos. While it is too early for definite conclusions to be drawn from this study, the performance of future generations of this promising strain of sheep will be followed.

The benefits of shade have continued to focus attention on practical ways of improving reproduction rates. A series of experiments on this subject has clearly shown that joining ewes on one shaded watering point and lambing them down on shaded bore drains improves lamb-marking percentages.

Diseases

Because of the extensive nature of the sheep industry in isolated areas, few specimens other than those for parasitological examination are received at the laboratories for examination. A problem with drought-fed sheep at Winton suggests that there are other problems which are possibly not being investigated. The Winton sheep were being fed molasses-urea blocks and 30 had died after showing nervous signs including opisthotonus, spasms, ataxia and dullness.

This clinical picture is not consistent with ammonia poisoning which is usually associated with these blocks and autopsy revealed brain lesions of the type known as polioencephalomalacia. This condition is usually responsive to thiamine therapy but it is most unusual in a drought feeding situation. Light mortalities due to polioencephalomalacia also occurred in flocks at Pikedale, Lawes and Thane.

Drought conditions in the sheep areas of south and western Queensland have predisposed to numerous outbreaks of pregnancy toxaemia and hypocalcaemia. Adequate supplementary feeding of ewes is necessary to avert outbreaks.

Scabby mouth outbreaks were reported from all sheep rearing districts but the highest prevalence of the disease occurred in the Quilpie and Hughenden areas.

The recovery of *Clostridium chauvoei* confirmed the diagnosis of blackleg as the cause of ovine mortalities at Stanthorpe.

Infestations of *Haemonchus contortus* requiring treatment were reported from all the sheep areas of south Queensland. Losses associated with the prevailing drought conditions were reported from the Roma, Charleville and Goondiwindi areas.

Goats

The growth of the Angora goat industry has resulted in a high level of utilization of the Sheep and Wool Branch's resources. In an attempt to rationalize its limited resources for this industry, the Branch has conducted a series of field days, schools and seminars in the Warwick, Stanthorpe, Roma, Gatton, Gympie and Atherton Tableland districts.

Studies into the performance of Angora goats in the semi-arid tropics, and the morphology of the skin and mohair fibres of Angora and Angora crosses have commenced. These latter are designed to assist in the development of selection criteria which can be successfully used in up-grading feral stock. Studies in the Charleville district have shown that goats do not adequately control the woody weed *Dodonea adenophora* (hopbush).

The recent trend to introduce feral goats into coastal and more densely settled areas for crossbreeding with Angoras has been associated with increased losses in the introduced goats. The stress of transport and starvation, overcrowding on small holdings, haemonchosis on the coastal area and trichostrongylosis on the Darling Downs, plant toxicoses and unfamiliar plants all contributed to the mortalities.

Others diseases also caused mortalities in goats. At Goondiwindi, 32 feral goats died following signs of weight loss, ataxia and recumbency. Laboratory examination supported a diagnosis of infectious myelitis due probably to a bacterial infection.

Mortalities occurred at Samford following signs of a nervous disorder. Polioencephalomalacia was diagnosed on histopathological grounds. Enterotoxaemia was diagnosed as the cause of mortalities at Haden. Septicaemia due to *Escherichia coli* caused mortalities in young goats at Corinda, Lowood, Woombye, Thane, Gunalda and Jondaryan.

Pig industry

Preliminary livestock statistics for Queensland released by the Australian Bureau of Statistics show a 7% increase in pig numbers at March 1980, compared with numbers in the previous year. At an estimated 522 000 head, this is only 3·5% below that of the peak year, 1973.

In the 12 months to March 1980, pig slaughterings in Queensland at 768 000 head and production of carcass meat at 47 660 tonnes were respectively 4·6% and 11·5% higher than a year earlier. In contrast, bacon and ham processing declined by 3% compared with 1978–79 levels.

National pig production figures in terms of slaughterings and carcass meat revealed a similar but more modest expansion at 2·1% and 4·6% respectively.

Earlier predictions of a 4% rise in the Australian sow population were exceeded by the preliminary estimates for March 1980 which show a 13·8% rise to 355 000 head. Consequently, the predicted expansion of 10% in pigmeat production to 225 kt in 1980 may well be realized despite currently reduced margins: in the longer term the present reduced demand for pigmeats is expected to lead to a production decline.

First advance payments for bacon pigs declined by 15% to $1.16 per kg hot dressed weight in the last quarter of 1979–80. While the upper limit of 85 kg was maintained throughout most of the year, a penalty of 7c per kg will not be imposed on baconer boars exceeding 77 kg.

Evidence that heavier pigs were marketed is provided by Queensland slaughterings statistics for the 12 months ended March 1980. These reveal an increase in the average carcass weight to 62·1 kg, a lift of 3·8 kg compared with a year earlier.

Figures available for the 6 months to December 1979 showed a considerable traffic in live pigs for slaughter between Queensland and New South Wales. More than 25 000 pigs were consigned from south-eastern districts for slaughter principally at Casino: 17 000 pigs from northern districts of New South Wales crossed the border for slaughter mainly at Brisbane factories. Some slackening in border trade is now evident with less favourable prices.

Feed supplies were generally adequate to meet needs in the first half of the year, but dry weather reduced the winter cereal harvest and prospects for summer crops. Prices for most feedstuffs tended to rise early in 1980 and shortages of some ingredients were reported.

The statutory organization of pig producers, which has changed its name to the Queensland Pork Producers' Organization, continues to flourish. All district staff of the Pig Section have been involved, by invitation, at Branch and District Council level and the Assistant Director, Pig and Poultry Branch, attended State Council meetings, again by invitation.

Two members of State Council were also members of the Departmental Liaison Group and contributed to discussion and decisions concerning research, performance testing and extension in the industry.

It is firm policy of the Organization to co-operate with district officers of the Pig Section in the organization of seminars at various country centres. In consequence, meetings were organized at Biloela, Boonah, Kilkivan, Kingaroy, Millmerran, Murgon and Peranga. All were well attended, successful meetings.

Other areas where co-operation has been close include research and the development of research priorities (through a pilot Delphi type survey at national level), promotion, tattoo branding, guidelines for effluent disposal and animal welfare. In the latter case financial assistance from the Organization enabled the Assistant Director, Pig and Poultry Branch, to attend with the President, a Melbourne meeting which had the objective of drafting a code of welfare for domestic pigs.

The organization is now in a sound financial position and is making a unique contribution to industry affairs at State and national levels.

Meetings, discussion groups and field days were a more significant means of contact by Pig Section staff with producers this year while farm visits, office interview or contacts by telephone continued to be important channels of communication. The available media were used where appropriate in support of regional extension programmes. Advisory leaflets were prepared on a variety of subjects. Pig Section officers maintained their involvement in district extension committees and programmes. Pig industry extension groups were operational in the Darling Downs and Moreton regions.

The buoyant state of the pig industry prompted an increased volume of enquiry from people contemplating entry into pig raising. A considerable amount of time was therefore devoted to servicing requests for advice and information. All requests for assistance were serviced as required in conjunction, wherever possible, with project activity. This unprecedented demand for information on pig raising from farmers and the general public rapidly depleted stocks of publications. These were reprinted through the Department's printing facilities but excluded photographic material.

A most successful field day was held on the 29 August 1979 to celebrate the inauguration of the Pig Research Centre, Wacol. Staff from several Branches addressed the producers and the talks were distributed to those attending in a booklet. Producers were given the opportunity to inspect the piggery and to comment on the facilities and their management. The theme of the day was 'Research for the Pig Producer', and the attendance of 150 was representative of the pig industry and associated industries.

A total of 30 pig carcass competitions was judged by Pig Section officers at the invitation of Agricultural Societies throughout the State. In addition, the Queensland section of the National Bacon Carcass Competition, sponsored by private enterprise, was judged during the Royal National Association's exhibition in August.

The superporker campaign appears to have fallen short of expectations in failing to create the necessary stimulus in consumer demand for pigmeats.

Live market reporters were familarized with the pig industry situation and were assisted in developing a system of classifying pigs for reporting purposes. The service was launched earlier in the year but as yet does not include a report on the live pig market.

At the request of the Australian Pig Industry Research Committee, officers of the Pig Section assisted the Committee in the conduct of a Delphi type survey. This was a pilot survey with a stratified sample of producers in all States. There were 198 separate subjects suggested for research, categorized under 10 headings of which health, nutrition and management were high on the list. The study demonstrated the feasibility of using the Delphi technique on a national basis with a highly motivated group of respondents.

Breeding

PERFORMANCE TESTING OF STUD BOARS. A total of 429 boars, of which 211 were approved as herd sires, completed performance testing at the Rocklea test station. About one-half of the boars tested had sires which were previously tested at Rocklea. The pass rate of these boars was 12% higher than that of boars whose sires had not been tested at Rocklea. This establishes that the station is identifying boars of superior breeding value. The number of boars tested increased by almost 50% in the last year—a reflection of the demand for this service as a contributor to genetic improvement in the Queensland pig population.

At work is Miss R. A. Spencer, the first woman Pig Husbandry Officer appointed to the field staff. She is stationed at Kingaroy.



The annual auction sale of tested stock at Toowoomba was well attended and assisted in extending the concept of objective selection of breeding stock.

ON-FARM PERFORMANCE TESTING. On-farm performance testing and central boar performance testing are complementary programmes increasing the genetic merit of Queensland's pig breeding stock and therefore improving the efficiency of production of pigs. Pig Section Officers in all districts continued to assist producers with their performance testing programmes and to develop the techniques involved. Increasing numbers of producers now operate their own programmes. As well as improving the genetic merit of breeding stock, the programme has 'spin-off' value in the areas of husbandry and general management.

SELECTION FOR EFFICIENT LEAN GROWTH IN PIGS. The first year's selection for efficient lean growth in the pig herd at the Hermitage Research Station was completed. Performance testing was carried out over a 12-week test period commencing at 25 kg liveweight. All pigs were fed a set amount of feed (162 kg) during the test and those with the highest carcass lean were selected as breeder replacements. Carcass lean was estimated from previously constructed prediction equations using liveweight at the end of test and ultra-sonic back fat measurements. So far, an accumulated selection differential of one standard deviation has been achieved.

MAINTENANCE OF CONTROL PIG HERD. The piggery at Biloela Research Station continued to maintain an unselected control herd, originally of similar genetic composition to the selection herd at the Hermitage Research Station. This control herd is being reproduced by a within-family selection and cyclic mating procedure to remain as genetically constant as possible into the future. The herd will act as a standard against which genetic progress in the Central Boar Performance Testing Station, Rocklea, and in the selection herd at Hermitage Research Station can be measured.

With the construction of the planned farrowing—weaner accommodation and the completion of the additional dry sow and boar accommodation at Biloela, the Hermitage herd will be transferred to that site.

SIMULATION OF PIG SELECTION USING MICE. The effects of performance testing regime on the results of selection for post-weaning growth are being investigated in two mouse lines. Both are being selected for high growth rate between 2 and 6 weeks of age. In one line, growth is on ad lib. feeding and in the other, food is restricted to an amount which can be consumed by all mice on test, so that appetite differences are not expressed. The expectation is that growth rate in both lines will increase. In the ad lib. line both carcass fatness and appetite should increase but in the restricted-fed line there should be no increase in these characters.

GENETIC CONTRIBUTION OF STATION-TESTED AND IMPORTED BOARS TO QUEENSLAND PIGS. This study was made using the appearances of boars in four generation pedigrees of 100 female Large White and Landrace pigs sampled from the 1979 herd book registrations. There has been a steady increase in the genetic contribution to these breeds of station tested boars with each succeeding generation. Tested boars contributed 11% of the Large White and 17% of the Landrace genes in the sampled population. Tested boars appearing in the pedigrees had higher than average test scores. Imported boars made a greater genetic contribution to Large Whites than station-tested boars but the opposite was true in Landrace. There was evidence of strong line-breeding to three Large White boars imported in 1972, 10% of all genes in the 1979 sample tracing back to these boars. The study is being expanded to measure the cost effectiveness of the Queensland testing station.

Nutrition

Interest was renewed in on-farm preparation of diets and staff were involved in advising producers on diet formulation, economics of farm mixing, mill-mixing plants and interpretation of least-cost diet printouts. Producers and feed compounders obtained least-cost diet computations on a regular basis. This service is valuable to the industry, particularly in view of changes which occur in feedstuff prices and availability. On the Darling Downs, least-cost diets are formulated on a district basis, published and updated monthly on the basis of current ingredient price and availability.

Assistance is also being given to the industry organization which has initiated 'Dial-a-Market Report' service providing feed prices which are updated on a weekly basis.

CONTROLLED FEEDING OF GROWING PIGS. Growing pigs are usually restrictively fed from about 45 kg liveweight in order to control fat deposition. This is done by daily feeding-out measured quantities of food—a system of feeding that is time consuming and hence labour-intensive in the absence of expensive automated mechanical feeding. Investigations with replacement pullets and layers at the Poultry Unit, Animal Husbandry Research Farm, Rocklea, have shown that food consumption can be closely regulated and hence fat deposition controlled by restricting time of access to feed.

A research programme has commenced at the Pig Research Centre, Wacol, to examine the applicability of this feeding concept for pigs. At this early stage of the investigation, experiments have been designed primarily to provide basic information on the pig response to the imposition of time restrictions of access to feed. Increasing the length of time feed was denied to pigs over a 4-hour cycle had no effect in reducing daily food consumption until the period of restriction exceeded 18 hours.

Restriction programmes based on either 24, 48, 72 or 96-hour cycles have also been investigated. It has been possible, using fairly severe restriction programmes, to reduce average daily food consumption to levels achieved by feeding pigs to scale. However, growth rates and economy of food conversion of pigs on such severe restriction programmes have been inferior to those of pigs fed to scale.

METHOD OF MILLING GRAIN. Studies comparing the benefit to the pig of either hammer-milling or roller-milling grain continued during the year. For sorghum, hammer-milling was preferable to that of roller-milling, but with barley the reverse was the case. On the other hand, with wheat there were no differences between methods of processing. These results differed in some aspects from those obtained in previous experiments where it was found that both sorghum and wheat were better utilized when hammer-milled than roller-milled.

EVALUATION OF PROTEIN CONCENTRATES. Studies with rats were initiated in 1978-79 to investigate the nutritive value of navy beans (*Phaseolus vulgaris*). This early work detected the presence in the bean of a relatively heat stable growth inhibitor that could be destroyed completely by autoclaving but not by dry roasting. In view of the commercial impracticability of using pressurized steam to process navy beans, alternative methods of heat processing including infrared and microwave heating and extrusion with soybeans have been investigated.

Rat growth assays have demonstrated that both infrared and microwave heat markedly reduce the level of growth inhibitor in navy bean, but not to the same extent as occurs following autoclaving. In contrast, extrusion of navy bean with soybeans appears in preliminary studies to have been successful in removing all of the growth inhibitor in the bean. If confirmed, this would be a significant finding as extruders are already used commercially in the feed processing industry.

FIBROUS DIETS FOR WEANER PIGS. Field trials currently in progress are investigating the value of fibrous diets as an alternative to restricted feeding and antibiotic supplementation in preventing post-weaning scours. There have been encouraging results from preliminary observations.

WATER QUALITY FOR PIGS. In a trial recently initiated during winter at Biloela Research Station the tolerance of growing pigs to nitrates and other dissolved salts in drinking water is being examined. A similar trial will be conducted during the coming summer period.

Reproduction

A case study in the Moreton Region aims at revealing the problems encountered in selection and breeding of gilts for herd replacement. It is expected that, together with survey results on gilt reproductive behaviour from several other properties, recommendations on gilt management can be formulated.

Funds provided by the Australian Pig Industry Research Committee continued to support investigations of the female reproductive cycle. Reproductive performance of the sow herd, Pig Research Centre, Wacol, is being monitored by using vaginal biopsies as a methed of pregnancy detection and by examining the reproductive tracts of animals culled for failing to breed. Reasons for failure include: hermaphroditism, cystic ovaries, ovarian adhesions, failure to ovulate and a disturbing number of gilts that have infantile reproductive tracts despite being well beyond normal mating age and weight.

Further work at the Biloela Research Station investigated heat stress effects on embryo survival. Gilts were mated and randomly allocated to a heat treatment (continuous supplementary heat load applied by an oil fired space heater) or normal shed conditions with additional cooling (fan and water spray). The heat stress imposed caused a significant fall in embryo numbers surviving to implantation from 54% to 40%.

Disease

Parvovirus is looming as an important cause of economic loss in the pig industry. The results of investigations into stillbirths, mummified foetuses and abortions on the Darling Downs and in the Brisbane Valley, Beenleigh, Lockyer Valley, Calliope and north Queensland areas suggested that parvovirus was probably the causal factor.



Feral pigs killed in a baiting trial at Cunnamulla as part of the low lambing studies.

A serological survey for haemagglutinating encephalitis virus (HEV) of 20 pig herds throughout the State revealed low titres suggestive of convalescence in six herds. The presence of active disease was confirmed on five properties on the Darling Downs and caused a high mortality rate in piglets (up to 60% a litter). Both the encephalitic and vomiting-wasting-diarrhoea forms were observed. Signs exhibited by piglets less than 14 days old included stumbling, tending to jump, falling over backwards, dog sitting posture, wasting and polydypsia. Viral encephalitis was confirmed as the cause by histopathological examination which revealed meningo-encephalitis with a mononuclear reaction, peri-vascular cuffing, neuronal damage and gliosis.

Lesions highly suggestive of encephalomyocarditis were seen in a herd near Toowoomba. Post mortem examination revealed large areas of necrosis in the heart muscle. This is a relatively new disease although cases have been diagnosed in New South Wales.

A diagnosis of rotavirus infection was made by electron microscope examination in several cases of diarrhoea in suckling pigs and in an older experimental animal.

Sporadic outbreaks of swine pox were reported. The disease affected 400 piglets on a property at Bell and 25 died. A current flea plague was considered to be the predisposing factor in the high morbidity rate.

Until this year myoclonia congenita (dancing pig disease) was a rare condition in Queensland. Outbreaks were reported from the Darling Downs and Gin Gin areas. In one outbreak, seven litters in a recently established Landrace herd were severely affected at 3 weeks of age, but no lesion could be defined in the spinal cord by light or electron microscope examination. Results of work performed in the United Kingdom and in New South Wales indicate that a virus may be the cause of this condition.

In view of the possibility that a porcine brucellosis eradication scheme may be instituted, diagnoses of this disease were given high priority. *Brucella suis* was cultured from four pigs that originated from a Biloela property and one porker pig originating from a property at Theodore. High titres to the serum agglutination test for brucellosis were detected in a boar and a sow in a small herd at Wandoan. The reactors were slaughtered but culture tests of tissues failed to isolate *Br. suis*. Retesting of the piggery indicates that the disease has been eradicated.

There were no positive serological reactions in pigs bled as part of the Brucellosis Tested Herd Scheme.

A serological survey of feral pigs being slaughtered for the export 'game meat' trade was conducted. A total of 962 sera was examined in 62 consignments. Positive sera were found in only four consignments, two from Taroom Shire, one from Clermont and one from the Rockhampton district. There was a total of eight positives in 54 sera in these four consignments. This survey was followed by a more detailed examination of feral pigs from the Taroom Shire. Serum, spleen, iliac lymph node and uterus have been collected from a total of 30 pigs in four consignments. Three of the 30 were serologically positive, but neither *Brucella suis* nor *Br abortus* has been cultured from any of the positives or a selection of serologically negative animals.

An examination of the results of serological tests for porcine brucellosis on samples submitted to the laboratories from non-feral and feral pigs throughout most areas of the State for the period July 1972 to March 1980 shows that, of the 24 979 samples from non-feral pigs tested by the serum agglutination test, only 0·04% were positive and of the 1 588 samples from feral pigs 1·2% were positive.

Investigations revealed that *Leptospira pomona* caused abortions in all districts.

Colibacillosis is a cause of serious economic loss in the pig industry. Outbreaks were widespread in all pig raising areas of Queensland. It is an important cause of scouring, weight loss and mortality in animals up to 8 weeks of age. Isolates of *E. coli* from outbreaks in the south Burnett and Darling Downs areas have been found to be resistant to a wide range of drugs including sulphadimidine, streptomycin and tetracycline.

Field experience indicates that resistance of *E. coli* to antibiotics is a major problem. Morbidity rates of colibacillosis were high, generally with a mortality rate of up to 50%. It is noteworthy that at one piggery at Crows Nest, 70 weaners died following signs of diarrhoea. Losses caused by *E. coli* in older growing pigs frequently follow symptoms of staggering and rapid death, but signs of oedoema disease are rarely seen.

Mortalities in 4-month-old pigs in a Toowoomba piggery were ascribed to pleuropneumonia due to *Haemophilus pleuropneumoniae*. Autopsy revealed extensive hepatization of the lungs with fibrinous pleurisy and pericarditis. There was a good response to antibiotic therapy. The disease is a recently diagnosed one in Queensland.

Swine dysentery was diagnosed in most pig rearing districts but the prevalence was higher in the Gympie, south Burnett and southern Darling Downs areas. Introduction of infected pigs and unsanitary conditions predisposed to all outbreaks. Control measures included medication with 'Emtryl' and 'Lincospectrin'.

Two pigs from a property at Home Hill and another four from the Townsville area were condemned at slaughter for melioidosis.

Salmonellosis continues to be an important cause of economic loss in the pig industry. Outbreaks were reported from all growing areas. The highest prevalence was reported in growing pigs. Carrier animals and inadequate hygiene were predisposing factors.

Erysipelothrix rhusiopathiae caused septicaemia and death in baby piglets in several herds.

Corynebacterium suis was isolated from lesions of metritis in two sows. The intestinal adenomatosis, regional ileitis, haemorrhagic enteropthy complex caused by *Campylobacter sputorum* subsp. *mucosalia* was responsible for sporadic disease but has the potential to cause extensive herd loss due to illthrift in weaners and deaths in older animals.

Nutritional deficiency caused by feeding unsupplemented grain-based rations to intensively housed pigs has caused overt disease on several occasions. Vitamin A deficiency causing losses in newborn piglets characterized by microphthalmia and spinal cord degeneration was seen in one herd. Combined Vitamin A and copper deficiency has been found in cases of spinal cord degeneration and ataxia paralysis in growing pigs.

A haemorrhagic disease with subcutaneous and intestinal extravasation of blood caused heavy losses in a herd of growing pigs. Severe anaemia and defective blood clotting caused by deficiency of Vitamin K dependent clotting factors in the blood were demonstrated and there was a good response to Vitamin K therapy. Tests for Warfarin poisoning were negative and contamination of feeding troughs with a toxigenic fungus was suspected.

The problem of epiphyseal fracture of the femoral head in growing pigs was investigated in one piggery. Rapid growth rate was thought to be the predisposing factor as mineral levels in the ration were normal and there was no evidence of rickets.

Management

On-going extension projects were maintained in addition to the provision of a wide range of advisory activity aimed at improving management expertise and efficiency.

PHYSICAL PERFORMANCE RECORDINGS. Recording of physical performance data has been encouraged for a number of years as a means of monitoring management efficiency and to assist in decision making. More than 300 record books produced with the assistance of C.E.S.G. funds were distributed to producers during the year. These enable analysis of data recorded and are considered a valuable tool in piggery management.

PIGGERY PERFORMANCE ANALYSIS SCHEME. As a result of guidelines formulated at a staff workshop in May 1979 projects were initiated in three districts in addition to an on-going financial recording project in north Queensland. Staff changes in two districts incurred delays in monitoring progress, but results recently to hand from the remaining areas are encouraging. The initial effort has concentrated on testing the system and assisting co-operators in analysis of data. It is expected producers will be able to undertake the work themselves with occasional assistance from advisers. The information gained from this work has considerable value in providing the basis for economic advice to other producers.

PIG HOUSING AND EQUIPMENT. Favourable returns from pig raising allowed producers to carry out previously deferred modifications or extension to existing housing. Field officers provided advice, often in consultation with the Engineering Services Section, on new construction and alterations to existing accommodation. Representatives of local government, building firms and officers of the Pig Section exchanged ideas and information on housing and equipment at a meeting held in Toowoomba. Departmental designs and plans are favourably regarded.

EFFLUENT MANAGEMENT AND PIGGERY SITING. Liaison was maintained with local government authorities and with the Water Quality Council in matters pertaining to piggery siting, establishment and effluent disposal. Revised guidelines for effluent disposal were prepared by officers of the Water Quality Council in consultation with Pig Section staff. The retention of pigs to higher market weights may require an increase in minimum capacity of anaerobic ponds to 4 m^3 per pig; the present recommendation is 3·5 m^3 per pig. Several local authorities have drafted by-laws with restrictions on piggery establishment close to urban areas.

Poultry industry

Egg industry

The egg industry continued to enjoy the benefits of demand-supply management during the year and producers are looking forward to a stable, profitable future. Net return to producers for the 10 months ending April 1980 was 82·03c per dozen which was 2·61c above that for the same period in 1978-79. An active sales promotion campaign has resulted in egg sales being maintained at 7% above the previous year's sales despite egg price increases. Improved prosperity in the egg industry has been reflected in the number of producers who are renovating or rebuilding their laying facilities. Most of the new units feature high-rise design and automated feeding and egg collection equipment.

Increasing egg production during winter and early spring months in past years has resulted in the build up of surplus eggs. In an effort to make demand-supply management operate with maximum effectiveness, the quota committee reduced the number of quota hens by 8% in the period July-August 1979 and restored the 8% in January-February 1980. It is envisaged that this pattern of reduction and restoration will continue in future years.

Basic hen quotas can be surrendered for $3 per basic quota hen. The Hen Quota Committee then distributes the surrendered quota hens to holders of small quotas for $3.25 per hen. Quota hens are reallocated to districts in which they were surrendered to applicants with fewer than 5 000 quota hens, such that the additional quota hens and the additional quota held do not exceed 5 000. This policy is deliberately aimed at improving the viability of the smaller producers by encouraging them to remain in the industry.

The main function of the Cost of Production Committee which is an industry committee is to provide Sunny Queen Egg Farms with an estimate of the cost of producing a dozen eggs for both current and future periods. The committee is advised by two Departmental staff, one from Economic Services Branch and the other from Poultry Section.

The estimated cost of production for the financial year 1978-79 was 73·91c per dozen eggs. The actual cost was 73·44c and the producers' actual average return received from the Board was 73·41c per dozen, a difference of 0·03c. In May 1979, the estimate for 1979-80 was 78·08c per dozen. This cost is now estimated to be 85·92c per dozen after considering the actual costs for the first three-quarters of the year and re-estimating the cost for the June quarter.

This increase of almost 8c above the original estimate is due mainly to the unprecedented rise in feed prices. The average price of 16% protein ration was $133.57 per tonne delivered on the farm at July 1979. In March 1980, it was $160.23 per tonne which represents an increase in price of 20%. Present indications are that this rate of increase will continue next year. This means that feed will be $207.66 per tonne in June 1981.

The escalating feed cost has increased the proportion of the total production cost of eggs representing feed from 36·9% in June 1979 to 41·2% in March 1980 and is estimated to be 44·7% in 1980-81. Because of such factors as changes in husbandry practices, the type of housing and equipment and improved performance of hens, it is planned to update the basic data used in the cost of production model by surveying the industry.

Poultry meat industry

Broiler industry expansion in south-east Queensland for 1979-80 of 22·2% was marginally above the national expansion rate of 19·5%. The Bureau of Agricultural Economics forecast a national production for 1979-80 of 271 000 tonnes of which Queensland could expect to produce 44 000 t. Australian per capita consumption is expected to be 18·8 kg for meat chicken and 20·6 kg per capita for all poultry meat. As at May 1980, there were 95 growers in south-east Queensland with 366 355 sq metres of shedding under contract to processors as compared with 350 000 sq metres in May 1979. Processor-owned farms contributed a further 40 000 sq metres of shedding.

More than 96% of Queensland broiler production is grown and processed in south-east Queensland. It is estimated that 31m birds will be processed in Queensland during 1979-80 and 33m birds in 1980-81 with proposed expansion.

The takeover of Provincial Traders Limited by Inghams Enterprises has resulted in some rationalization of abattoirs and feed mills. In addition, the takeover of Red Comb Stock Feeds by Fielder Gillespie has made it necessary for Inghams Enterprises to upgrade the former Provincial Traders Feed Mill to meet all Inghams' feed requirements which were originally serviced under contract by Red Comb Stock Feeds. In addition, this major Australian company has heavily invested in the setting up of multiplication breeder farms at Beaudesert to supply their Queensland and part of their N.S.W. operations' requirements for fertile eggs for broiler chick production.

Further performance gains have occurred during 1979-80 with better strains weighing approximately 1·85 kg at 49·5 days on a feed conversion of 2·11 and mortality of 3·5% This means that the same weight was achieved 5·5 days earlier than in 1978-79. Stocking density is approximately 15 birds per sq metre with batch output approximately 5·1 batches per year and is higher than that of the last year.

The red meat industry continues to govern the production situation and market stocks of birds. As at May 1980, a build up of stocks has resulted in longer turnabouts being imposed by processors.

Marketed chicken has changed dramatically in recent years with 45·2% of the marketed product being sold as frozen and 54·8% fresh as at June 1979, while at June 1976 it was 60·8% frozen and 39·2% fresh. This trend will be encouraged by processors in their sales marketing strategies because of lower storage costs and better cash flow results.

Locally available spent hens are sought by specialist processors and sold readily on the local market whereas duck and turkey meats are still largely supplied frozen to the Queensland market by southern processors.

Disease

The co-ordinated disease prevention and control project which began in 1977-78 has concentrated on the layer industry and small broiler companies in 1979-80. The major integrated broiler companies have already adopted vigorous disease control measures and there is little need for extension in this area. The long-term objective of the project is to create awareness and understanding of the physical and economic effects of disease and the role management plays in disease prevention and control.

During the winter months of 1979, a survey of the incidence of infectious bronchitis (I.B.) was carried out. Few cases of I.B. were recorded, compared with the winter of 1978 when the survey was first recorded. The mild winter, together with the introduction of day-old spray vaccination, appears to have affected the incidence of this disease.

The weather pattern throughout the year appeared to influence the incidence of infectious poultry diseases. Fewer than normal respiratory diseases outbreaks were reported throughout the year in both broiler and egg producing flocks. The mild winter of 1979 and mild autumn of 1980 appeared to contribute to this favourable situation. Very little infectious bronchitis or chronic respiratory disease was reported. Few cases of coryza were reported. Problems were seen in January and May after periods of wet weather. The hot, dry summer may have been a factor. The incidence of fowl pox and coccidiosis did not occur until very late in the summer. The hot, dry summer resulted in low populations of mosquitoes, the vector for fowl pox. Producers reported seeing little lice infestation over the summer.

In November 1979, a simulated Newcastle disease outbreak control exercise was held for 4 days in the Brisbane area. Staff of several departmental Branches and industry participated.

Assistance was received from the State Emergency Service. The exercise increased staff expertise and pointed out areas where modification of procedures was required. The movement of feed, stock, poultry products and maintenance staff within the industry is very complex and the exercise highlighted for producers several areas where procedures can be improved or adopted to prevent the introduction or spread of disease.

In May 1980, a survey for Newcastle disease antibodies in layers and breeders was conducted in south-east Queensland. Most layer farms outside the Brisbane area did not have antibodies to the local lentogenic 'V4' strain of Newcastle disease virus. The survey is continuing. Seven Newcastle disease viruses were isolated from fowls in the course of disease diagnostic investigations. The results of virological tests indicated that the seven viruses were lentogenic (avirulent) strains similar to those previously isolated from poultry in Australia. Characterization of these viruses is important as part of the surveillance procedure for exotic diseases of poultry.

Avian encephalomyelitis was confirmed by histopathological examination in two flocks of broilers that originated from the same commercial breeding flock. Vaccination against this disease had not been used in the breeders. Apart from the economic loss due to death of chickens, the importance of this disease is that export of poultry to some countries cannot be undertaken for 3 months once an outbreak of avian encephalomyelitis is confirmed.

Psittacosis, a disease which can cause pneumonia in man, was diagnosed by mouse-inoculation tests in three aviaries of budgerigars and in three flocks of parrots. Details of these cases were transmitted to the Health Department.

Extensive laboratory testing of birds from flocks with respiratory disease revealed that infectious laryngotracheitis, a notifiable disease of poultry, was the cause on seven properties. However, the disease was relatively mild in each case. The severe haemorrhagic form of infectious laryngotracheitis that occurred in 1978-79 was not seen in the current year. Nevertheless, quarantine precautions and vaccination of affected flocks were undertaken to prevent the spread of this disease to other properties.

Outbreaks of infectious bronchitis (I.B.) were reported from Pittsworth, north Queensland and Brisbane. At Pittsworth, 40 layers died from IB and another 80 were sick in a flock of 4 000. In Brisbane; flocks on a small broiler grower-abattoir property were severely affected by infectious bronchitis complicated by necrotic enteritis. The disease resulted in extremely wet litter. The flocks responded to electrolyte replacer and bacitracin. A severe reaction to IB vaccination was observed in pullets on a north Queensland farm. The major broiler integrators are using or have experimented with spray vaccination at day-old.

Marek's disease was diagnosed in all poultry raising areas and also in many hobbyist flocks in the State.

A project to classify avian adenoviruses and study their importance as a cause of disease and production loss in broiler chickens was conducted by the Pathology Branch with funds provided by the Australian Chicken Meat Research Committee. A collection of 132 adenoviruses has been established from diagnostic accessions of diseased birds, by requesting avian disease laboratories throughout Australia to send suspected adenoviruses and by culturing rectal swabs obtained from normal broiler chickens just prior to slaughter.

One hundred and two adenoviruses were isolated from faecal swabs of 300 broilers from 10 farms. To date, 36 isolates have been serotyped with F.A.O. typing reagents imported from Northern Ireland. Types found were type I (27), type II (4), type IV (1), and type V (3). Four viruses could not be typed with the standard sera. None of the isolates agglutinated fowl red blood cells. Haemagglutinating adenoviruses have been the cause of a severe 'egg-drop syndrome' in Europe in the last 3 years. The pathogenicity of a number of isolates of different serotypes has been tested in 3-week-old, specific-pathogen-free chickens. All isolates caused a mild disease in the upper respiratory tract and atrophy of the bursa of Fabricius and thymus. Some isolates also produced a mild focal hepatitis. No significant differences were detected between the means of the body weights of adenovrius-inoculated birds and the negative-control birds.

Pathogenicity trials were also undertaken to determine the effect of interactions of adenoviruses with infectious bursal disease virus. However, the results were inconclusive because the chickens were contaminated with a reovirus which was transmitted via the eggs of hens from the SPF flock which inadvertently became infected with that virus. This work has been undertaken to investigate whether interacting factors exacerbate adenovirus-related diseases.

Despite extensive testing, no pullorum disease was diagnosed and no positive reactors were seen in any of the breeding flocks tested.

Cholera and concomitant colibacillosis occurred in a north Queensland broiler flock. Cholera caused mortalities in broiler flocks at Beerwah and Toowoomba and in layers in Brisbane. To prevent outbreaks of cholera, two companies continued vaccination programmes in breeders using an autogenous vaccine derived from *Pasteurella multocida* strains isolated at the Animal Research Institute.

Chronic respiratory disease (CRD) was reported from Townsville and the Darling Downs.

Salmonellosis due to Salmonella Gp B caused mortalities in flocks at Helidon, Gympie and Brisbane.

Botulism was diagnosed as the cause of mortalities at Kingaroy. Flaccid paralysis of the neck and inco-ordination of the gait followed the eating of decomposing grass clippings. A large percentage of a commercial pheasant flock in Brisbane died from botulism. The birds were at a marketable age, so losses were high. The pheasants were housed in outside runs and were being fed on the ground.

Necrotic enteritis was responsible for the deaths of approximately 40 growers in a commercial flock of 4 000 at Murgon. A concomitant osteomyelitis was probably caused by *E. coli*.

Infectious coryza was the cause of recurring respiratory disease problems in six flocks of adult hens. A project to characterise Australian isolates of *Haemophilus* sp. is being undertaken by the Pathology Branch with financial support from the Australian Chicken Meat Research Committee and the Poultry Research Advisory Committee. The ultimate aim of this work is to provide a basis for the development of effective vaccines against infectious coryza of fowls. Initially 15 isolates were revived from a collection of *Haemophilus* sp. stored at the Animal Research Institute for many years, 17 were recently isolated from Queensland poultry and 13 isolates were obtained from laboratories in Sydney, Armidale and Melbourne.

Preliminary tests on 35 isolates have established that 24 were catalase negative and 11 were catalase positive. Literature reports suggest that catalase negative isolates cause infectious coryza. The viability of isolates stored in yolk from 5-day-old embryonating eggs is being checked at 3-monthly intervals. Four prototype cultures—the Modesto, 0222 and 083 strains of *Haemophilus gallinarum* and *H. paragallinarum*—were imported from the National Animal Disease Center, Ames, Iowa, for use in the development of serological tests to detect antibody in chickens in pathogenicity trials and for the serological characterization of Australian strains of *Haemophilus* sp.

An initial study to determine a suitable liquid medium for the growth of Australian *Haemophilus* sp. indicated that a medium developed overseas was used successfully to provide inocula for chickens in pathogenicity trials and to transport *Haemophilus* sp. between laboratories. A number of pathogenicity trials has been undertaken with catalase-negative isolates. Clinical signs or lesions of infectious coryza were

produced in both inoculated and in-contact birds in the test groups but not in the negative control group. *Haemophilus* sp. was consistently reisolated from the sinuses and occasionally from the trachea but not from the lungs or air sacs. Thus at this stage of the project, a representative collection of *Haemophilus* sp. has been established, necessary reference cultures have been obtained from overseas, progress has been made on the *in vitro* growth and storage of *Haemophilus* sp., initial pathogenicity trials have shown that the Haemophilus isolates tested will cause disease and collaborative work has commenced with other laboratories in Australia.

Broiler growers with all the major integrators experienced problems with aspergillosis in 2 to 3-week-old broilers from July to September. The affected farms used pinewood shavings from the same mill in Brisbane.

Coccidiosis continues to be one of the most prevalent diseases causing mortality in smaller poultry flocks. Examination of smears of the intestine by Pathology Branch confirmed this disease in 35 flocks during the year. The main reason for these outbreaks appears to be a lack of knowledge of coccidiosis prevention programmes and the failure to use feed-containing coccidiostate.

Outbreaks of feathering defect and runting were investigated in a number of batches of young meat chickens from two firms. Lesions found at necropsy included gizzard erosions, omphalitis, myocarditis, atrophy of the bursa and thymus, enteritis, tracheitis and hepatitis. Specific diseases that were diagnosed by laboratory testing were coccidiosis, vitamin A deficiency and infectious laryngotracheitis. Aflatoxin (60-160 p.p.b.) was also detected in peanut meal used in the ration fed to some batches of chickens. Virological and serological tests performed by the C.S.I.R.O. Melbourne indicated that reticuloendotheliosis virus was not involved.

Many enquiries were made by hobbyist producers about the control of stickfast flea (*Echniophaga gallinacea*) during October and April. The main districts affected were Boonah, Park Ridge, Deagon, Narangba and Bribie Island.

Infestations with poultry eye worm (*Oxyspirura mansoni*) were detected in two flocks at Townsville.

Perosis was diagnosed as the cause of leg abnormalities in chickens at Mount Isa.

Deficiencies in vitamin E and riboflavin were thought to have caused nervous signs in 2-week-old broilers on an independent broiler farm.

Four outbreaks of vitamin A deficiency were investigated during the year.

Fatty liver and kidney syndrome (FLKS) is a disease of young chickens partly characterized by pale liver and kidneys indicative of high tissue fat content in birds post mortem. Flocks with the disorder respond to biotin supplementation. Whether FLKS is a biotin deficiency disease as such or what other factors may be involved is still a matter of continued scientific investigation world wide. What has been established elsewhere is that a change in the spectrum of liver fatty acids in birds is specifically characteristic of the disorder.

Although FLKS has occurred sporadically in southern States, the disorder has never been conclusively identified in flocks in Queensland. Invariably birds examined post mortem as having pale liver and kidney and suggested as resulting from FLKS have shown after biochemical analysis to have high lipid content, but with normal fatty acid spectrums. This lack of specific diagnosis was usually confirmed by a total lack of response of the flock to biotin treatment.

In a flock of chickens recently analysed after suspected FLKS, 12 specimens had liver lipid content of from 9·0 to 17·8 g per 100 g of fresh liver and a palmitoleic acid content of from 16·1 to 19·6 g per 100 g of liver lipid. In unaffected chickens, the values were 5·6 g% and 9·4 g% for liver lipid and palmitoleic acid respectively. Further, the changes in palmitoleic acid content were largely due to an increase in the proportion of this fatty acid esterified to glycerol. The fatty acid spectrum of other lipid components remained relatively unchanged from those normally observed.

This accurate typing of the biochemical characteristics of FLKS resulted in the first conclusive diagnosis of the disorder in a flock in Queensland. This was further qualified by the immediate and rapid response of the diseased flock to biotin supplementation.

Fatty liver haemorrhagic syndrome (FLHS) is a significant cause of death in egg production and breeder stock. In the syndrome, fat level and rupture of the liver are closely related. However, it is not simply a case of the fatter the liver, the greater the likelihood of haemorrhage. A further condition, lysis of the liver reticulum (*reticulolysis*) is probably the primary lesion of the syndrome.

An investigation is being conducted by Husbandry Research, Biochemistry and Pathology Branches to establish the heritability of reticulolysis, to investigate the biochemistry and physiology of both reticulolysis and fat metabolism in the liver, and to devise methods for the control and/or prevention of the disorder. The investigation is being partially supported by the Poultry Research Advisory Committee.

In the physiological and biochemical investigations there has been continued monitoring of plasma components which might be used as diagnostic predictors of reticulolysis. There appears to be little difference in the levels of plasma aspartate aminotransferase between high and low liver fat lines of birds. However, we have observed in some flocks a correlation between this enzyme and both degree of liver haemorrhage and liver fat levels. But, in general, plasma aspartate aminotransferase is not a sufficiently sensitive index for selecting against liver haemorrhage or reticulolysis. No other measured plasma parameter appears to be a suitable index for predictive purposes.

A number of agents, including potassium ioxide (KI), thiouracil and oestradiol has been evaluated in both young pullets and layers to experimentally induce obesity. None of these agents produced haemorrhage. However, KI with and without oestradiol induced hepatic steatosis and increased the level of circulating lipids. Livers taken from lines of birds which have been bred to develop high and low liver fat levels at various ages have been analysed for a number of key lipogenic enzymes.

Results suggest that malic enzyme and acetyl CoA carboxylase are different in the two lines of birds indicating that genetic selection is expressed at the level of liver lipogenic enzyme activity.

A new trial in which the effect of dietary cereal and energy content on hepatic steatosis in both a high and a low liver fat line of hens is being investigated has commenced. It is hoped that the role of dietary factory on liver fat infiltration will be elucidated. The report that a high incidence of subclinical FLHS appears in birds fed diets based on maize will be investigated.

There are no published reports of the detailed causes of disease in broiler breeders in Australia. To investigate this, a project was initiated in which approximately 35 000 breeding birds of three breeds on six farms were sampled throughout the laying period. Laboratory examinations were done on all sick and dead birds collected from the farm at 2-weekly intervals. Neoplasms, particularly of lymphoid origin, and respiratory disease were the most prevalent causes of sickness or death.

Other less prevalent diseases were tenosynovitis, coccidosis, cholera and fatty liver haemorrhagic syndrome. Serological surveys of the six flocks indicated that all flocks were infected with infectious bursal disease virus. *Mycoplasma gallisepticum* avian adenoviruses and reticuloendotheliosis virus (REV). Testing for REV was undertaken by the C.S.I.R.O., Melbourne and the University of Sydney, Camden. Antibody against Newcastle disease virus was detected in only two of the six flocks when they were 40 weeks of age or older.

Nutrition

CONTROLLED FEEDING OF LAYER STOCK. Investigations at the Poultry Section, Animal Husbandry Research Farm, Rocklea, have demonstrated that restricting the feed intake of both the replacement pullet and laying hen are effective means of controlling fat deposition and, as a consequence, improving the efficiency of egg production.

An extension programme which began in 1976-77 continued during the year to promote the practice during the rearing period. Most replacement pullets in the Queensland egg industry are now controlled fed. Application commercially has indentified new areas for extension initiatives and further research.

It is believed that a significant reason for less than total acceptance of controlled feeding has been conflict in recommendations made by various sectors in the industry. The programme being promoted by the Department involved feed denial for 40 hours in 72 hours commencing at 6 to 8 weeks of age and finishing when the flock is laying at 5% egg production. The responses of three commercial strains of layers to this programme were compared with responses to programmes advocated by breeding companies. The findings illustrated a consistent response to restriction by all three strains. The type of restriction applied was of lesser significance. Time of access restriction programmes, however, are much more easily applied in practice than strict adherance to bodyweight scale programmes.

The influence of levels of nutrients in diets fed to the pullet in the starting and growing periods on subsequent laying performance is a largely unexplored area.

Experiments this year have demonstrated that the influence of prelay nutrition will be primarily on age at sexual maturity. Unpredictable delays in maturity can severely disrupt replacement programmes with consequent production losses. Inadequate amino acid levels in starter diets produced delays of up to a fortnight. The feeding of low energy grower diets, a practice advocated commercially in recent times, produced delays of over a week when the birds were reared ad lib. and over 7 weeks when controlled feeding was used.

OBSERVATIONS OF FEED INTAKE. We must know what our birds eat and what influences their intake. Unfortunately, one of the greatest deficiencies in knowledge in the field of poultry nutrition is ignorance of calorie intakes and requirements of stock in the commercial situation. Without such information formulation to optimize amino acid and mineral intakes becomes essentially guesswork.

Data are being collected and evaluated from both experiments at Rocklea and on commercial farms on the Darling Downs, Brisbane and North Coast areas. Producers in all areas are being encouraged to record feed intake on flocks so that nutrient intakes can be established and requirements satisfied.

Equations to predict calorie intakes have been developed at Rocklea for replacement pullets, layers and broiler breeders. These models need to be tested under commercial conditions.

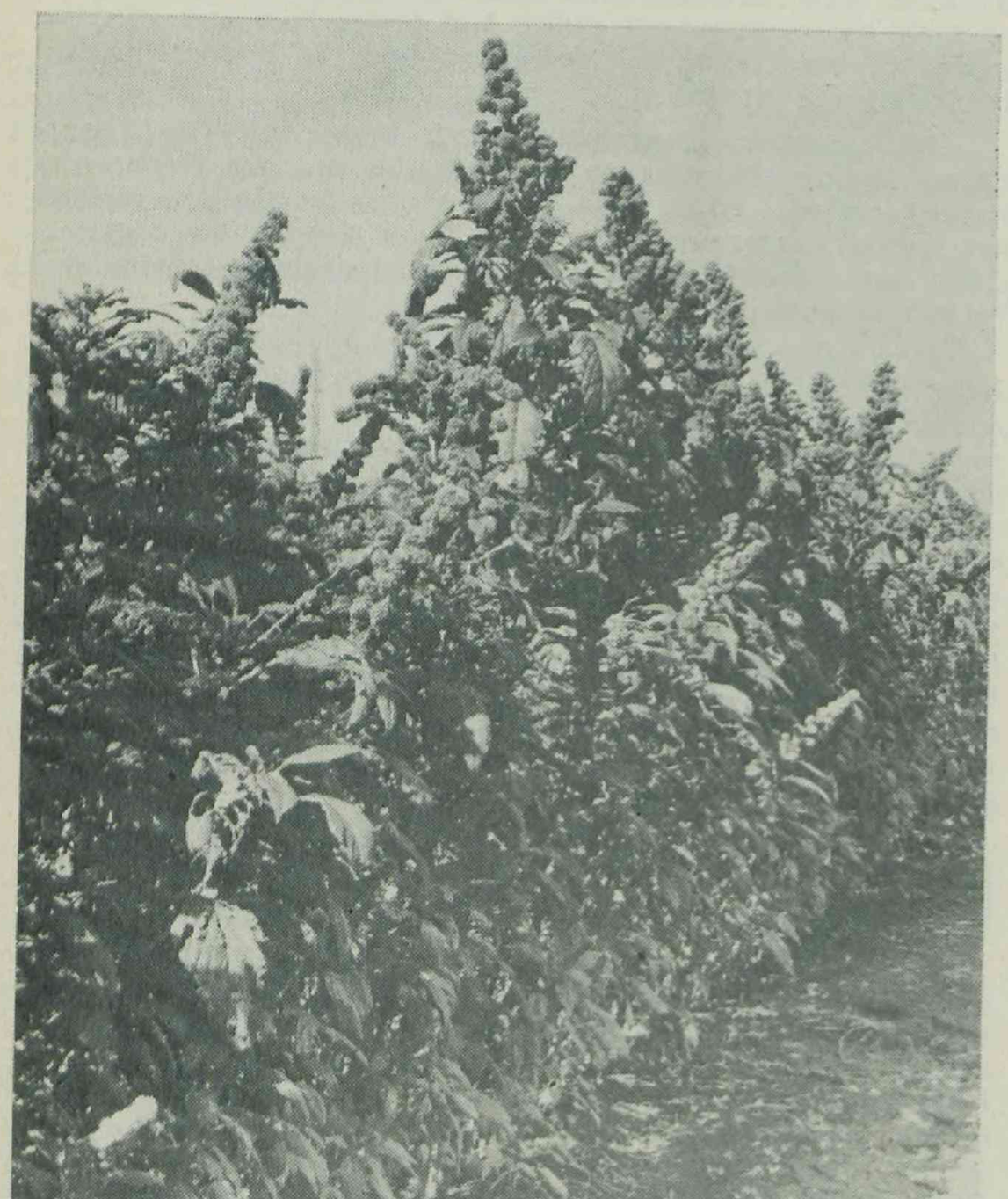
FEED INGREDIENT EVALUATION. Investigations in this area have been directed to better definition of our traditional feedstuffs and evaluation of the nutritional potential of new materials.

Although the technology is well developed for the determination of total amino acids in feedstuffs, we have yet to establish a totally satisfactory means of expressing the availability of these amino acids to the chicken. Developmental work on a chicken bioassay for available lysine in protein concentrates was carried out during the year.

The principal sources of energy in poultry diets are the cereal grains. The grains also supply a significant contribution to the amino acid contents of diets. An extensive investigation is being conducted by Husbandry Research and Biochemistry Branches, in association with Agriculture Branch staff, to evaluate the available energy and amino acid compositions of grains.

The project concentrated this year on evaluation of barleys. Barley has been extensively used in the commercial milling industries in recent years. The Department has also been conducting a breeding programme to develop feed grade barleys. These grains, while being of poor malting quality, have been shown to yield up to 20% more grain than established malting varieties. The metabolizable energy contents of feed grade varieties tended to be lower than some, but not all, malting grades. However, the results showed that availability of energy from the grains will not be a limitation on the development of a viable feed grade barley industry.

A stand of Amaranthus edulis *plants. Research on the nutritive value of the grain of this plant for pigs and poultry is in progress. This grain supported the Aztec and other civilizations before the Spanish conquest.*



Developments in a project to evaluate *Amaranthus edulis*, which historically was a major food source for Central and South American Indian nations, include progress in the isolation and identification of a toxic factor in the grain by Biochemistry Branch, significant developments in grain production at the Hermitage Research Station, and limited evaluation of the plant as a forage crop. The outstanding feature of *Amaranthus edulis* grain is its ability to supply most of the essential amino acid requirements of monogastric animals.

Along with many other Australian industries there is increasing emphasis in abattoirs on the treatment of waste water. The by-product of this water-treatment biomass, known as waste activated sludge, is being evaluated as a feed ingredient. Its amino acids have been shown to be poorly available and the organic matter digestibility of the material seems to be poor.

Breeding

SELECTION FOR EFFICIENCY OF PRODUCTION. Five generations of selection of Australorps for high and low levels of liver fat have resulted in lines that are significantly different in that character (high=24.9%, control=15.8%, low=11.0%). Associated with these changes in liver fat have been changes in egg production to 68 weeks of age (high=171, control=182, low=194) and feed consumption from 16 to 68 weeks (high=36.5 kg, control=37.3 kg, low=35.3 kg). Translated to economic terms, the value per bird of eggs produced less the cost of feed consumed was: high fat $8.01, control $9.27, low fat $10.04.

Work is continuing with both layers and broiler breeders to develop selection methods that could be used by commercial breeders to achieve similar results.

SELECTION FOR EGG SHELL STRENGTH. A period of 5 years selection for increased egg shell strength in an Australorp flock was completed. Selection was for high average specific gravity of eggs laid over a 2-week period from 36 weeks of age.

Specific gravity responded readily to selection (realized heritability of 30%) and there was a number of favourable correlated changes in other traits of economic importance. The production of soft shelled eggs was halved. Although there was a slight reduction in egg size, this was compensated by a reduction in the food consumed per unit weight of eggs produced. There was also a reduction in the rate of decline in albumen quality with egg storage.

Egg quality

Experiments in 1978-79 evaluated the benefits to be obtained by spraying the egg shell with a light mineral oil at the farm on the day of lay. The results obtained showed that both oiling and storage conditions had significant effects on albumen quality and egg weight loss and their effects were complementary.

For the egg producer, oiling at egg collection materially assisted in the achievement of albumen quality incentive payment standards enforced by marketing authorities. A further benefit of oiling was its efficacy in controlling the loss of egg weight. Savings in the maintenance of gradings alone would more than compensate the producer for expenditure on oiling.

Both the consumer and producer were benefited by the contribution of oiling to the control of albumen quality loss for up to 14 days under retail conditions. In the summer of 1979-80 the alternative procedure of oiling 3 days after lay, at the grading floor, rather than on the day of lay was examined. This practice was effective in giving half the saving in albumen quality loss and five-sixths of the saving in weight loss produced by oiling at the farm.

SHELL QUALITY SURVEY ON THE DARLING DOWNS. As a result of 'feedback' from Darling Downs discussion groups, one of the major problems identified was shell quality. Egg Marketing Board grading does not sufficiently isolate or identify the problem, nor does it indicate the actual farm level of poor shell quality. Moreover, the grading floor is dealing with consignments after eggs with obvious cracks and shell defects have been removed.

A sample of 250 eggs was collected from each of 42 flocks from 14 farms. Individual eggs were candled and shell defects categorized. The results of the survey over some 10 500 eggs showed that the accepted level of approximately 5% poor shell quality is greatly underestimated. A figure of 12% would appear to be more realistic for the Darling Downs.

As these figures were collected during winter months, higher figures would be expected for summer when body calcium mobilization is affected by high temperatures. It was noted also that there was a significant rise in poor shell quality with age and that there was a detectable difference in shell quality between two strains of layers present on these farms.

Animal behaviour

STUDIES ON BEHAVIOUR OF BROILER CHICKENS UNDER COMMERCIAL CONDITIONS. These studies are being conducted by the poultry behaviour specialist in the Poultry Section with funds from the Australian Chicken Meat Research Committee. Studies are made on commercial farms.

Work continued on determining the numbers of chickens actually drinking from drinkers of different designs and at different positions within the brooding shed some hours after the chickens were first placed in the shed. The greatest value of this series of experiments will be to determine why there is a difference in the use of various drinkers and their setting so that remedial design changes can be effected. Detailed observations in the activities of individual chickens at drinkers is yielding information on the frequencies and duration of drinking bouts to allow an estimate to be made of the optimum number of drinkers required.

Observations were made also on how management procedures affected bird behaviour in ways that might influence bird performance. Four sheds were involved which had some differences in drinkers, feeders, insulation and wall construction and which were managed differently with respect to weaning procedures and blackout training. Examinations were made on chick placement procedures, chickens drinking 2 hours after placement, use of feed pans and scratch trays during brooding especially as the latter were removed, chicks' use of drinkers of various heights, incidence and possible causes of litter eating and weaning procedure. The results allowed recommendations to be made to the producer.

ANIMAL WELFARE. The ethologist, Poultry Section, is a member of the Standing Committee on Poultry Welfare established by the Australian Branch of the World's Poultry Science Association. This Standing Committee, under its terms of reference, will assist in development of codes of practice in all States; provide objective information on matters raised by animal welfare groups; prepare an Australian poultry welfare situation statement; and recommend research on poultry welfare matters when necessary.

Poultry welfare is of increasing significance to government departments and to industry. Increased campaigns are being mounted by organizations associated with animal welfare against intensive livestock industries, particularly the poultry industry.

Poultry Section staff met with the executive of the Brisbane group of the Animal Liberation Movement who expressed their concern about the welfare of poultry produced intensively. Staff were concerned at their lack of knowledge of the poultry industry and their lack of objectivity in assessing the welfare of poultry in intensive systems.

An 'Intensive Poultry Husbandry Code of Practice' was prepared for distribution to all commercial egg producers and broiler growers.

Regulation

Poultry Section field staff who are also inspectors under the Poultry Industry Act were involved in the following regulatory activities during the year.

Hatchery inspections were made of 18 hatcheries to determine their eligibility for re-registration in 1980. Re-registration followed a satisfactory inspection report.

Poultry Section staff 'bloodtested' 29 000 birds on 14 properties for pullorum disease. There were 78 000 birds in these flocks. Licensed testers tested on 14 properties. A further four people were registered as pullorum testers, three of whom work with one integrator. The fourth tester operates in north Queensland. A total of seven people are now registered as pullorum testers having met the prescribed requirements by examination and practice.

Six licensed chicken sexers were operating during the year. Returns of chickens sexed by these sexers for the year ended 30 November 1979, showed that 4 001 355 chickens were sexed compared with 4 669 000 in the previous year. This downturn in sexing reflected the introduction of variation in quota cuts, for example, 8% in September 1979, following an earlier 4% in January 1979.

Twenty-nine licensed egg pulping premises operated during the year. Only one of these was licensed to pasteurize egg plup. Routine inspections of all premises showed that most were being satisfactorily maintained. A few owners were required to make minor improvements to bring their premises up to the required standard.

The degree of compliance with the requirements of the egg marking and grading regulations as indicated by the number of breaches reported was satisfactory. Some smaller producers were warned regarding selling eggs while not licensed to sell. However, there has been a marked reduction in the number of producers attempting to evade the regulations.

Extension

The poultry industry group set up early in 1978 continues to function effectively. The group's major role is to plan and review the progress in the poultry extension programme in the East Moreton region. Because most of the industry is concentrated in southern Queensland, the objectives of the group are applicable with some modifications to all other recognized poultry production areas.

As part of the comprehensive extension programme to the poultry industries, staff of the Poultry Section have organized producer discussion groups in some of the major poultry producing areas of the State; the Darling Downs, near North Coast, Townsville, Cairns and Atherton. Meetings are held bi-monthly. The programme content is by producer request and the meetings are organized by Departmental staff.

The discussion groups are well received by producers and have proved effective in defining industry problems and efficient in implementation of remedies. The groups have been instrumental in improving information flow among producers.

Egg producers in the metropolitan area do not tend to form discrete groups and most of the outer suburban poultry clubs are no longer existent. They do, however, attend producer meetings called by Egg Marketing Board Suppliers' Organization, the South Queensland Egg Marketing Board or the Hen Quota Committee. The district adviser always attends these meetings. The same could be said of the broiler growers, who strongly support the Queensland Broiler Growers' Association and attend its meetings. Poultry Section staff and in particular the officer specializing in broiler extension, usually attend these meetings.

To provide a regular contact service with both commercial producers and commercial interests servicing the poultry industry, newsletter type publications are distributed regularly. 'Birdwise' is distributed monthly on the Darling Downs; 'Feather Front' quarterly in north Queensland; a newsletter for broiler growers, quarterly; 'For your info' to broiler growers in response to industry needs; and 'Quill' to the layer industry, annually. The 'Australian Poultry Newsletter' is collated and edited by Poultry Section and sent to all extension and research organizations in Australia. Three editions were distributed.

Several farms on the Darling Downs have changed hands with the new farmer being inexperienced. There is also a number of successful poultry farmers who have stayed with the industry through 'good' and 'bad' times and are now reaching retiring age and are wanting to hand over the active operational management of their farms to their children. The Darling Downs staff identified an urgent need to provide a part-time poultry farm managers' course for these groups. Initially there are 14 enrolled, including nominations from company representatives servicing the poultry industry. This is indeed a very healthy sign that the poultry industry in its totality looks to the Poultry Section of the Department to meet many of its needs.

The ninth Poultry Information Exchange (P.I.X.) which is organized by the Department and industry was held in March 1980. Approximately 260 people from all sections of the industry in Queensland and interstate attended.

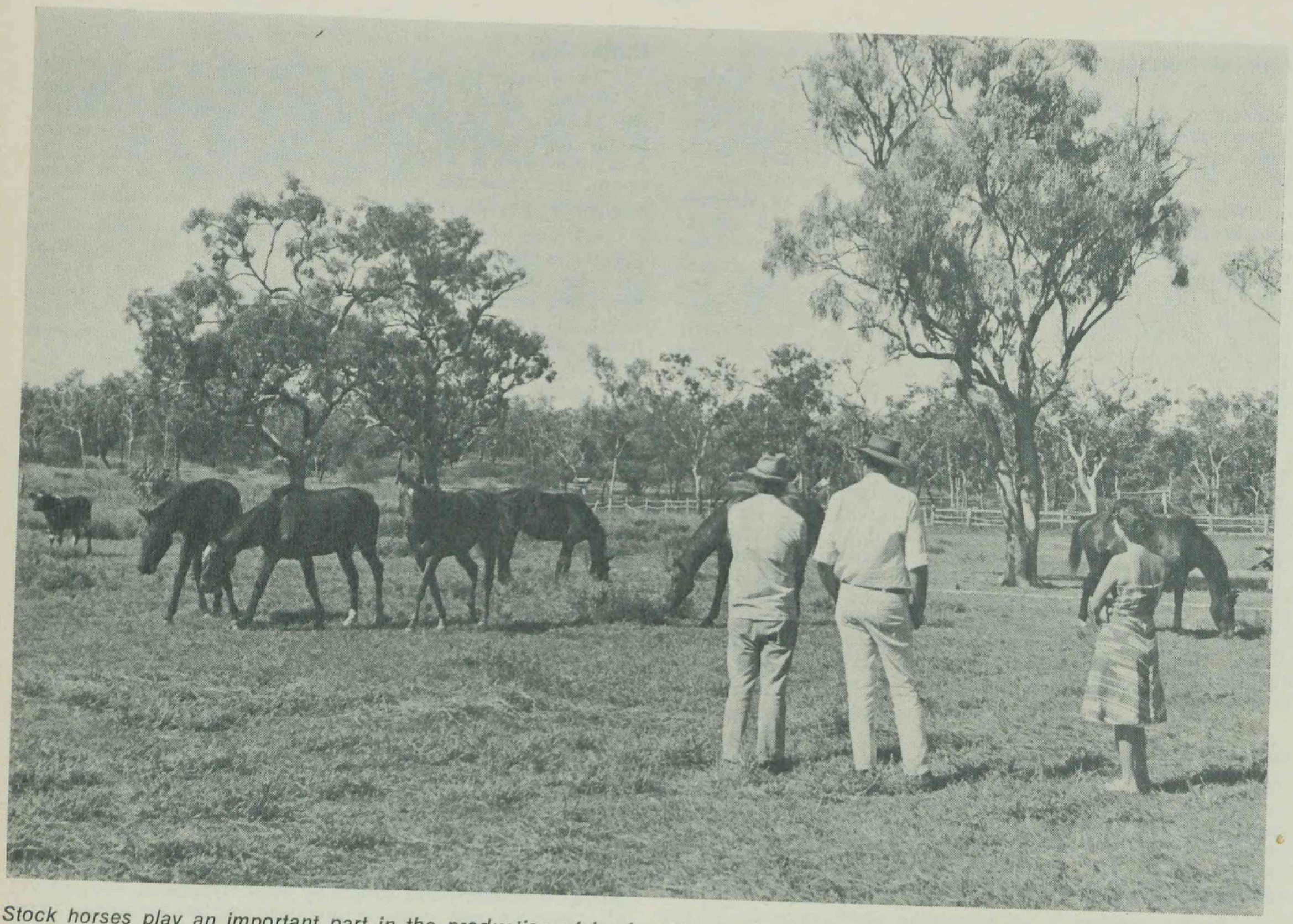
A Newcastle disease seminar was arranged by Veterinary Services Branch in conjunction with Pig and Poultry Branch to outline the proposed Newcastle disease eradication plan. Particular emphasis was placed on the role of vaccination. Approximately 60 people attended.

Horses

While the horse still maintains a very important role in the pastoral industries, its popularity for recreation purposes continues to increase. The stud breeding industry continues to strengthen and regular sales of the various breeds are now conducted. A new sale complex has been established on the Gold Coast to cater for the Thoroughbred industry and the first yearling sales were conducted this year at the new centre.

The general growing interest in horses has created a growing demand for advice on horse husbandry and disease control and continues to occupy a significant portion of the time of advisory and inspectorial staff.

A substantial amount of material continues to be submitted to the laboratory from equine abortions and mortalities of young foals. Organisms isolated included *Actinobacillus equuli*, *Salmonella typhimurium* and *S. bovismorbificans*, *Enterobacter agglomerans*, *E. cloacae* and *Klebsiella pneumoniae*. Of these organisms, only the first three are proven pathogens. An unusual finding was that *Actinobacillus suis* was isolated in pure culture from lung, abomasum and heart blood from a foetus aborted at 4·5 months gestation. No significant histological changes were noted in the foetus, there was an acute necrotizing placentitis. Small gram negative organisms consistent with the morphology of *A. suis* were demonstrated in the placenta.



Stock horses play an important part in the production of beef cattle. Beef Cattle Husbandry Officers receive many enquiries on horse nutrition.

The relationship between fistulous withers and poll evil and infection with *Brucella abortus* is being studied by serology and bacteriological examination. This study is hampered by the fact that serological tests for brucellosis in horses are not as well established as they are for cattle.

Strangles was again diagnosed in north Queensland. Equine infectious anaemia was confirmed as the cause of death on a property in the Gulf where it is claimed to cause about five deaths per year.

Numerous cases of infertility in mares on the Darling Downs were investigated by private veterinary practitioners. Bacteria incriminated included *Pseudomonas aeruginosa, Streptococcus zooepidemicus, Klebsiella pneumoniae, Straphylococcus aureus, Strep. enteritidis* and *Escherichia coli.*

Ps. aeruginosa was recovered from the semen of a stallion at Cambooya following unsuccessful matings with 20 mares. Infection with this bacterium looms as a major cause of infertility in Thoroughbred studs.

All horses in Queensland which have been imported from the United Kingdom and/or the Republic of Ireland are kept under surveillance for signs of contagious equine metritis (CEM). The period of surveillance lasts for the 2 years next following importation. To date CEM, which is a veneral disease of horses characterized by infertility, has not been diagnosed in Queensland.

Periodic opthalmia is a common disease in stock horses in north Queensland. Investigations are being carried out to determine if it is caused by leptospiral infection. On one property in the lower Cape York Peninsula area, 16 of 20 horses with opthalmia had significant titres to *Leptospira pomona.* Leptospirosis in horses appears to be of greater importance in north Queensland horses than is generally realized and it is hoped that the investigations will clarify the situation.

Osteodystrophia fibrosa (ODF)

ODF was reported from areas in coastal and central Queensland and in far north Queensland. Grazing improved pastures containing buffel grass, green panic grass or setaria was the predisposing factor.

The collaborative investigation of O.D.F. has continued. This programme has many facets and is partially supported by the Queensland Equine Research Foundation and Commonwealth Extension Services Grant. This year's programme has seen the completion of studies on the long term feeding of oxalate to horses, the continuation of equine mineral balance trials and the investigation and extension of supplements aimed at protecting horses in the field.

The study on the long-term effect of feeding oxalates which involved feeding oaten and lucerne chaff with added potassium oxalate was terminated in July 1979, after 18 months. Three of the 10 horses showed clinical signs of ODF. On microscopic examinations of tissues, the majority showed ODF. One of two horses fed oaten chaff plus potassium oxalate (a lower calcium level than oaten-lucerne) developed lameness typical of ODF after 4 months. The calcium and phosphorus drain on these two horses was shown to be similar to that in horses fed buffel grass hay, and supports the field observation that ODF can develop in relatively short periods of lush grazing when oxalate-calcium ratio is increased.

The balance trials of horses fed grasses containing oxalates showed that the negative calcium balance produced in horses fed tropical pastures (buffel, kikuyu, pangola, setaria, green panic, para) can be overcome by feeding relatively large (40 g) amounts of Ca daily. A supplement containing only Ca, such as limestone, reverses the negative Ca balance but not a negative phosphorus balance. The calcium from calcium oxalate is not absorbed. Using rock phosphate or a mixture of limestone and dicalcium phosphate results in both a positive Ca and P balance. For convenience, the supplement can be fed mixed with molasses on a once-a-week basis.

Field trials were undertaken to investigate practical ways to prevent or treat ODF in grazing horses. The trials were done in the Arcadia Valley area of the Brigalow Development Region and the methods used were based on the results of the balance studies. A supplementation formulation of 0·33 kg ground limestone and 0·66 kg dicalcium phosphate in 1·5 kg molasses to be fed to each horse once a week was developed. This formulation was compiled to provide the required amounts of Ca and P in a palatable form for the minimum cost yet avoiding the excessive intake of fluorine which is a common contaminant of phosphorus sources. Four property owners in the Arcadia Valley with a total of 35 horses agreed to co-operate. Over a 6-month period all co-operators reported that the supplementation system suggested was practical and the supplement was very palatable to their horses. Horses consumed this weekly allocation within 2 days of its being offered.

The major result was a significant improvement in the clinical conditions of those horses which had been lame due to ODF before supplementation. Horses previously unsafe to ride became sound. Minor reductions in the size of the jaw swelling of some horses were also noted. Those horses which had been introduced to the pastures and immediately placed on supplementation did not develop signs of ODF. One mare successfully foaled and is raising a healthy foal in circumstances where previously mares have been severely affected and died.

Breakdowns in these control measures can be expected due to either non-consumption of the supplement by some horses or competition in group feeding situations or extra stresses imposed by periods of lush pasture growth. These are being currently investigated.

Meat inspection

Pending the result of the Committee of Inquiry's investigation into Meat Inspection in Australia, inspectors of both Commonwealth and State in Queensland continued to work side by side at export meatworks under the terms of the 1964 agreement.

The Committee of Inquiry which was set up by the Commonwealth Government continued its investigations into the various submissions presented by many interested parties which included, Commonwealth and State Government departments, graziers' organizations, meat authorities and other organizations and individuals. Members of the Committee also visited a number of meatworks throughout Australia for the purpose of making personal observations.

The Committee of Inquiry in its report published in 1980 proposed the establishment of an Australian Meat Inspection Service (AMIS). AMIS would appoint, train or arrange the training of all inspectors required by the Bureau of Animal Health of the Commonwealth and all Departments who require the services of full-time meat inspectors in the various States. Another important proposal of the Committee was that management of the various meatworks or abattoirs at which meat inspectors are employed would be responsible for the salaries and expenses of the inspectors employed at their particular meatworks.

It was stated by the Committee that this proposal would act as a restraint on the numbers of inspectors employed as each board of management would be involved in consultations over inspectorial staffing. However, the Commonwealth or State department responsible for inspection and hygiene standards would have to be satisfied that the numbers of inspectors were adequate for the tasks involved. The Committee of Inquiry was also critical of the differing procedural requirements and fee structures in the various States.

Since the Committee of Inquiry published its report, consideration has been given to the substance and recommendations by the various State Departments. The departments of the eastern States (Queensland, N.S.W. and Victoria) are unanimous that the Committee's main recommendation is unworkable and does not take into account the differing responsibilities with regard to meat inspection by the various departments. However, senior officers from the eastern States are at present jointly examining the proposals particularly those urging greater rationalization of procedures between the States to see whether any improvements can be made with the object of reducing costs.

Slaughtering and Meat Inspection Branch has completed investigations which began in Townsville in 1978 into meat inspection procedures. Recommendations for modified procedures which will enable more efficient overall inspection will soon ensue. Other States are undertaking similar investigations so that the ramifications of the initial work in the sphere of domestic meat inspection could be widespread.

Slaughtering facilities

A recently completed export extension at Queensland Bacon, Murarrie, was officially opened on 10 March 1980. Reconstruction of the pork cut area was completed during the year. A new machine for the removal of meat residue from bones was installed. Recovery rate is in excess of 30% or approximately 2 t of meat per day, now recoverable for edible manufacturing purposes, instead of rendering to meat-and-bone meal.

The Ipswich Public Abattoir Board was disbanded during the year and the abattoir became a Regional Abattoir under the direct control of the Authority. Renovations of the main chiller were completed, considerable improvements to the ingesta-effluent disposal system were made and roofing was provided over the small stock pens. In spite of the provisions of increased chilling accommodation, meat continues to leave the abattoir inadequately chilled.

Work continued on new by-product installations at Tancreds, Bromelton, during the year. New equipment included a sharples machine and a final centrifuge to upgrade the quality of the inedible oil and a fully enclosed, automated hammer-mill for the production of meal. In addition, work continued on the heat exchanger which will ultimately utilize exhaust steam from the cookers to heat water for use around the works.

At Cannon Hill Abattoir, C.S.I.R.O. is experimenting with the centrifugal removal of sludge using a decanter instead of a vacuum filter, firstly with the object of improving plant performance and secondly to separate activated sludge for the possible utilization of protein as a stock feed. It is understood that Hawkesbury Agricultural College is experimenting on the use of this method for production of meat meal. Experiments are also being carried out by C.S.I.R.O. on equipment for the skinning of sheep and lamb heads before inspection in order to meet an E.E.C. requirement. In addition, the Board is experimenting with the removal of the skin of the forequarters of sheep and lambs with a puller.

Trials on rail electrical stimulation have continued at Kilcoy Abattoir with encouraging results. Management is hopeful that the system will be fully operational in the near future. An overhead blow line has been installed to convey boning room residue to the digester.

During the year, continuing advice and assistance have been given by officers to licensees of country slaughterhouses to ensure compliance with legislative requirements. In some areas, particularly the Cairns district, slaughterhouses have been upgraded to a higher classification and some to abattoir standard. In the case of the abattoirs, this has necessitated the provision of full time inspection at Tolga and Innisfail. In the Sunshine Coast area, north of Brisbane, some licensees have made application to the Authority for relicensing in a higher classification.

More supervision of slaughterhouse procedures and inspection of meat is required at slaughterhouses but location and distance between premises make the provision of more staff to undertake these duties difficult. The Queensland Meat Industry Organization and Marketing Authority is investigating the feasibility of providing inspection at Class 1 and Class 2 slaughterhouses. To be an economic proposition, it may be necessary to stagger killing times at these slaughterhouses, if this is feasible, to allow inspectors to carry out inspection at more than one slaughterhouse.

With the higher cost of red meat during the year, sales of poultry meat have boomed. One Class 2 poultry slaughterhouse operator in the Brisbane area took advantage of the amended Regulation 84 (3) of the Meat Industry Regulations 1973, to upgrade his premises and provide an approved chain system of dressing. This permits the operator to kill up to 80 000 poultry per month. Regular inspection of poultry slaughterhouses was carried out during the year.

Butchers' shops and smallgoods establishments

A Government Committee of Inquiry into butcher's shop standards in Queensland reported that, in the view of the committee, present standards were not excessively high. The Committee noted that Slaughtering and Meat Inspection Branch was doing everything possible to ensure that uniform standards applied throughout the State.

A review conference on butcher's shop standards was held during the year with trade representatives attending. A more uniform interpretation of standards and requirements is expected to result and closer liaison with the trade should occur.

The foundations for a new concept in meat marketing, the first in Queensland, were established at the Garden City Markets at Mt. Gravatt towards the end of the year. The meat market will incorporate 12 butchers' shops in one air conditioned complex. The butcher's shop units will be registered as Class 5 butchers' shops which are defined as butchers' shops situated within a retail meat market. The various units are leased to individual butchers. Each Class 5 butcher's shop will have to meet the standard for a Class 1 or Class 3 butcher's shop. A similar meat market has existed in Melbourne for some years and has apparently been a success. The completion and opening of the first Queensland retail meat market are awaited with interest.

Disease recording

A new quarterly slaughtering and disease recording format has been introduced as from the January-March quarter. It embraces a standard nomenclature. The forms themselves have been colour-coded for easier recognition for each type of animal slaughtered.

Difficulties are still being experienced with delayed returns from country slaughterhouse licensees. This delays the compilation of the overall quarterly return. The problem appears to be a difficult one, particularly in the more remote areas where visits by inspectors are infrequent.

A liver fluke survey which had been conducted in conjunction with the Animal Research Institute in the meatworks for some years has now been concluded.

Meat quality

Several years have passed since the last major review of grading and branding activities. While no major trade or consumer problems are evident, grading systems must be updated from time to time to meet changing circumstances. There is also evidence of growing consumer and political interest in this area. The review will be preceded by a survey of trade attitudes and needs. The trade and consumer groups will be consulted.

Some progress has already been made. A questionnaire is being designed in consultation with the evaluators in Extension Services Section. A small scale pilot survey of trade attitudes is being collated and the Meat Research Laboratory of C.S.I.R.O. has been consulted.

It is clear that attractive brands result only when carcasses are relatively dry. It is policy to try to improve the presentation of brands by encouraging dry branding. Branding of lamb carcasses at the Metropolitan Public Abattoir remains a problem. Difficulties were also being encountered, but overcome, with the formulation of the ink for the blue ribbon branding. The dyes used for a long period are no longer manufactured and the new dyes tried resulted in the blue having a greenish tinge.

Tenderstretch usage remains unchanged. Acceptance of the green band for identification remains low, probably associated with poor branding techniques.

There has been a welcome increase in the use of electrical stimulation. Sixteen low voltage rectal probes are in use at country slaughterhouses and small abattoirs. Arrangements have been made to have an electrical stimulation device on loan from the manufacturers for extension purposes. An automatic 110 volt stimulator has been installed at the Kilcoy Pastoral Company abattoir. Contact is being maintained with the Meat Research Laboratory of C.S.I.R.O. on development of electrical stimulation.

In consultation with the Kilcoy management, a new system of branding and grading has been planned and will be implemented on a trial basis. Green is still the identifying colour for branding. This new system of branding and grading has two important innovations which are to be assessed on a performance basis. For the first time, boning room cuts are to be branded and grading will be done by works personnel using the existing system. Their performance will be supervised and monitored by inspectors. There will be no extension of these procedures to other operators until evaluation is completed.

Usage of the lot-fed system of branding has grown slowly during the year. Two more abattoirs have adopted it: Kilcoy and Beaudesert. The system is working to the satisfaction of producers and retail butchers handling the product.

The Meat Quality Officer prepared a review of lamb grading and branding. Since this system is really a classification system, this review was made available to the National Carcass Classification Supervisory Committee with the suggestion that uniformity be sought throughout Australia for lamb for domestic consumption.

Activities associated with show societies continue to be important. Judges, stewards, demonstrations and assistance are supplied. At the Royal National Association Exhibition the bone-out carcass competition in collaboration with Woolworths continues. A similar competition for super porker carcasses was designed and implemented by the first time with K.R. Darling Downs. This was well received. It is expected that this will produce valuable data on yield of saleable meat related to weight, sex and depth of fat. The meat information booth in the Meat Hall was a great success again in 1979.

Staff have continued to collaborate with the trade on super porker promotion but no significant increase in usage has occurred and possibly there has been a slight decrease. There has been an increase in the number of talks and film showing by staff to interested groups. Regular lectures and films for each intake of apprentice butchers to the Food School continue. One group of butchers requested and received regular talks. An increased number of requests from various consumer groups has been met and well received.

Carcass classification

During the year, Queensland Meat Industry Organization and Marketing Authority staff completed training in carcass classification. Full responsibility for activities in relation to trials of a national system of carcass classification has passed to the Authority.

Branch staff continue to collaborate with and advise Authority staff at three levels: informal contact, membership of the Kilcoy and State working parties, and trial activities. Classifier's performance in the trial is supervised, monitored and recorded. This is done not only to ensure accuracy of measurement in the trials but also to produce a data base, which is needed to develop standards for performance and monitoring systems. These activities are taking place with cattle at Bundaberg and Kilcoy and with pigs at Kingaroy.

Extension to Murgon (both species), the Metropolitan Public Abattoir (pigs) and Huttons (pigs) is planned when the Authority staff set up trials there.

Staff collaborated in surveys of producers and butchers in the Kilcoy trial. Results indicated ignorance and apathy among producers. There was an encouraging interest in carcass classification among retail butchers. The survey also showed that the retailers rated carcass conformation low among factors they considered important in selecting carcasses. Increased extension activities were recommended.

There is a need to begin the second beef carcass classification trial planned at Murgon if the timetable for evaluation is to be met. In this context, the Bundaberg trial has been running for a long time. Its valuation is now needed as a guide to methods to be used in evaluation of other trials.

Compared with other States, pig carcass classification is lagging in Queensland. While measurement for feedback to producers continues at Kingaroy and negotiations are going on to start it in Murgon, there are no pig carcasses with P2 or standard fat depth measurements yet entering the meat trade in Queensland. There should be great value in making P2 measurement available with carcasses for trading. As well as encouraging objective description of pig carcasses, there is every reason to expect that, in time, favourable trade attitudes to carcass classification in general could be developed.

The results of a recent project which studied the backfat thickness in pigs will be of great benefit to those measuring backfat thickness for carcass classification. It will enable rational monitoring of classifiers. Good co-operation on the part of retail butchers enabled its early completion.

The Meat Quality officer continues to represent the Department on the National Carcass Classification Sub-Committee and its beef working party. Studies made by Branch staff on distribution of subcutaneous fat in beef and pig carcasses have been important. A statistically designed sampling plan for monitoring beef carcass classification has been developed and circulated to other States.

Weight verification at abattoirs and definition of a standard carcass are important issues which should be pursued irrespective of the outcome of carcass classification trials. The Slaughtering and Meat Inspection Branch has suggested to the Authority that a committee including a Division of Occupational Safety and Weights and Measures representative should be established to study the problems including related abattoirs structures and functions.

Investigations

Staff collaborated with C.S.I.R.O. in investigations of brown discoloration of meat resulting from the use of welding torches in chillers. Nitrous oxide is produced, and this produces the colour change and also persists in cold temperatures at levels considered dangerous to man. Similar collaboration occurred on discoloration and odours produced in veal necks by electrical stunning.

Investigations were commenced into the incidence of bursitis in the ligamentum nuchae in Brucella reactors.

Some new butcher's shop chillers have been noticed to cause dehydration and darkening of exposed meat surfaces. Investigations into the cause are being made by officers of the C.S.I.R.O. Meat Research Laboratory and a senior Slaughtering and Meat Inspection Branch inspector.

Serious microbiological contamination and associated changes were found at re-inspection in a large consignment of mechanically deboned meat from interstate. The Food Standards Committee of the National Health and Medical Research Council has stated that more information is needed on this type of product. In view of those comments, it was decided that a survey should be made into the composition and microbiological status of Queensland-produced mechanically deboned meat.

Preliminary results indicate a reasonable composition but high levels of contamination. As the reasons for the contamination are not clear, local producers of the product

have agreed to use it only in heat treated products and to collaborate with the Departmental teams in a programme of investigation and improvement.

Studies of the level of *Salmonella* contamination of intestinal lymph nodes of cattle travelled long distances were completed in August. The study complemented work done by the Queensland University into this bacterium of major public health significance.

A project to study the transfer of salmonellae from the mesenteric lymph nodes to meat was carried out by the Animal Research Institute to provide basic information for the review of meat inspection procedures mentioned previously as being undertaken by the Slaughtering and Meat Inspection Branch. Examination of meat inspectors' knives showed that some of the viscera inspectors' knives were positive but all the knives from the iliac lymph node inspector and the 'finals' inspectors' were negative. Counts ranged from 27 to 69 salmonellae per knife. Serotypes isolated were *S. eastborne, S. typhimurium, S. oranienburg, S. chester* and *S. arizonae.*

In laboratory studies, counts of salmonella on artificially contaminated knives were reduced by 99·8% by cutting through meat. Salmonella could subsequently be re-isolated from the meat.

Poisonings and mycotoxicosis

Poisonous plants

LOSSES IN STOCK. A wide range of poisonous plants continues to cause sickness or death in all classes of livestock.

A spectacular outbreak of nitrate poisoning occurred in cattle due to the ingestion of liverseed grass (*Urochloa panicoides*), at Gracemere, near Rockhampton. Nineteen cows and calves were untrucked into a small holding yard after travelling for 2 days. The holding yard contained a dense growth of liverseed grass and green panic and 5 hours later all 19 cattle were dead. The liverseed grass contained up to 5·5% nitrate in the stems and 4·2% overall. Factors contributing to the mortality were stressed, hungry cattle and overcast weather leading to a build up of plant nitrate. Two cattle at Rosewood and eight dairy cows at Moura died from nitrate poisoning following access to fertilized and irrigated ryegrass.

Widespread outbreaks of St. George disease were reported from the areas south of Roma and Mitchell.

Mortalities due to poisoning with *Bryophyllum tubiflorum* (mother of millions) were reported from Kingaroy (5), Kilkivan (5), Tiaro (1) and Laidley (3). In the Kingaroy and Kilkivan outbreaks the plant was heavily in flower. The flowers of *Bryophyllum tubiflorum* are suspected as being the most toxic part of the plant. The plant is a frequent cause of poisoning in south-east Queensland during drought periods.

Yellow wood (*Terminalia oblongata*) caused losses in cattle herds in the Clermont and Springsure areas. Outbreaks are usually restricted to the Central Highlands area where the tree flourishes. The leaves of this tree contain high levels of tannins and these are considered to be the toxic factor.

Mortalities in calves and/or cows occurred at Pimpama, Woombye and Numinbah due to ingestion of bracken fern (*Pteridium esculentum*). Green cestrum (*Cestrum parqui*) was responsible for the deaths of cattle in herds at Bundaberg and Cannon Hill. Two cows at Bundaberg, three at Rathdowney and four at Nerang died following ingestion of leaves of *Trema aspera* (poison peach). Eleven cattle died and nine others became sick when drought affected cattle from the Charleville area were released into a paddock at Boonah containing *Lantana camara* and six bulls at Kilcoy died following access to this plant. A bovine at Toowoomba developed a profuse watery diarrhoea and ascites following ingestion of Apple of Peru (*Nicandra physolodes*).

The highest mortality rate in cattle for about 20 years from saw-fly poisoning (*Lophyrotoema interupta*) has been reported from the Tambo-Mitchell area.

Ellangowan poison bush (*Myoporum deserti*) was suspected as the cause of five deaths in a mob of 600 wethers at Roma and caused mortalities in sheep on a property at Wandoan. Besides causing toxicity in travelling stock, Ellangowan is capable of causing mortalities in paddocked sheep or cattle during drought times.

Nitrate toxicity associated with the ingestion of marshmallow (*Malva parviflora*) was suspected as the cause of death in sheep at Goondiwindi.

Outbreaks of humpy-back were reported from the Charleville area.

Crofton weed (*Eupatorium adenophorum*) continues to cause losses in horses in the coastal hinterland of the Albert shire. Affected horses showed signs of respiratory failure culminating in sudden death.

Pie melon (*Citrullus lanatus*) was suspected of causing severe colic in horses on a Richmond property. Six mortalities in a mob of 14 were reported and the seeds of this plant were identified in the intestinal contents.

Helichrysum raniosissimum, a member of the daisy family, was suspected of causing blindness and death of horses in two instances. Members of this genus have been shown to be toxic for cattle and sheep in Victoria and in South Africa.

Mexican poppy (*Argemone mexicana*) was diagnosed as the cause of mortalities in week-old chickens at Townsville. The oedema and atrophic changes in the liver and spleen were similar to those changes seen in chickens in feeding trials in which as little as 1% Mexican poppy seed was fed.

Research

A trial to demonstrate toxicity of white cedar berries (*Melia azedarach* var *australasica*) to pigs was carried out. The toxic principle was confined to the flesh of the berries and oral dosing caused acute neuromuscular symptoms and death.

In affected pigs, significant elevations in enzyme concentrations including aspartate amino transferase, acid phosphatase, alkaline phosphatase and creatinine phosphatase were recorded. These were consistent with changes expected to be associated with observed pathological lesions but lack the specificity for self sufficient diagnostic indices.

Experimental work with Crofton weed poisoning in horses continues as losses continue to occur in the coastal hinterland of the Albert Shire. The work is aimed at elucidating the pathogenesis of intoxication and defining the toxic stages of growth of the plant so that management practices to minimize the problem can be instituted.

The structure of the toxin previously isolated from the larvae of the saw-fly at the Animal Research Institute has been elucidated by a scientist working at the Australian National University, Canberra.

Work over several years on the isolation, purification and structural characterization of the toxin of *Wedelia asperima* has been completed. In the field, this plant (sunflower daisy) has been responsible for serious losses of sheep in north-western Queensland. The structure of the toxin has been elucidated by staff of the Australian National University, Canberra, on purified material supplied by the Animal Research Institute, Yeerongpilly. It has been shown to be related to a group of toxins present in the plant *Atractylis guminifera.*

At the Animal Research Institute, preliminary experiments based on indications of this relationship suggest that the toxin has an inhibiting effect on tumors. Tumors were induced in 10 rats (five female and five male) by successive weekly doses over 4 to 5 weeks of purified aflatoxin B1 (total dose 1 mg per rat). One female animal died 20 weeks after the final injection and autopsy revealed tumors at a number of sites.

Five of the surviving rats (two male and three female) were then dosed weekly for 8 weeks with 0.1 lethal dose (30 mg) of Wedelia toxin. The remaining animals were left as controls. All animals were kept until they died (2 to 3 years). The four controls that received aflatoxin B1 but no treatment all showed tumors on autopsy. The five animals that received aflatoxin B1 followed by dosing with Wedelia toxin showed no tumors. The method of administration and dose of aflatoxin B1 have been recorded as producing 100% incidence of liver tumors in rats.

Further experiments are also in progress to determine the effect of the toxin at a cellular level. These are being done in collaboration with the University of Queensland and the Chester Beaty Cancer Institute in England.

The nutrient components of *Amaranthus edulis* which contains 1% lysine and levels of the other essential amino acids which approach the requirements of monogastric animals indicate that it could be used at high levels in monogastric diets. However, it contains a heat labile hepatotoxin(s). Work during the year by Biochemistry Branch has isolated two compounds which it is believed are the toxic fractions of the seed.

Mineral poisonings and drug overdosing

Arsenic poisoning was resonsible for the deaths of 16 heifers in a mob of 34 which died at Mackay. The heifers had been held in a yard where an arsenic dip overflowed following a heavy rainfall. Mortalities in calves and/or cattle occurred at Brisbane, Yerra, Bundaberg, Laravale (10 steers), Breyneside, Berajondo, Gayndah, and Tansey. Sources of arsenic in these outbreaks included leakage from broken containers, fence posts, old dips, rubbish dumps and weed-killers.

Seven outbreaks of lead poisoning in cattle were reported. Apart from the deaths of two bullocks at Gayndah and one cow at Alpha, calves were involved in the outbreaks which were reported from Atherton, Roma (2), Amby and Drillham.

Eight sheep died at Charleville from arsenic poisoning following treatment off shears for lice infestation.

Two horses died at Goondiwindi following the ingestion of grain that had been treated with '1080'.

In one flock, 120 birds (chickens, turkeys and ducks) died following the ingestion of grain treated with dieldrin.

An oedematous condition in a batch of 1 800, 3-week old pullet chickens in central Queensland was attributed to highly mineralized water. When city supply water replaced the mineralized bore water the chickens responded spectacularly.

The need for care in the use of drugs to treat diseases in animals was illustrated in four instances. In one, overdosage with imizol caused a toxic nephrosis in cattle. In the second, administration of a long-acting preparation of terramycin by an incorrect route (intravenously) caused the death of aged, heavily pregnant cows also with nephrosis. In the third, Furasolidone poisoning killed 80% of 1 to 6-week-old pheasants on two Brisbane properties. The drug had been administered in the drinking water at the normal rate for poultry of 1 g per 1.5 L for 12 days. The pheasants were drinking 1½ times the amount of water calculated for poultry of the same age. Birds went over on their sides, trembling and died within half an hour. The kidneys and ureters were distended with urates. In the fourth instance the same drug killed 50% of 3-day-old broilers which were mistakenly given the drug at 10 times the recommended dose rate. The kidneys and ureters were distended with urates. The affected chickens recovered subsequent to removal of medication.

Mycotoxins

Biochemistry Branch undertook 30 assays for aflatoxin on feeds from 19 properties. Of these, four had toxicologically significant levels. In addition, 40 samples of peanuts were assayed including 25 assayed and certificates issued on behalf of the Peanut Marketing Board.

Aflatoxin poisoning was responsible for causing deaths of fowls at Richmond.

Acute aflatoxin poisoning with severe illness and 10% mortality in two pig herds was caused by feeding waste material from peanut harvesting. The waste material consisted of about 50% nuts in shell, 20% soil and 30% hay and very high levels of toxin were detected in samples (20 to 45 p.p.m. of total aflatoxins). Recent drought conditions enhanced the invasion of peanuts by *Aspergillus flavus* the fungus which produces the toxin.

Laboratory services

Specimens examined

The Division's laboratories at the Animal Research Institute, Yeerongpilly, Brisbane (Pathology, Biochemistry and Sheep and Wool Branches); Oonoonba Veterinary Laboratory, Townsville (Pathology Branch); Tick Fever Research Centre, Wacol (Pathology Branch), continue to examine a considerable number of specimens in order to support the regulatory, product control, extension and research officers servicing the livestock industries and the consumer public.

A major part of the operation of the Tick Fever Research Centre, Wacol, is the manufacture of vaccines for the control of babesiosis and anaplasmosis. Specimens from the brucellosis and tuberculosis eradication programmes are examined not only at the Animal Research Institute and the Oonoonba Veterinary Laboratory, but also at the Rockhampton Veterinary Laboratory and mobile laboratories now located at the Charleville Pastoral Laboratory.

The total batches of specimens examined by the Pathology Branch excluding those received in connection with the brucellosis and tuberculosis eradication programmes were 8 282. This is lower than in the previous year and reflects the adverse effects of the drought on normal flock and herd management in the grazing industries. For the examination of these batches of specimens the following tests were undertaken by Pathology Branch: serological (124 056), microbiological (8 757), haematological (2 509), parasitological (6 925), protozoological (1 514), histopathological (3 940). In addition, 60 rumen samples or plant specimens were forwarded to Botany Branch for plant identification.

The laboratory services provided by the Toxicology and Clinical Biochemistry Sections are an integral part of the diagnostic services of the Animal Research Institute. The toxicology diagnostic service which involved 1 092 analyses

Isolation units for transmission of suspect harmful organisms to disease-free poultry. The units are presently being used for infectious coryza and virus studies. Only sterile air and uncontaminated feed and water enter the isolators so that fowls are not exposed to organisms in the environment and cross-infection is prevented.



concerning 597 poisonings or suspect poisonings included estimates of aflatoxins, arsenic, cyanide, lead, mercury, nitrate, oxalate, pesticides, strychnine and warfarin. The clinical biochemistry diagnostic service analysed 3 001 tissue or excreta samples for a wide range of biochemical parameters including proteins, urea, chlorides, minerals, glucose and enzymes. Changes in the levels of these elements in tissues or excreta aid in a more definitive disease diagnosis.

To service production research programmes undertaken by Departmental staff in several Branches, the clinical Biochemistry Section of Biochemistry Branch examined 2 332 samples for a variety of parameters including copper, iron, zinc, calcium, magnesium, ceruloplasmin, enzymes, volatile fatty acids. In addition, the Nutritional Biochemistry Section analysed 1 520 samples of faeces, feeds or carcasses for protein, fat, ash, phosphorus, calcium, gross energy, metobolizable energy, *in vitro* dry matter digestibility and trace elements.

Assistance to other Branches by Biochemistry Branch involved 250 analyses of hair samples for chlormethurion in connection with air misting and acrylic techniques and the investigation of leachates from plastic containers used in conjunction with tick fever vaccine production.

The radio isotope facility at the Animal Research Institute as well as servicing A.R.I. trials has examined a total of 3 500 samples from Entomology, Plant Pathology, Agricultural Chemistry and Dairy Research Branches, the Charleville Pastoral Laboratory and the Alan Fletcher Research Station. Because of funding difficulties, the unit operates only with the provision of contingency inputs from users.

From studs and properties undertaking breeding programmes, the Wool Biology Laboratory subjected 6 072 wool samples to the fleece measurement examination for yield, clean fleece weight and fibre diameter. A further 1 001 samples were examined from wether competitions. This laboratory also examined 1 441 wool and skin samples from the research programme at 'Toorak' Research Station and 1131 wool and skin samples from the research programmes of other Departmental Branches or other organizations. A variety of examinations was done on 265 wool and skin samples emanating from the Department's chemical defleecing programme. With the escalation of the mohair industry in Queensland and the Department's increased activity in extension and research on Angora goat production, the laboratory undertook fleece measurement examinations on 293 mohair samples.

The dipping vat analysis service of Biochemistry Branch analysed 2 839 samples from vats. Only 12 acaricides were represented although the service has the capacity to estimate all registered products. The need for such a service is apparent as 40% of all samples were greater than 20% overstrength representing a waste of chemical and increasing the risk of residues in excess of statutory limits. Nine per cent of all samples were more than 20% under strength and would have been significant with respect to control failure.

Method development

Method development is an important component of laboratory services and considerable manpower resource is consumed in developing or adapting methods to improve the efficiency and accuracy of diagnostic and biological analytical tests.

The need for objective methods for investigating 'taint' in meat is apparent as this is a regular interface of the Department and the consumer. The use of microwave heating and head space analysis shows promise but requires further development.

The study of serum protein electrophoretic profiles is being developed as a new diagnostic tool to assist in the interpretation of diseased states. The normal patterns for major domestic animal species have been established and changes in pathological conditions have been monitored. Methodology related to the estimation of cyanide by specific ion electrodes and by an enzyme method applicable to cassava was developed.

Development of methods for paraquat in urine and monensin in grain was also undertaken. An on-going programme to increase the efficiency of Atomic Absorbtion Spectroscopy has led to major modifications of the carbon rod furnace and new operating techniques. In addition, the digestion of samples using ozone and infra-red or ultra violet radiation is being investigated.

Another major study concerns the nutritional value of processed navy bean. When adequately heat processed, navy beans are a useful alternative source of vegetable protein concentrate for animal diets. The biochemistry laboratory has developed a technique for rapidly assessing the adequacy of heat treatment. The binding of dyestuff to the processed bean is highly correlated with the efficiency of utilization of the feed by animals.

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Considerable investigations have been carried out with the view to adapt commercially available human-orientated Radioimmunassay kits for animal parameters. It has been found that the *NML* and *Amersham Amerlex* kits are readily adaptable for T4, T3U and T3 determinations in avian plasma and *Biorad* B-12 kit for bovine plasma. Work is under way to adapt commercial Parathyroid Hormone Kits for equine studies. Except in the case of T4 and B-12 which are species non-specific, a degree of experimnetal work would be necessary to readapt these kits to other species' protocols.

The indirect haemolysis test (IHLT) was introduced during the year following development of the test by the Rockhampton Veterinary Laboratory. An investigation has indicated that immunization of cattle with tick fever vaccine that contains bovine red cells does not adversely affect the specificity of the IHLT. The results of both routine and research work will form the basis for evaluating the use of IHLT in the brucellosis eradication scheme.

Staff of the Oonoonba Veterinary Laboratory co-operated with C.S.I.R.O. staff in a project to evaluate the anamnestic test as a means of detecting animals infected with *Brucella abortus*.

The techniques used in the tuberculosis laboratory at the Animal Research Institute were reviewed and modifications made taking into account recent overseas developments. Isolates of mycobacteria were identified for both South Australia and Northern Territory.

Vaccine production

A total of 814 915 doses of vaccine was supplied from the Tick Fever Research Centre (T.F.R.C.), Wacol, during the year. This was an increase of 11 515 doses over last year and may have resulted from the increased value of cattle and the necessity to immunize susceptible cattle moved from drought stricken areas to tick-infested country on agistment. About 65% of the vaccine contained *Anaplasma centrale* as well as *Babesia bovis*. There was a small demand for B. bigemina either mixed with the other two organisms (3 778) or with *B. bovis* alone (266). *B. bigemina* vaccine was used to control isolated disease outbreaks due to this parasite or to protect valuable animals either entering the enzootic area within Queensland, or being exported from Australia. In two consignments, 2 600 doses of frozen vaccine containing the three parasites were exported to Trinidad and Tobago.

Miscellaneous

The Tables of the Nutrient Composition of Feedstuff Ingredients published by the Poultry Section of Pig and Poultry Branch have been updated to include the results of comprehensive amino acid analyses determined by the Biochemistry Branch. These include the amino acid contents of sorghum, maize, wheat, barley and soybean over a range of protein concentrations. The amino acid content of Queensland grown lablab bean, mung bean, cow pea and cottonseed meal have also been included.

A comprehensive investigation into the stirring of dips by mechanical pumps was undertaken by the Biochemistry Branch on behalf of Veterinary Services Branch. Sludge pumps were originally examined and found to be ineffective. A high-volume, circulating pump was found to be adequate in stirring most types of dip. Trials were undertaken at Helidon, in the Brisbane Valley (three-sites), Rocklea and Townsville and resulted in the development of adequate techniques to provide effective stirring without the use of cattle. Three pumps have now been purchased and field trials will be undertaken in collaboration with field staff of Veterinary Services Branch.

An infra-red spectroscopy technique developed at the Laboratory was used to confirm and quantify petroleum-based hydrocarbons in mud samples on behalf of the Queensland Fisheries Service.

The Animal Research Institute library collection has been extended to 2 509 catalogued volumes, and 1 653 indexed pamphlets and reprints, with 381 serials being received currently. Reference services have been greatly enhanced by the use of Lockheed Dialog Information Retrieval Services. Twenty-six literature searches have been conducted for A.R.I. officers, with satisfactory results in most cases. In January and April 1980, the librarian attended Dialog training workshops which dealt with searching techniques and problems in the biological and chemical sciences.

A major change to library services was effected with the cessation of journal circulation. This has been replaced by a display of current journal issues and has made recent issues more readily available.

Since the appointment of a new library committee in January 1980, problems with services, budget control, collection organization and rationalization of journal subscriptions have received considerable attention. Publications lent to institute staff totalled 2 051, and to the other departmental officers 1 336. In addition, 613 items were borrowed on inter-library loan; while 449 were lent to other libraries.

Division of Plant Industry

QUEENSLAND'S rural industries encompass wide environmental diversity from tropical to temperate and from humid to arid conditions for plant production. This diversity is reflected in the plant species utilized commercially. For many of these, particularly in the tropical regions, production problems are unique and related research has its major affinities with that in the developing countries of the world.

The objectives of the Division of Plant Industry are to maintain and to improve and stabilize the productivity of the agricultural, pastoral and horticultural industries of Queensland and to conserve the soil and plant resources for the benefit of the entire community. This requires broad ranging programmes of research and extension which extend from improving the native pastures of the arid regions to ensuring superior quality of wholesome fruit and vegetables on the consumer's table.

The Division's functions are developed by two major production Branches: Agriculture Branch, which is responsible for research and extension for native and sown pastures, field crops and heavy vegetables; and Horticulture Branch, which undertakes research and extension in the fruit, vegetable and ornamental plants industries. Specialist services are provided by Agricultural Chemistry, Botany, Entomology and Plant Pathology Branches.

The Director of Horticulture administers Plant Quarantine in Queensland as an agent for the Commonwealth. Divisional officers are also involved in the administration of regulations concerned with crop production and beekeeping.

Four special research units established within the Division carry out research for particular industries.

At 'Brian Pastures' Pasture Research Station, Gayndah, research is aimed at improving beef production through the development of improved nutrition and husbandry practices. The Australian Meat and Livestock Corporation contributes an agreed sum each year with staff salaries and running costs being met by the State Government.

Toowoomba is the site of the Queensland Wheat Research Institute where an integrated programme of research into the many production problems of the wheat industry is conducted. The Australian Wheat Research Council and the Queensland Wheat Industry Research Committee are responsible for financing most of the activities with the State Government making a major contribution to staff salaries and operating expenses.

Staff at the Charleville Pastoral Laboratory are involved in studies on the management, productivity and maintenance of the semi-arid rangelands of the south-west. Evaluation of new pasture species forms part of the programme. Grants from the Wool Research Trust Funds meet most maintenance costs, while the State Government is responsible for most staff salaries.

Tobacco experimental work is centred at the Southedge Tobacco Research Station, Mareeba, with a small field station at Beerwah. The emphasis in research is on plant breeding, crop protection and management. These centres are financed very largely by the Tobacco Industry Trust Account with some salaries again being met from State funds.

Much of Queensland's arable soil is vulnerable to water erosion and there has been a significant expansion of research and extension effort towards erosion stabilization. This requires the evolution of new tillage practices and farming systems and is a vital challenge if the huge agricultural potential of Queensland is to be realized.

Agricultural development has also created soil salinity problems in dryland and irrigated areas. Many of these are complex hydrological problems associated with deforestation of upper catchments and increased ground water movement. Research to identify the sources of saline outbreaks and to develop preventive and remedial measures has made important progress during the year.

Genetic improvement of plants by breeding and selection for yield, product quality and resistance to pests and diseases continues to be a most effective avenue for productivity advance. New varieties of tobacco, tomato, wheat and the pasture legume *Stylosanthes* entered production from Divisional breeding programmes. Two macadamia nut varieties and the soybean variety, Cannapolis, were also released.

Fertilizer research has led to the resolution of production problems of cotton in the Emerald Irrigation Area and to the development of diagnostic soil analyses for soybeans and pastures. The confirmation of root lesion nematodes as a primary factor in the long fallow disorder of wheat on the Darling Downs is an outstanding contribution towards the resolution of this complex problem.

Publication of *Weeds of Queensland* provided a valuable illustrated guide to the identification of more than 350 weeds affecting primary producers and home gardeners. Another major publication covered the taxonomy of the genus *Acacia* which is the largest genus of Queensland plants.

Agriculture Branch

IN broad terms, Agriculture Branch seeks to improve the productivity and stability of field crop, forage crop and pasture production in the State through a combined research and extension programme.

The extraordinary diversity of Queensland's agricultural environment necessitates major plant breeding effort in wheat, barley, sorghum, maize, sunflower, soybeans, peanuts, tobacco and cotton to seek superior local adaptation and disease resistance.

Significant selection programmes are also applied to varietal improvement in forage oats, linseed, safflower, rice, navy and mung beans, potatoes, sweet potatoes and onions. Exploratory work is assessing the potential for such new crops as chickpea, sesame, lupins and cassava.

Soil fertility and weed problems are also diverse and Branch research encompasses tillage practice, plant nutrition, fertilizer technology, crop and pasture rotation systems and weed control. Irrigation developments require specialized technical servicing.

The pasture research programme seeks principles to guide balanced use of our natural grazing lands with emphasis on the mulga, Mitchell grass, blue grass and bunch spear grass communities.

Improvement of animal production from natural grasslands is pursued through legume selection and introduction to extensive grazing lands in the humid eastern sector of the State. For intensively developed areas, forage crops and sown pastures are researched for superior species, grazing management, optimum fertilizer strategies, seed production and establishment methods.

Branch research relies heavily on support and collaboration from other Branches of the Department, and particular effort is directed at linking the Branch's practically oriented research with the important but more basic studies undertaken by C.S.I.R.O. and Universities.

To provide a continuum in the service to industries, communities and farmers, the Branch maintains a widely deployed extension staff skilled in promoting the application of crop and pasture technology to commercial enterprises. This is a particularly demanding activity which has to blend profit motives with a conservative treatment of natural resources. Extension services maintain effective liaison with all agricultural industries, and in this way identify problems to ensure a proper orientation for research activities.

Agronomy research

Wheat

The variety Oxley continues to be a popular variety with Queensland growers though there has been some reduction in the area planted. This results from the variety's susceptibility to rust and the attendant risk of loss of yield due to the disease in a moist season. However, in the midseason variety trial series, Oxley was again the highest yielding variety, outyielding the next best line by 11%.

The quick maturing variety Cook was released by the Queensland Wheat Research Institute in 1977 and has become very popular with growers. This popularity was reinforced by the performance of Cook in the quick maturing variety trials in 1979. Cook performed well above average at all sites and was the highest yielding variety overall.

The Queensland Wheat Research Institute released the variety Banks in 1979 and it has given good results in its first season of commercial growing. The grain quality of Banks is superior to that of Cook. In the 1979 quick maturing variety trial series, the average yield of Banks was exceeded only by Cook. Banks was, however, superior to Cook in the Dawson-Callide, the Near south-west and the Maranoa regions.

In the 1978 season in Queensland, early maturing varieties planted early suffered severe frost damage, while in 1979 in central Queensland the few farmers who planted early (in March) obtained reasonable crops. These occurrences clearly demonstrate the need for a quantification of the risks involved in planting wheat varieties of differing maturities at the relatively infrequent opportunities provided by autumn-winter rainfall events.

In a series of trials on the Darling Downs over the past 3 years, it was shown that quicker developing varieties produced less dry weight by flowering and used less water. When quick, midseason and slow maturing varieties flowered on the same date there was little difference in yield potential when water was abundant. However, with both late planting and low growing season rainfall, the quick maturing varieties yielded less than mid season and slow maturing varieties despite their lower water use.

When the same varieties were planted on the same date, the well-known decline in yield with late flowering had a greater effect than the reduced potential of the quicker varieties. This resulted in their yields of the quick-maturing varieties being 5 to 20% above the medium and slow varieties.

The actual yield effect therefore depends on planting time, differences between varieties in time to flower, frost risk in relation to flowering time, and water available to the crop from planting to flowering. Quantification of these effects in terms of yield probability statements for varieties at various planting times will provide an important management aid to wheat growers.

Barley

Selections, particularly from the cross Bussell x Zephyr, have been tested extensively over the last four seasons. The most promising of these selections, BUS*ZEP 166, was included in 30 trials and had an average yield advantage of 22% above the commercial malting barley variety, Clipper.

Micro-malting tests conducted at the Queensland Wheat Research Institute indicate that BUS*ZEP 166 has at least as good malting quality as Clipper. Additional malting tests will be carried out by commercial malting organizations before consideration is given to releasing this line for commercial production.

In the 1979 regional variety testing programme, an entry from New South Wales consistently produced good yields. Malting tests, however, indicated that this line would be useful only as a feed grain. In the same trials, the feed variety Corvette gave its poorest performance since it was first tested in the 1968 season.

A barley crop physiology programme was commenced in 1979. It is desirable to achieve flowering in barley as soon as possible after the last frost. This allows the grain to develop in the less harsh conditions of spring and summer. To meet this aim, varieties are required which allow flexibility for a wide range of planting dates which result from irregularity of planting rains. This can be achieved, in varying degrees, by winter varieties through their responses to daylength (photoperiodism) and mean and minimum temperatures (vernalization).

If the vernalization requirements are satisfied, all varieties develop more rapidly in warmer temperatures. Varieties differ due to the interactions of genotype with cold temperatures and daylengths. Currently barley varieties are being 'typed' according to their responses to photoperiod and vernalization. Thereafter, genotypes will be selected as parents from which to produce varieties suited to the environmental constraints of particular locations.

Sorghum

In the recent past, the Department released breeding lines with resistance to sugarcane mosaic virus. These lines were eagerly taken up by seed companies for use in their programmes and in the 1979-80 season five hybrids based on this material were available commercially. Three seed companies were responsible for the release of the five hybrids but another four seed companies have hybrids, incorporating the same resistant material, in the advanced stages of testing.

Sorghum downy mildew is a disease which does not occur in Australia. It does, however, occur in a number of the under-developed countries in Asia and Africa. The International Crops Research Institute for the Semi-Arid Tropics, which is based in India, has co-operated by screening the Department's lines for resistance to downy mildew. One line, QL3 which was released some years ago, is immune to the disease. A further four sugarcane mosaic virus resistant KS4 type lines are also immune to the disease. As these KS4 type lines are agronomically better than QL3 it is proposed to release one in the near future as a source of resistance to downy mildew.

In 1978, the Department released a late flowering Sudan grass line, QL18, as a parent for hybrid production. One seed company attempted hybrid seed production but failed due to lack of 'clicking' between QL18 and the company's female line. In view of the short day flowering requirement of QL18 hybrid seed production is best carried out under short day conditions between March and September.

Development of grain sorghum hybrids with resistance to sorghum midge depends on incorporation of resistance into both male and female parents of the hybrid. The sources of resistance available to the breeding programme were all male lines and the development of agronomically suitable resistant female lines has been a major objective.

Recent results indicate that such female lines have been produced, and these are currently being tested in hybrid combinations with resistant male lines. Further improvement in both agronomic performance and level of resistance is being sought through population breeding techniques.

Maize

High yields were recorded in the 1978-79 regional variety testing programme, particularly in the trials at Gatton Research Station where the mean yield of the early maturing varieties was in excess of 10 tonnes per ha.

In north Queensland, the QK hybrids received competition only from the Grafton hybrids and in particular GH 3001 which was the third highest yielding variety after QK 231 and QK 690.

In southern Queensland the commercial hybrids XL 81, Sergeant and Captain generally performed above average and Macquarie Valley hybrids did very well in the trials in which they were entered.

An experimental hybrid, KTW 654, from the Queensland maize breeding programme, performed very well in north Queensland where it outyielded the best available commercial hybrid, QK 690, by 10%.

A few years ago it became apparent that the Department's maize collection contained germplasm with adaptation to south Queensland environments. A southern population was made up and several improvement cycles conducted. This improvement was confirmed by the performance of test crosses when compared with commercial varieties. In 1979-80, a hybrid produced from parents selected from the improved population and designated KTW 743, outyielded the standard commercial check varieties by 15% in the South Burnett and by 20% at Hermitage Research Station.

Soybeans

The primary objective of the soybean breeding programme is the release of improved varieties for commercial production. During the year the variety Canapolis was released and recommended for central Queensland. This variety was originally introduced from Brazil and matures 1 to 2 weeks later than Davis in central Queensland.

Some very high yielding lines from the cross Davis x Bragg have been identified in strain trials and are now being advanced to the regional variety trials.

The crossing requirements for the population breeding programme were completed with the production of 34 eight parent crosses. After a winter generation in the glasshouse, over 4 000 F_2 generation plants were grown in the field in the 1979-80 summer and are being heavily screened. It is intended to make approximately 400 selections for yield testing in the 1980-81 summer.



Hybrid maize varieties bred at the Kairi Research Station provide the base for the Atherton Tableland maize industry.

Nineteen trials were planted in the regional variety testing programme and all were successfully harvested. Yields at most sites were above average, reflecting the good growing conditions in most districts. Results supported those of previous years and recommended varieties were among the top yielding varieties at most sites.

The appearance of *Phytophthora* in commercial fields of soybeans in 1979 and again in 1980 suggests that the emphasis of the breeding programme may have to be changed to incorporate resistance to this disease into any new varieties released. Unfortunately, the *Phytophthora*-resistant parents included in the population breeding programme are not resistant to the race of the disease which has been isolated on the Darling Downs.

However, suitable sources of resistance are available and will be incorporated into the population in future recombination cycles.

Sunflowers

In the 1978-79 season, advanced variety trials were conducted at eight sites in southern Queensland, eight sites in central Queensland and one site in north Queensland. Sunking gave the best overall yield and together with Hysun 31 and Suncross 52 was among the six top yielding varieties in both the southern and northern sets of trials. Five large-scale variety trials were also conducted in which experimental lines and new varieties were tested. The 12 highest yielding entries included seven new varieties and experimental lines as well as Sunking, Hysun 31 and Suncross 52.

The sunflower development and yield model has been used to evaluate long-term crop expectancy for both the Emerald and Biloela environments. Times of planting x three levels of antecedent soil mixture were tested. The same pattern of expectancies was found at each antecedent soil moisture level. Similar patterns were also found between Biloela and Emerald although yield levels were comparatively lower at Emerald because of higher evaporative demand and lower available moisture in the shallower soils in that area.

The results have emphasized the importance of the level of soil moisture at planting, when making time of planting decisions. High levels of subsoil moisture at planting will extend the number of planting times, throughout the year, at which reasonable yields can be expected.

The probability of early to mid March plantings producing good yields was shown to be low and plantings during this period should be avoided. Similarly plantings from early July through to early December cannot be recommended.

At all levels of antecedent subsoil moisture, early January plantings are preferred but, should the crop be planted in a frost free area, high yields could also be expected from April and May plantings of Sunfola 68-2 and from April plantings of Hysun 30.

Peanuts

The programme to re-select higher yielding lines within the existing commercial varieties was continued. Two hundred and fifty-five single plant derived lines from Virginia Bunch and 187 single plant derived lines from Red Spanish were evaluated. Significant variation existed among the Virginia Bunch lines but not among the Red Spanish lines. Although no lines significantly outyielded the commercial variety, improvement should be effected through elimination of inferior types. The best 40 Virginia Bunch and 35 Red Spanish lines were retained for more intensive testing.

In the crossing programme, South Johnstone Research Station has been used for winter generation advance. A useful advance was achieved despite cool conditions which caused delayed maturity and premature harvesting of some lines.

The indeterminate growth habit of peanuts causes difficulties in deciding when to harvest. An index of maturity is being sought which will be of assistance in the breeding programme and perhaps to growers in selecting the best harvest time. The arginine maturity index, kernel/hull weight ratio and internal pericarp colour have been monitored over time in Virginia Bunch and Red and White Spanish varieties. Changes in these indices do not appear to be closely related to changes in yield and crop value over six harvest dates.

The vining habit of the peanut plant frequently results in pegs being set in the inter-row spaces when growth is lush, especially in irrigated crops. This results in losses at harvest and experiments are being conducted with a growth regulant to overcome the problem. The growth regulant, Kylar, applied 6, 8 and 10 weeks after planting, reduced inter-node and branch length considerably. The plants later recovered, however, and by harvest plant size was quite substantial. Further work, using later and split applications, is being undertaken.

Tobacco

The flue-cured tobacco variety ZZ100, bred at the Southedge Tobacco Research Station, Mareeba, has been registered for growing in north Queensland for the 1980-81 season. This variety, a selection from Speight G28 x CSIRO 40T, incorporates resistance to blue mould (APT1), bacterial wilt and black shank, but gives a severe reaction when infected with potato virus Y (PVY).

In extensive tests ZZ100 has given higher returns per hectare than any of the other varieties registered for north Queensland. Appreciable grower acceptance of this variety is expected, particularly in those areas where the disease bacterial wilt is prevalent. Because the performance advantage of ZZ100 has not been as clear cut in trials in south Queensland, further assessments will be made in several bulk plantings during 1980-81 in all three southern tobacco growing districts.

The plant breeding programme is directed towards developing varieties incorporating a higher degree of resistance to blue mould, bacterial wilt and black shank. Imported American varieties, having a high yield potential and incorporating resistance to bacterial wilt and black shank, are used as parents in producing material with a limited higher yield potential consistent with acceptable leaf quality. As some American varieties used as parents are the origin of severe reaction to PVY, assessment of breeding material has been extended to screen for PVY susceptibility. A screening method developed by Plant Pathology Branch provides a practical technique to screen seedlings for severe reaction to this virus.

A further development in genetic improvement techniques has been the adoption in 1979-80 of breeding by anther culture. This method is expected to shorten the time involved in producing new breeding material.

A common practice in north Queensland is for growers to separate plantings by a few weeks. The Department is examining the feasibility of planting crops more widely spaced in time as a means of reducing costs of production. This involves identifying problems associated with growing tobacco in a winter environment. Two aspects are currently being investigated: the feasibility of increasing leaf number of currently registered varieties and selecting varieties better adapted to winter conditions.

Progress has been made in improving the performance of early planted (May) crops by the use of alternative varieties and by modifying management practices. These studies are being continued and will include evaluation in more detail of the effects of growth regulators and plant spacing on crop performance.

Cotton

Deltapine 61, an introduction from the United States, again produced yields superior to those of the commercial varieties Deltapine 16 and Deltapine SL 13 over all Queensland sites in the Australian Cotton Variety Trials in 1978-79. On the basis of its performance over 3 years of tests, it was recommended for commercial production in the 1979-80 season.

Evaluation of varieties and breeding lines incorporating a range of characters conferring resistance to, or escape from, insect attack continued in 1978-79. Results indicated that early maturity, nectariless and high gossypol characters were important in achieving high yields with low insecticide usage.

None of the varieties combines all three characters but high yielding, high gossypol breeding lines and high yielding, early maturing varieties with commercial promise are being tested. The early maturing Coker 310 gave yields similar to those of Deltapine 61 in its second year of test and, in addition, has superior fibre quality.

Water use strategies for cotton are being investigated at Emerald so that individual farmers can decide how best to make use of the water available to them to achieve the best economic return. Preliminary experiments over the past two seasons comparing watering treatments based on evapotranspiration indicated that yield loss did not occur until the water deficit exceeded 75 mm between irrigations. A deficit of 150 mm reduced cotton yield by 23% below that achieved at 75 mm which is the basis for current recommended practice.

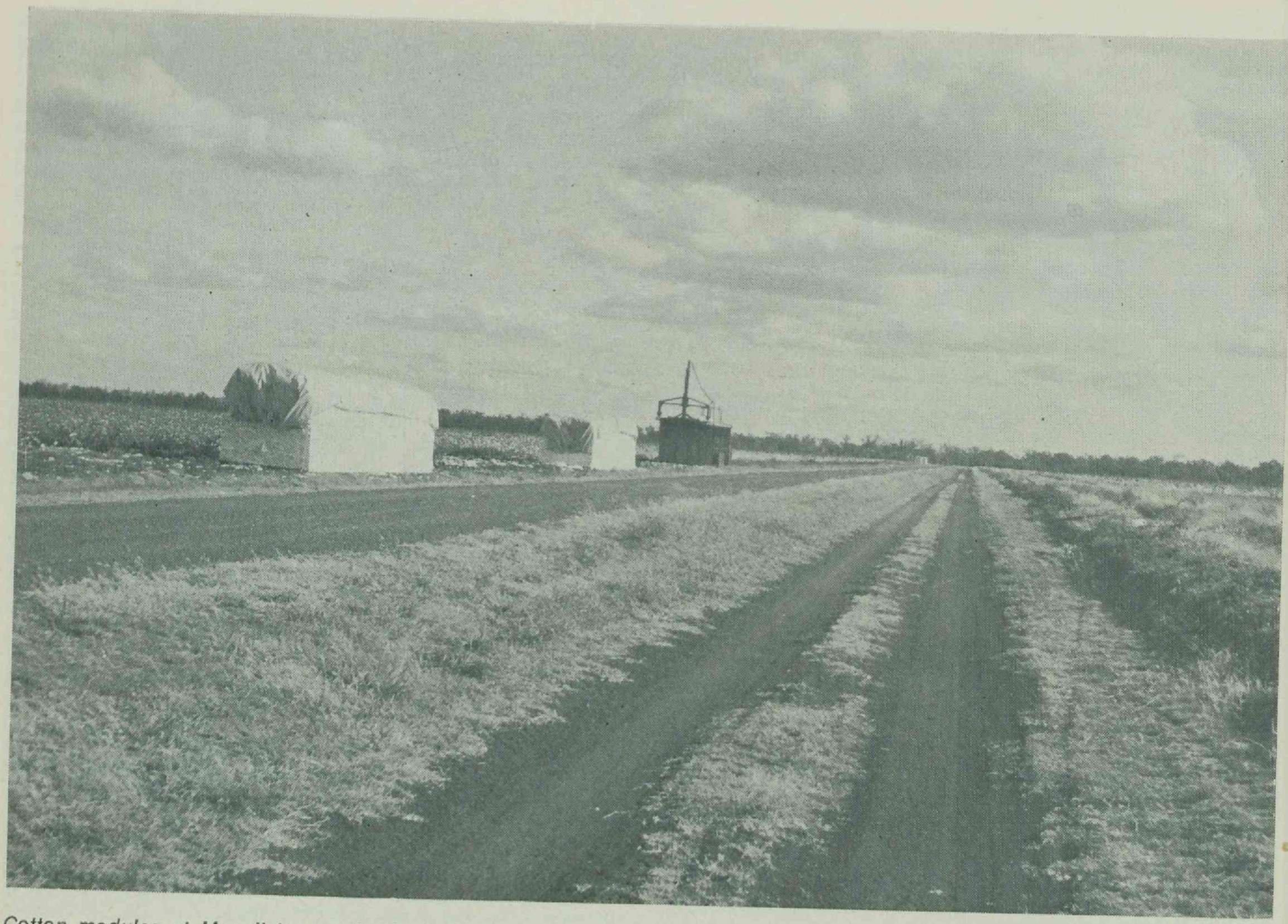
Rice

The introduction of rice varieties and breeding lines from overseas and interstate has been continued. There are now 199 lines available for field testing. These comprise 75 lines from the International Rice Research Institute in the Philippines, 40 lines from the International Institute for Tropical Agriculture in Colombia, 4 varieties from the U.S.A., 40 lines from Western Australia and 40 lines from New South Wales.

Seed multiplication to quantities sufficient for large-scale testing is in progress and to date it has been possible to examine only the early maturing lines from the Philippines and the U.S.A. in large trials. None of the lines was outstanding and many of the lines from the Philippines will be discarded as they are susceptible to lodging. Of the American varieties, Bonnet 73 looked quite promising. This variety is reputed to have a low whole grain millout in the U.S.A. and this aspect of its performance in Queensland is yet to be checked in milling tests.

A high-yielding cotton crop in the Emerald Irrigation Area, a locality that is now making an important contribution to Queensland's overall cotton production.





Cotton modules at Macalister on the Darling Downs in the 1979 season.

In single row seed increase and observation plots some spectacular yields were obtained particularly from some Colombian lines. Yields of more than 12 000 kg per ha were obtained compared with 8 000 kg per ha from a check row of Starbonnet. While too much weight cannot be put on yields from non-replicated, single-row plots, the magnitude of the yield advantage in these lines suggests promise.

It has been suggested that chemicals phytotoxic to rice can be used to control red rice in rice crops, provided the rice is treated with an inhibitor before planting. This hypothesis was tested experimentally but herbicides such as EPTC were extremely phytotoxic on rice even when the seed had been treated with inhibitor. Two herbicides, however, molinate and trifluralin, were selective to a degree against red rice both with and without the use of the inhibitor. These two herbicides will be more critically tested in future trials.

Safflower

The most important factor influencing safflower production in central Queensland is the disease *Alternaria carthami*. This seed-borne disease has been shown to survive for at least 2 years on safflower stubble. This finding underlines the importance of crop rotation in minimizing the development of this disease.

The set of all possible crosses among eight safflower varieties with differing levels of tolerance to *A. carthami* has been produced. These crosses and their parents are being evaluated by Plant Pathology Branch to determine whether the tolerance of the progeny is greater than that of the parents. It was found that leaf and bract tissue on the same plant demonstrated different levels of tolerance to the disease, and this difference varied with parent genotype.

As the parents used in the crosses cover the full range of these differences, it may be possible to identify progeny with superior tolerance to *A. carthami*.

Potatoes

Clod formation in medium and heavier soils of the Lockyer Valley used for potato growing is but one manifestation of soil physical deterioration resulting from intensive cash crop production under irrigation. Marginal irrigation water quality and soil compaction by heavy farm machinery and transport vehicles contribute to this deterioration.

An investigation was commenced in 1976 to compare the effects of: ripping to 50 cm with non-ripping; conventional hilling with chemical weed control; gypsum at 8 tonnes per hectare with no gypsum; and a high residue crop (sorghum) with a low residue crop (processing green beans). In the first three cycles rotating potatoes with sorghum produced fewer clods than rotating with beans, and chemical weed control in the potato crop produced fewer clods than did normal cultivation. The differences were not great, however, and some treatments did not have a consistent effect.

The seed potato production investigation conducted over some 8 years showed that it was technically feasible to produce good quality seed potatoes of the Sebago variety in Queensland. The investigation is now complete and consideration is being given to Departmental involvement in and commercial acceptance of, a seed production scheme.

Onions

The Gladalan Brown and White varieties are higher yielding than the Early Lockyer Brown and White varieties. The Gladalan varieties also show tolerance to downy mildew (*Peronospora destructor*). Unfortunately the Gladalan varieties if planted before mid May produce seed stems rather than bulbs in more than 95% of plants.

A selection programme is in hand to reduce the percentage of seed stem producing plants in early plantings. This programme is showing considerable success with 10 brown and 9 white lines exhibiting fewer than 5% flowering stems in April plantings. The selected lines appear to have retained the good characteristics of the Gladalan varieties and it is envisaged that seed of a selected Gladalan White and a Selected Gladalan Brown could be available for release after the 1981 season.

Chickpeas

The chickpea assessment programme has run for 3 years and the crop appears to be well adapted to the heavy clay alkaline soils which are characteristic of the wheat belt. Data suggest that best results accrue from May plantings in southern Queensland and April plantings in central Queensland.

Phytophthora megasperma var. *sojae* was identified in plots at Hermitage Research Station and on old lucerne land at Cambooya in 1979. This disease was devastating and could jeopardise the establishment of a permanent industry. The Queensland collection, which extends to about 300 lines, is being screened for resistance to the disease. In addition, lines with reputed resistance are being introduced from California.

Lupin

In the dry 1979 winter, lupins performed poorly on heavy alkaline clay soils. Plantings made in late June or in July are unlikely to be successful as flowering occurs in late spring when high temperatures have an adverse effect on pod and seed set.

At Biloela Research Station, early flowering single plant selections were made from the variety Ultra which showed considerable variability. Eighteen of the selections were tested and all gave higher yields than the parent variety. The highest yielding line also had a very low seed alkaloid content and has been selected for further testing.

Guar

Sixty-one lines of guar were screened at Biloela and Emerald in 1979. Yields ranged from 2 527 kg per ha to 4 196 kg per ha at Biloela and from 943 kg per ha to 2 352 kg per ha at Emerald. A condition, with symptoms similar to phosphorus deficiency, was recorded in the trial at Emerald.

Trials were continued in 1980 and the condition, recorded at Emerald in 1979, was recorded at other sites in central Queensland. A virus has been isolated from affected plants and is thought to be associated with the condition. Further research is needed to separate the effects of the virus and environmental and nutritional factors.

Navy beans

Three variety trials were grown in the 1979 season. The trial at Hermitage Research Station experienced very dry conditions early in its progress necessitating an irrigation supplement. The best yield overall was obtained from a re-selection in Selection 37. This re-selection significantly outyielded the four commercial varieties at Kingaroy and the variety Actolac at Hermitage Research Station.

The screening of breeding lines was continued at three sites and a number of high yielding, rust resistant lines was selected for more intensive testing.

Large seeded lines were also tested and three were selected for their high yielding ability. In processing tests, the highest yielding of these lines was found to have a high percentage of hard seeds which renders it unsuitable for the processing trade. The other two lines, one of which is resistant to peanut mottle virus, are being retained for further testing and preliminary seed increase.

The international Institute for Tropical Agriculture, centred in Colombia, has a considerable interest in navy beans and this Department has participated in its International Field and Adaptation Nursery Programme. In the trial with 25 entries, grown at Kingaroy, the highest yield (2 824 kg per ha) and the mean yield (1 893 kg per ha) were both greater than the yield from the Queensland check line Sel. 46 (1 835 kg per ha).

Cassava

Cassava has long been known to be an excellent source of quality starch. An interest by starch processing firms, together with the possibility of cassava being used as an alternative source of liquid fuel, led to the commencement of a cassava research programme 5 years ago.

A variety testing programme, conducted in co-operation with the University of Queensland, selected the variety MAUS7, which is thought to have originated in Fiji, as being suitable for Queensland environments.

A programme to study the regional adaptation of cassava was initiated towards the end of 1978. With rain-grown sites at Coolum, South Johnstone and Southedge and an irrigated site at Southedge, the range of Queensland climatic environments with possible adaptation for cassava is sampled.

Results indicate that early tuber production is related to temperature and available moisture. In autumn plantings tuber yields after a 6-month growing period have ranged from 4 t per ha (Southedge, rain-grown) to 16 t per ha (South Johnstone). After a 9-month growing period, tuber yields ranged from 7 t per ha (Southedge, rain-grown) to 43 t per ha (Southedge, irrigated). The best yield after a 6-month growing period, to date, was 36 t per ha from a midsummer planting at Coolum, but harvests from similar plantings at other sites have yet to be made.

Weed control

Experimental work in north Queensland to compare methods of controlling nut grass (*Cyperus rotundus*), showed that glyphosate, bromacil and repeated dry weather cultivation were superior to the use of thiocarbamate herbicides. Glyphosate produced a most spectacular reduction in shoot growth but reduction in tuber numbers was less marked. However, germination and tetrazolium tests conducted on these tubers showed that many were moribund or dead.

Because a long period exists between planting cassava and full plant canopy development, effective weed control is necessary during this period. It has been found that combinations of the grass-killing chemicals alachlor and diphenamid with the broad-leaf weed killers diuron and fluometuron give the best weed control with no visible harm to the crop.

Climbing buckwheat is a weed of increasing significance in the Callide Valley. Experimental work over three seasons showed that early applications of herbicides consistently gave better control than later applications. Wheat yields, however, were reduced by 2,4-D amine at 1 100 mL per ha when applied at the early growth stage. Bromoxynil, applied early at 1 400 mL per ha, has provided the most effective control but Dicamba plus MCPA also applied early has performed almost as well. The Dicamba plus MCPA treatment has the added advantage of costing approximately half of the bromoxynil treatment.

Anoda weed (*Anoda cristata*) has proved rather difficult to control in peanuts. Five post-emergence herbicides, dinoseb, bentazone, 2, 4-DB, MCPB and 2,4-D were tested and bentazone was found to give 95% control of Anoda weed at the 2 to 3 and 3 to 4 leaf stages. At the 5 to 6 leaf stage control by bentazone fell to 12% but a mixture of bentazone and dinoseb achieved a 95% control.

In a study of the control of Johnson grass (*Sorghum halepense*), it was demonstrated that the first initiation of fresh rhizomes occurs approximately 3 weeks after emergence following cultivation. It has also been demonstrated that rhizomes are viable in the field only for the growing season following the season of initiation. It was, therefore, surmised that Johnson grass could be eradicated by cultivations made to prevent the formation of new rhizomes.

Field experimentation showed that 11, 3-weekly cultivations over the 1978-79 growing season were fully effective in preventing further regrowth up to November 1979. When nine, 4-weekly cultivations were made a small amount of regrowth was found in mid November 1979. Cultivations at 5-week and 6 week intervals had little effect on regrowth following each cultivation and the patches of Johnson grass re-established at the beginning of summer in 1979.

In tests of the tolerance of barley cultivars to wild oat herbicides, difenzoquat was completely safe to use. WL43425 did not affect yield but tiller height was reduced if applied at the first node stage. Dichlofop methyl appeared to be safe on barley at the $4\frac{1}{2}$ to $5\frac{1}{2}$ leaves stage, but by this time the wild oats would be at or beyond the optimum application stage of 2 to 4 leaves.

Cultural techniques and surface management

At Hermitage Research Station, the long-term trial designed to compare the agronomic consequences of various methods of fallow management for the production of winter cereals on a black earth soil was continued. The eleventh fallowing period was completed and the eleventh crop sown in 1978-79.

The first six crops in the trial were wheat (var. Timgalen). However, yellow spot disease (*Pyrenophora tritici-repentis*), which varied with stubble management systems, masked yield responses to other important agronomic effects of the treatments. Barley (var Clipper), which is little affected by the disease, was sown for the seventh to ninth crops. Wheat (var. Timgalen) was again sown for the tenth crop.

A feature in the three barley crops had been the relatively poor and uneven early crop growth in the zero tillage with stubble retention treatments. The wheat crop in 1978 did not demonstrate the problem so in 1979 the trial plots were split and sown to wheat and barley for the eleventh crop. In this season the establishment problem was apparent in both species in the zero tillage treatment and is therefore not species specific. The possibility of nematodes being involved in the problem is to be investigated in 1980.

On the Darling Downs retention of stubble has been shown to substantially reduce evaporation from the top 15 cm of soil leaving higher soil water levels. Results of experiments to determine whether these higher soil water levels improve crop emergence are conflicting and further work will be undertaken.

The effects of stubble retention and method of cultivation of grain sorghum are being investigated in central Queensland. Grain yields from sorghum grown on conventionally cultivated land were similar to those from sorghum grown on land which had been stubble mulched with a blade plough. However, yield of sorghum grown on land under zero tillage was significantly lower because of plant establishment problems. No major differences in soil moisture accumulation or soil nitrate levels occurred over the fallow period as a result of the different tillage treatments.

A research programme has been commenced to determine the extent to which soil physical factors influence the yield of field crops grown on the red soils of the South Burnett. Initially the programme is investigating peanut crop performance and a preliminary survey was made of crops on 26 farms in the 1979-80 season.

This survey revealed that primary root distortion occurred in many peanut crops at depths of 5 to 10 cm which suggests sub-surface compaction as a probable cause.

When peanuts were grown in soil which had not carried peanuts for many years or where deep ripping was carried out at regular intervals primary root distortion was not apparent.

Summer crop nutrition

In a study of nitrogen and phosphorus nutrition of summer cereal crops in the South Burnett, it was found that there was a significant interaction between the two fertilizer elements. Best yields of sorghum resulted when the nitrogen and phosphorus were applied together at planting.

Results of field trials in the soybean nutrition programme on red forest and scrub soils in the South Burnett indicate that present soil tests do not provide a sound basis for prediction of grain yield response to applied phosphorus. Soil phosphorus test calibration work over the past 4 years showed that soybean grain yield was poorly related to both acid and bicarbonate extractable phosphorus. However, a measure of the soil equilibrium phosphorus concentration was found to have a high association with grain yield response.

Reliable estimates of both grain yield response and phosphorus fertilizer requirement would be of great benefit to growers and a field testing programme is now planned to assess the usefulness of this test under commercial growing conditions.

At Emerald, nutrient screening trials on irrigated cotton were conducted in 1978-79 and 1979-80 on the open downs basaltic clay soil where cotton growth and yields were poor in 1977-78. Yield responses were obtained in both years to application of nitrogen and phosphorus.

At nitrogen rates of 120 to 180 kg per ha, responses to phosphorus applied at 40 kg per ha ranged from 50 to 80%. This result is of considerable significance to the Emerald Irrigation Area, as this soil type is typical of approximately half the irrigated area.

A major research programme on sunflower nutrition and fertilization is being conducted in central Queensland. Both rain-grown and irrigated trial sites are being used in an attempt to relate nutritional requirements with moisture availability.

Early results obtained in the Biloela area indicate that, though responses to phosphorus occurred in early vegetative growth in both rain-grown and irrigated environments, grain yield responses were obtained only under raingrown conditions. Yield responses to nitrogen fertilizer were greater at the irrigated site where the optimum rate was 80 kg nitrogen per ha. At the rain-grown site the optimum rate was 40 kg nitrogen per ha.

In irrigated sunflowers in the Emerald area yield responses were obtained from phosphorus applications up to 40 kg per ha and from nitrogen applications up to 120 kg per ha.

Production of Virginia Bunch peanuts is presently expanding in the traditional tobacco-growing areas of north Queensland where soil calcium levels are frequently sufficiently low to cause yield reduction and crop failure in extreme cases. This is brought about by failure of kernels to develop, resulting in the production of empty pods or 'pops'. A programme to investigate the problem was commenced in 1978-79.

No responses to added calcium were obtained over four sites in 1978-79 and this may have been due to the very wet conditions experienced in that year. Interactions with moisture availability are likely and will be investigated in future experiments.

Winter crop nutrition

In the study of the residual value of phosphorus fertilizer in western wheat growing soils, grain yields from the field trials were very low because of the poor growing season. Nevertheless the yield of 1 600 kg per ha from the fertilized soil was double the yield from the unfertilized soil (<800 kg per ha). It was also found that fertilizer applied before planting and mixed into the topsoil had a better residual availability than fertilizer banded into the soil with the seed at planting.

A research programme was commenced in 1978 to study the influence of various factors such as the form of nitrogen used, water regime, stubble treatment and time of fertilizer application on the fate of nitrogen applied to the wheat crop. In one experiment, labelled fertilizer nitrogen was applied to the fallow in February and artificially watered through the February-April period to simulate a very wet season.

Results indicated a large potential loss of fertilizer nitrogen. In a companion field experiment with unlabelled nitrogen fertilizer and watering equal to average weather conditions, there was no detectable loss.

In a linseed fertilizer trial on a Darling Downs black earth at Allora, it was found that low to moderate rates of nitrogen (10 to 30 kg per ha) and low rates of phosphorus (10 to 20 kg per ha) were adequate to ensure high production of linseed.

A heavy crop of Panorama millet at Kaimkillenbun in the 1979 season.



Pasture research

Seed production studies

In north Queensland, pasture legume seed production work has been occupied with recently released or emerging cultivars: in the production and distribution of seed to ensure smooth passage into commercial use, and in the provision of information necessary to enable farmers to grow the new cultivars successfully.

Research on the seed production characteristics of C.S.I.R.O.'s eight advanced breeding lines of Siratro (*Macroptilium atropurpureum*) is now completed. It has confirmed that four lines have effectively the same seed production characteristics as cv. Siratro. One moves more quickly into flowering during each soil drying phase, and with individual treatment could outyield Siratro. Two lacked flowering vigour throughout the season, and produced only two-thirds the seed that Siratro did, while one, though a late starter, finally yielded satisfactorily.

With the new *Stylosanthes scabra* cultivars Seca and Fitzroy, effort has been put into the monitoring of seed production and loss in order to determine harvest strategies and potential yields. Both cultivars lend themselves readily to either header or suction harvest systems. Seca retained about two-thirds of its total production as standing seed for 5 weeks. Monitored production of standing seed was as high as 1 000 kg per ha in Seca and 1 500 kg per ha in Fitzroy. A similar monitoring project with an older established cultivar, *Desmodium intortum* cv. Greenleaf, identified major losses of seed during the harvest operation.

Work on grass seed crops is now concerned with post-harvest treatment to improve seed quality, and with the relationship between field performance and the laboratory record of quality.

It has been amply confirmed that early post-harvest handling, especially the rate of drying, is critical to the subsequent quality of grass seed (rapid drying being very damaging), and methods of brief re-wetting of stored seed as a means of improving quality are being examined. These have improved laboratory germination but not subsequent field establishment in the past, and attempts are now being made to do both.

Earlier conclusions that the germination test is a reliable guide to the planting value of tropical grass seeds have been considerably modified in view of the second year's results of an experiment designed to show the association between the two. Although seed with very high or low laboratory germination usually behaves predictably well or badly in the field, intermediate seed samples exhibit a wide variation in field performance which is totally unpredictable from their laboratory behaviour. The causes of this must continue to be investigated.

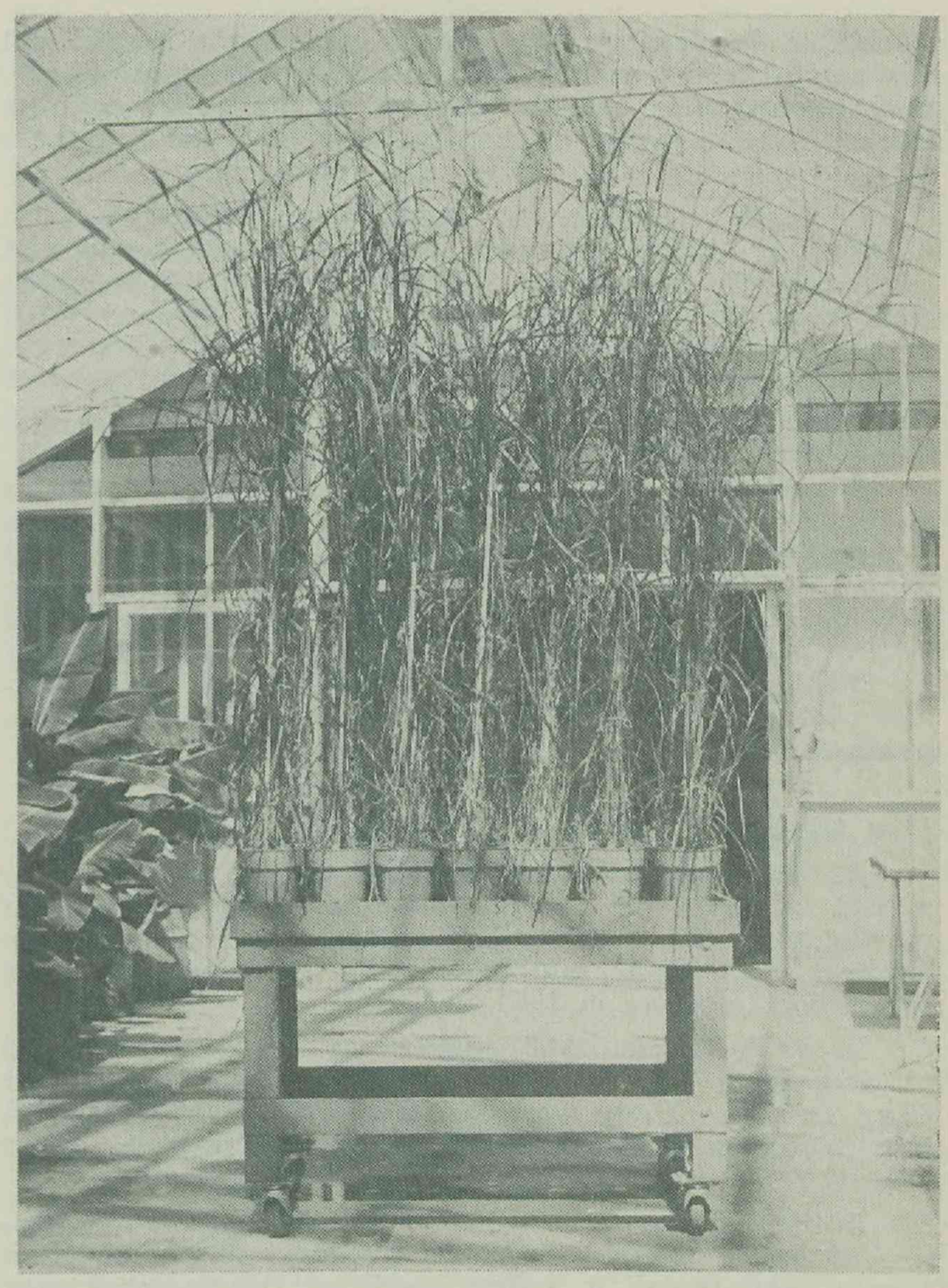
Some 110 ha of certified Callide Rhodes grass (*Chloris gayana*) were harvested for seed in southern Queensland in May-June 1979, which should provide about 12 tonnes of cleaned seed. This cultivar is well and truly restored to commerce. For the first time since release in the 1960s, 0·5 t of Samford Rhodes grass seed will also be available.

The value of these seeds to growers will be in the order of $100 000, and is a direct result of the Gympie programme. The Rhodes grass work is now being finalized and a start made to look at other plants including Oxley fine stem stylo. Narok setaria (*Setaria sphacelata*) is a low seed producer and the problem appears insuperable; Narok is a shy seeding cultivar.

The seed production and loss from *Paspalum plicatulum* cv. Bryan have also been monitored for 3 years. Well synchronized crops have a peak of yield for only 3 to 5 days in late April or early May and then a slow decline period of 6 to 11 days. The largest inflorescences and seeds are produced early in the reproductive phase, after which size declines with time. The yield potential for header harvesting of well fertilized crops is in the order of 100-200 kg ha^{-1} of pure seed.

High rainfall tropical pasture

On the wet tropical coast, the two grazing studies —at King Ranch's Tully River Station and at Utchee Creek —are continuing. On the fertile basaltic rain-forest soil at Utchee Creek, 3·7 beasts ha^{-1} have again been carried, with mean daily liveweight gains of 0·40 to 0·45 kg head^{-1}. On the less fertile granitic forest soil at Tully River Station the 3·7 beasts ha^{-1} stocking rate was maintained throughout the year on systems using buffer areas of signal grass (*Brachiaria decumbens* cv. Basilisk). Corresponding grass-legume systems only managed 2·47 beasts ha^{-1}. The average daily liveweight gain of 0·40 kg head^{-1} was considered low for these pastures. Cobalt supplementation improved daily gains by 0·11 kg head^{-1} but feeding salt had no lasting effect.



Studies of daylength effects on flowering of Callide Rhodes grass underlie the successful seed production of this cultivar.

The *Calopogonium caeruleum* grazing trial at Utchee Creek has been terminated. While the legume grew well and persisted strongly, it was poorly grazed; with time the guinea grass was all eaten out and weeds began to appear widely. In the third year (1978-79) liveweight gain fell dramatically to less than 0·1 kg day^{-1} head^{-1} from 0·5 kg the previous year.

At South Johnstone, on the deep red Um6 soil (average annual rainfall, AAR 3 200 mm), an assessment of three centro hybrids against cv. Belalto and two setarias against common guinea (*Panicum maximum*) has not revealed any superior type of either grass or legume in the first year. However, an area (1·6 ha) of *Setaria splendida* at Utchee Creek, in the second year of grazing at 3·67 beast ha^{-1}, has given 682 kg LWG ha^{-1} and 0·51 kg LWG head^{-1} day^{-1}, a substantial improvement on its first year performance despite a still low legume content.

At both South Johnstone and Mackay, the new lines of Siratro bred by Dr E. M. Hutton before he retired are under test. At this stage little separation has occurred between lines.

From Mackay, a series of nurseries has been operated seeking new legumes, especially for the wetter soils where persistence of Siratro has been a problem. These have suggested that *Alysicarpus rugosus* and *Aeschynomene americana* may provide useful plants. At 'Tedlands', south of Sarina on a sandy duplex soil, *A. americana* in particular has spread widely throughout the nursery and continues to spread under grazing. *Desmodium heterophyllum* is also spreading and several accessions of *Centrosema pubescens* are persisting well on a fine sandy loam (Gn2.01) at Mackay.

Within the genus *Stylosanthes* various lines of *S. scabra* continue to prove the outstanding legumes, especially Seca in the high rainfall areas. CPI 40205 (now cv. Fitzroy) is also performing well in drier areas. In another series of plantings, the plots located in grazed commercial paddocks, *S. guianensis* cv. Graham (formerly CPI 40255) and CPI 40294 have produced most dry matter with nil fertilizer and have greatly outyielded siratro under these conditions.

On heavily grazed paddocks of the old 'Tedlands' grazing trial the natives *Desmodium triflorum, Alysicarpus vaginalis* and *Aeschynomene indica* were the most frequent legumes and had nitrogen contents similar to Siratro. At more lenient stocking rates, the native legumes decreased in frequency and yield. Only *A. vaginalis* and *A. indica* gave reasonable yield (*c.* 2 000 kg ha^{-1} oven dry matter) when protected from grazing for some months by cages.

After 7 years' grazing, the Siratro levels in this old trial are declining under all but the lowest stocking rate (1·2 steers ha^{-1}); but the increase in the native legumes has enabled the heavier-stocked paddocks, 2·5 and 2·0 steers ha^{-1}, to maintain good LWG until frosts occur.

In the efforts to restore sown legume to these pastures, a series of studies has been undertaken and commercial pastures in the district are also being observed. Soil legume seed levels are high in the old trial area (around 1 260 seed m^{-2} for Siratro) but are much lower in most commercial pastures (around 80 seeds m^{-2}). High levels of *Stylosanthes* spp. such as cvv. Fitzroy and Graham (> 2 800 m^{-2}) have also been recorded in old plots.

Ripping plus overseeding of old overgrazed pastures has resulted in substantial increases in Siratro stands but the response has tended to be short lived. The reason for this is not yet clear; in part it may have been due to heavy stocking during wet weather in March 1979. Burning old Siratro pastures produced more seedlings in the first year but their survival was poorer over the first wet season, perhaps because the trash layer is necessary for wet season Siratro survival.

Dry tropics pasture

At Kalinga, on the red earths of Cape York Peninsula, a field fertilizer trial using *Stylosanthes scabra* cv. Seca as the test plant has given variable responses to P in the establishment year (1976) and in 1978 (a dry year), but clear and strong responses in 1977 and 1979.

In 1979, the initial P applications increased DM yield of Seca from 1 250 kg ha^{-1} at nil to 3 900 kg ha^{-1} at 80 kg ha^{-1} P. There were suggestions of both Zn and K responses when more than 10 kg ha^{-1} P were applied. These responses are occurring 4 years after application.

In the first year of an experiment comparing the effectiveness of double superphosphate and Duchess rock phosphate on Verano pasture on a yellow earth at 'Morecambe' near Mt. Garnet, rock phosphate was ineffective as a phosphate source, while double superphosphate increased DM yields to near maximum levels at an application rate of 50 kg ha^{-1} P. Similar effects were observed in native legumes (*Crotalaria, Glycine, Desmodium* and *Indigofera* spp.), but no significant effects were measured on the native grasses (*Themeda australis* (kangaroo grass) and *Heteropogon contortus* (spear grass)). Bicarbonate extractable soil phosphorus was a better measure of phosphorus available to the legume than acid extractable phosphorus, particularly where rock phosphate had been applied.

A strong S response to up to 20 kg ha^{-1} S as gypsum was also recorded on the red earths at Kalinga whilst in pots, using a strongly S deficient soil, there was little difference in DM yield of a range of *Stylosanthes* spp. Small additions of S caused marked yield separations between cultivars and maximum responses were between 5 and 10 kg S ha^{-1}. At 5 kg ha^{-1} S, descending order of responsiveness was cvv. Paterson, Verano, Endeavour, Schofield, Seca and *S. viscosa* (34904).

On the euchrozem soils at 'Meadowbank' south of Mt. Garnet, successive applications of variable S rates since planting of a *S. guianensis* cv. Graham pasture in 1973 have shown that maximum response in stylo yield is obtained from a current season's application of 5-10 kg ha^{-1} S. The residual value, especially of gypsum, is low. Elemental sulphur has a higher residual value but its peak yield, when freshly applied, is below that of the equivalent gypsum rate. In the third year after application of S ceased, only 80 kg ha^{-1} S produced a yield response.

These 'Meadowbank' pastures were grazed in 1978-79 using the legume areas as supplements to areas of native pasture. The *Stylosanthes* stands were themselves supplemented with sulphur and sodium (Na) licks, or refertilized with elemental sulphur at 50 kg ha^{-1} or left untouched.

Pasture yields were high and remained adequate until a wild fire burnt out the area in October 1979. From September 1978 to June 1979, the NP (native pasture) alone, NP + stylo fertilized, and NP + stylo without supplement performed similarly and gained around 108 kg mean LWG (live-weight gain) beast^{-1}. The NP + stylo with S + Na lick gave 177 kg LWG head^{-1}. From June to October 1979, NP control held weight, NP + stylo + S + Na lost 50 kg head^{-1} and the NP + fertilized stylo and NP + stylo and no supplementary S or Na each lost about 25 kg head^{-1} LW. A single stocking rate was involved in all treatments and the control. An adjacent area planted to Archer (*Macrotyloma axillare*) and grazed in conjunction with native pasture without any recent fertilizer or supplementation gave steady LWG throughout the period without any winter loss; the final seasonal LWG from September 1978 to early October 1979 was 120 kg head^{-1}.

Yearling Herefords grazing nitrogen-fertilized pangola grass pasture.



Within the species evaluation field the two *Stylosanthes scabra* cvv. Seca and Fitzroy consistently have been the most widely established plants in a series of sowings in the Burdekin region, especially at the drier sites, whilst *S. hamata* cv. Verano is combining well with *Bothriochloa pertusa*, which is naturalizing extensively in the Burdekin area. Superphosphate has generally improved legume establishment and growth and there has been only limited spread away from the sown plots.

Within the grasses, Callide Rhodes and *Bothriochloa insculpta* cv. Hatch have been amongst the most promising.

Where the *Stylosanthes* spp. have been grazed they have generally proved effective legumes. In the northern sandy forest country between Normanton and Croydon, strip plantings have been made on a number of properties, with only *S. scabra, S. hamata* cv. Verano and *S. humilis* lines establishing and persisting. Continuous heavy grazing along the strips, however, is beginning to take its toll and the 1978 drought in particular has resulted in reduced legume and native grass densities on these strips. Some limited spread of the legumes from the strips has occurred.

In the quarantine nursery at Walkamin, 126 lines from various sources were processed and 400 older samples regrown to rejuvenate seed supplies. Of the new lines the most promising material appeared to be in the genera *Desmanthus, Galactia* and *Rhynchosia.*

A collection of shrubby legumes for browse was also grown at Walkamin, Yalkula and Kalinga. At Walkamin, *Acacia angustissima* CPI 40175 was the best line with *Flemingia macrophylla* CPI 53911 also growing well and persisting under severe defoliation. At Yalkula, *F. macrophylla* persisted well on a different solodic soil, as also did *Rhynchosia sennaarensis* CPI 52724; the latter, however, is strongly aromatic and may be unpalatable. Only *Tephrosia elegans* CPI 52963 looks promising at Kalinga, which is a particularly harsh site.

Within the *Macrotyloma uniflorum* breeding programme, further crosses have been made to increase the number of early flowering lines available in the hybrids between crop and wild type plants. A few though mostly sterile, plants have been derived from interspecific crosses between *M. uniflorum* var. *stenocarpum* and *M. africanum,* and between *M. axillare* and *M. uniflorum.* The latter offers prospect of developing a non-seed-shattering line akin to cv. Archer if colchicine induced fertility can be achieved.

Pasture studies—central Queensland

The survey of the state of disturbance of the original vegetation in central Queensland has concentrated this year on the brigalow lands. One third of the area covered has a severe woody regrowth problem with greater than 4 000 plants ha^{-1}. Another third has a negligible to minor problem with fewer than 1 500 plants ha^{-1}. Brigalow (*Acacia harpophylla*) is the main problem species but currant bush (*Carissa ovata*), yellowwood (*Terminalia oblongata*) and black gidgee (*Acacia argyrodendron*) also occur. Forty-one per cent of the cleared brigalow country carries only native pastures, made up of a range of species.

Within the regional legume evaluation on a series of matching clay and duplex soils and red earths at three centres, the *Stylosanthes scabra* lines continue to be outstanding. They gave the best initial establishment and are now persisting well under intermittent grazing. Anthracnose (*Colletotrichum gloeosporioides*) does not appear to be a problem on susceptible lines even at the wettest site, north of Rockhampton.

In fact, a survey of a wide range of plants of *S. scabra* lines, especially cv. Fitzroy, has suggested that anthracnose is not a problem with this species west of the 750 mm isohyet, nor even at higher rainfalls south of 22°C latitude; it would appear that both high temperatures and high humidity are required for the disease to occur widely in damaging proportions.

Under grazing at 1·1 beast ha^{-1} when sown into buffel grass pastures on Brigalow Research Station, the *Stylosanthes* have had a battle to survive, especially on the heavier Ug5·2 soil. The two *S. guianensis* lines, Graham and CPI 40294 in particular, have reacted poorly to the dry summers. *S. viscosa* CPI 34904 and *S. scabra* CPI 40205 (Fitzroy) and 34925 have survived better. Verano has also done well but was affected by the cold winters with only about 15% survival.

Pasture studies at 'Brian Pastures' and Isis

To date no adverse effect in cows having access to planted areas of leucaena over winter has been noted at 'Brian Pastures' in the Burnett region, while improved calving percentages and low winter weight losses have been recorded. In 1978, these breeders actually gained 24 kg $head^{-1}$ LW while those on native pasture with urea-molasses supplement lost 21 kg $head^{-1}$.

Pastures where the legume is fine stem stylo (*S. guianensis* var. *intermedia*), available all the year but only planted initially in strips, are showing breeder performances midway between the pastures supplemented with leucaena and with urea-molasses.

Supplementary leucaena plantations available to the growing progeny of these breeders beyond weaning has reduced the normal 50–60 kg winter-spring LW loss to only 6 kg in 1979. At first grazing, only 900 kg ha^{-1} of leucaena was available and only 0·4 ha is provided for each steer.

In the intensive production system at 'Brian Pastures', a good winter-spring season in 1978 resulted in 90 kg LWG $head^{-1}$ from weaning in May to November. These animals were on sown green panic (*Panicum maximum* var. *trichoglume*) pasture. From December to mid April, the last 6 weeks with leucaena supplementation, a gain of 65 kg $head^{-1}$ was recorded on native pasture with a further 40 kg LWG from mid April to May on crop residues and 81 kg on lablab chaff (*Lablab purpureus*) and sorghum grain from the cropping areas fed in stalls from June to September. The final LW of these 60 steers before sale was 453 kg $head^{-1}$.

The performance on the green panic pastures is correlated very closely with pasture age. The average LWG on a 1-year-old green panic stand is 85% greater than on a fifth year pasture. Total dry matter yields on offer in May are similar, but leaf N and S contents are both declining with age of the pasture.

Nitrogen and sulphur contents of diets selected by fistulated animals were superior to those of the presentation leaf in both green panic and native pastures. The presentation N content of leaf in green panic was 0·94% and that of the bolus 1·407%. Sulphur figures were 0·061 and 0·082% S respectively.

A water balance model (WATSUP) being developed at 'Brian Pastures' has shown good predictive ability, especially on the lighter textured soils. It is less reliable on heavy cracking clays. Even on these, however, when tuned with local soil moisture data, actual to predicted values for soil moisture in various levels for green panic pastures at 'Brian Pastures' are highly correlated.

At the Isis Experimental Site on the wallum country north of Maryborough, liveweight gain per head decreased from 192 to 137 kg as stocking rate of the weaners increased from 1 ha $head^{-1}$ to 0·4 ha $head^{-1}$, but gain ha^{-1} increased from 192 kg to 343 kg. *Lotononis bainesii* cv. Miles withstood the higher stocking rates much better than Siratro and the proportion of leaf in the pasture increased while standing biomass declined drastically. Faecal crude protein levels were essentially constant at all stocking rates.

Lucerne studies

The evaluation of lucerne cultivars for aphid resistance has continued at Biloela and Gatton under irrigation, and under rain-grown conditions at Biloela, Toowoomba and Mitchell. Aphid populations have been low at all sites and spraying for control has rarely been necessary.

As a result, no depression in yields even of Hunter River and other control cultivars has been recorded in the absence of spraying. First year yields under irrigation at Biloela have exceeded 25 t ha^{-1} for Matador, CUF 101, Pioneer 572, Paravivo and Siro Peruvian. CUF 101 (16·1 t ha^{-1}) was also the highest yielding at Gatton where *Phytophthora* root rot has been active with plant losses ranging from 54% for C3 Composite to 81% for Hunter River.

A small row trial initiated at Gatton when the aphids first appeared failed to reveal any resistances in a range of Hunter River samples.

With reference to lucerne seedlings, there was no association between population of either of the two aphid species carried and the cultivar seedling resistance to aphids. By the two to three trifoliate leaf stage, seedlings of all cultivars showed considerable tolerance to blue-green aphid while seven winter-vigorous types exhibited fair seedling resistance to spotted alfalfa aphid.

Through selection it has been possible by the F_2 generation to substantially improve the field resistance of both Hunter River and Siro Peruvian lucernes to anthracnose, at the same time retaining the initially superior yielding ability of Siro Peruvian as the stand ages.

Three lucerne cultivars, Hunter River, Siro Peruvian, and Walkabout were waterlogged in the glasshouse at Biloela after varying periods (0 to 16 days) of regrowth after cutting. The cultivars did not differ in their reaction but stage of regrowth had a major effect, the plants with the least regrowth being most seriously damaged.

Annual medic studies

Annual medics (*Medicago* spp.) grown in a small plot trial on an alluvial Ug5 soil at Biloela since 1973 have been rated over recent springs for dry matter production. The medics have had a major effect on grass growth and over

the 1978-79 summer, soil N and grass yield and N status were measured. Both total and available soil nitrogen were curvilinearly related to previous medic yield. Grass N (nitrogen) and DM (dry matter) yields were similarly associated with medic yield, grass yield being around 3 t ha^{-1} in the 0·6 to 2·0 t ha^{-1} yr^{-1} medic yield, increasing to around 6 t ha^{-1} in the medic yield range of 2·0 to 2·6 t ha^{-1} yr^{-1}. Grass species also changed, being chiefly natives below 1·3 t ha^{-1} medic, Rhodes grass between 1·3 and 2·3 t ha^{-1} yr^{-1} medic, and green panic at greater than 2·3 t ha^{-1} e.g. with Jemalong barrel medic.

In the regional medic studies carried out from Warwick, with further sites at Gayndah 'Brian Pastures' and Roma, seed yields after the wet 1978 winter ranged from 370 to 725 kg ha^{-1} of cleaned seed for Jemalong and Robinson cultivars respectively.

On the heavy soils at Roma and Gayndah, virtually no seed was set in the dry 1979 winter, but some seed set occurred on the lighter soils. The best mean dry matter yields in 1979 were only in the order of 500 kg ha^{-1}, although the Hermitage (Warwick) site made 830 kg ha^{-1} with the best cultivar (Robinson) reaching 2 100.

Under irrigation, dry matter yields of Robinson and Jemalong reached 9 300 and 5 500 kg ha^{-1} respectively at Warwick and 9 700 and 7 300 kg ha^{-1} at Gayndah by late spring. The mid August yields for Robinson, however, were only 2 700 at Warwick and 8 100 at Gayndah. Presence of a sown grass had no effect on medic yields while yields of Silk forage sorghum with Robinson were equal to those with 100 kg ha^{-1} applied N at Warwick.

With the initial year being a dry one, a range of temperate annual legumes has been grown in West Moreton on prairie and black earth soils. Sanza barrel medic, common burr and Sair and Robinson snail medics gave the highest yields. Sub clovers (*Trifolium subterraneum*) and disc medic yielded poorly, and Jemalong barrel medic was affected by aphids.

Temperate species

There are within Queensland small pockets where, even under rain-grown conditions, temperate plants have a major role to play in animal nutrition. Under irrigation, these areas are much greater. One small area occurs along the eastern edge of the Darling Downs where a range of temperate grasses is under evaluation. Demeter tall fescue, (*Festuca arundinacea*), Sirosa and Australian phalarises (*Phalaris aquatica*) and Currie cooksfoot (*Dactylis glomerata*) have proved the most persistent grasses and would probably be ideally planted as mixtures of several cultivars.

The South African developed ryegrass (*Lolium* sp.) cultivar Midmar has performed well in a series of plantings over the last 2 years in south-east Queensland, being the most productive or equal to the most productive cultivar in each planting. It also exhibits excellent rust resistance, a major fault with some ryegrass cultivars in some years.

Sub tropical species evaluation—southern Queensland

Evaluation of a range of bred lines of *Desmodium intortum* has failed to reveal any superior to Greenleaf or Silverleaf, the present commercial cultivars, at Coolum Research Station. These have also been inferior to Siratro over the seasons experienced since they were planted in 1976.

The *Macroptilium* strain evaluation has also continued from Gympie and Ipswich with two sites each spanning a range of soil types and rainfalls. Only at Peak Crossing, south of Ipswich, have any lines significantly outyielded the cultivar Siratro. Here two lines have been outstanding. One has also been one of the better at Gympie.

More than 200 legumes representing 33 genera and 90 species have been planted in a programme to seek summer legumes for the arable lands of southern Queensland. Brigalow clays and deep sandy soils at both Wandoan and Bringalily were the first sites planted. In an initially dry year (rainfall 25% below average) the most promising genera have been *Alysicarpus, Clitoria, Macroptilium, Macrotyloma* and *Vigna*. Best establishment was on the clay soils and 25% of the legumes produced mature seed before senescence or frosting.

In the preliminary stages of the investigation of legume degeneration in coastal pastures, a survey has been made of soil seed levels. Even in pastures from which they have disappeared, up to 130 seeds per m^2 of Siratro have been recovered. Figures from Greenleaf desmodium, lotononis and white clover (*Trifolium repens*) have been up to 450, 1 700 and 500 seeds per m^2 respectively. Much of this seed is thought to be viable, indicating possibilities of rejuvenation if simple but effective techniques can be devised. These would involve controlled grazings with relatively long rest periods.

Management studies in semi-arid pastures

The monitoring of a range of sites throughout Western Queensland for long term vegetation changes suggests that in the Mitchell grasslands the number of species present is reduced in wet summers and the Mitchell grasses (*Astrebla* spp.) assume greater dominance. At one site (Yaraka), species numbers fell from 37 in 1972 to 15 in 1979. During the same period, *Astrebla* spp. rose from 12% to 71% of all plants recorded and basal area rose from 0·8% to 3·8%.

These studies are also indicating a large increase in the density of most woody plants with the recent wetter years.

A series of studies on the reaction of two important grasses, *Aristida jerichoensis,* a weed species, and the valuable *Thyridolepis mitchelliana* (mulga Mitchell) has suggested that the *Aristida* is well equipped to compete for space and to withstand defoliation, and begins seeding much earlier. Destocking during seedling regeneration may be necessary to achieve reasonable levels of *Thyridolepis* in pastures.

On the Mitchell grass country at 'Burenda', east of Augathella, the heavy grazing treatments are still giving the highest return despite damage to the pasture which has been so grazed since 1975. The gap in their favour is, however, narrowing. Only under light grazing did sheep not lose weight under the 1979 drought conditions.

In the similar study on mulga pastures at 'Arabella', east of Charleville, commenced in 1978, little change has so far occurred in grass composition, with different grazing pressures and animal performance is still holding up well; although by late 1979 sheep on the heaviest grazing treatment were losing weight under drought conditions.

Agricultural extension

Farmers, primary producer organizations and government instrumentalities at local, State and Federal level require technical information and managerial advice on crop and pasture production, soil and farm management. Agri-business firms and their representatives, hobby and weekend farmers and backyard gardeners are also making increasing demands for such assistance. The extension service exists to meet these needs.

The extension officer's role is to link industry with developing technology and to temper this with consideration and concern for the stability of the soil and water resources. In this role, extension officers undertake specific projects emphasizing new problems or techniques, they engage in routine dissemination of information and they are frequently involved in technical training.

There has been a noticeable change in extension activities towards more group activities. The farm visit is still the foundation of extension activities, but group activities are increasing in number to access more of the farming population and to stimulate farmer discussion of complex issues. Discussion groups, workshops and farm walks are more effective when farm and financial management, farming system, crop sequence and land management problems are being addressed.

Pasture development has accelerated in all districts in the last 12 months as beef producers in particular seek to increase productivity. In most districts, these development programmes have only been hindered by the dry summer. However, seed supplies of Oxley fine stem stylo have been scarce and pasture development programmes in the Burnett region have been thwarted. Similarly, pasture development programmes based on the recently released *Stylosanthes* cultivars Seca, Fitzroy and Graham which offer promise of a significant boost to beef productivity in the dry tropics have been delayed by scarce seed supplies.

The demand for pasture development advice has been associated with a demand for advice on timber control. Extension programmes have been mounted in most pastoral districts to provide graziers with up-to-date technology on timber and timber regrowth control.

Recommendations on the appropriate crop varieties to plant in each district have been continued. This service covers wheat, oats, barley, grain sorghum, maize and soybeans and provides grain growers with information enabling them to choose top performing varieties or hybrids.

Outbreaks of Australian plague locusts occurred in many southern inland districts towards the end of 1979. Plague Locust Destruction Committees were formed in many districts. These Committees co-ordinated landholders' efforts to minimize crop damage and together with the Australian Plague Locust Commission mounted a successful control programme. This programme was aided by the extreme hot, dry weather in midsummer to avert what could have been significant production losses.

The extension programme to control insect pests of stored grain was again directed at on-farm sites of infestation. The standard of farm hygiene has improved significantly on Queensland grain farms although further improvement is necessary. Extension efforts to minimize insect infestations on farms will be an on-going requirement if the State's grain handling and marketing authorities are to continue to meet market requirements.

Agreement was reached with the Navy Bean Marketing Board on the establishment of a certified navy bean scheme. Branch officers in conjunction with officers from Agricultural Standards Branch will supervise the production of seed certified true to type and free of specified diseases. This certified seed will be used to produce approved seed for distribution to navy bean growers.

Inservice training activities were held in all regions during the year. The major workshop reviewed forage crop production. Branch officers from all regions in the State participated as did officers from the Division of Animal Industry and the Division of Dairying.

Training activities in the regions included a woody weeds workshop at Dysart for officers working in the brigalow areas, a planting machinery workshop at Emerald, soils workshops on the Darling Downs and in the Burdekin and a pasture seed production workshop at Walkamin Research Station.

The demand for farm machinery advice increased. The ever-increasing cost of farm machinery has created this demand and advice is being sought on matching farm machinery, tillage and planting equipment and header cleaning in particular.

Most extension programmes are planned and implemented on a district or regional basis.

North Queensland

The peanut industry continued its expansion and extension activities were mainly directed at helping new growers become established and familiar with peanut agronomy. Particular attention has been directed at on-farm storage facilities to minimize the risk of disease and insect infestations until the nuts can be delivered to the Peanut Marketing Board.

Other significant extension activities in the peanut industry were directed at pulling and threshing operations and weed control. Whereas herbicides were not widely used only a few years ago, there is possible overuse of these chemicals now and extension activities have been directed at reducing reliance on herbicides.

The systemic fungicide Ridomil has been widely adopted by north Queensland tobacco growers to control the disease blue mould. Its use in seedbeds has, however, resulted in 'softer' seedlings and modified husbandry practices have been advocated to avoid this and other adverse side effects including early flowering and damage from suckercides.

Solid set irrigation systems have been used in the Mareeba-Dimbulah irrigation area for many years and many of these systems were operating at below peak efficiency. An extension programme urging tobacco growers to check their irrigation systems was conducted with satisfactory results.

The rice industry continued to expand. There are now 11 growers planting 1 100 ha at Mareeba and some 3 500 ha in the Burdekin. The 1979 winter crop in the Burdekin produced a record 11 800 t of paddy.

Major extension efforts are directed at reducing the level of off-types particularly red rice and at insect and weed control strategies.

Rice growers in the Millaroo and Dalbeg areas are experiencing low mill-out percentages and attention is being directed at alleviating this problem.

Crop emergence has been a production restraint in the Burdekin for many years particularly on the heavier soil types. Narrow rigid planting times in association with concave zero pressure press wheels offer promise on the self-mulching clays. These planters are being commercially assessed at Gumlu and the Burdekin Rural Education Centre.

The legumes, Seca and Verano stylo, are the basis of the extension effort in the dry tropics beef production areas of north Queensland. Grazing demonstrations have been established at Mareeba, Georgetown and Laura. The Mareeba demonstration has been producing animal performance information for some $3\frac{1}{2}$ years and has been used for a number of extension activities among Peninsula and Gulf graziers. Animal performance on the stylo-based pastures is considerably better than that from native pastures and grazier interest is high.

The Georgetown demonstrations were sown in December 1978 and stocked in January 1980. The Laura demonstration was sown in December 1979 and will be stocked in December 1980. These demonstrations will enable these stylos to be assessed under a wider range of environmental conditions and will provide animal performance data of more local relevance to graziers.

On the wet tropic cost, Utchee Creek and East Palmerston are the sites of areas demonstrating the grazing systems developed at South Johnstone Research Station. Beef producers are utilizing the production information coming from these demonstrations and fertilizer sales have increased significantly.

Farther south in the high rainfall areas around Proserpine, two major projects are being conducted. The effect of slashing and ploughing tea tree (*Melaleuca* spp.) regrowth is being assessed. The other project is endeavouring to increase productivity of pastures dominated by *Sporobolus* spp. and *Eriachne* spp. which have invaded what were previously productive Townsville stylo pastures. Initial results with applications of superphosphate and the use of Graham stylo have been encouraging.

In the Atherton Tableland dairying areas, the main extension thrust has been the demonstration of winter feed systems involving nitrogen fertilized ryegrass, ryegrass and clover mixtures and pure clover pastures. An economic analysis of these feed systems was prepared and a number of farm walks organized.

Capricornia

Cropping continues to expand in the Capricornia Region and extension activities to improve the efficiency of crop production were emphasized.

The 1979-80 cotton crop consisted of 9 000 ha of irrigated cotton at Biloela and Emerald and 1 400 ha of rain-grown cotton in the Dawson-Callide. The crop will produce an estimated 39 000 bales of cotton. Extension activities directed at the cotton industry have concentrated on monitoring insect populations, integrated insect pest management, weed control and irrigation strategies.

The arable lands of the Capricornia region are prone to soil erosion and considerable extension inputs were directed at cropping practices designed to minimize soil erosion and stabilize cropping systems. These extension projects co-ordinated the activities of Soil Conservation Branch and Agriculture Branch officers and emphasized stubble mulching, modified tillage and planting machinery, contour cultivation and crop sequences.

Crop establishment has been a major production restraint in the Central Highlands. Farmer practices were monitored to identify crop and soil management factors which improve crop establishment.

Extension activities directed towards the beef industry emphasized control of timber regrowth and monitoring the performance of the newly released pasture legumes, Seca, Verano, Fitzroy and Graham stylos. In addition, the role of the browse shrub *Leucaena leucocephala* on commercial beef properties is being elucidated.

An extension project directed at the dairying industry in the Mackay hinterland has successfully promoted clover pastures to boost winter milk production with minimal fertilizer inputs. However, another extension effort is promoting fertilizer usage on mat grass infested kikuyu pastures to increase the kikuyu component of the pasture.

Burnett and South Burnett

Grain cropping continued to expand at Monto, Gayndah and Kingaroy. Most extension activities in these sub coastal districts were directed at improving crop husbandry practices and land management.

Extension projects were undertaken to improve insect and disease control by effective monitoring of insect populations and disease incidence to assist in the framing of pesticide strategies. Weed control was also emphasized and correct use of herbicides was promoted. The impact of these activities was somewhat thwarted by the hot, dry summer but farmer pest management strategies were more appropriate and relevant.

Another project at Kingaroy was directed at appropriate fertilizer strategies. The use of fertilizers has been widely accepted but fertilizer mixtures used are often inappropriate. Some progress has been made in relating applied fertilizer to previous crop history, length of fallow, predicted crop yields and soil nutrient status.

At Bundaberg, a project to promote the use of high analysis fertilizers on tobacco achieved a 65% adoption in its first year. The use of these fertilizers significantly reduces fertilizer costs. Another project directed at the Bundaberg tobacco industry has encouraged growers to convert to bulk curing barns with some success.



Making hay from nitrogen-fertilized pangola grass pasture.

In the beef areas, extension activities to promote Oxley fine stem stylo have been restricted by the scarcity of seed supplies and graziers have been encouraged to develop their own seed production areas. *Leucaena leucocephala* also offers promise to increase beef production and this legume is attracting attention.

In the coastal areas, extension activities were directed at management and maintenance of existing sown pastures. Many producers have renovated sown pastures which became degraded during the beef industry recession. These producers have returned to a programme of maintenance fertilizer dressings.

Near North Coast and Moreton

In the dairying areas, emphasis has been placed on pasture management, cow nutrition and farm diversification. These activities have demanded the integration of extension activities with those of Dairy Field Services, Soil Conservation and Economic Services Branches.

In the Lockyer Valley, a joint project with Soil Conservation Branch and the Queensland Water Resources Commission has assisted many farms build on-farm water storages. These farms have then been able to diversify into crops or increase dairy production.

Berseem clover production was monitored at a number of sites in the region. The performance of other clovers, particularly cultivars of subterranean clover, both as pure swards and in association with rye was also monitored. These species are attractive in providing winter and spring feed under irrigation and in reducing the high fertilizer costs associated with high density fertilized ryegrass feeding systems.

Land management projects were pursued in a number of districts. In the Logan Valley, a survey revealed that only a restricted number of properties had drainage problems and drainage work has commenced in association with the Queensland Water Resources Commission.

In the Lockyer Valley, *Paspalum vaginatum* established well on salt pans. Other extension activities related to the emerging salinity problem in that district emphasized the usefulness of gypsum as a soil ameliorant and the need for continual monitoring of water quality.

Another programme has been developed to rehabilitate areas of the Tin Can Bay Army base in conjunction with Army personnel. At Nambour, a project to develop pasture recommendations for tree-crop situations is nearing completion. Lotononis, stylo and *Aeschynomene falcata* offer promise in association with blue couch. Commercial seed production of *Aeschynomene falcata* was initiated.

Oilseeds and coarse grains continue to expand in the Moreton region and extension activities emphasized the varietal selection and weed control aspects of crop husbandry.

Darling Downs and Near South West

The number of enquiries received by officers in these regions continued to increase and restricted the time available for planned extension activities. Officers in these regions, in common with those in other regions, are also being more involved in extension activities generated by agri-business firms.

This trend has advantages for both the Department and the agri-business firms but also restricts planned extension activities. Despite these restrictions, officers are devoting 20 to 25% of their time to planned activities.

A highlight of the year was the extension programme to improve farm management skills. A workshop was held at the Dalby Agricultural College for 16 farmers from a number of districts in these regions and resulted in a regular newsletter to participants and an analysis of their individual farm operations. The farmers from Jandowae who attended the workshop formed a group to develop further their skills in planting machinery, weed control and summer crop husbandry.

A project was established with a farmer group at Norwin to study crop management. Farm management reports have been prepared for each of the 12 farmers in the group together with a group summary report. Subsequently, visits were made to each farm to discuss the reports and decide upon changes in farm plans, crop management and crop rotation strategies.

Weeds are a major production restraint in these regions and a number of extension projects addressed these issues. Projects promoting the control of grassy sorghum off-types were undertaken in the St. George Irrigation Area and in the Jondaryan Shire.

At St. George, a sorghum weed eradication committee was formed to co-ordinate the efforts of farmers, the Queensland Water Resources Commission and the Department. In the first year of the project, the number of infestations was reduced by an estimated 60%.

In the Jondaryan Shire, considerable progress has been made, in conjunction with the Shire Council, in a roadside slashing campaign. Some 50% of the farmers in the target area have been contacted and many have implemented farm control strategies. Roadside slashing programmes have also been promoted in the Pittsworth and Millmerran Shires as a strategy to reduce spray drift from normal herbicide spraying campaigns.

African boxthorn (*Lycium ferocissimum*) is a weed in many Darling Downs pastures and control strategies are being demonstrated in the Wambo and Crows Nest Shires.

Weed control is also of increasing importance in grain sorghum production and the use of the herbicide atrazine to control many broad-leaved weeds is being actively promoted in the Taroom, Wambo and Chinchilla Shires. The use of atrazine instead of the traditional phenoxy-type herbicides is also being promoted to minimize spray drift problems in the Millmerran and Pittsworth Shires.

Another project is directed at control of the perennial weed Russian knapweed (*Centaurea repens*). A farm demonstration has been established to monitor crop performance on land heavily infested with the weed and known infestations on the Darling Downs were surveyed to map the present limits of the weed. At the same time, herbicide control of the weed is being studied in conjunction with the Department of Lands.

A fat lamb industry is developing at Inglewood and extension activities have been directed at planning feed programmes. Irrigated ryegrass, medic and clover pastures appear ideal for this enterprise. The introduction of a pasture phase into the irrigated cropping systems of the district is welcome to rehabilitate the poorly structured silty clay loams which have been intensively cropped for many years.

The irrigation areas at St. George, Goondiwindi, Inglewood, Texas and Chinchilla continue to expand. St. George is expected to produce some 27 000 bales of cotton from 12 500 ha in 1979-80.

Significant extension activities were directed at the comparison of costs of insecticide strategies and at the economics of alternative irrigated crops. The first commercial crop of irrigated cotton at Goondiwindi yielded 6·5 bales per ha and further expansion is expected in that district.

A successful field day on irrigation systems at Texas attracted more than 200 irrigators from all irrigation areas in southern inland Queensland. A range of irrigation equipment was displayed under field conditions and this field day has generated considerable follow up work.

Annual medics are attracting increasing attention from graziers in these regions to boost animal production in winter. On the basaltic uplands of the Darling Downs, topdressing of medic pastures with sulphur has been successfully promoted in a co-ordinated project with Consolidated Fertilizers Limited and agricultural pilots.

The medic demonstration areas in the traprock country south and west of Warwick continue to excite grazier interest. Many have made initial plantings and the performance of these pastures will determine future action.

Farther west, the dry 1979 winter affected extension activities at St. George but there was a pleasing response to the extension activities promoting the use of annual medics in the Taroom Shire.

Horticulture Branch

DEVELOPMENT of the productivity of the horticultural industries of the State is the primary objective of the Branch. These industries include the wide range of fruit and vegetable crops as well as ornamentals and nursery production.

The activities of the Branch include extension, regulatory and research services in the major producing areas. As most fresh fruit and vegetables are perishable, emphasis is also given to maintaining quality through the marketing chain from the farm to the consumer.

Many crops such as pineapples, citrus and vegetables are grown especially for processing and both the pre- and post-production aspects of these industries are serviced. Cut flowers, ornamentals and nursery plants are becoming an increasingly important section of the overall horticultural industry.

The extension services are in strong demand. As well as providing producers with a wide range of technical information, advice is given on land use in relation to resource maintenance and development and adoption of sound farm management practices.

The solution of specific problems and development of production opportunities is a major Branch function. To support this work, field research stations are operated at Applethorpe, Redlands, Nambour, Bowen and Cairns. In addition, field trials are conducted on grower properties in many districts. Post-harvest and processing research is carried out at the Sandy Trout Food Preservation Research Laboratory, Hamilton.

The Branch also has a substantial regulatory function. It plays a major part in administering the Diseases in Plants Act, which aims at controlling the incidence of and limiting the spread of pests and diseases of plants within the State, and at preventing their entry from other States.

As an agent of the Commonwealth, it also administers, within the State, the Commonwealth Quarantine Act (Plants) designed to prevent the entry into Australia of any pests or diseases of plants, or weeds which might constitute a hazard to primary production. As well as inspections of passengers and cargo entering the country, increasing emphasis is being given to monitoring and surveillance of the northern areas of the State to prevent the spread of serious pests and diseases from neighbouring countries.

Research

The major aim of the research programme of Horticulture Branch is to improve the quality and availability of fruit, vegetables and ornamentals to the consumer, while containing or reducing production and distribution costs; and to make the production of these commodities more efficient, less labour-intensive and more reliable.

The work covers plant introduction and breeding, the development of improved cultural and management systems, the integration of mechanized production and harvesting systems, and improvement in methods of handling, transport, storage, and distribution. Some emphasis is also given to the development of potential new crops, including extension of some existing crops to new areas.

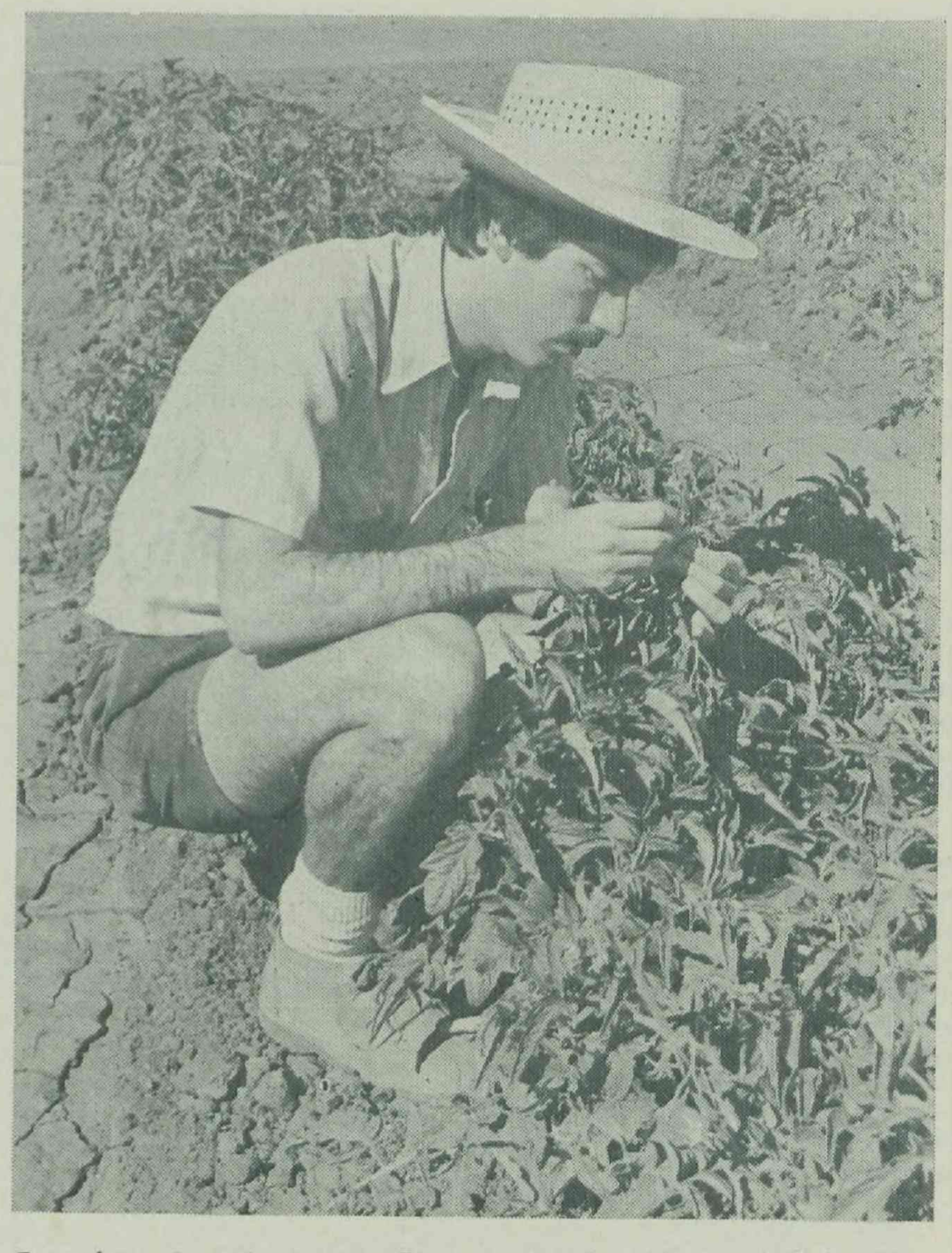
Vegetable breeding and varietal importation

The programme to develop improved vegetable varieties for use in the Queensland industry is continuing. Large numbers of vegetable varieties considered to have potential for Queensland were imported from overseas, tested for adaptability, improved disease resistance, yield and quality characteristics and the most promising varieties distributed to major producing areas throughout the State for Local evaluation. In addition, major local breeding programmes have proceeded in tomatoes, French beans, capsicums and sweet corn.

A new race of fusarium wilt has recently been identified in tomatoes in the Bowen district and this is the first time this race has been reported anywhere in the world. The disease represents a serious threat to the future of the Queensland tomato industry, and because resistant commercial varieties are not presently available, a major emphasis is being given to breeding a variety with resistance to the disease. Resistance to the new race of fusarium wilt has been identified in the species *Lycopersicon pimpinellifolium* Line PI 124039, and a crossing programme with present



The fluid drill planter, imported from the United Kingdom, plants pre-germinated vegetable seedlings.



Crossing tomatoes at Bowen to breed a variety with resistance to the new strain of fusarium wilt recently identified in the district.

commercial tomato varieties is in progress. Assistance from overseas tomato breeders has been sought. Tomato foot rot caused by the organism *Fusarium solani* remains a significant problem in the Bowen district. Tolerance to the disease has been identified in the variety Q3 and a breeding programme to incorporate this tolerance into desirable commercial cultivars is in progress.

A new tomato variety suitable for trellised production in south-east Queensland and with resistance to bacterial wilt has been approved for release to industry. The variety is especially suited to trellised production in south-east Queensland during the warmer months of the year. The breeding programme presently aims at incorporating Verticillium wilt resistance into this variety. An F_1 hybrid from the cross Floradel x Flora-Dade developed at the Redlands Horticultural Research Station has performed well in trellised production trials in south-east Queensland and other hybrids show promise. Other imported varieties performing well are Castlex 1014, Duke, Count and Pole Boy.

Breeding work in capsicums is especially directed towards developing a line similar to the present major commercial variety Northern Belle, but also having resistance to bacterial spot, plus increased virus resistance, and an improved ability to set fruit under the range of environmental conditions experienced in Queensland production. Resistance to bacterial spot, a serious disease of capsicums in Queensland, has been identified in an imported hot pepper, and this is being used in the breeding programme. A source of resistance to the physiological disorder green pitting is currently being sought. All newly imported capsicum varieties have proved susceptible to our local strain of bacterial spot, but Florida VR-2, Hybelle and Lady Belle proved to be productive with good quality fruit, and should be suitable for production in districts with less humid production seasons.

Three cabbage varieties have been identified as having potential for replacing Olympic as the major summer cabbage variety for south-east Queensland. These are YR Rampo, YR CS, and Selection 1448, all from Japanese seed companies. Japanese seed companies have ceased producing seed of Olympic and a replacement variety is of high priority to this $1·2m industry. Selection 1448 also has excellent potential for production in south-east Queensland in other seasons. The cabbage variety Green Coronet which was identified in this programme in 1978 has now become a major Queensland commercial variety with excellent yield, quality and disease resistance.

Forty-three new cauliflower importations were evaluated during the year. The varieties Brendo, Hornstar, Hormade and Solocrop, all of European origin, showed promise as a replacement for the present early season varieties.

The cold tolerance French bean breeding programme has produced five fresh market lines which, during the cold winter of 1979, set straight pods and produced considerably higher yields of marketable pods than other present commercial cultivars. Final trials this winter will allow the selection of one or more lines for commercial release. The variety Redlands New Pioneer, previously released from this programme, continues to outperform other stringless cultivars during cool weather and has become a major commercial variety. Varieties originally bred for processing have performed well as fresh market varieties for autumn and spring production. These include Majorette, Providor and Sinatra. Trials are continuing to find a processing bean variety showing more adaptability to production in south-east Queensland than present commercial varieties.

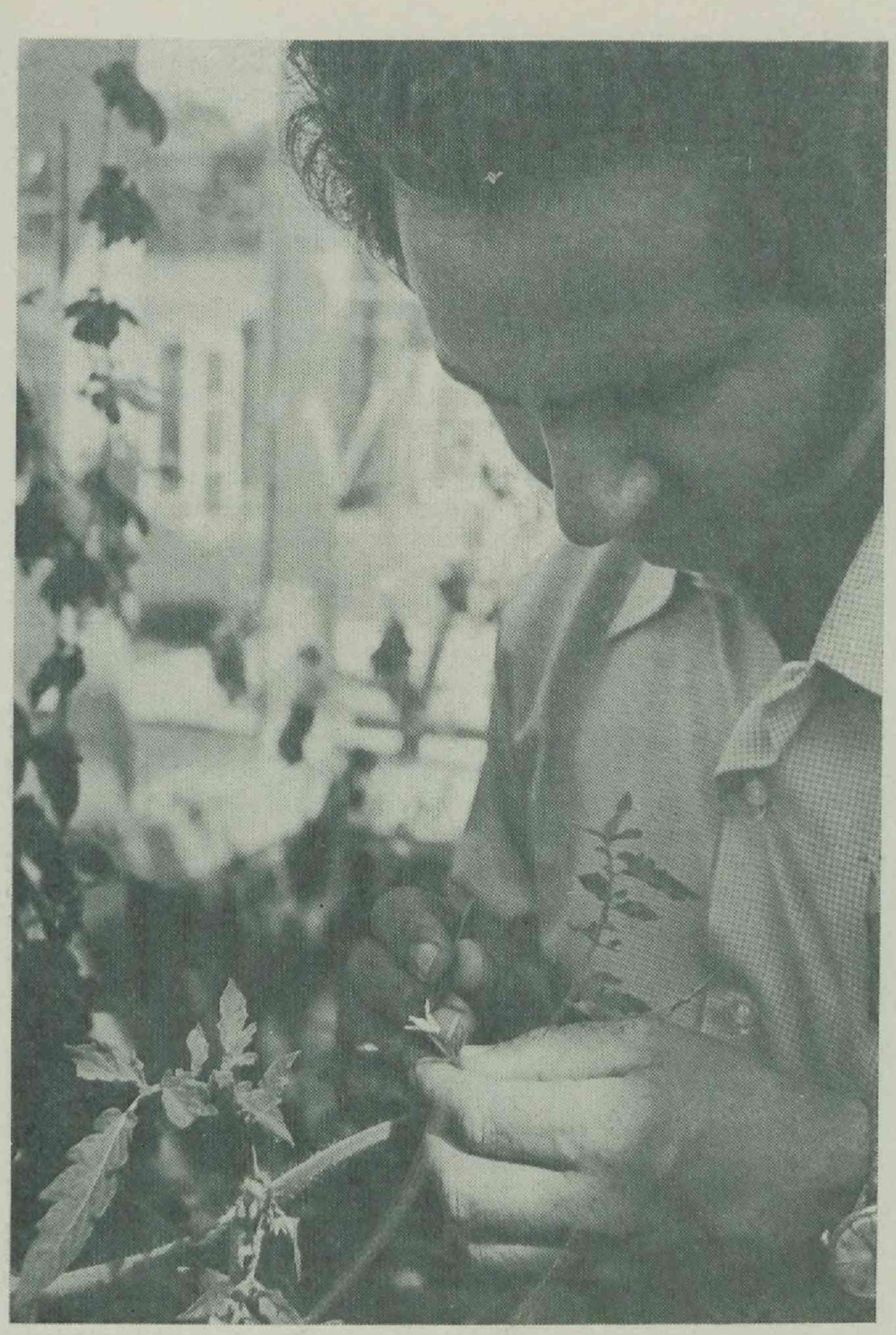
Mechanized tomato production

Container-grown seedlings are continuing to replace bare-rooted seedlings for establishment of Queensland tomato crops. This method of establishment has been shown to improve crop uniformity, which results in a more concentrated harvest pattern and thereby a reduced number and cost of harvesting operations.

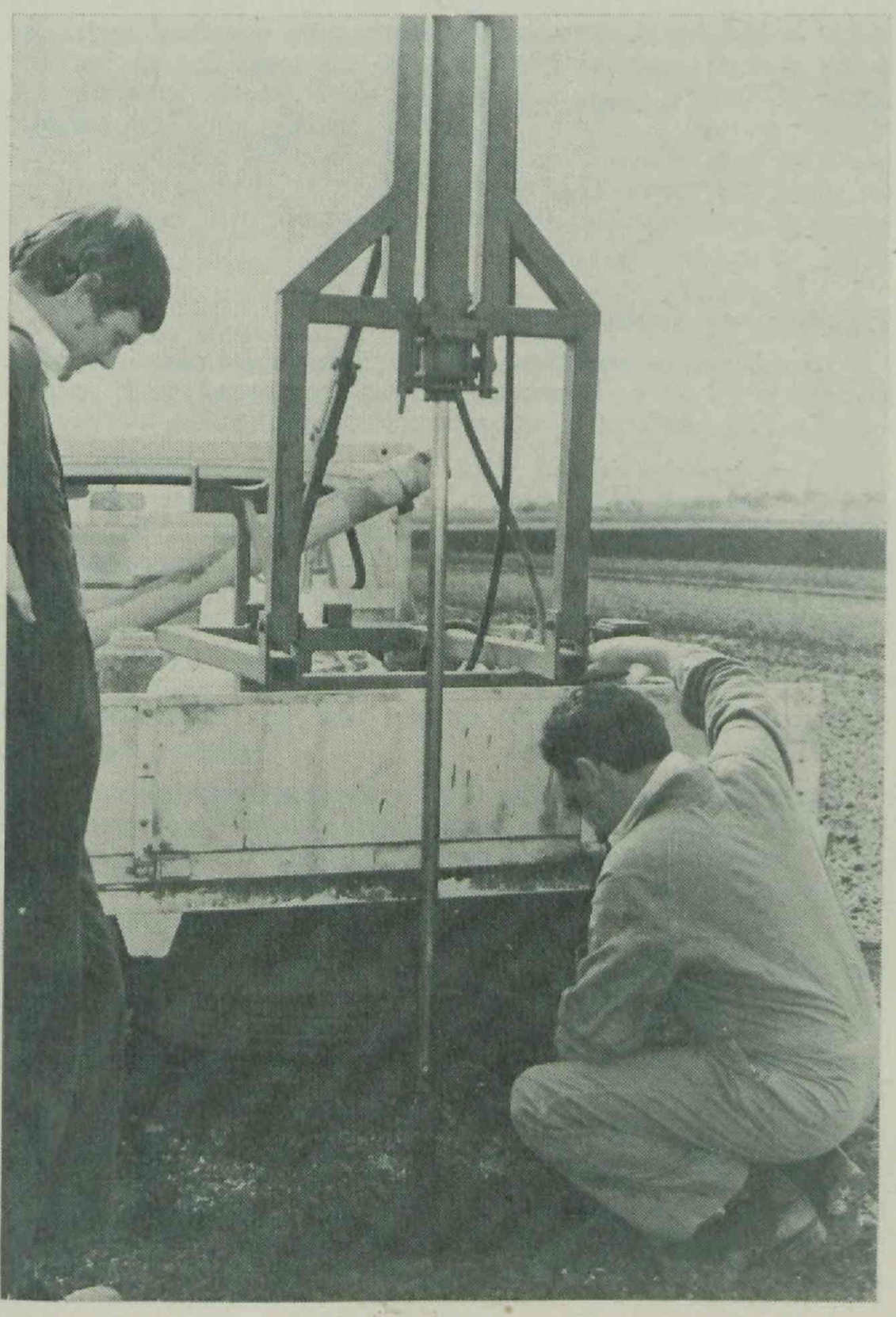
Growers of trellised tomatoes in southern Queensland are now widely using the indeterminate variety Flora-Dade. This has resulted in reduced trellising and harvesting costs. This variety is ideally suited to ground production and the programme is investigating the possibility of using ground culture on plastic mulch as an alternative to trellised production.

This system is more adaptable to mechanization of production and harvesting and may result in increased returns per ha. The programme is investigating the use of both overhead sprinkler and trickle irrigation in conjunction with the plastic mulch. The plastic mulch system integrates well with soil fumigation techniques for the control of soil-borne diseases. The fluid drilling concept, where pre-germinated seed are planted in the soil by extrusion in a gel matrix, is also under investigation.

Plant density trials with tomatoes in the Bowen district have shown that progressively reducing the spacing between plants within the row from 90 cm down to 15 cm, increased per ha yields, but at the highest densities fruit size was reduced. Since larger-sized tomatoes bring a premium price on the markets, then a compromise must be reached between the two factors. The present commercial varieties Flora-Dade and Walter proved to be unsuited to a once-over harvesting operation because of the spread of fruit maturity on each bush, and a minimum of two picks is required.



Pollination of tomatoes as part of the tomato breeding programme.



Soil samples being extracted to a depth of 1 metre to assist in understanding soil salinity problems in the Lockyer Valley.

Varieties with a more concentrated fruit maturation pattern are required for once-over harvesting for the fresh market. In the trials a plug-mix planting system produced higher yields than the most commonly-used grower system of planting bare rooted seedlings.

Plant nutrition and soil fertility in processing vegetables

Nutrition and soil fertility studies have previously established that calcium deficiency is an important factor in the production problems frequently experienced with beetroot in salt-affected soils in the Lockyer Valley. The incidence of calcium deficiency appears to be caused by a combination of high pH, high magnesium and sodium levels, and poor soil structure.

Therefore a series of long term trials is in progress in the Lockyer Valley to study the effects of soil applications of gypsum on growth of beetroot and soil fertility generally. Soil, water and crop monitoring on these areas will continue for a number of years.

Nutrient uptake studies in French beans, beetroot, carrots and peas in the Lockyer Valley have been completed to assist in predicting fertilizer requirements and in defining the optimum stage of growth for the diagnosis of plant nutrient status. The data indicate that beetroot and carrots should be sampled for nutrient diagnosis at a later stage than has previously been recommended. When similar studies have been completed with sweet corn, a comprehensive picture of the present nutritional status of processing vegetables in the Lockyer Valley will be available.

Bean seed production research

The research programme aimed at improving the yield and quality of French bean seed grown in Queensland has reached an important stage of consolidation. The results from the research programme and from industry experience have been integrated into a production blueprint which is believed to contain the major important factors involved in successful French bean seed production.

The blueprint is currently being evaluated in observation strips in the Burdekin. The yield and quality of seed produced will define whether further research or modification to the schedule is required.

Environmental factors have emerged as being of major importance in French bean seed production in the Burdekin. The time of planting regulates the seed size, which in itself has important implications in seed quality, and the environmental conditions during seed maturation have major effects on seed quality.

The combined results indicate that early plantings, preferably in the first half of April, will result in optimum conditions for seed size, quality and yield. In addition, alternative windrowing systems offer the potential for further reducing the temperature experienced by the seed during maturation, thus resulting in improved seed quality.

Manipulation of the environmental factors, together with redesigned irrigation, nutritional and soil management practices, and with the use of alternative harvesting systems as developed by Engineering Section, should result in major improvements in the quality of French bean seed produced in the Burdekin. Varieties with improved seed quality characteristics are still required for the industry.

Sub-tropical and tropical tree fruits

Research projects continue to evaluate the potential of kiwifruit, avocados, litchis, and mangoes for drier, cooler, areas inland from the south Queensland coast and of guavas, custard apples, litchis and persimmons for the more poorly drained soils of the wetter coastal districts. Numerous industry evaluation and developmental trials have been established with these crops on growers' properties throughout southern Queensland. In addition, the potential of a wide range of lesser-known fruit crops, including rambutan, pulasan, sapodilla, and durian, is being investigated.

The Hawaiian macadamia varieties 741 and 800 have been released to industry through Queensland nursery producers of macadamia. These varieties have been assessed as having good potential for production in the Queensland environment. The search continues for individual trees which are performing well in the Queensland environment.

Kiwifruit continues to appear a promising crop for slightly elevated areas inland from the coast and two further evaluation plots were established this year in the central Burnett. Abbott proved to be the highest yielding variety in plots in the Mary Valley and South Burnett, with Bruno being the first variety to mature. The South Burnett was the earliest region to mature its fruit followed by the Mary Valley, Blackall Range and then Mt Tamborine.

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Heavy yields of kiwifruit in the South Burnett make the potential for a new industry look promising.

A technique for clonally propagating custard apple varieties and rootstocks by cuttings has been developed. Studies to date indicate that cuttings produce a more vigorously growing and uniform plant than is obtained with grafted trees, a major part of the variability in the latter being due to the use of seedling rootstocks.

The initiation of flower buds and fruit bearing laterals was shown to be enhanced by prior use of pruning and defoliation techniques, including the use of sprays containing Ethrel (R) and urea, and this technology is now being evaluated in commercial orchards.

The use of clonal guavas established from cuttings resulted in a first crop of 77 kg per tree, which is more than twice that obtained from first crops from seedling trees. Studies continue to define the most suitable varieties for processing and fresh market, and the management technology necessary for scheduling harvesting and for promoting high yields. Delaying defoliation with urea for 6 weeks after normal defoliation time (the first week in August) has delayed crop harvest by approximately 4 weeks. This allows a shift of the harvest time to a drier period when fruit fly activity is lower. The timing of urea sprays may thus be used as a crop scheduling method.

High temperatures have been shown to reduce the effectiveness of induction of flowering of pineapples with Ethrel (R). Recommendations to industry are that the chemical should be applied during cooler days and especially not when the daily maximum temperature is likely to be 28°C or above.

Investigations continue to seek varieties and management techniques which will allow reliable commercial production of litchi in Queensland.

Irregular bearing continues to be a major problem with this crop. Thirty varieties are now under evaluation in north Queensland and a large collection also exists at the Maroochy Horticultural Research Station. Under north Queensland conditions, heavy alluvial soils with good soil moisture characteristics offer the best prospects for regular production and high yields. Recommended varieties for north Queensland coastal areas are Kwai Mi, Mauritius, Bosworth 3, and Gee Kee.

In excess of 60 varieties of mango have been imported into Queensland since 1975, coming mainly from Florida, South Africa, Philippines, Thailand, Singapore and Hawaii. Evaluation of these varieties is continuing to define varieties which allow for an extension of the production season in Queensland and to identify any which will set fruit when moist conditions are experienced during the flowering period. The salinity tolerance of the varieties is being assessed to determine their suitability for production in the South Burnett.

Banana research in north Queensland

Maturity bronzing continues to be a significant problem associated with the production of bananas in north Queensland. Cutting the bunches before the completion of finger filling will minimize the incidence of the disorder but this results in a considerable reduction in fruit yield. In research studies, the incidence of the disorder has been strongly associated with high humidity and rainfall during bunch development, and the disorder appears to be worse in poorly drained plantations.

The anatomy of the banana skin in healthy fruit has been compared with similar tissue from fruit affected with maturity bronzing, using a scanning electron microscope, and the amounts and types of waxes present on the surface of the fruit are being quantitatively determined.

X-ray dispersion analysis has revealed that mineral nutrient content in healthy and affected tissues is similar, confirming earlier findings that maturity bronzing is not likely to be a nutrient disorder. An understanding of the ultrastructure of cells affected with maturity bronzing may lead to an understanding of the nature of the disorder and the development of control measures.

Nutrient leaching models to define the rate of nutrient movement in tropical soils under high rainfall conditions are being developed to assist in defining optimum fertilizer practices for bananas in north Queensland. Applications of lime and dolomite continue to produce yield increases in trials with bananas in acid soils in north Queensland and growers have widely adopted the practice of using these materials in banana production.

The double row system of growing bananas, developed at South Johnstone Research Station, has been progressively adopted in new plantings in north Queensland. Increased yields have been obtained up to a density of 3 500 plants per hectare. Finger length and incidence of maturity bronzing were not affected by plant density within the range 1 000 to 3 500 plants per hectare. Studies have defined the optimum size and type of planting material required for high yields and crop uniformity in banana plantations.

Citrus research in South Burnett

Six new citrus rootstock-scion trials have been initiated in Queensland in a significant review of the citrus rootstock situation in Queensland. The trials are with lemons at Beerwah, and with Ellendale mandarin, Imperial mandarin, Navel orange, Valencia orange, and Marsh grapefruit at Gayndah. Especially being evaluated are two new citrus rootstocks obtained from Florida. Swingle citrumelo is a hybrid between Duncan grapefruit and trifoliata and is reported to be resistant to *Phytophthora,* citrus nematode, exocortis virus, salt and cold.

Rangpur lime x Troyer citrange hybrid is reported to have a number of special features including a dwarfing characteristic. Troyer citrange, which has been widely used in Queensland as a rootstock for oranges and mandarins because of its *Phytophthora* resistance, will be evaluated in all trials.

The spray coverage on citrus trees produced by several different types of citrus sprayers has been determined using a UV light technique. Spray coverage by standard hydraulic boom sprayers was as high as 90% on some leaves but the backs of leaves inside the canopy were poorly sprayed. A 'Tower mister' consisting of a low profile air blast sprayer to which was attached an air tower, designed and constructed by the Department of Primary Industries engineers, gave an excellent coverage and further development will continue.

Deciduous fruits

The breeding and plant introduction programme in apples, plums, peaches and nectarines has continued and several varieties are under test on growers' properties.

A major aim of the plant improvement programme is to extend the production season for these fruits, especially by the development of early maturing varieties. In apples, Selection 7/41 is creating interest and more budwood has been distributed to growers. The Delicious x Earliblaze cross continues to produce superior fruiting trees some of which mature in late January. A plum selection resulting from a Wilson x Santa Rosa cross and which matures before Wilson has attractive fruit quality and has been distributed for grower evaluation.

One peach and one nectarine selection resulting from the breeding programme have been distributed for grower evaluation. Both produce large, yellow-fleshed, attractive fruit of good flavour and mature in mid season.

Low-chilling peach varieties continue to create interest in Queensland. There is a range of varieties with different chilling requirements. The low-chilling peach variety Flordasun matures in north Queensland in October and around Nambour in early November. It was produced in commercial quantities last season and received good market prices. The low-chilling nectarine Sunred matures in Nambour in mid November and has attractive fruit. Eight low-chilling peach varieties and two low-chilling nectarines were distributed to industry in various parts of the State last year and, in addition, varieties were established on various Departmental research centres throughout the State.



The exposed root system of an apple tree grown under trickle irrigation at the Granite Belt Horticultural Research Station reveals a strong root system developed throughout the soil profile. However, a proliferation of roots is evident in the two places where the trickle outlets operated.

In two apple close-planting experiments, now in their fifth and seventh years of harvesting respectively, MM 106 continues to prove a suitable rootstock for this method of apple production. It is being recommended to industry. Northern Spy is also performing well as a rootstock for close planted Delicious apples. A close-planted peach trial is now in its second year of cropping and observations are continuing.

In a grower demonstration trial, trickle irrigation of Delicious apples proved its value last season when fruit from non-irrigated trees was unmarketable. Root distribution studies with a 10-year-old Delicious apple tree have shown an adequate and healthy root system can be developed under trickle irrigation. There was extensive root development outside the area wetted by the trickle irrigation system, although the roots were more dense in this wetted area.

Research to assist the developing wine industry in the Granite Belt has continued with varietal assessment trials to study field performance, laboratory production of wines from these trials, and advice to producers on wine making technology.

The trials have resulted in good recommendations for red wine grapes but further research is required to find varieties suitable for white wine production. With consumer preferences presently in favour of white wines, propagation and evaluation of a wide range of white wine grape varieties is being given top priority.

Ornamentals

Winter flowering of statice was promoted by subjecting seedlings to 7 weeks of temperatures between 11 and 13°C under specific controlled lighting conditions. Several growers have used the treatment this year to control flowering in this crop. Studies are also in progress to develop a technique for controlling flowering time in asters. A new grafting technique which will simplify the nursery production of roses is being assessed.

Tissue culture research

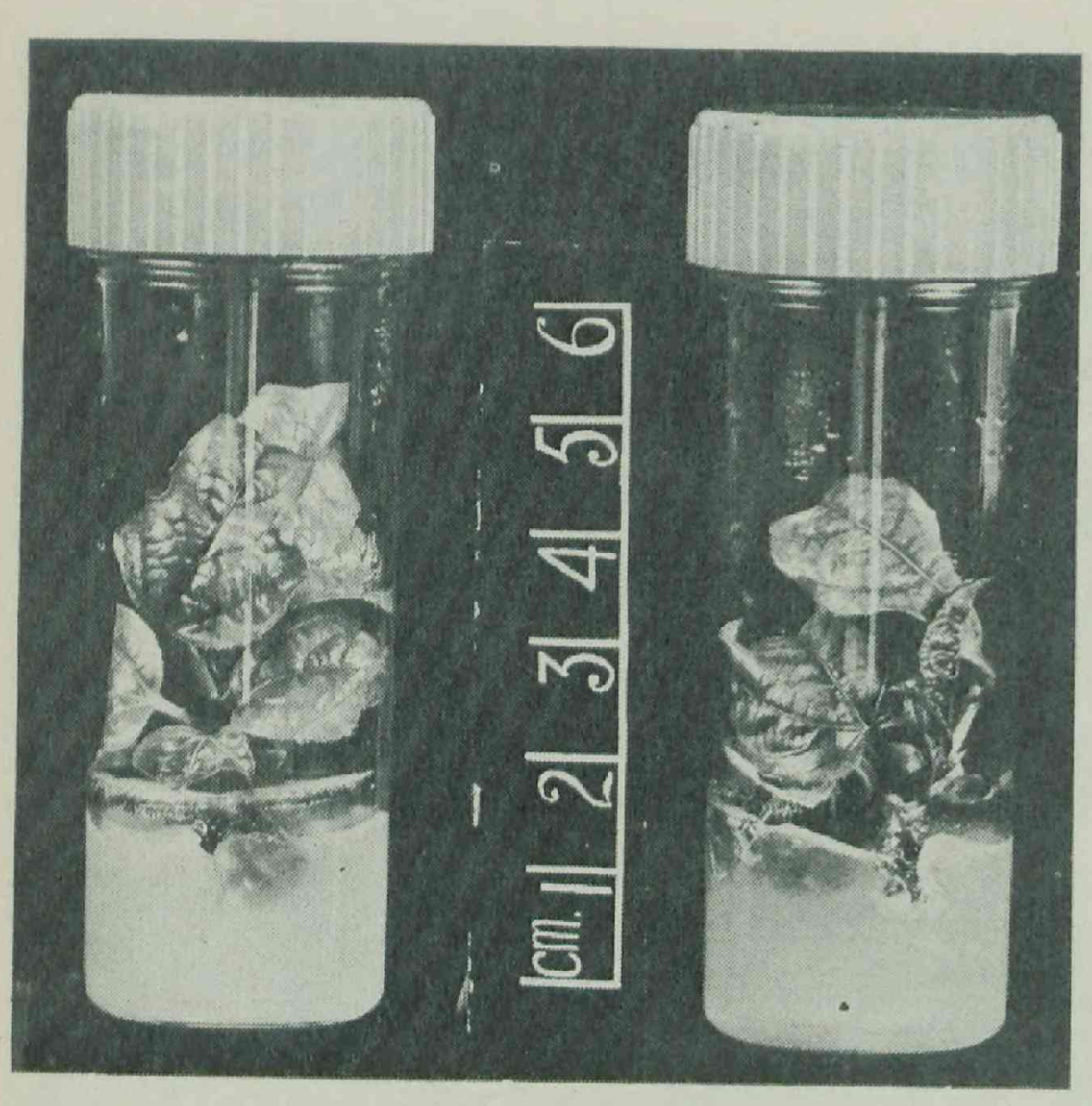
A satisfactory technique for initiation of growth of dormant lateral buds has now been developed for passionfruit. The method involves the use of nodal sections, initial incubation in darkness, and the transfer of the culture to a new medium as soon as bud growth has been initiated.

Inspecting root development in a poinsettia potting mix trial.



The production of virus-free plants will now depend on whether fine dissections from the apices of these developing buds will continue to make growth on synthetic media. Heat treatment of these small buds may be necessary to ensure freedom from virus. The buds can then be grafted into virus-free stock produced from seed.

A commercial method for the propagation of pineapples by tissue culture has now been developed and plants produced by this technique will be planted in the field to determine whether they are similar to the parent material.



The first passionfruit shoots grown successfully by tissure culture techniques after 5 years of research.

Virus-free plants of the sweet potato varieties Red Abundance and White Maltese have been produced by tissue culture and released to industry. Improved yield and quality should result from the use of this planting material.

Post-harvest processing and storage studies

Development of processing techniques for various fruit and vegetable products and the evaluation of the suitability for processing of various varieties of fruit and vegetables continued during the year. The effects of various field factors on processing characteristics were also evaluated for some commodities.

Research into the development of blends of citrus juice has shown that fruit from trees grown on Rough Lemon rootstock produce a bitter juice but that other rootstocks are satisfactory. Studies are in progress to produce a suitable guava fruit juice drink after taste panels have requested a drink with less body than the present one. The research has identified the most suitable guava cultivars for processing.

In cool room studies, pineapples showed chilling injury when stored at 21°C or below. The chilling injury symptoms are similar to those of blackheart of pineapples, a troublesome field disorder. A field trial is in progress to see if sufficient variation exists in chilling susceptibility in pineapple clones to select out resistant types.

Tomato fruit quality

Studies have investigated the effects of plant nutrition, variety, production district, stage of maturation and ripening with ethylene on the quality of fresh market tomatoes. Laboratory evaluations of sugars, acids, pH, firmness, density and taste panel evaluations have been used to measure fruit quality.

Fruit quality was largely unaffected by the rate of nitrogen or potassium applied to tomato plants and it was concluded that only extremes of nutrient deficiency or excess, perhaps coupled with specific environmental conditions, will significantly reduce quality. There were obvious differences between varieties and, to a lesser extent, between the same varieties produced in different production districts.

These studies will continue to better understand the environmental factors affecting tomato fruit quality. This understanding will also assist the programme to breed improved tomato varieties.

Harvesting the fruit too immature reduced the eating quality of the fruit after ripening as assessed by laboratory measurements and taste panel evaluations. This information is being developed to define the earliest stage at which it is possible to harvest the fruit without significantly affecting fruit quality, and the optimum ripening procedures that should be applied to produce high fruit quality.

Packaging, handling and distribution

The use of refrigeration to remove field heat from fruit and vegetables before forwarding to markets continues to increase rapidly. The continued use of temperature control right through the marketing chain is also important for maintaining quality in most fruit and vegetables. Marketing agents and retailers are becoming more aware of this need and facilities are gradually being developed.

The greatly increased demand for technical information on temperature control for fruit and vegetables from all sections of industry has shown the need for more basic information about the effects of package dimension, ventilation holes, path length, fan strength and product type on air flow and cooling rates of produce. This information is being developed.

The Department is co-operating with the Committee of Direction of Fruit Marketing and the Australian United Fresh Fruit and Vegetable Growers' Association in developing package designs for package rationalization. The concept is related to the use of pallets for transporting produce and packages are being designed to fit a standard pallet with a number of sizes of package to suit all types of produce.

Package designs are such as to allow integration of all types of package on a single pallet, provided a whole layer of each package type can be established. The system is based on the concept of forced air cooling of produce. A number of problems is being encountered but considerable progress has been achieved.

A model for predicting bruising and bruise distribution in apple packs has been developed in conjunction with engineers at the University of Queensland. The method takes into account the variables to be expected in distribution systems, such as bruise resistance, number of layers, package rebound and impact conditions. The model can be used to evaluate package design, and packaging and handling systems.

The introduction of returnable crates for handling fruit and vegetables has made steady progress in Australia. The Queensland Department has had a major influence in crate design and in the introduction of this system. A trial crate pool system will be operating in Queensland shortly.

Extension

Seasonal conditions

All horticultural areas of Queensland received below-average rainfall for the year, putting a heavy demand on irrigation resources. Apart from cyclone Simon, which devastated some tree crops on the Central Coast during February, no cyclonic influences brought the usual heavy summer rains to the State.

Mild temperatures throughout the year in tropical areas gave generally excellent conditions for crop production. Winter temperatures were generally mild in all horticultural areas, but on the Granite Belt, a late frost in October caused considerable crop damage. In contrast, above-average summer and early autumn temperatures in central and southern horticultural areas had an adverse affect on the growth of many crops and caused a significant level of sunburn damage.

The dry conditions reduced the incidence of fungal and bacterial diseases and allowed harvesting of crops to proceed without check; but growers were forced to expend considerable effort on irrigation.

In all areas except Bowen and Mareeba, reserves of irrigation water were very depleted and there is general concern regarding the availability of irrigation water for winter crops. The light rainfall produced little run-off to replenish water storages, and salt levels increased. Some vegetable crops on the Granite Belt were abandoned when irrigation reserves were exhausted before the end of the production season.

Torrential rain in the headwaters of the Don River caused heavy flooding in the Delta, destroying 50 hectares of prime horticultural land and damaging many properties. Restoration of the damaged areas is nearly completed.

Extension activities

The increase in demand for technical information on horticultural crop production has continued in all horticultural regions of the State, reflecting both expansion in plantings and entry of new growers into the industry. New growers in particular tend to demand close personal attention. The constant repetitious demands are satisfied where possible by the use of written pamphlets and publication of articles in *Fruit and Vegetable News*, the fortnightly journal of the Committee of Direction of Fruit Marketing. Specific technical problems often require collaboration with other Branches of the Department.

The following comments relate to the more important extension projects being undertaken in the various horticultural regions.



Most new apple plantings in the Granite Belt use higher tree densities developed in research projects by Departmental officers.

GRANITE BELT. The Granite Belt extension programme was supported as usual by wide use of mass media to disseminate extension information. The local press and radio carried 36 timely items, mostly on pests and diseases of deciduous and vine crops.

A survey of growers receiving the Deciduous Fruit Spray Schedule showed that the majority used it throughout the season, and nearly all used the compatibility chart. As a result of the evaluation, the Schedule will be published biennially in future. To assist growers in identifying varieties of deciduous fruits, some hundreds of colour prints have been assembled in reference book form.

A simple and effective new technique for hot water treating vegetable seed was promoted, and growers were informed of the application of new grading and packing standards. As local nurseries have failed to supply the demand for fruit trees, propagating material of new and superior varieties was distributed, and articles on nursery management were published to assist growers to produce their own trees.

Promotion of close planting of apple trees continued. At a well-attended field day, growers inspected demonstration plots where close-planted trees of all varieties spectacularly outyielded widely spaced trees. Growers were shown at another field day the operation and advantages of electric fencing to protect young orchards.

In collaboration with the Sandy Trout Food Preservation Research Laboratory staff, Granite Belt extension officers confirmed that the period 15 to 22 February was the most suitable time for harvesting Delicious apples intended for controlled-atmosphere storage.

SOUTH MORETON. In the South Moreton region, the demand for technical information on crop production is increasing as a result of land subdivision. More than 100 farm visits are made each week; and while every effort is made to satisfy individual requests for assistance, increased emphasis is being placed on group or industry-oriented extension activities. Numerous field days, farm walks, seminars and discussion groups were convened, designed to attract particularly interested growers. Mass media are also used widely to disseminate information in response to the demand.

Extension projects were conducted to evaluate and promote improved cultural and management techniques to overcome problems in a range of vegetable crops. The Processing Vegetable Discussion Group continued to function successfully as a vehicle for greater co-operation between growers, processing companies and the Department to overcome problems in the industry. Several tours have been conducted to enable growers to observe cultural methods practised in other districts.

NORTH MORETON. In the North Moreton region, the demand for information on commercial crop production has continued to escalate, largely as a result of land sub-division and the entry of many inexperienced growers into the horticultural industry. Considerable effort has been directed towards the preparation and updating of a wide range of well researched technical pamphlets, together with a crop summary for each crop grown in the region, covering all aspects of production.

There has been an increase in co-operative activity with specific industry groups and groups of growers producing particular crops. Contact with these groups is made through field days, farm walks and discussion groups.

One of the more successful projects completed involved a situation analysis of the passionfruit industry. This highlighted the problems requiring attention and provided a sound basis for the development of an effective extension programme.

The development of the avocado industry in the North Moreton region has slowed down; it is estimated that there are some 200 growers on approximately 130 hectares producing more than 50 000 cartons a year with a gross value of about $1m. Nursery production of trees reached an all-time high of 50 000. Ginger plantings expanded by 40% last year, and the predicted crop is 6 740 tonnes compared with 5 216 tonnes in 1978-79.

There has been a considerable expansion in the macadamia industry during the past year and, if the projected plantings eventuate, the total area under crop in Queensland could be in excess of 2 000 hectares by the end of 1980. The pineapple remains the major crop in the region, the gross value in 1979 being $15.29m. An additional 700 hectares were planted during the year.

BURNETT REGION. In the Burnett region, a new horticultural extension publication, the Burnett Horticultural Bulletin, was initiated. This is to be issued twice a year, and will include a range of articles dealing with all aspects of crop production. The annual Citrus Spray Programme booklet issued to all commercial citrus growers in the State included information on biological control of citrus pests and promoted the adoption of an integrated pest control programme.

Surveys showed an increased adoption of close planting of citrus trees in the Central Burnett district. Biological control of citrus pests is gaining momentum, and information is being evaluated on techniques for operating the newly-developed hydraulic and air blast spray equipment. Management techniques for improving drainage in sloping orchards

are being assessed in association with Soil Conservation Branch. Promotion of the technique for thinning Imperial mandarin crops with ethephon spray is continuing. At Maryborough, technical assistance has been provided to the expanding macadamia nut industry.

Cash crop production in the Bundaberg area is expected to decrease slightly during the 1980 winter production season with the withdrawal of many of the sugar growers who entered the industry in 1978.

More growers have adopted forced air cooling as standard practice, and a transport company is installing a large room at Gin Gin to service growers' needs. Other results of recent Branch extension activity in the region include:

- wide adoption of container growing of winter tomato seedlings at Bundaberg;
- adoption of post-harvest dipping of rockmelons, and adherence to the pakaging and maturity standards;
- adoption of new cultivars, and the use of container-grown seedlings by the small but significant Bundaberg lettuce industry;
- wide adoption of heavy mulching of avocados in the Central Burnett;
- adoption of heat treatment of banana planting material at Bundaberg.

Central Queensland. In central Queensland, considerable use has been made of local newspapers and radio to disseminate horticultural information. This has tended to generate further heavy demand for cultural information from home gardeners and hobby farmers. Pineapple newsletters have served to inform pineapple growers of new technical developments in their industry, while other growers are serviced by means of an increasing range of locally-produced Crop Summaries.

Extension efforts included the successful promotion of post-harvest dipping of mangoes to prevent losses from anthracnose. Work has continued on the promotion of techniques to control anthracnose in avocados, development of post-harvest cooling facilities for fruit and vegetables, eradication of neglected areas of bananas; and artificial colouring of the winter papaw crop. Co-operative extension is being developed with the Callide-Dawson Bean Growers' Association; and extension has also been directed towards promoting irrigated commercial production of mangoes, early peaches, custard apples and avocados in the Callide-Dawson and Emerald areas.

Dry Tropics. In the dry tropics, the demand for extension services continued to increase, largely as the result of an additional 200 hectares planted to horticultural crops. Much of this expansion at Bowen involved marginal land farmed by inexperienced growers. There has been a reduction in demand for assistance from Burdekin sugar growers as they are tending to discontinue horticultural production.

Close co-operation with fruit and vegetable growers was maintained and further support was provided to the developing Rollingstone-Mutarne fresh pineapple industry. Successful extension activity was directed to the expanding rock-melon industry, and there has been almost universal adoption of post-harvest dipping techniques and adherence to the new marketing requirements. There has been difficulty in satisfying the demand for extension services from Ingham, Charters Towers, Mt. Fox and Majors Creek.

Wet Tropics. In the wet tropics, a Banana Liaison Group has been set up including 18 growers representing all producing districts. The group meets to discuss research and extension related to the needs of producers.

Spectacular increases in pineapple productivity have resulted from the use of the Queensland Cayenne clonal mixture, and the adoption of soil fumigation and plantation drainage. Efforts are continuing on the Atherton Tableland to promote improved avocado culture through attention to nutrition, drainage, mulching, windbreaks, spacing, varieties and pest and disease control. Extension is also being directed towards improvements in papaw production methods in relation to varieties, drainage, fruit spotting bug control and prevention of boron deficiency.

In the expanding litchi industry, extension has concentrated on varieties, crop management to promote flowering and fruit retention and pest and disease control. Work with nurserymen has reduced field losses resulting from *Fusarium* infection and parasitic algae.

Following the recent stationing of a Quarantine Officer on Thursday Island, and with the assistance of the Department of Aboriginal and Islanders' Advancement, it has been possible to provide an advisory service to remote aboriginal communities in the area. As well as assisting these people with fruit and vegetable production, the service should help to limit the movement of planting material and produce from Papua New Guinea and therefore the risk of spreading pests and diseases.

The Sandy Trout Food Preservation Research Laboratory has maintained close liaison with fruit and vegetable processors throughout the State. There has been a heavy demand for information on the technology of pre-cooling and cool storage of fruit and vegetables from growers, transport operations and Queensland and interstate agents.

These enquiries have highlighted the need for rationalization of fruit and vegetable packaging for adequate temperature control in association with modern handling systems. Workshops on coolroom design and the technology of forced-air cooling were held during the year for the benefit of field extension staff.

Evaluating the effects of different storage temperatures on the incidence of chilling injury in pineapples.



Servicing activities

Market Extension Service

The Marketing Extension Service is now in its fifth year of operation and continues to be received very favourably by fruit and vegetable growers. At the Brisbane Market, improvement in the quality and presentation of horticultural produce has been very evident.

Daily inspections of consignments at the markets identify deficiencies in quality and presentation. A notification of the defect is then transmitted to the extension officer in the district of origin of the produce so that he can discuss the matter with the grower and provide appropriate advice.

The quantity of pre-cooled fruit and vegetables arriving at the Brisbane Market has increased substantially during the past year. In contrast, some losses of zucchinis and button squash were incurred through over-heating in transit. It is evident that greater care is still required in the handling and transport of highly perishable horticultural produce.

In spite of the State-wide drought, quality of most orchard fruit at the markets was excellent, although fruit size was generally smaller than usual. Anthracnose was a problem in some autumn-marketed avocados and many consignments contained fruit that was excessively blemished as a result of attack by fruit fly or spotting bug. Papaw quality improved last year and there was a reduction in the incidence of ripe fruit rots on fruit from most districts.

Citrus Budwood and Seed Distribution Scheme

During 1979, 40 Queensland nurserymen and orchardists were supplied with 131 600 citrus buds. This was a little less than the 1978 sales. Quantity of seed sold for root-stock production rose by 18% to 109 kg. The demand for Troyer citrange seed and for some exocortis-viroid-free lines exceeded the supply. Simple machinery is being developed to assist with seed extraction.

More than 600 trees have now been field planted in the two Citrus Budwood Mother Blocks and are growing satisfactorily. Budwood from the first trees has been submitted to Plant Pathology Branch for virus indexing. It is planned to supply all budwood ultimately from these mother blocks.

Strawberry Runner Approval Scheme

The objective of the Strawberry Runner Approval Scheme is to provide virus-free, high quality, true-to-type planting material to the strawberry industry. Over the 17 years that the scheme has been in operation, the demand for runners has increased steadily, and in the 1980 season 811 454 Redlands Crimson and 330 600 Earlisweet runners supplied to 268 growers. All runners were produced by a contract grower at Crows Nest.

Strawberry growers have commented very favourably on the quality of the runners. In spite of difficult weather conditions which prevailed during the crop establishment period, no serious problems were reported.

The major responsibility for the operation of this Scheme was passed to the Strawberry Sub-Committee of the Other Fruits Sectional Group of the Committee of Direction of Fruit Marketing during the year.

Bean Seed Scheme

The Burdekin area remains the most important French bean seed producing region in the State, with a registered area of 462 ha producing 483 000 kg of clean seed in 1979. Production from Bowen is now minor. However, the area under crop in the Biloela district increased to 210 ha in 1980, and it is expected that annual increases will occur for the next few years.

As the Biloela district is not a bean seed quarantine area, production of culinary and navy beans is allowed without restriction. The Callide-Dawson Bean Growers' Association in collaboration with Departmental officers, has therefore initiated voluntary limitation on the introduction of bean seed in an effort to prevent the introduction of halo blight and other seed-borne diseases into the area.

Most Burdekin bean seed crops germinated satisfactorily in 1979 with the exception of some areas of Apollo. Yields of all crops were generally good due to the excellent growing conditions and absence of rain during harvesting. Although no notifiable diseases were detected, root rot, *Sclerotinia* and insect damage affected several crops. The Biloela crop suffered to some extent from insect pests and nutritional problems.

Regulatory

Plant quarantine

Administration of the Plant Quarantine Service in this State is a substantial commitment of this Branch. This service is undertaken on behalf of the Commonwealth. The purpose of the surveillance is to minimize the risk of introducing a serious pest or disease of plants or plant products or any serious weed pest.

It involves two somewhat distinct operations, one being the inspection of passengers' baggage and cargo entering the State from overseas by sea and air and the other the treatment and supervision of plant introductions.

The trend to containerized cargo, which started in 1969, has continued and now more than 80% of all cargo entering the State from overseas is in containers. Those requiring detailed inspections are identified from shipping manifests and, in addition, a percentage of containers are selected at random for inspections.

The quarantine workload at the international airport has increased with a greater throughput of passengers. In addition, there has been an increase in the amount of cargo imported by air. Many of these items such as fruit and cut flowers are perishable and require detailed inspections before release can be approved.

Surveillance of the area at Gordonvale where an outbreak of the Giant African Snail was detected in 1977 has continued. The detection and baiting programme will be extended for another season and, if no further specimens are located, the control of the pest will be considered to have been successful.

During the year, a plant quarantine officer was located at Thursday Island. This Cape York-Torres Strait area is of increasing concern to quarantine authorities because of its close proximity to other countries where serious pests and diseases not found in Australia are known to occur.

As well as increasing the level of quarantine surveillance in the area, this appointment has allowed the programme to monitor the area for occurrence of exotic insect pests to be intensified.

Fumigation facilities have been upgraded at Townsville and Thursday Island with the provision of new buildings and gas chambers. Plant fumigations can now be carried out at Thursday Island, Cairns, Townsville, Rockhampton and Brisbane.

As part of an overall plan to increase quarantine awareness in Queensland, the three branches of the service have united to hold a series of seminars at all Queensland outports. As well as quarantine staff, participants have included Customs, Fisheries, Harbours and Marine, State and Commonwealth Police and others closely involved in port situations.

The following table gives details of passenger movement and cargo and plant imports that were supervized by plant quarantine officers during the year—

—	1978–79	1979–80
Total number of passengers by sea and air	160 300	191 334
Miscellaneous packages ..	365 250	258 220
Containers from overseas ..	19 800	31 843
Timber in cubic metres ..	87 600	57 447
Consignments of plants released from Quarantine	275	370

The value of the Plant Quarantine Service continues to be evidenced by the regular interception of serious pests and diseases that do not occur in Australia.

Treatment of plants for interstate movement

The number of operators in the nursery industry has continued to increase and there are now more than 1 300 nurseries registered in the State. Extension aimed at encouraging nurseries to raise the standard of their facilities in order to qualify for export registration has been successful and there are now eight with Group A and 100 with Group B registrations. As the volume of the interstate plant trade continues to expand, registered export nurseries are playing an increasingly valuable role in applying the necessary treatments to these plants without requiring the supervision of Departmental officers. However, officers have still devoted a considerable amount of time to the supervision of treatment by nurseries which are not registered in an export category.

Banana Industry Protection Board

During 1979-80, the Banana Industry Protection Board increased its drive to have neglected areas of bananas eradicated, and the campaign has met with considerable success.

While the number of banana growers in the State has remained fairly constant at 1 124, the total area under crop has increased from 3 300 ha to 3 650 ha.

In the Southern Banana Quarantine Area, bunchy top disease continues to be an important problem, with a total of 1 786 infected plants being found on 176 properties.

The campaign to eradicate bunchy top in the Brisbane Metropolitan Area has continued, its success being indicated by the reduced number of infected plants located. Although a large section of the Metropolitan Area has been covered, completion of the project is still some years away.

The levy payable by growers on Queensland-produced bananas was not raised during the year, as increased production accounted for an additional 40% in revenue. This fund is used to offset the cost of field inspections.

The Board visited the North Moreton and South Moreton banana growing areas during the year and met representative groups of growers. The aim of these visits is to publicize the Board's functions, and to make growers more aware of their responsibility to control pests and diseases of bananas.

Plant Pathology Branch

THE objectives and functions of the Branch are—

To develop and incorporate into field practice more effective and economical methods of reducing losses caused by fungi, bacteria, nematodes and viruses in crops other than sugar-cane.

This involves the accurate diagnosis of diseases, including those intercepted in quarantine, studies of causal organisms and the factors affecting their severity, disease control by chemical, cultural and biological methods including cultivar resistance and the dissemination of disease control information.

To maintain a record of all plant diseases found in Queensland (other than those in sugar-cane) with reference specimens stored in an herbarium and a collection of plant pathogens particularly fungi and nematodes.

To develop more effective strains of rhizobia for legumes, particularly tropical pasture legumes and to improve their field performance.

Research

Field crops

BARLEY. Four field experiments were conducted to determine the effect of seed and foliar treatments with triadimefon on powdery mildew (*Erysiphe graminis hordei*) and yield of barley.

Seed treatment gave good control of mildew for about 6 weeks after planting. Some control for an additional 2 to 3 weeks was obtained by spraying the plants 5 to 6 weeks after planting. Averaging over four trials, seed treatment gave a 6·8% increase in grain yield and seed treatment followed by a foliar spray an increase of 9·2%.

CHICKPEA. A root rot caused by the fungus *Phytophthora megasperma* var. *sojae* affected chickpeas on the Darling Downs, Fassifern Valley and at the Hermitage Research Station. Eleven fungicides were screened as seed dressings, and metalaxyl was the only one to provide adequate protection under severe conditions.

Resistance of 200 breeding lines is being assessed under glasshouse conditions at Toowoomba.

MAIZE. At Gatton Research Station, 164 S_1 lines were rated for their reaction to sugarcane mosaic virus (SCMV), cereal chlorotic mottle virus (CCMV) and wallaby ear disease. Lines highly susceptible to SCMV, CCMV and wallaby ear disease were identified.

On the Atherton Tableland, 45 maize crops were inspected for head smut (*Sphacelotheca reiliana*). Most crops in which the disease was found had less than 5% of the plants affected. The highest incidence was 91% in a planting near Tolga. The plant breeding programme at the Kairi Research Station has produced a number of smut-resistant cultivars and this has led to a reduction in the importance of head smut.

SAFFLOWER. Sixty-nine lines were tested for resistance to leaf-blight (*Alternaria carthami*). Although none was immune, some had low leaf and bract infection and might be useful sources of resistance for a breeding programme.

SORGHUM. Charcoal rot (*Macrophomina phaseolina*) and Fusarium stalk rot (*Fusarium moniliforme*) occurred in most crops and led to substantial grain losses through grain pinching.

In field trials the hybrids Goldrush, SM 8, Q5161 and E57 were resistant to charcoal rot while Sundowner, F64a, TX610SR, Goldfinger, Dorado and Leader S were susceptible or highly susceptible.

The co-operative breeding programme with Agriculture Branch has already resulted in the release of 12 parental lines which have been incorporated into five commercial cultivars. A further three releases which combine SCMV and head smut resistance are proposed.

SOYBEAN. Root and stem rot (*Phytophthora megasperma* var. *sojae*) was again a problem on heavy soils at Cecil Plains and on the Hermitage Research Station. At Cecil Plains, the cultivars Semstar and Fitzroy were severely affected and complete crop failure occurred in a few plantings. Other cultivars in adjacent fields were not affected.

SUNFLOWER. Most sunflower rust (*Puccinia helianthi*) samples collected in Queensland were identified as Race 1. Two samples collected in the Central Highlands behaved like Race 3 and, during April, rust collected from a recently released cultivar in the Cecil Plains and Wyreema areas behaved differently from either Race 1 or 3.

One hundred and eight sunflower lines were screened for resistance to blight (*Alternaria helianthi*). Although no immunity was found, differences in reaction to infection were noted.

Contamination of sunflower seed lots with sclerotes of *Sclerotinia sclerotiorum* is a serious problem. Some sclerotes are similar in size and shape to sunflower seeds and are difficult to remove by sieving. In laboratory and glasshouse tests, benzimidazole seed dusts killed sclerotes without reducing seed germination. A flotation method of separation performed well under commercial conditions.

TOBACCO. Since the introduction of metalaxyl in the 1978-79 season, blue mould (*Peronospora hyoscyami*) has been virtually absent from north Queensland. However, there has been an increase in brown leafspot (*Alternaria longipes*) and frog eye spot (*Cercospora nicotianae*) which were previously kept in check by dithiocarbamates.

Bacterial wilt (*Pseudomonas solanacearum*) continues to concern growers and the introduction of the resistant cultivar ZZ100 in the 1980-81 season will be welcome. However, this cultivar displays a necrotic reaction to potato Y virus.

Wildfire (*Pseudomonas tabaci*) was recorded for the first time in Queensland and seriously affected some crops in the Mareeba-Dimbulah area. Silver nitrate treatment of tobacco seed before distribution to growers has been reintroduced in an endeavour to limit the spread of the disease.

WHEAT. Long fallow disorder of wheat crops has been a problem in some areas of the Darling Downs for many years. Good control has been achieved by soil fumigation and soil treatment with insecticide-nematicides particularly aldicarb. Some cultivar resistance to the disorder has been established. Unfortunately, the recently-released cultivar Banks appears to be very susceptible.

Crown rot (*Gibberella zeae*) was favoured by dry conditions in the middle of the growing season and tended to be more severe than usual. The reference cultivar, Gala, showed the highest level of resistance while Cook, Timgalen, 2338-9, 2421-4 and Puseas ranged from moderately to highly susceptible and Banks, 7605 and the triticale cultivar Satu were very susceptible.



Threshing grain from the heads of a wheat cultivar resistant to crown rot.

Common root rot (*Cochliobolus sativus*) was most serious in the south-western Downs. Disease loss assessment studies indicated that yield reduction varied between 0·1% and 30% over all sites with a mean of 8·7%. In field experiments, fungicide seed treatments controlled infection until tillering but, between flowering and maturity, the incidence continued to rise until the treated plots had as much common root rot as the untreated plots.

Yellow spot (*Pyrenophora tritici-repentis*) has increased in importance in recent seasons and there appears to be a strong association between the severity of the disease and the quantity of surface stubble. In field trials, the cultivars Shortim, Banks and Oxley were more susceptible than Gamut, Gatcher and Kite.

Pastures

STYLOSANTHES. In collaboration with C.S.I.R.O., we continued to screen *Stylosanthes* lines for resistance to anthracnose, determine the races of the pathogen and test the value of seed treatments for eliminating seedborne propagules.

Heat treatment (140°C for 15 sec) reduced seed germination but did not eliminate contamination with *Colletotrichum gloeosporioides*.

Horticultural crops

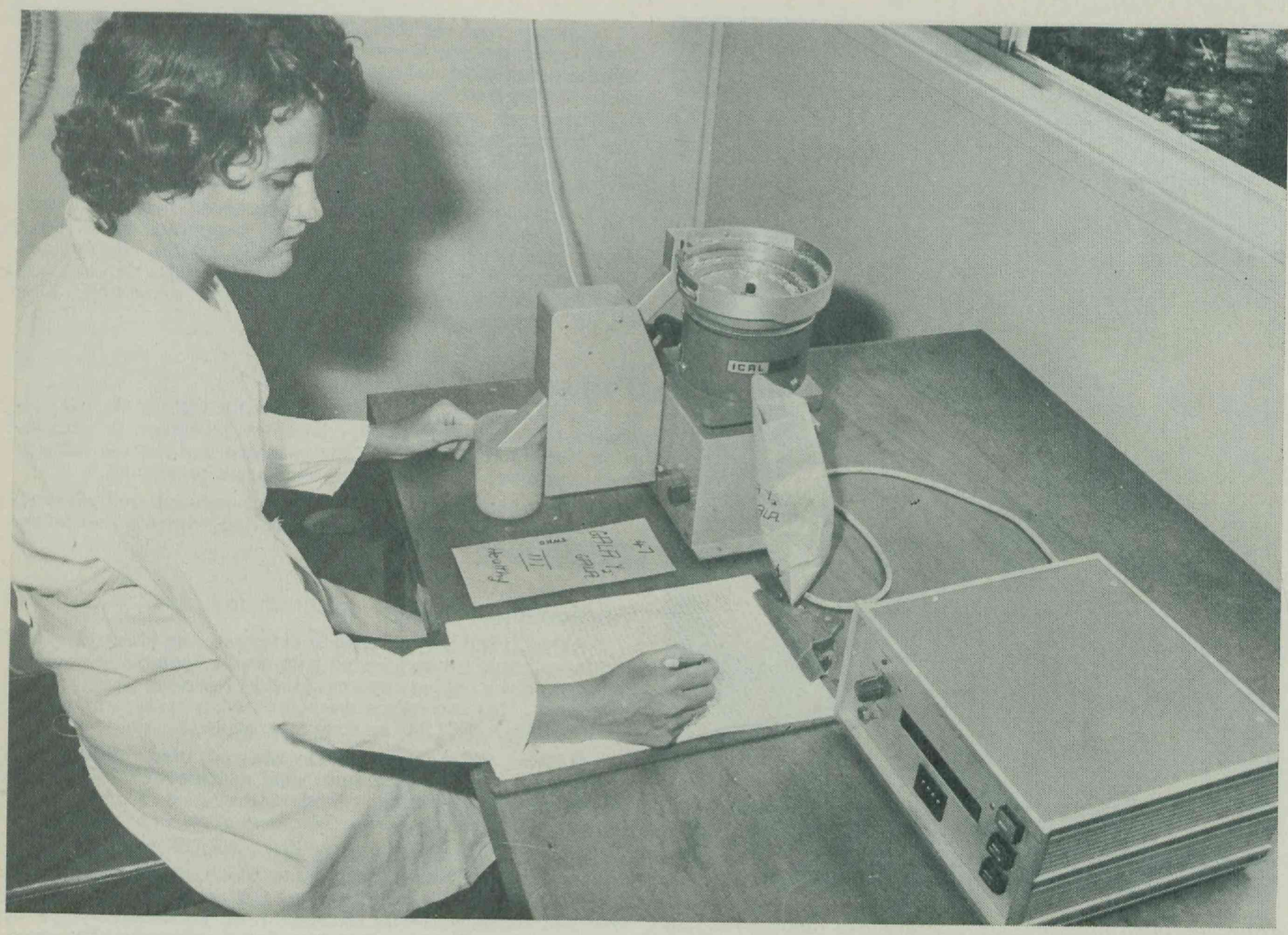
APPLE. Field experiments to determine the effect of spraying fallen apple leaves affected with scab (*Venturia inaequalis*) on the release of ascospores in the following spring were continued. No ascospores were released from leaves sprayed with benomyl, KC1500 or sodium arsenite.

Studies on apple dieback showed that the fungus *Trametes versicolor* is a serious wood rot pathogen. The value of treating limb pruning wounds with Pancil T, Anti-mould enamel paint, or Valsa wax was demonstrated.

AVOCADO. Anthracnose (*Colletotrichum gloeosporioides*) is a major post-harvest disease for which there is as yet no satisfactory control. In a screening trial with cv. Fuerte, seven systemic fungicides were compared as post-harvest dips at 45°C or at ambient temperature for 5 minutes. The most

A technician examining wheat roots for the incidence of common root rot.





A technician counting the number of grains produced by a variety resistant to crown rot.

promising were KC1500, prochloraz and carbendazim. Prochloraz was more effective at 45°C than at ambient temperature but caused skin browning. The experiment was repeated at Mareeba where KC1500, prochloraz and quazatine gave the most promising results.

An officer of Plant Pathology Branch applying a fungicide in a spray trial on the Granite Belt.



Co-operative work with Horticulture Branch on graft-indexing of material for use in budwood production and commercial seed sources has benefited from the understanding of the high temperature symptom expression requirements of avocado sunblotch disease. The efficiency of the graft-indexing method of detecting sunblotch has been greatly improved.

Biochemical indexing techniques have also been improved and it has been shown that the c-DNA probe technique is more sensitive and specific than polyacrylamide gel electrophoresis. Three sources of avocado sunblotch viroid were located.

CAPSICUM. Powdery mildew (*Leveillula taurica*) is often a problem in the Bowen district. In a field trial, benomyl, sulphur, pyrazophos and triadimefon were used on a 10-day schedule and triadimefon was also used on a 20-day schedule. Benomyl and triadimefon gave better control than pyrazophos.

Isolates of *Xanthomonas vesicatoria* (bacterial spot) collected in Queensland were identified to pathotype according to the classification scheme of Cook and Stall. Two pathotypes were found. The pepper strain was more common and affected all capsicum cultivars. No capsicum cultivar was susceptible to the tomato strain.

CUCURBITS. Watermelon mosaic virus (WMV) causes serious losses of cucurbits especially zucchini, pumpkin and watermelon. Work in conjunction with Horticulture Branch on the introduction of virus resistance from *Cucurbita ecuadorensis* to pumpkins and zucchinis has given promising results. Attempts are also being made to introduce resistance to pumpkins from a *Cucurbita maxima* introduction.

GRAPES. In a field trial in the Granite Belt with cv. Waltham Cross, Bordeaux mixture or sodium arsenite applied immediately before bud burst did not improve the control of anthracnose (*Elsinoe ampelina*) achieved by spraying with ziram every 7 to 21 days after bud burst. Captafol was as effective as ziram and both were markedly superior to mancozeb.

PAPAW. Post-harvest losses are still a major problem. In a joint trial with Horticulture Branch and the C.S.I.R.O. Division of Food Research, a benomyl dip at 47°C for 15 minutes, developed by the Queensland Agricultural College, was tested for control of post-harvest wastage during storage in modified atmospheres within polythene bags. Polybag storage increased stem-end rot (*Ascochyta caricae-papayae*) and surface rots (*Glomerella, Colletotrichum* and *Ascochyta* spp.). The benomyl dip controlled stem-end rot and reduced surface rot under all conditions.

Powdery mildew (*Sphaerotheca humuli*) has been controlled in the past with sulphur. In a field trial at Beerwah, dimethirimol and dinocap were more effective. The addition of a wetting agent caused fruit injury and did not improve disease control.

PASSIONFRUIT. A new type of brown spot caused by the fungus *Alternaria alternata* appeared in the Nambour district in 1978 and was not controlled by the recommended brown spot spray programme. In a field trial, chlorothalonil and iprodione gave better control of alternata spot than mancozeb or copper oxychloride.

During the year, 410 passionfruit tips from all major varieties were indexed and all were found to be infected with passionfruit woodiness virus (PWV). Two hundred and nine of these were infected with both the common and severe strain while the remainder were infected only with the common strain. The cultivar Purple Gold shows tolerance to severe strain infection. Four strains of PWV have been purified and antisera made against two of them.

PINEAPPLE. Studies on control of root and heart rot (*Phytophthora cinnamomi*) indicated the value of treatment with metalaxyl, difolatan or aluminium ethyl phosphite. Propamocarb gave poor control.

STONE FRUIT. Fungicides were tested for their effect on bacterial spot (*Xanthomonas pruni*). All copper fungicides gave good control of fruit spot and shoot cankers on Doris plums but only Bordeaux or copper oxychloride at leaf fall gave good leaf spot control. However, they caused severe fruit russet.

ROCKMELON. In a trial at Bundaberg with cv Planters Jumbo, benomyl mixed with dicloran or quazatine controlled Fusarium rot for 11 days and soft rots (*Geotrichum candidum* and *Rhizopus stolonifer*) for 8 days. Both mixtures were more effective at 55°C than at 25°C (ambient). The benomyl-quazatine dip has been introduced into commercial use.

TOMATO. Foot rot (*Fusarium solani*) and fusarium wilt caused by a new race of *Fusarium oxysporum* f.sp. *lycopersici* continue to cause concern in the Bowen district and efforts to find sources of resistance were continued without success.

In south Queensland, studies on Verticillium wilt (*Verticillium dahliae*) were continued. Good control was obtained by preplant soil fumigation with Di-Trapex. There were marked differences between isolates of *V. dahliae* in their ability to cause disease symptoms in reputedly resistant cultivars.

A cultivar resistant to bacterial wilt (*Pseudomonas solanacearum*) had been bred in co-operation with Horticulture Branch from an initial cross between VC9-1 and cv. Floradel and application has been made for its commercial release. The cultivar is also resistant to *Fusarium oxysporum* f.sp. *lycopersici* race 1 but not to race 2 nor to *Verticillium dahliae*.

New diseases

Damping off of sorghum by a *Pythium* sp. caused serious losses necessitating crop replanting on some farms on the Darling Downs. The soil was warm and very wet at planting.

Wildfire of tobacco, caused by the bacterium *Pseudomonas tabaci*, appeared in the Mareeba-Dimbulah area where it caused severe crop losses.

Phytophthora megasperma var. *sojae* was isolated from roots of dying soybean plants at Brookstead-Cecil Plains and on the Hermitage Research Station.

In a survey of chickpea crops on the Darling Downs and Fassifern Valley in September 1979, two crops were found to be seriously affected by root rot caused by *Phytophthora megasperma* var. *sojae*. The isolate from chickpea did not affect soybean and the isolate from soybean did not affect chickpea.

Extension services

The *Handbook of Plant Diseases* met with continued demand and approximately 2 600 copies of Volume 1 and 1 700 copies of Volume 2 have been sold. The set of disease control recommendations with Volume 1 has already been updated.

Diagnostic services

More than 2 600 enquiries requiring disease diagnosis were handled through Indooroopilly and the seven country field stations.

The specialist bacteriologist handled 180 samples most of which required detailed laboratory checking. The nematologists examined 1 100 plant and soil samples. In the virology section over 750 specimens were examined with the electron microscope and 200 were indexed in the glasshouse.

Bacteriology

The epiphytic survival of the bacterial wilt pathogen *Pseudomonas solanacearum* on the foliage of capsicum and tomato was demonstrated when the seed was inoculated with the bacterium and germinated at 90 to 95% or 72 to 75% relative humidity. The pathogen was carried from the inoculated seed to the foliage of the seedling during emergence. The work was extended to show that eipiphytic populations could be detected when surface sterilized seed was planted in infested soil containing 10^7 or more bacteria per gram of soil.

Legume bacteriology

During the year, 57 cultures were supplied to agronomists and farmers for 11 different legumes for which no commercial cultures are available.

The testing of rhizobial strains for a broad spectrum replacement for CB756 continued. Strains were tested on *Lespedeza stipulacea, Clitoria ternatea* and *Teramnus uncinatus*. Six promising strains are emerging with good performance on the seven legumes so far tested.

Virology

Changes in the type of symptoms seen in a range of solanaceous crops infected with potato Y virus (PVY) has led to a study of the variability of this virus. A more precise knowledge of the different strains of PVY is important in breeding and screening of tobacco, tomato and capsicum for PVY resistance. The reactions of commercial tobacco cultivars and breeding lines to PVY strains are being checked.

Mycology

The Queensland Fisheries Service sought assistance in determining the cause of high mortality of grey mangrove (*Avicennia marina* var. *australasica* near Gladstone, along the Calliope River and Auckland Creek and on islands near the mouth of the Calliope River. An undescribed species of *Phytophthora* was consistently isolated from lateral absorbing roots of dying trees.

A study of fungi previously classified in *Helminthosporium* was continued. This group contains several species which cause important diseases of wheat, sorghum and maize. Data obtained support the proposal that the species would best be placed in the three genera *Drechslera, Bipolaris* and *Exserohilum*.

More than 1 100 new accessions representing a broad range of plant parasitic fungi were added to the Plant Pathology Herbarium and 37 isolates were added to the culture collection.

Mycotoxins

The study of the invasion of peanuts by aflatoxin-producing fungi before harvest was continued. Results to date support the following conclusions—

1. Under moisture stress, pods lacking visible damage can be penetrated by *Aspergillus flavus*. Virginia Bunch is more susceptible than Red Spanish.

   With minor exceptions, the incidence of invasion tends to be lower in the larger kernel grades.

2. Under moisture stress, a significant level of invasion occurred in perforated pods of both Virginia Bunch and Red Spanish. The incidence of perforations was higher in Red Spanish where it largely took the form of burst pods caused by rapid kernel growth following rain at a late stage of crop development.

Quarantine

Approximately half of 75 lines of guar imported from India, Pakistan and the U.S.A. were found to be carrying a potyvirus identified as guar symptomless virus.

About 300 orchids (60 different cultivars) from Brazil, France, Hawaii, Papua New Guinea, Singapore and Thailand were found to be infected with Cymbidium mosaic virus or tobacco mosaic virus-orchid strain.

Agricultural Chemistry Branch

THE work of the Agricultural Chemistry Branch falls into the categories of research, regulatory, and supporting analytical services for research and extension. With its city and country laboratories, the Branch provides chemical services and specialist advice in such fields as analytical chemistry, soil science, pesticide science, cereal chemistry, plant chemistry and land evaluation.

Research

Pesticide chemistry

Before a pesticide can be registered for use, a field trial must be conducted and measurements made of the resulting pesticide residues in the produce. Authorities then make use of the residue data in setting maximum residue limit (MRL) values for the pesticide.

Although such information is provided by manufacturers, the Branch provides additional data on residue levels arising from new pest control compounds or from existing Departmental recommendations. Completed residue trials this year are: ethylene dibromide (EDB) in passionfruit, pawpaw, mango and capsicum; permethrin, phenothrin, fenvalerate and decamethrin in sorghum, wheat and bread; and methidathion in Ellendale mandarins.

In some seasons, the recommended spray schedule using azinphos methyl has given poor control of codling moth on apples. A possible cause is the rapid breakdown of this pesticide under some weather conditions. An experiment was designed to test the persistence of azinphos methyl on apples at Applethorpe, and in 1979 the half-life of azinphos methyl was 16 days. The study is being continued in 1980.

The storage life of dithiocarbamate fungicide formulations has been questioned. Tests on 16 formulations (maneb, zineb and mancozeb) were carried out according to the CIPAC standard method. All of the formulations except one, zineb, were within the specification for storage stability.

The stability of aqueous pyrethrin formulations in various containers was studied at both room temperature and 40°C. Results showed that, while no losses occurred in sealed glass containers, significant losses occurred in both plastic (PVC and PET) and lacquered tins. Further tests, showed that the pyrethrin and the synergist, piperonyl butoxide, dissolved in the plastic and that the loss was greatest in the non-polar plastic. Plain tin containers minimized initial losses but were subject to rusting. For long shelf life, aqueous pyrethrin formulations must be stored in glass or a plastic in which the pyrethrin will not dissolve.

The project to study the breakdown of the four pyrethroid insecticides (permethrin, phenothrin, fenvalerate and decamethrin) on grain for various conditions of storage (time, temperature and moisture) is nearing completion. Analyses of pyrethroid residues on wheat after 12 months' storage at 25°C and 12% moisture indicate half-lives far in excess of this storage period for these four pyrethroids.

Bees are important primary pollinators of crops and, because of their susceptibility to poisoning by insecticides, should be kept from freshly sprayed areas. Synthesis of compounds as bee repellents for this application has continued and a further 19 compounds have been tested. Preliminary field trials of one of the potentially useful compounds are encouraging and further field-testing is being arranged. Another compound has proved at least as effective for robbing hives as those currently used. Toxicological data are being obtained.

Plant chemistry

Free arginine levels in the maturing peanut kernel were measured in three varieties, Red Spanish, White Spanish and Virginia Bunch, as a possible index of peanut maturity. Both free arginine and moisture levels fell rapidly during early development and then levelled out towards physiological maturity. The level of free arginine was correlated with yield and dollar return. Preliminary examination has shown the agreement to be less than expected and it appears unlikely that free arginine by itself would be a useful maturity index.

Further progress has been made on the introduction of high lysine characteristics into north Queensland maize. Following further crossing, 330 samples were analysed for lysine and protein. Results show a satisfactory high lysine incorporation combined with high protein and vitreous endosperm. A further back-cross will be undertaken to reach the required level of all desired characteristics.

Samples of mould-damaged peanut kernels were examined for free fatty acids and peroxide value. Since the mould was not *Aspergillus* spp., these kernels could have been included in graded nuts. The oil from the most seriously affected kernels was found to contain up to 50% free fatty acids with lower amounts in those less affected. Off-flavours can result from high levels of free fatty acids. Peroxide value was not markedly changed by mould infestation.

Lupins are being increasingly grown for their high protein grain which is used as a stock feed. Only the low alkaloid (sweet) varieties are useful in this application and alkaloid analyses must be carried out to prove the worth of the grain. Alkaloid levels in the sweet varieties have ranged from 0·001% to 0·07%. Some grain in the higher part of this range has been unpalatable to pigs.

A sample of oil extracted from lupin seeds *(L. albus)* contained 7% palmitic, 2% stearic, 56% oleic, 19% linoleic and 10% linolenic acids as triglycerides. There were also other unidentified minor constituents.

In continuing support of the cotton programme aimed at developing lines resistant to *Heliothis* spp., this year's analyses have revealed the highest levels of terpenoid aldehydes yet recorded for Queensland-developed high gossypol cotton.

A method for measuring trace quantities of cobalt in plant material has been developed. Contamination during sample preparation was found to be the most serious source of error. Subsequently a survey of cobalt levels in a pasture near Bundaberg found plant concentrations were low enough to be detrimental to animal health, thus confirming a Beef Cattle Husbandry Branch diagnosis of cobalt deficiency in stock. A cobalt survey of pastures from other cattle properties has commenced.

Cereal chemistry

The cereal chemistry section, stationed at the Queensland Wheat Research Institute, has the responsibility for quality assessment within the Department's wheat and barley breeding programmes.

A grant of $40 000 was received from the Australian Wheat Industry Research Council to enable the section to purchase instrumentation to continue its research on the use of near infrared reflectance spectroscopy for measuring wheat quality characters.

In the wheat programme, 13 crossbreds were evaluated from the regional trials, the final stage of testing. Eight of these are to be retested during the 1980 season. One of these QT7765, a potential replacement for Oxley, is the result of quality reselection undertaken on grain from single plants of a crossbred which was rejected because of poor quality.

Data on the protein content and classification of wheat delivered to Queensland depots during the past 10 years were summarized as part of a feasibility study into the zoning of varieties to optimize the match of quality type and protein content.

In the barley programme, two promising crossbreds from the Department's breeding programme, Bus/Zep 166 and Bus/Zep 379, were included in regional trials for the first time. Both showed malting quality equal to that of Clipper although there is some evidence that their malting behaviour may be slightly different. Maltsters and brewers are presently evaluating the Bus/Zep 166 line in their own laboratories.

Regional soil fertility assessment

Soils from the Burdekin region, central Queensland, and the South Burnett continue to be screened for nutrient status in a programme involving soil mapping, soil sampling for chemical and physical analyses, and glasshouse nutrient experiments.

The effects of stocking rate on soil chemical properties have been monitored annually over a 5-year period at Isis Junction. Soil changes attributable to stocking rate have not yet emerged but there is evidence that fertilizer phosphorus is being lost by leaching.

Soil and plant diagnostic criteria

Field studies on commercial grass-legume pastures in south-east Queensland, designed to develop diagnostic criteria for predicting responses to topdressed phosphorus, sulphur and potassium fertilizers have been completed. Phosphorus critical levels for white clover, Siratro and Greenleaf desmodium pastures have been published while interpretation to derive sulphur and potassium critical soil levels for these pasture species is continuing.

Fertilizer experiments in the South Burnett have shown that present laboratory tests are not good predictors of phosphorus requirement of soybeans on these soils. A soil analysis based on the phosphorus sorption ability of the soil has proved successful and is being further tested in glasshouse experiments.

Trials to relate potassium responses in soybeans to soil potassium values are also under way in the South Burnett.

Crop and pasture nutrition

Nutrition studies on rice in the Lower Burdekin area have identified nitrogen and phosphorus as the only nutrients likely to become deficient in this region. Rice was found to be an efficient exploiter of low phosphorus soil and also to require only low tissue phosphorus levels (0.08%) to achieve maximum growth. Thus fertilizer phosphorus requirements for rice are low and residual effects are likely to be high.

Expansion of peanut growing into low fertility soils of the Dimbulah and Mt. Garnet areas on the Atherton Tableland has necessitated the start on a programme to define nutrient requirements of peanuts in these areas. Officers based at the Mareeba laboratory are co-operating in a series of peanut nutrition trials with particular emphasis on defining soil calcium levels below which gypsum is required to prevent 'pops' in the major variety Virginia Bunch.

Soil physics

Suitability of soils for irrigation was studied in the lower Burdekin Valley. Plant available water, measured using small-plot sorghum experiments, showed that highly sodic duplex soils held only about 6 cm available water (compared with 12 cm for cracking clays) and would need irrigation every 7 days. Root development in the subsoil was the critical factor and this was limited by subsoil strength and salinity. Soil improvement techniques developed 14 years ago at Millaroo Research Station (pioneer rice, deep ripping, gypsum) are still showing effects and should improve the suitability of duplex soils for irrigation.

Gypsum is being used increasingly on soils with structural problems. Soil structural response to gypsum is being studied to develop a diagnostic test for gypsum requirement.

A co-operative trial has commenced to measure the effects of lime, gypsum, sand and molasses addition to a silty clay loan used for tomato growing at Bowen. Physical effects are being measured in terms of surface structure, water movement into soil and energy needed for cultivation.

Irrigation efficiency being studied at the Emerald Irrigation Area showed pre-irrigation for cotton on one soil was only 72% efficient with no deep percolation. High nitrates in tail water (up to 99 p.p.m.) were detected.

Method development

In a chemistry laboratory there is a continuing need for analytical methods to be updated, modified or developed to meet analytical requests and to keep up with modern technology.

The major development of new methods has been in association with the inductively coupled plasma spectrometer (ICP) and the high performance liquid chromatograph (HPLC). Methods are now available on the HPLC for the analysis of formulations of pyrethrins, MCPA/dicamba, bromoxynil, and seven carbamates. The ICP can now be used for boron, copper, calcium, magnesium in plants and calcium, magnesium and aluminium in soils. Work is continuing on other elements.

A statistical approach has been developed for testing new inorganic methods of analysis and comparing them with existing methods.

Other methods developed during the year have been for the measurement of oil content in avocados, gossypol in cotton, alkaloids in lupin grain, dicamba and picloram residues in plants, acetylene reduction technique for measuring nitrogen fixation and new Auto Analyser systems for soil analysis.

All plant analyses are now reported on a print-out of the PDP 11/10 computer. Work is proceeding to have major instruments connected directly to the computer.

Land degradation research

Increasing awareness of salting problems both in dryland situations and as a result of irrigation has led to an increase in research input in this field.

In the Emerald Irrigation Area, high water tables have developed after 4 to 5 years of irrigation, producing a salt-affected area of approximately 400 ha spread over 14 of the 43 irrigation farms. Tile drainage systems have been installed to reclaim some of the affected areas.

Soil analyses show that salinity decreases rapidly as a result of this measure, but there are indications of increased sodicity (and thus poorer soil structure) in the leached soil. Further amelioration studies, involving the use of gypsum and deep ripping in tile-drained areas, are under way.

A laboratory and field study has been completed on the effects of irrigating cracking clay soils near Murgon with waters of five different qualities. Recommendations on a suitable water quality for irrigation on these soils have been made.

In the Lockyer Valley, an extensive field sampling programme is planned to measure soil changes that occur through irrigation, and the effect of soil type, land management, and water quality on these changes.

Studies are being carried out on landform and land-use factors contributing to dryland salting at Oakey and Dalby. Strategically placed piezometer tubes are used to identify the sources and monitor the ionic composition of ground waters. This technique also monitors the effects of rainfall and farmer practice on salt movement and is providing the basis for predicting latent dryland salting areas.

In the lower Burdekin Valley, studies have continued into salt outbreaks that occur near the base of slopes of neutral red duplex soils developed on granodiorite. Deep drilling and the installation of piezometers have shown that the salt content of the rock material is low. The decomposed rock acts as a semi-confined aquifer providing for the transmission of ground water and the redistribution of salts in the lower part of the landscape.

Land resource assessment

A 1:100 000 soil survey of the 190 000 ha of the agricultural lands of the South Burnett (the Kingaroy, Wondai, Murgon and Nanango Shires) will include 1:25 000 surveys of 10 reference areas representative of the major soil landscapes. It will provide a soils inventory for soil conservationists, agronomists and agricultural extension officers in the design and implementation of their programmes. The legend-making phase is complete and the reference areas have been selected and are being mapped.

A soil survey of the Lockyer Valley entails 1:50 000 survey of 61 000 ha of the alluvia, which produces 80% of the Valley's agricultural production, and a 1:100 000 survey of 234 000 ha of the uplands. It will provide a soils inventory for research into problems including the use of saline waters (33% of the soils on alluvia use saline irrigation water), soil compaction, calcium-magnesium balance, soil amelioration with gypsum, soil salinization from upland seepages, erosion and pasture management. The legend-making phase is complete for the alluvia and mapping has commenced.

A 1:50 000 soil survey of 2 300 ha of the North Mulgrave Coast north of Cairns will give a soils inventory for the Beach Protection Authority and botanists in their study of lands within 1 km of the beach. The field survey is complete and representative profiles have been sampled for laboratory analyses.

Evaluation and planning of State projects

A 1:25 000 soil survey of 15 000 ha of the right bank of the Nogoa River in the Emerald Irrigation Area provides the soils inventory for the sub-division of irrigation farms by the Queensland Water Resources Commission. The field survey is complete, a map is in preparation and representative profiles are being sampled for laboratory analyses.

A 1:100 000 soil survey of 200 000 ha of the southern area of the Lower Burdekin Valley includes 1:25 000 surveys of four reference areas representative of major soil landscapes. This survey will complete the 1:100 000 soils inventory, with associated 1:25 000 reference area mapping, of the 370 000 ha of the Lower Burdekin Valley for planning irrigation and pastoral development and management. The field survey is approaching completion.

A 1:100 000 soil survey of 35 000 ha of the Proserpine Lowland on both banks of the Proserpine River provides a soils inventory, with associated irrigated land capability map, for an irrigation feasibility study primarily for sugar-cane, at the request of the Queensland Water Resources Commission. The field survey is complete and maps are in preparation. Representative profiles have been sampled and are being analysed.

A 1:50 000 soil survey of 20 000 ha on the right bank of the Macintyre-Dumaresq River, Macintyre Brook to Goondiwindi, is to give a soils inventory for planning and development of irrigated agriculture. The legend making phase has commenced.

Regulatory

The Branch provides the analytical service for officers of Standards Branch who administer the Agricultural Standards Act and the Agricultural Chemicals Distribution Control Act. The number of samples analysed for this purpose were:—

Pesticides	158
Veterinary medicines	22
Fertilizers and limes	99
Stock feeds	457
Pesticide residues	90

The Pesticide residue analyses relate to complaints under the Agricultural Chemicals Distribution Control Act over the incorrect distribution of pesticides by aircraft. In addition, 206 export grain samples were analysed for the Australian Wheat Board for protein content, upon which the export price is based. Thirteen stone-fruit samples from interstate were tested for fungicide residue. The testing of fumigation chambers for certification has continued.

General chemistry and services

The analytical services and specialist expertise are widely used by the Divisions of Plant Industry and Land Utilisation in research and extension activities. The Branch soil and plant analytical laboratories service research projects but also receive a large number of samples from extension officers. Results from chemical and physical analyses are used for giving advice to primary producers. Other Branch officers provide advice on plant nutrition problems, suitability of waters and soils for irrigation, soil classification, use of agricultural chemicals and identification of damage from them, and soil physical problems.

Samples analysed at the Indooroopilly laboratory were—

Plants		
	Elemental analysis	14 678
	Oil seeds for oil content	1 740
	Oil seeds for fatty acids	154
	Tobacco for alkaloids	440
	Total plants	17 012
Waters		2 861
Soils		13 715
Pesticides and pesticide residues indentification		27
Stockfoods and fertilizers		83
Miscellaneous samples		36

The number of water samples for analysis increased, probably as a result of the continued dry conditions. The water analysis laboratory is participating in a research programme with C.S.I.R.O. with the eventual aim of controlling salvinia. There was also an increase in the number of soil samples from extension officers. During the year, the laboratory was able to assist the Brisbane Cricket Ground Association in solving problems of the Gabba wicket.

There is an increasing demand for carbohydrate analysis and requests have come for analysis of such widely different plants as cassava, lucerne and macadamia nuts. Work on analytical methods is proceeding.

Other analyses done have included chromium in animal faeces, cobalt in pastures, fluorine and phosphorus in rock phosphate, oxalate in plants, and carbon in stubble.

Entomology Branch

THE objectives and functions of the Entomology Branch are—

To develop practical and economic methods of controlling insect and allied pests of plant crops (excepting sugar-cane and forest products) and crop products grown in Queensland.

Through the extension services to make these control measures available to primary producers.

To investigate the taxonomy, biology and ecology of economically important insects (whether pests or beneficial species) with the aim of establishing a sound, scientific basis for the development of pest management systems.

To provide an insect identification service for other Branches of the Department, quarantine authorities, primary producers and the community in general.

To develop improved methods of beekeeping and to provide an advisory service to apiculturists.

The Branch operates on a decentralized basis from Branch headquarters at Indooroopilly, five field stations in southern Queensland, three in central and one in north Queensland.

Pest activity

Locusts

During 1979-80, the only significant locust problems were caused by activity of the Australian plague locust *Chortoicetes terminifera*. The spur throated locust *Austracris guttulosa* and the migratory locust *Locusta migratoria* existed only as scattered individuals in central Queensland and were of no concern to primary producers. Although at times the Australian plague locust was widely distributed throughout most western areas, damaging populations were confined mainly to southern border districts and the Maranoa region, particularly near Roma.

As expected, the survival rate of overwintering eggs of the Australian plague locust was high and hatching in the Goondiwindi, Millmerran and Cunnamulla districts started in late August. Activity was more intense at Goondiwindi where hatching and formation of dense, hopper bands continued through September and into October. Crops of ripening wheat and green oats were attacked and, in one instance, most of a seedling crop of panicum was destroyed.

Extensive aerial and ground spraying of hopper bands was carried out by the Australian Plague Locust Commission and the Waggamba Shire Plague Grasshopper Destruction Committee, over a 5 weeks' period from mid September to mid October.

In addition to its normal contribution to funding of Australian Plague Locust Commission operations, the Queensland Government provided financial support for the Waggamba Shire Plague Grasshopper Destruction Committee's control campaign.

There is little doubt that spraying operations carried out in the Goondiwindi district during the spring were largely responsible for preventing further increases in damaging populations of the Australian plague locust in that area.

Some northward movement by Australian Plague locusts from areas in northern New South Wales occurred in November and the Roma and Surat districts were invaded by flying swarms. Control operations were carried out against those near Roma by the Bungil Shire Plague Grasshopper Destruction Committee with financial assistance from the Queensland Government and technical assistance from Departmental officers and the Australian Plague Locust Commission.

Inevitably, some locusts escaped treatment and laid eggs. Hoppers from these eggs formed bands and sub-bands in the Mitchell, Roma and Surat districts in late December and early January. After fledging, several concentrations of adults were found, but they did not develop into true swarms. There was no significant movement by locusts out of these areas and after some scattered egglaying, the populations declined.

Farther north, substantial breeding occurred in the Longreach, Jundah, Isisford and Blackall districts of central Queensland during January and February. The locusts matured rapidly and numerous swarms of adults developed in late February. Control operations were carried out in the region by the Australian Plague Locust Commission with the aim of preventing large-scale invasion of southern States. However, some swarms escaped treatment and migrated southward. This resulted in scattered concentrations and a few low-density swarms around Cunnamulla, Quilpie, Eromanga and Thargomindah.

Father southward migration by some swarms into New South Wales occurred, but the majority remained in south-western areas to lay eggs and then die. Some hatching of eggs was reported during March from areas a few kilometres north of Cunnamulla, but in the far-south-west, the eggs had been laid in dry soil and are unlikely to hatch before next spring.

As a result of migration or death following oviposition, numbers of locusts in all areas had declined to insignificant levels by the end of the year.

Heliothis

Heavy infestations of the native budworm, *Heliothis punctiger* in linseed on the Darling Downs and in lucerne in the Lockyer Valley during September resulted from intensive, early egglaying during August. Infestations of 40 to 60 larvae per 10 m of row were recorded from several linseed crops. Such early activity is unusual for *H. punctiger*, which normally does not appear in significant numbers until later in the spring, around October. By the end of September, many larvae were infected with a disease, which helped to reduce populations.

Early infestations of *H. punctiger* severely damaged cotton seedlings in the Emerald Irrigation Area during the late spring—early summer. An unusual aspect of the attack by *H. punctiger* was that some crops were only at the cotyledon stage. By contrast, *Heliothis* spp. were never a major problem in cotton crops at St. George or on the Darling Downs. Infestations in these areas were much lighter than those of previous seasons and fewer insecticide applications were needed.

Spring sunflower crops in the Emerald Irrigation Area were severely infested with native budworm, *H. punctiger* during late November. Despite a high level of infestation of 10 larvae per plant, no economic damage ensued, as the larvae restricted their feeding to the foliage and the backs of flowerheads.

By late summer, infestations of the budworm, *Heliothis armiger* were widespread on grain sorghum crops on the Darling Downs and in the Emerald, Rockhampton and Mareeba districts, necessitating control measures in many instances. The carbamate insecticide, carbaryl was commonly used and gave good control.

During the summer months, tobacco crops in the Mareeba district experienced the heaviest egglaying activity by *Heliothis* spp. moths for many seasons. However, damage was negligible owing to a high level of natural control by the Braconid wasp parasite, *Microplitis*, which parasitized the budworm larvae before their period of greatest feeding could occur. In some instances, parasitism levels as high as 99% were recorded.

Pests of stored products

Major pest problems in stored products continue to focus on the grain industry where a high level of pest control is needed to meet a 'nil tolerance' for live insects at export. During the past 15 years, this standard has been attained throughout Australia, largely through the use of pesticides. Although changing buyer attitudes indicate that pesticides may not be as acceptable in the future as they have been in the past, it would be irresponsible not to continue our active participation in the development of new materials. These pesticides offer cheap, effective and flexible pest control for the industry. Alternative technologies are being developed elsewhere in Australia, but considerable time will be required before they can replace pesticides completely.

The major pest species in Queensland are the lesser grain borer *Rhyzopertha dominica*, the rust red flour beetle *Tribolium castaneum*, the rice weevil *Sitophilus oryzae* and the tropical warehouse moth *Ephestia cautella*. These species are controlled effectively by the currently approved combinations of fenitrothion, pirimiphos-methyl with bioresmethrin or carbaryl.

The major pest to cause most concern has been *R. dominica* which has shown an ability to reach high numbers in pockets of grain in bulk storages. These pockets have been found to have been underdosed with bioresmethrin, the material that controls this species. The problem was particularly evident in carry-over wheat from the record 1978-79 harvest in temporary storages. Generally, however, the level of pest control has exceeded expectations.

So far, there has been no evidence of resistance development in the field in Queensland, although high-level, cross resistance to fenitrothion has been detected in maldison-resistant populations of the lesser pest species, the sawtooth grain beetle *Oryzaephilus surinamensis*.

During 1979, the exotic pest *Trogoderma variabile* was the subject of an eradication campaign in New South Wales. There was widespread concern when infestations were found in stores which had shipped seed to Queensland. An intensive trapping and inspection programme was undertaken, mainly in central Queensland, to determine whether the pest was present in this State. It is encouraging to be able to report that none was found, but it will be several years before we can be confident that the insect is not here.

Research

Insecticide management in French beans

Processing French beans are grown in the spring and autumn in south Queensland. The proportion of insect-damaged pods tolerated by processing companies is specified by contract agreement, allowing processors the right to reject the entire consignment if insect damage exceeds a preset limit.

Consequently, in seasons when budworm *Heliothis armiger* and bean pod borer *Maruca testulalis* are abundant, growers, to comply with contract requirements, apply insecticides so frequently that the profitability of the crop is seriously reduced.

From observation it seemed that growers applied insecticides rather late in the life of the crop, when damaging larval populations already had become well-established. This is too late to achieve satisfactory control. In trials carried out in the Redlands district, insecticide applications were timed to coincide with the period of maximum egglaying.

Experimental results showed a direct relationship between number of eggs laid and flowering intensity. A single application of a suitable insecticide at midflowering gave satisfactory control, resulting in the production of beans of high marketable quality. Yield and quality were equivalent to those obtained by commercial growers using a much more intensive spraying programme. Permethrin, fenvalerate and methomyl were the most effective insecticides used.

Lucerne leaf-roller insecticide investigations

Since the invasion of the spotted alfalfa aphid *Therioaphis trifolii* f. *maculata* and blue green aphid *Acyrthosiphon kondoi* into Queensland lucerne fields, it has become necessary to re-examine the control measures used against the other major pest of lucerne, the lucerne leaf-roller *Merophyas divulsana*. Control measures for the aphids include utilization of imported wasp parasites and naturally-occurring predators as well as specific insecticide treatments.

Of the two insecticides currently recommended for control of leaf-roller, methidathion has been shown to kill the larvae of the imported parasite *Trioxys complanatus* at time of application as well as the adult wasp alighting on treated foliage up to 7 days after treatment. Its effect on the predators is not known. The other recommended insecticide, carbaryl, is notably toxic to the major coccinellid predators, but is considerably less harmful to *T. complanatus*.

One chemical has emerged as a potentially useful insecticide from extensive testing of a range of materials in several field trials. Chlorpyrifos at the dosages tested provided control of *M. divulsana* superior to that achieved with the standard carbaryl treatment. Although a dosage of 250 g per ha chlorpyrifos has been shown to be only slightly less toxic to *T. complanatus* than the alternative methidathion, it is expected that adequate leaf-roller control can be maintained with less effect on the aphid parasite by lower dosages.

Experience has confirmed that integration of the various control measures against both aphids and leaf-roller into a harmonious system is essential to successful production of high-quality lucerne hay.

Resistant lucerne varieties

The blue green aphid *Acyrthosiphon kondoi* and the spotted alfalfa aphid *Therioaphis trifolii* f. *maculata* continue to be significant pests of lucerne.

A co-operative programme involving workers from Entomology and Plant Pathology Branches of the Department and from C.S.I.R.O. Division of Tropical Pastures aims at producing new lucerne varieties with resistance to the aphids and the pathogens that cause root rot and crown rot of lucerne. Two types of lucerne are being bred—one is semi-dormant in winter like its parent cv. Hunter River, while the other is more winter-active like its parent cv. Siro Peruvian.

Selection and seed increase has continued throughout the year and the lines should be ready for field testing in 1981.

Tests of 25 cultivars from overseas that reputedly are resistant, have shown that all possess considerable tolerance to blue green aphid infestations under field conditions. Cultivars, DK167, AS13, AS49, WL318, WL514 and CUF101 showed most resistance. In glasshouse tests DK185, AS13R, WL311, WL508, WL514, CUF101, PS545, PS581 and UC Cargo were most resistant to the blue green aphid, while AS49, WL600, Matador and Hunter River were the most susceptible.

Cultivars WL508, WL512, WL514, CUF101, PS572 and UC Cargo exhibited the greatest resistance to spotted alfalfa aphid in both field and glasshouse tests. Cultivars DK185 and PS545 showed promise in glasshouse tests, but were less resistant in the field, while WL600 performed better in the field, where it rated among the most resistant cultivars, than in the glasshouse. Cultivar Hunter River was the most susceptible variety in both types of test.

Infectivity studies on Heliothis virus

A commercial preparation of a nuclear polyhedrosis virus (NPV), 'Elcar', has been tested as a biological insecticide against budworm *Heliothis armiger* on cotton, navy beans and sorghum in recent years. The virus is specific for the *Heliothis* caterpillar and so has considerable potential for use in integrated control programmes in combination with beneficial parasites and predators. 'Elcar' is produced in the United States and has a potency similar to that of a native virus commonly found in populations of *Heliothis* in Australia.

Recent laboratory studies have shown that the young insects are highly susceptible to the virus, but rapidly develop tolerance. Week-old larvae (14 mm long) required an infective dose approximately 150 times that needed to infect newly-hatched larvae. The virus reproduces rapidly in newly-hatched larvae which produced in their bodies approximately 1·5 million times the dose needed to infect them.

Hence, it is important that virus sprays be applied early in the development of a population while the caterpillars are still small. This approach not only ensures that the larvae are infected while they are most susceptible and least damaging, but also allows the virus to increase and spread to uninfected larvae.

Cultural control of white rice stem borer

The white rice stem borer *Tryporyza innotata* is the major pest of rice crops in the Mareeba district of north Queensland. On hatching, young larvae enter the plant at water level and begin feeding. Subsequent larval development takes place within the rice stem where the insect is protected from contact insecticides.

Infestation in the early stages of crop development causes death of terminal leaves, while stem borer damage at or following panicle initiation results in sterile florets and a consequent reduction in grain yield. Only the summer crop is attacked and five generations of the pest can occur during this period.

Late-stage larvae of the later generations enter a temporary resting stage within the bases of the plants to enable them to withstand the unfavourable conditions of the dry season. Resumption of development—pupation and emergence of adult moths—is triggered by the first rains of the wet season.

As control with insecticides is difficult to achieve owing to the pest's mode of feeding, investigations have been carried out to explore the potential of cultural control methods, either to reduce seasonal carry-over or to enable rice crops to escape serious infestations. Variation in time of planting was investigated. Early-planted crops sown in November escaped the first major egglaying and suffered less damage (4%) than crops sown in December which suffered approximately 20 to 40% damage.

Experiments to test different methods of destroying crop residues found that burning the stubble reduced the carry-over population by 60%, while rolling the stubble gave an 80% reduction. Burning followed by rolling did not reduce the population more than rolling alone, while ploughing was the best treatment, reducing the carry-over population by more than 80%.

Current investigations are exploring the possibility of inducing a pre-season, suicidal emergence of stem borer moths by early, heavy irrigations. In the meantime, growers can do much to reduce the risk of carry-over infestations by early and thorough destruction of rice crop residues.

Biological control of green vegetable bug

The green vegetable bug *Nezara viridula* which, as its name suggests, is a common pest of a wide range of vegetable crops, in recent years has become a major pest of soybeans in Queensland. A minute wasp *Trissolcus basalis,* which parasitizes the eggs of the bug, was introduced several years ago and has been effective in controlling the pest in coastal areas, but not in subcoastal and inland regions where soybeans are grown.

Further introductions of this wasp from other parts of Australia and overseas are being released in an attempt to obtain biotypes climatically adapted to these regions. So far, 150 000 of these wasps have been reared in the laboratory and released widely throughout the State.

Other egg parasites are being investigated and another minute wasp, *Telenomus nakagawai* is the first additional species to be introduced. Colonies of this wasp now have been increased to the point where releases may begin soon.

Grain protectant studies

Intensive studies with new grain protectants have been continued. Carbaryl was used commercially in combination with fenitrothion on wheat for the first time during the 1979-80 harvest. Previously the combination had been used successfully on sorghum.

It is disappointing to report that, despite a cost saving of 30c a tonne, usage of this treatment on wheat was restricted to 500 000 tonnes owing to buyer attitudes in some export markets. Nevertheless, the fenitrothion-synergized bioresmethrin treatment developed earlier gave satisfactory results under the difficult conditions associated with the 1978-79 record harvest, some of which remained unsold and held in storage through the 1979-80 season.

Testing and development is proceeding on an additional range of organophosphorus, pyrethroid and carbamate compounds so that, should resistance become a problem or market attitudes impose restrictions, effective alternative treatments will be available. This work is undertaken in conjunction with the Australian Wheat Board Working Party on Grain Protectants.

Reservoirs of infestation in grain storages

Surveys of farm infestations have given, for the first time, a measure of insect numbers in various locations on farms. The work has provided estimates of an average of 250 000 insects on each farm but, as could be expected, variability is high. Infestation levels in grain delivered to central storages were confirmed at an average of 10 insects a tonne, but again variability was high.

These figures, together with biological data, are being used in two predictive models—one for populations of insects in grain bulks and the other for populations on farms. Despite obvious difficulties, these estimates and models serve a useful purpose in providing a fundamental and realistic understanding of grain insect populations.

Services

Insect identification service

One of the responsibilities of Entomology Branch is to operate an insect identification service to provide determinations of the identities of insect specimens for Departmental officers, other Government Departments, primary producers, householders, quarantine authorities and workers of other scientific institutions. During the past year, more than 2 000 such determinations were made.

The insect reference collection housed at Indooroopilly has been built up over many decades and contains approximately 60 000 named specimens, many representing economically-important species. It is an invaluable asset in confirming identifications. As such, it is an integral part of the identification service and its maintenance receives high priority.

Cotton Pest Activity Monitoring Service

Entomology Branch continued to provide cotton growers in central Queensland with details of the seasonal activitiy of the major production pests *Heliothis armiger* and *Heliothis punctiger* so that appropriate control strategies could be planned. This was achieved by means of light traps located in the Biloela, Theodore and Emerald districts. Moth catches were examined daily and growers were advised of the need for control action and, depending on the species composition of the trap catches, the appropriate insecticide to use.

As in previous years, *H. punctiger* was the dominant species for most of the season, averaging 90% of trap catches, or more, in all areas until February. *H. armiger* numbers increased in the Biloela and Theodore areas to 60% of the total during February, but a similar increase did not occur in the Emerald district until later in the month when most crops already were maturing.

Rice Pest Prediction Service

Officers of Entomology Branch stationed at Mareeba have instituted a prediction service to advise local rice growers of the seasonal incidence and activity of the major pests of rice in that area, white rice stem borer *Tryporyza innotata* and brown plant hopper *Nilaparvata lugens.* Suction traps and yellow pan water traps have been used to sample brown plant hopper populations with the aim of detecting major flights of winged immigrants.

Chemical control of stem borer is difficult to achieve as there is only a limited period before the newly-hatched larvae enter the rice stem when they are vulnerable to insecticides. Timing of applications is vital and monitoring of egglaying flights of the moths by light traps has assisted growers to plan their control operations

The light traps used in the monitoring service employ a design based on a kerosene lamp. They are inexpensive traps, simple to make and operate. It is hoped that eventually the rice growers will operate their own light-trap warning systems. This will provide much more precise information on stem borer activity, as emergence of the first summer generation is governed by local rainfall or heavy post-sowing irrigation.

Apicultural services

Services to the beekeeping industry include the provision of advice on all aspects of honey production together with the implementation of regulatory duties associated with *The Apiaries Act* of 1972. Inspections carried out by officers of the Apiculture Section under the Apiaries Act provide the means of restricting the spread of diseases and pests harmful to the beekeeping industry.

In this context, regular inspections of apiaries are vitally important. Approximately 1 400 colonies in far western areas were examined for brood disease during the year. Four colonies in the Wyandra area were found to have American brood disease *Bacillus larvae* and were destroyed. As an added safeguard, the apiaries concerned have been under quarantine for the whole of the year.

The European brood disease situation again dominated extension-regulatory activities. In an attempt to prevent the entry of European brood disease into Queensland, a ban on the transport of hives, bees and used beekeeping equipment from southern States into Queensland has been in force since the beginning of the year. Beekeepers from New South Wales who previously have worked southern and south-western areas of Queensland requested a relaxation of the ban to enable them to continue working these areas. Following discussions between Departmental officers and representatives of the Queensland Beekeepers' Association, it was decided that the ban should remain in force in its present form but subject to review at a later date.

During May 1980, the New South Wales Department of Agriculture widthdrew all restrictions on the movement of hives from Victoria to New South Wales provided they were accompanied by a health certificate certifying that the apiary had been free of American brood disease for the past 12 months and free of European brood disease for the past 30 days.

The reasons for this decision were that Victorian beekeepers have been forced to accept the presence of European brood disease and are able to keep it in a non-epidemic form by treatment with terramyacin, and the New South Wales Department of Agriculture has confirmed the presence of the casual organism *Streptococcus pluton* in several areas in that State.

Intensive sampling of apiaries in critical areas of the far south-west, the Darling Downs and the south-eastern coastal region has confirmed that the causal organism of European brood disease has not yet been identified from Queensland. That the disease has so far failed to become established in Queensland has been due, in no small part, to the prohibition on movement of bees, hives and used equipment from infected areas into this State.

If the entry of European brood disease into Queensland can be prevented, Queensland beekeepers will be able to avoid the undesirable necessity of having to undertake regular and continuing treatment of hives with the antibiotic terramyacin. As the disease has not yet been found in this State, the measures taken to prevent its entry appear to have been effective so far and there would seem to be sufficient justification for retaining the ban on movement of bees and associated equipment.

Botany Branch

THE aims of Botany Branch are the acquisition, collection, analysis and publication of information on individual and groups of plants and plant communities in Queensland. A service is provided to the public, private industry, and State and Commonwealth Government agencies by identifying plants, advising on their properties, and by assisting in a variety of ecological problems.

This service has been maintained during the year despite increased demand and periodic staff shortages. Research, which is necessary if efficient service is to continue, declined slightly during the year.

In keeping with the aims of the Branch and the requests for services, the officers of the Branch have been divided into three interacting groups. A Taxonomy Group deals with queries concerning individual plants and groups of plants that occur in Queensland; an Ecology Group studies plant communities in the state; and a Supporting Services group maintains the Queensland Herbarium and provides assistance to other groups.

Research

Taxonomy

The correct naming and description of all native and naturalized vascular plants in Queensland are major objectives of the Taxonomy Group. Much applied botanical research, including work in the fields of range management, agrostology, ecology, phytochemistry, phytogeography and geobotany, depends on correct identification of plants, supported when necessary by competent taxonomic research.

A check-list of Queensland grasses and a key to Queensland grasses were produced as Botany Branch technical bulletins. This information on 720 native and naturalized species will be of great value to both professional and amateur agrostologists.

An analysis of distribution of grasses in Australia was completed and will be published. As a preliminary for the account of the Poaceae in the *Handbook to the Flora of South-eastern Queensland* descriptions of 14 new species of grasses were prepared. With the aid of a grant from the Commonwealth Bureau of Flora and Fauna a revision of the grass genus *Aristida* was commenced. Field work was undertaken in areas of tropical Australia and other Australian herbaria were visited and their specimens of *Aristida* examined.

The study of wild oats continued, and analysis of data collected from glasshouse plantings in 1975, 1976 and 1977 completed.

The second (concluding) part of the revision of *Acacia* in Queensland was published during the year. This is the largest genus of Queensland plants (with 234 native and naturalized species) and the revision is probably the largest single critical account of any group of Queensland plants. A supplementary paper on *Acacia* is to be published next year.

A revision of the legume genus *Atylosia* was submitted for publication and work leading to a revision of *Tephrosia* continued.

Work progressed steadily on a manuscript revision of Sapindaceae (excluding *Dodonaea*), a family well represented in Queensland, particularly in rainforests. The first part of the revision has been prepared for publication. This comprises the genera *Atalaya* (nine species), *Diploglottis* (five species), *Jagera* (three species) and *Harpullia* (eight species.)

Work on a number of other groups continued though work on some projects was curtailed because of the increase in demand for services. A start has been made on writing an account of the nomenclature of the tribe *Dianelleae* (Liliaceae) and on a revision of the family Hypoxidaceae in Australia. Substantial basic work, mostly bibliographical, was undertaken on the project to revise *Melaleuca* in Australia. A study to clarify some of the problems in the *Rubus moluccanus–R. alceifolius* complex in northern Queensland was initiated. Plants of about 40% of the species of Convolvulaceae known from Queensland are being grown in the glasshouse and descriptions of species in the tropical genera are being prepared. No significant progress was made in studies in *Cordyline* (Agavaceae), *Breynia* (Euphorbiaceae), *Leucopogon* (Epacridaceae) or Nymphaceae.

Officers contributed to the *Flora of Central Australia.* Accounts of the families Apiaceae, Capparaceae, Convolvulaceae, Gyrostemonaceae, Nyctaginaceae and Polygalaceae were prepared.

Compilation of the *Handbook to the Flora of South-eastern Queensland* continued. Parts of Mimosaceae and Caesalpiniaceae have still to be completed for the first volume but substantial progress has been made with the second volume, Myrtaceae and Asteraceae being the major families to be completed. Little further work on the third volume has been done but keys to the Poaceae are now available. Proofs of a large part of the *Handbook to the Ferns and Fern Allies of Queensland* are being read.

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Ecology

The Ecology Group continues to advise on ecological problems and maintains a close liaison with other Branches of the Department and with other State Government organizations. Two botanists were involved in the Western Arid Region Land Use Study (WARLUS) which is co-ordinated by the Development Planning Branch, Division of Land Utilisation.

Field work for part 5 (Longreach-Winton-Muttaburra area) was completed early in the year and considerable progress has been made on the botanical part of the study report. Draft manuscripts of all botanical sections of Parts 3 (Charleville area) and 6 (Boulia-Birdsville) are virtually complete. The report for Part 2 (Adavale-Blackall) is in press.

Mapping and description of mangrove communities along the eastern coast continued. This is a Queensland Fisheries Service project, 'Biological Resources Survey (Estuarine Inventory)', but two officers of the Ecology Group have done the botanical work. It is expected that the botanical text, to accompany the maps of the mangroves of Moreton Bay published several years ago, will be published next year.

Botanical information on the mangroves of the Round Hill Head-Tannum Sands area is including in a Fisheries Research Bulletin currently in press. The maps have already been published. Four maps covering the coast from Round Hill Head to Baffle Creek have been printed.

A report on Trinity Inlet, Cairns, with partially marked-up aerial photographs was forwarded to the Queensland Fisheries Service for their use. Following a visit to the Marrett River estuary last year a report has been prepared for the Fisheries Service. It contains an introduction to the area in a regional context and chapters on landform, soils and vegetation.

The mangroves are described to fit in with land units described in the report on the lands of the Mitchell-Normanby area prepared by C.S.I.R.O. In the course of field work at Marrett River, *Diospyros littorea* was collected in Australia for the first time.

Surveys of coastal dune vegetation for inclusion in Beach Erosion Investigation Reports prepared by the Beach Protection Authority continued. Maps showing dune systems and headlands and their associated vegetation are prepared together with a report explaining the map units and commenting on the dune-vegetation processes going on in the area. The maps and reports are used by the B.P.A. in preparing notes on dune management and are published separately as Botany Branch Technical Bulletins.

The technical bulletin on the Capricorn Coast (Livingstone Shire) was released during the year. Field work in the Mulgrave Shire (Cairns beaches) was completed; a list of species has been compiled and a draft map prepared. A survey of Sunshine Coast beaches (Teewah to Bribie Island) continues. Field sampling has been completed.

Requests for advice were received from the Commonwealth Department of Housing and Construction and the Department of Transport regarding problems associated with the construction of the new Brisbane Airport. Advice was sought on re-afforestation of areas on both sides of the runways to reduce bird populations, on growing mangroves to stabilize the banks of a channel being constructed north-west of the new airport, and on monitoring the effect of the construction on existing mangroves.

These requests have led to field and glasshouse studies of mangroves. Approximately 2 000 seedlings of grey mangrove (*Avicennia maria* var. *australasica*) were raised in the glasshouse and many were used in trials on the Serpentine Creek anabranch at Cribb Island and at Landers Pocket. Yellow mangrove (*Ceriops tagal* var. *australis*) and river mangrove (*Aegiceras corniculatum*) have also been transplanted and seedlings of the latter are being raised in the glasshouse. Establishment and growth have been good and a considerable amount of information on aspects such as suitable bench levels for planting, suitable species and sources of planting material, has been made available to the departments concerned.

Special projects

Three projects are funded largely through grants from the Commonwealth Government. They are Herbarium Data Storage Project (HERBRECS) and Vegetation mapping of Southern Queensland, both supported by the Australian Biological Resources Study, and Moreton Region Vegetation Mapping partly funded by grants under the National Estate Programme.

1. HERBRECS is the establishment of a computerized data bank based on information on specimens in the herbarium collections. Coding of label information from incorporated material, except for type specimens, was completed in February. The phase of the project has taken $5\frac{1}{2}$ years to complete.

Midway through the financial year, records on the master file were enlarged to include plain-language locality information for Australia and New Guinea specimens. A total of 40 500 records was entered during the year bringing the total to 320 000.

A number of retrievals, mostly of data from coastal areas, was carried out and a system of indexing the masterfile for easier access to records was devised and demonstrated.

2. Vegetation mapping of southern Queensland. Field work continued on the south central sheet which lies immediately to the east of the south-western sheet and is bounded in the east by longitude 149°E.

Photointerpretation and field work commenced on the far northern sheet which covers the area north of 26°S. Concurrently with the mapping of this northern sheet a check-list of the flora of the region, backed up by herbarium specimens, is being prepared. About 800 specimens have been collected for this inventory.

3. Moreton Region mapping. Murwillumbah and Caloundra 1:100 000 Vegetation Maps and explanatory booklets were published during the year. A summary report on the Caloundra, Brisbane, Beenleigh and Murwillumbah map areas is being prepared. Various aspects of non-urban land suitability and flora reserve suitability are discussed and chapters on conservation and species of note are included.

The 72 units recognized in the areas mapped have been grouped into 15 habitat types. A check-list of native and naturalized plants is included.

Some preliminary work on the 1:250 000 Ipswich sheet has been done.

Service and extension

Plant identification and related advisory services maintained by the Taxonomy Group and examination of environmental impact studies by the Ecology Group are major functions of the Branch.

About 18 000 specimens were identified by the Taxonomy Group during the year. State Government departments (including the Department of Primary Industries) accounted for 27% of the specimens submitted, the public 24%, Australian tertiary institutions 20%, and Commonwealth government organizations (mainly C.S.I.R.O.) 18%.

The demands for indentification of plant material by the State and Commonwealth police officers continue to increase and samples submitted by the Commonwealth Quarantine Export Centre reached significant proportions during the year.

Certificates of Identification were issued in connection with 1 283 samples of *Cannabis sativa* submitted by Police, an increase of 36% over the previous year. Officers attended court on 32 occasions, a slight decline.

One officer spent two days in the field assisting police officers in collecting evidence in connection with one drug case and the same officer gave evidence at a court martial in Sydney.

Sixty-nine statements were issued in connection with samples submitted by Quarantine Officers in relation to Commonwealth Plant Quarantine regulations. This is a marked increase over the 17 of the previous year, and there is likely to be a further increase as quarantine regulations are being more strictly enforced.

Twenty-six samples of rumen contents from post-mortem examination of stock were examined for possible poisonous plants for the Animal Research Institute.

The Ecology Group advised responsible authorities on botanical matters, including establishment of native plants, in relation to development in Queensland likely to have major environmental effect. Terms of reference for a proposed aluminium smelter to be built by Alcan Qld Pty Ltd were prepared.

Impact Assessment Advice Reports were examined and commented on for dam site investigations on the Proserpine and Upper Dawson Rivers, for a proposed paper pulp mill at Beerburrum, for the Tarong power station water supply, and for two transmission lines from Tarong. A preliminary Environmental Study of the Curragh (Coal) Project, the draft Impact Assessment Study Report of the German Creek (Coal) Project, and the draft Environmental Impact Statement of a proposed bridge to North Stradbroke Island were also dealt with.

Advice was also offered on two proposed canal developments. More than 200 less formal service enquiries were handled by the Ecology Group during the year.

The leader of the Ecology group continued as a member of the inter-departmental committee advising on rehabilitation after sand-mining. Two field inspections each lasting a week were held during the year. Satisfactory rehabilitation is being carried out by all the companies concerned.

Miscellaneous advisory activities of the Branch included the collection and identification of a set of known 'allergy plants' flowering in summer for the Allergy Centre, Queensland Department of Health. Advice on the production of a leaflet on plants poisonous to people was given to officers of the Health Education Council.

As a result of the experience gained in mapping vegetation in the Moreton Region, officers have been asked to assist officers of other departments and occasionally private organizations in small scale vegetation surveys.

There has been an increase in the educational and public relations activity of the Branch. Talks on the functioning of the Branch were given on 17 occasions to groups, students and departmental officers visiting the Queensland Herbarium, and on four occasions in Mareeba. Talks and demonstrations were given to interested groups by officers in addition to their official duties.

The third part of the Branch's publication *Austrobaileya* was issued during the year. During the year *Weeds of Queensland* was published and has been well received. Eleven articles in the series *Wildflowers of South-eastern Queensland* were published in the *Queensland Agricultural Journal* during the year. Most dealt with wattles (*Acacia* spp). Two articles in a series on the aquatic plants of Queensland were published and more have been prepared or are planned.

An account of grasses, including a key to genera, was prepared for a book entitled the *Flowering Plants of Australia* which is in the course of preparation and a chapter on Australian plants sketched by Sydney Parkinson was prepared for a book—*Sydney Parkinson: Artist of Cook's Endeavour Voyage*, a joint project of the Australian National University and the British Museum (Natural History).

Symposia

Two officers attended a symposium on the evolution of the flora and fauna of arid Australia held in Adelaide in May 1980. One of the officers was in Adelaide in the course of his duties and the other took the opportunity to visit the State Herbarium, Adelaide and Herbarium Australiense, Canberra.

Another officer attended a symposium 'Ecological Gradients and Boundaries' held in Melbourne in May. As part of the same trip, the officer visited the N.S.W. National Herbarium and discussed vegetation mapping projects.

Queensland Herbarium

There was a decline in the number of specimens prepared for incorporation. This was mainly due to the shortage of technical staff for mounting and incorporating. The movement of specimens through exchanges and loans was also less than last year. Further work was undertaken on the spirit, carpological and photographic collections and sorting of the unincorporated material.

In anticipation of an increase in activity in the next financial year, a survey of the current state of the herbarium collections was undertaken. Approximately 60 000 specimens in the herbarium require mounting and a further 64 000 remain unincorporated. A scheme to complete mounting all specimens and to incorporate all material by 1990 has been developed.

The herbarium collection is still crowded. Specimens of exotic material are not being incorporated but are being stored separately by family. The planned increase in specimen incorporation will further exacerbate the storage problem.

During the year 5 800 new accessions were added to the herbarium; 1 300 specimens (48 loans) were despatched; and 2 800 (67 loans) were returned to the herbarium. Specimens for exchange to other herbaria decreased to 1 600, and 1 300 were received.

Miscellaneous

The Director attended the annual meeting of the Committee of Heads of Australian Herbaria in Alice Springs in September. He also attended, as proxy for Professor R. L. Specht, a meeting of the advisory committee of the Australian Biological Resources Study.

Much time was devoted to the Flora of Australia project (which aims at producing a concise written Flora within 15 years), and to the selection of its editorial committee. Mr L. Pedley, Assistant Director, was elected to an advisory group, which will eventually be formed into the editorial committee. The Flora project, though financed from Commonwealth funds, is expected to boost taxonomic research in Australia in the next decade and will consequently generate considerable work in all herbaria, most of which are State government institutions.

The Director continued as a member of the Noxious Plants Consultant Committee to the Stock Routes and Rural Lands Protection Board and the Interdepartmental Committee for Timber and Woody Weeds.

The Assistant Director continued as member of the Poisonous Plants Committee an interdisciplinary committee which co-ordinates investigations into plant poisoning in Queensland.

Mr R. J. Henderson's term as Australian Botanical Liaison Officer at Kew, England, expired early in the financial year and he resumed duty as leader of the Taxonomy Group in December.

The botanist stationed in Mareeba made extended visits to the McIlwraith Range, the Chillagoe area, Iron Range, and the Alma-den-Wrotham Park area, as well as shorter trips. An officer from Brisbane spent some time systematically collecting weedy plants in urban areas of coastal towns from Townsville south. An account of this survey will be published as a technical bulletin.

Division of Dairying

THE Division of Dairying comprises three Branches: Dairy Cattle Husbandry, Field Services and Research. Their major operations are related to the following four general objectives—

- To provide advisory services to producers in those farming practices related to dairy cattle feeding, breeding and management, based on producers' perceived needs and officers' assessments.
- To provide advisory services to processors in the manufacture, packaging, storage, distribution and quality control of dairy products.
- To undertake research into problems which emerge from activities associated with dairy farming and dairy product processing.
- To implement the terms of the *Dairy Produce Act* 1978–1979 and the *Margarine Act* 1958–1978, and to assist in the implementation of the *Milk Supply Act* 1977–1978.

Staff and organization

As a consequence of the Departmental approach to programme management, Branches have delineated their activities into work programmes concerned with administration, research, service and regulatory and extension.

Training of staff in technical areas has been maintained at a level comparable with that of previous years. Valuable benefits have accrued through participation in courses conducted by the Department in Management Development.

Industry trends and production

During the year, a new replacement market milk pasteurization plant was commissioned at Mackay and a new highly automated cheese factory opened at Malanda. Together, these represented an industry investment of $3.5m.

The market milk processing plant at Ingham ceased to operate and all north Queensland is now serviced by the Atherton Tableland Co-operative Dairy Association. Butter manufacture ceased at Mundubbera and cheese manufacture ceased at Mt. Tyson.

Total milk production from 3 351 registered dairy farmers was 538m litres compared with 565·3m L for the previous year. Considering the decline in the number of producers and the unfavourable climatic conditions during the period, this was a very satisfactory production performance. Cream sales increased by about 60% and the sale of modified milks nearly trebled. As was expected, butter production decreased considerably, although cheese production was maintained. Butter packed in Victoria in retail packs is now being sold in Queensland.

Details of number of producers and types of production are given in the following tables:—

Type of Supply	No. of Producers		
	1977–78	1978–79	1979–80
Cream	761	643	579
Market milk	3	17	26
Manufacture milk	128	35	0
Market milk + Manufacture milk	2 974	2 823	2 632
Cream + Market milk + Manufacture milk	1	2	90
Milk—Raw for human Consumption	30	27	24
TOTAL	3 897	3 547	3 351
Goat dairies	18	18	24

Product	1979–80	% Change in Production 1979-80–1978-79
Market milk including cream (m L) ..	266·8	+11*
Flavoured milk (m L)	6·4	−45
Modified milks (m L)	19·6	+184
Butter (tonnes)	3 852	−37
Cheese (t)	11 867	−3
Casein (t)	938	−2
Powders (t)	10 720	−5

* The major portion of this increase was due to increased cream sales.

Milk quality committee

Two officers of the Division were appointed members of a special committee established in conjunction with the Queensland Milk Board to review milk quality. As a consequence of these reviews, more attention to quality of raw and processed milks is now being given by processors.

Milk entitlements

Adjustments to processor market milk entitlements among processors in south-east Queensland were continued by the Milk Entitlements Committee under the terms of the *Milk Supply Act* 1977–1978.

A Royal Visit . . . His Majesty, King Tautá ahau tupou IV, of Tonga, inspects the semen processing facilities at the Department's Artificial Breeding Centre, Wacol.



Since the commencement of the milk acquisition and redistribution scheme in June 1978 a total of 57 817 L of market milk entitlements has been acquired from 310 drop-outs among the 15 market milk processors in the region. This milk has been distributed to the 12 processors who were below 60% in the 1977-78 production year. No market milk has been reallocated to Metropolitan Milk Producers Co-operative Association Ltd., the Suncoast Milk Producers Co-operative Association Ltd., and the South Coast Co-operative Dairy Association Ltd.

A total of $1,394,388.50 was expended in reimbursing 'drop-out' producers for milk entitlement. The Committee has made this milk available to processors at a purchase price of $50 per L.

In addition to this redistribution of drop-out milk, a quantity of 7 064 L of milk was acquired through growth in the market and this was distributed to the same 12 processors free of charge. It is expected that, by October 1980, all 15 processors will be processing 44·2% and above of total milk as market milk within their franchise milk districts approved under the Milk Supply Act.

Post graduate study and study tours

Two officers received awards of Ph.D.:—B. Kitchen and T. Cowan. Miss Underwood obtained her Masters Degree in Agricultural Extension. Mr E. V. Sigley obtained his Bachelor of Arts degree. Mr J. Dulley obtained the Post Graduate Diploma in Business Administration. The Director of Dairy Cattle Husbandry, Mr I. Rayner, undertook a study tour of Europe and U.K. to examine husbandry research and herd improvement programmes. Details of other studies and study tours are given in the individual Branch reports.

New research station

Arrangements were finalized to purchase suitable properties in the West Moreton region to establish a research station capable of specialising in dairy cattle and beef cattle research.

This station will provide facilities for research into pastures suitable for dairying and into cattle husbandry practices. It will also allow field investigations into milking practices. The Research Station at Ayr will eventually be closed in order to establish this South-east Queensland Research Station.

Field Services Branch

THE number and types of supply of registered dairies supervised by officers are detailed in the following table. Details for the previous 2 years are included for comparison.

Type of Supply	1977–78	1978–79	1979–80
Cream	761	643	579
Market Milk	3	17	26
Manufacture Milk	128	35	..
Market + Manufacture Milk	2 974	2 823	2 632
Cream + Market milk + Manufacture Milk ..	1	2	90
Milk—Raw for human Consumption	30	27	24
TOTAL	3 897	3 547	3 351
Goat dairies	18	18	24

This represents a decrease of 5%, which is the smallest reduction for a number of years. The demand for a more equitable sharing of market milk trade has reduced the number of suppliers on manufacture milk from 35 to nil. The decline in the number of cream suppliers continues and these numbers are expected to fall as collection costs increase and cream routes become uneconomic. Most cream suppliers now deliver their own produce.

The Milk Entitlements Committee during the year reviewed its policies on pooling, retention and distribution of processor entitlement, and made some adjustments to retention of market milk by some factories.

Returns to dairy farmers in the 1979-80 year have increased substantially above the previous year due to price increases. The price paid for both market and manufacture milk increased during the year. The average return for all milk produced increased from 12·6c per litre in 1978-79 to 14·3c per L in 1979-80.

Production

The number of suppliers has decreased and there has also been a decrease in milk production. This was accentuated by the very favourable conditions experienced last year compared with this year which was severely drought affected. This has resulted in a marked decrease in the amount of milk used for manufactured products but pasteurized milk has increased slightly. Total milk production for 1978-79 was 565·3m L (including cream as milk equivalent), compared with 538·0m L for 1979-80. This is a satisfactory performance considering the drop off in numbers and the unfavourable conditions.

Product	1979–80	% Change in Production 1979–80–1978–79
Market milk including Cream (m L) ..	266·8	+11*
Flavoured milk (m L)	6·4	−45
Modified milks (m L)	19·6	+184
Butter (tonnes)	3 852	−37
Cheese (t)	11 867	−3
Casein (t)	938	−2
Powders (t)	10 720	−5

* The major part of this increase was due to increased cream sales

There has been an increasing demand for products with lowered fat content and increased solids and also for flavoured modified milks. Sales of pasteurized milk have increased substantially and there has been a large increase in cream sales of almost 60%. Cheese production has been maintained and butter production has decreased by 37%.

Branch activities

The programmes and activities of Branch staff are directed towards the implementation of five objectives. In summary, the highlights of these activities are reported in their appropriate sections.

Objective No. 1

Objective No. 1 is 'to provide advisory services in the field of dairy cattle management to Queensland dairy farmers.' Major highlights associated with this objective are discussed below.

Co-ordinated extension

Officers have again devoted considerable time during the year to district extension advisory programmes, and they have co-ordinated well with other Departmental staff to ensure effective programming and work planning. There appears to be a move towards streamlining activities in some regions. This has decreased the need for excessive staff meetings.

Dairy cattle nutrition

Drought existed in all dairying regions of the State during the latter half of the year. This caused considerable problems in ensuring the supply of good quality feed. In the early part of the year, fair conditions prevailed even though rainfall was below average. There was a continued expansion of irrigated, fertilized ryegrass, and some increased use of clover-based irrigated pastures.

A highlight of last year and the current season has been this increase in interest in using clover-ryegrass mixtures or straight clover pastures to offset the high cost of nitrogeneous fertilizer used under the ryegrass system.

Interest in using nitrogen on kikuyu pasture for autumn and summer feed has been maintained, although lack of good rain reduced the effectiveness of this practice during the year.

There is a growing awareness among farmers of the sound economics of feeding molasses as an energy supplement rather than grain. The Lands Administration Commission, through the Dairy Farm Adjustment Scheme, continues to play an important role in financing the installation of storage facilities for molasses.

Unfortunately, the demand for molasses exceeded the supply after the last crushing season. This shortage caused some feed problems in south-east Queensland, especially when the drought set in during March and April. Increased on-farm storage appears to be the answer.

Because of the drought conditions, most officers have been involved in assisting farmers develop drought feeding strategies. This has once again highlighted the need for more fodder conservation on dryland farms.

The poor grain crop during the year has also resulted in a shortage of good quality grain at reasonable prices. Many farmers are relying on heavy grain feeding to maintain production during the coming winter period.

The dry season experienced in all regions resulted in reduced production. The Wide Bay and South Burnett areas were in severe drought condition for much of the year. Dry conditions in north Queensland during the early part of the year substantially reduced their summer production.

The seasonal conditions disrupted most planned extension activity in dairy cattle nutrition. It is obvious that the principle of fodder conservation, including adequate on-farm storage of molasses and grain, will have to be heavily promoted in future.

Mastitis

CELL COUNT PROGRAMME. All farm bulk milk supplies throughout the State continued to have cell counts estimated on a monthly basis using the Fossomatic Automatic Cell Counter. Cell count results were provided to both farmers and field officers. A summary of test results for the last 12 months is detailed below.

Cell count results have remained fairly consistent throughout the year, rising slightly from the low levels achieved the previous year. Twelve-month Statewide mean cell count for 1977-78, 1978-79 and 1979-80 were 553 000; 443 000 and 459 000. It is likely that some of the improvement evident throughout 1978-79 was a direct result of increased culling of old cows in response to improved beef prices. However, improved mastitis control techniques on farms have kept this year's cell counts around the same levels as the previous year.

MONTHLY ELECTRONIC CELL COUNT RESULTS
APRIL 1979—APRIL 1980

Month	No. of Tests	Mean* Cell Count (x 1 000)
May 1979	2 392	390
June	2 547	437
July	2 577	532
August	2 592	539
September	2 572	486
October	2 352	473
November	2 179	428
December	2 109	440
January 1980	2 248	475
February	2 554	485
March	2 520	446
April	2 417	386

* All milk suppliers in the State.

Routine calibration of the Fossomatic includes regular checks against the Direct Microscopic Cell Count and quarterly Australia-wide cell count calibration trials. During the year, a long-term cell count standard has been developed in co-operation with Otto Madsen Dairy Research Laboratory. So far, these standards have lasted more than 6 months at refrigeration temperatures, without change in cell count.

A flexible disc mass storage system was purchased during the year for connection to the Hewlett Packard 9825A Desk Top Computer system interfaced to the Fossomatic. This has greatly improved the reliability and operating efficiency of the system enabling it to be used for analysis of trial results as well as normal data recording.

EXTENSION ACTIVITIES. The Mastitis Cell Count Extension Programme has been continued in the current year on a low key basis. Most of the activity has occurred during the course of normal farm visits although, in some districts, there has been more intensive work on farms with high cell counts or serious clinical mastitis problems. Some extension activity has occurred on farms involved in the individual cow cell count trial with farmers seeking advice on interpretation of results.

Mastitis investigations

TEAT DIP AND DRY COW THERAPY TRIALS. Final reports have now been submitted on all of the 18 farms involved in these trials. The aim of this work was to demonstrate the advantages of teat dipping and dry cow therapy on commercial farms. Responses to treatments were measured in terms of clinical mastitis, sub-clinical mastitis and milk or butterfat production. The responses have been quite variable and, in general, less than would be expected.

MASTITIS EVALUATION SURVEYS. A third mastitis evaluation survey was commenced during the year and will be completed shortly. This survey is a follow-up to previous surveys held in 1973 and 1976. It is designed to determine farmers' knowledge on, and attitude towards, mastitis and mastitis control and the level of adoption of the recommended mastitis control practices.

INDIVIDUAL COW CELL COUNTS. Farmers continue to show a high level of interest in receiving cell counts of individual cows, particularly where cow samples are available through the herd recording scheme. Likely uses of such information include selecting cows for culling or dry cow therapy and monitoring recovery after treatment of clinical mastitis.

A series of trials involving four commercial herds is now in its final stages. Cows are aseptically quarter-sampled monthly and the samples examined for cell counts and other indirect mastitis measures together with bacteriological examinations for mastitis pathogens.

These results are compared with cell counts on herd recording samples in an attempt to assess the value of individual cow cell counts and to set a cell count threshold to distinguish between infected and non-infected cows.

Results have now been examined in detail. While cell counts from infected cows and non infected cows are quite different, the frequency distributions overlap too much to set a statistically reliable ($p<0{\cdot}05$) cell count threshold. The best cell count threshold available (250 000 lactation arithmetic mean) would correctly predict the infection status of 76% of all cows with 9% of infected cows (false negatives) and 31% of uninfected cows (false positives) wrongly classified.

A total of 70 herds throughout the State is involved in a pilot individual cow cell count service associated with the herd recording scheme. Cow samples are counted every second month with results appearing on the herd production sheet together with a lactation arithmetic mean for cows in late lactation.

Co-operative farmers were interviewed during the year and it is proposed to interview them again after about 18 months to ascertain farmer reaction and likely acceptance of the individual cow cell count service.

Herd improvement

HERD RECORDING. The major change during the year was the revised fee structure. Members now pay a base herd rate and a fee per cow tested. Officers were involved in introducing the new fee structure. Herd recording members were not adversely affected by the change. The number of members has increased even though total herd numbers in the State are decreasing. The farmer-own sampling scheme has been well received. At present 67 farmers (or 10% of recording members) use the scheme.

A breeding management option was introduced through the production recording scheme. This has proved a useful service for those officers whose extension programme includes a programme to reduce intercalving interval.

ARTIFICIAL BREEDING. Twenty-five herdsman courses were conducted throughout the State. High interest in this important concept is maintained with courses booked through until November 1980. Dairy Cattle Husbandry Branch officers conduct the courses with the initial organization and assistance given by officers of this Branch.

'Do It Yourself' insemination appears to be the major area for farmers to improve their herds. All 'Do It Yourself' farmers are fully committed to artificial insemination. Most breed 100% of their herd artificially. On the other hand, farmers serviced by co-operatives are not totally committed, breeding on average 25% of their herds artificially.

Semen depots at Malanda, Mackay and Rockhampton are operated by Branch officers.

Surveys to determine the situation of herd improvement have been conducted in some areas. These surveys provide a useful background for extension programmes.

CALF REARING. Interest in calf rearing has been sustained in all districts. There has been a steady demand for extension material in covering this area. The increase in value of milk has resulted in greater use of milk replacers in some areas. It appears that more farmers are rearing replacements rather than purchasing them as in previous years because of cost and for disease control purposes. A highlight of the year was a field day held in the Wide Bay region with an attendance of 150 people.

Farm accounting schemes

There are currently 43 dairy farmers using the Dairy Farm Management Scheme. These are from central Queensland, Wide Bay, East Moreton and Downs regions.

As the numbers of farmers taking part in these schemes increase, so does the work load for officers collating the data. Discussions have been held with officers of Economic Services Branch and a suitable computer programme has been provided to process information more quickly and to allow more co-operators to take part in these data collection schemes. Interest in these schemes is increasing rapidly and a further increase in farmer numbers is expected.

The schemes assist farmers in evaluating their own farming methods and feeding systems, and also provide officers with factual, meaningful information on costs of production. This gives them the opportunity to talk with producers in monetary terms and gives the dairy farmer relative costs of alternative feeding practices.

Dairy Assistance Scheme

In most regions, officers have co-operated with the Land Administration Commission and have supplied farmers with details of this Assistance Scheme. There has been increased interest in schemes for the financing of A.B. equipment and molasses storage, and in the construction of new or renovated dairy sheds.

Training for overseas participants

Branch staff were associated with the Australian Development Assistance Bureau, a Commonwealth agency of the Department of Foreign Affairs, in the presentation of a Special Group Course in Veterinary Services Administration. Although the Veterinary Services Branch provided the major input for the course, Mr K. B. FitzGerald, District Dairy Adviser, was Director of Studies and organized the course. Other Branch staff contributed.

In the latter part of the year, a request was received from the German Foundation for International Development for training of eight people from Bangladesh and two from Thailand in dairy production and pasture management. This training course will run from July to December 1980. The course has been organized and will be presented by Branch staff.

Regional newsletters

Each dairying region has a newsletter for dairy farmers. These newsletters are largely written and published by dairy officers in each region.

In many cases, these newsletters are the only direct written method of communication with dairy farmers and as such are extremely valuable.

Happy Jack Calendar was published once again in a one page, full colour format. It was financed by commercial sponsorship from eight firms.

Special investigations on nutrition

BERSEEM CLOVER TRIALS. Berseem clover was grown in south-east Queensland in a number of trials. Results show that Berseem provides a useful feed at the same time of the year as ryegrass without requiring large inputs of nitrogen fertilizer.

Farmers have planted increased areas this season and results will be monitored.

RYEGRASS, RYEGRASS-LEGUME, STRAIGHT LEGUME TRIALS. Three major trials, in conjunction with D.C.H.B. and with Agriculture Branch participation, are being conducted at Rockhampton, Gympie and Beaudesert to compare milk production from ryegrass plus nitrogen, ryegrass-legume mixtures and legume mixtures.

These trials are an extension of a successful trial completed at the end of 1979 at Ayr, which showed that straight clover produced more milk than did heavily fertilized ryegrass.

The legume species chosen for each trial were the result of species evaluations carried out last season, and are combinations of sub-clovers, white and red clovers, Berseem and lucerne varieties.

Smaller demonstrations using various ryegrass and clover varieties are being carried out in the other dairying regions.

ANALYSIS OF RYEGRASS AND OATS—DOWNS REGION. A continuing programme with ryegrass and oats is being analysed for energy, protein and mineral content. Energy determinations are being carried out using the Modified Acid Detergent Fibre method of determining Metabolisable energy. Sampling areas have been reduced from four to three.

OATS SICKNESS TRIAL—DOWNS REGION. A programme is coninuing to determine the cause of sickness which is evident in cattle grazing oats. The trial is in conjunction with A.R.I. and Agriculture Branch.

HEIFER SUPPLEMENTATION TRIAL—WIDE BAY REGION. The results of this trial showed that by feeding 1·5 kg of molasses from 2 months of age to 15 months of age, target mating weight was achieved. The cost of the supplement is covered by the extra milk gained during the first lactation.

With some minor modifications, the trial is continuing, in conjunction with Dairy Cattle Husbandry Branch.

Special investigations on husbandry

SURVEY OF PRACTICES AND ATTITUDES—WIDE BAY REGION. All suppliers to the Wide Bay Producers' Co-operative Association were surveyed as to their adoption of key practices. This information has been and will be used to develop a comprehensive situation appraisal. The survey is a joint project with Economic Services Branch.

TAIL PAINTING TRIAL—SOUTH BURNETT. A trial using tail paint as a guide to heat detection proved that is was a useful detection aid. Of 70 heat periods, 61 (87%) had scuffed tail paint.

LABOUR UTILIZATION PROJECT. A workshop was held at Ipswich to review and collate existing knowledge in the area of milking machine equipment, shed and yard design. Mr P. Smith, from Werribee, participated and gave extremely valuable information to augment local knowledge.

A booklet, 'A Review of Milking Management', was prepared. The booklet covers the latest information on labour saving in milking equipment, milking management, shed and yard design. It will be an extremely useful booklet for field officers to advise farmers on new shed design or conversions of old systems. This work was sponsored by the Dairying Research Committee.

Objective No. 2

Objective No. 2 is 'to provide advisory services in the fields of dairy product processing to Queensland manufacturers'.

Processing centres

There are 44 dairy products processing centres presently operating throughout the State. While several are operating as multi-product plants, the following processing categories are provided; butter 13, cheese (Cheddar only) 3, cheese (Cheddar and other varieties) 7, cheese (non Cheddar varieties only) 4, pasteurized milk 20, powders 11, casein 3, ice-cream 6, yoghurt 5, other dairy products 6.

This section of the industry is serviced by officers who review quality control programmes and conduct special surveys to identify causes of problem conditions. This service co-ordinates with official gradings on manufactured products and the bacteriological and chemical analytical programmes undertaken by the Dairy Research Branch.

A total of 902 visits and 88 investigational surveys was completed during the year by specialist dairy product officers. Visits include inspections of milk depots and dairy produce stores.

The Milk Quality Control Committee was set up during the year. This is made up of representatives from the Queensland Milk Board and the Dairy Division. The Committee meets once a month to consider long-term trends in milk quality and to recommend action as required to the Queensland Milk Board. The activities of this group have resulted in a change in attitude to quality by some factories. It has had an important bearing on work in the dairy products area.

Rationalization

AMALGAMATIONS AND CLOSURES. Milk suppliers to Kingston factory joined the Metropolitan Milk Producers' Association. The Mt. Tyson suppliers conducted several meetings in an attempt to close the factory but at this point have been unsuccessful.

MILK PACKAGING. New carton packaging equipment is being installed in factories throughout Queensland as the trend away from packaging milk in bottles continues.

The new factory at Mackay has retained a small bottle line but the trend here is significantly towards cartons.

DAIRY PROCESSING, BUILDINGS AND EQUIPMENT. During the year ending 30 April 1979, factories in Queensland had applied for and received approval for expenditure of $3,114,618 on new equipment and $2,274,562 on new buildings and building alteration. Naturally some of this money was intended for use in the current year.

Since 1 May 1979, approvals have been granted for $2,290,658 to be spent by dairy companies on new equipment and $1,171,600 to be spent on renovations to factories and new building works.

FACTORY OPERATIVE TRAINING. In association with the Queensland Dairy Processing Industry Training Committee and the Australian Society of Dairy Technology, several training programmes were completed during the year.

Two of these were held in Brisbane for factory operatives who were sitting for Certificates in Milk and Cream Testing and Milk Grading.

In-factory hygiene seminars were conducted in the Darling Downs region for factory operatives, while in the Wide Bay region a number of seminars on such subjects as hygiene/housekeeping, detergents and sanitizers and milk processing were conducted with success.

A 1 week 'live-in' school on liquid milk and milk processing was held at Gympie for 17 factory operatives.

These activities provide meaningful assistance to industry in the training of factory operatives.

District officers continued to provide assistance to factory operatives undertaking certificate courses in their own regions.

Extension

The bulletin, 'Dairy Products' is published quarterly by the Branch and continues to supply information on dairy technology to factory management and staff and is a useful medium for general dissemination of information on dairy practices.

INVESTIGATIONAL PROGRAMMES. The Branch collaborated with Research Branch in investigational programmes which included pesticide residues in dairy products, shattering of curd in cottage cheese manufacture, a starter costing study, development of an organoleptic grading system for cheese other than Cheddar, and iodine residues.

Objective No. 3

Objective No. 3 is 'to administer the provisions of the relevant legislation, namely The Dairy Produce Act, the Margarine Act, and the Filled Milk Act'.

Dairy Produce Act

The new Act was proclaimed December 1979. New regulations were gazetted on 14 June, 1980.

DAIRY BUILDINGS. A total of 37 new buildings was erected and 92 renovations completed. A total of 95 bulk milk vats was installed under guidance of district staff in accordance with Regulation 220. Many of these were installed as second vats.

MILKING MACHINES. There were 72 new milking machines installed and 112 second-hand units placed into operation. In association with this supervision, officers completed performance testing on 1 127 milking machines. This was a substantial increase on the previous year's figure.

CERTIFICATE IN COMPETENCY. A total of 21 examinations was held in connection with Certificate examinations conducted under the Act.

DAIRY PRODUCE GRADING. The amount of choice butter received from Queensland factories is still declining. A small seasonal supply was received from four factories. Supplies of special butters as cultured from Toowoomba and 'Softa' from Booval have been maintained throughout the year. The standard of these products has been good.

Victorian butter graded came mainly from Rochester factory with some supplies from Leongatha and Koroit.

The following table indicates the total amount of butter received as choice from Victoria together with grade percentages for this report year and the past 2 years.

	Total Tonnes	GRADES % 93	92	91	90	<90
Year						
1979–80 ..	9 269	59·12	28·83	7·34	3·61	1·10
1978–79 ..	9 006	43·7	45·6	6·8	3·2	0·7
1977–78 ..	9 061	77·9	9·7	6·6	2·9	2·9

There has been a slight increase in the amount of 'Choice' butter received from Victoria. Grading results in Queensland have been similar to those of the previous 2 years, the main variations occurring in the 93 and 92-point allocations.

The presentation of aged butters has a marked effect upon the grading of 92 or 93-point butter.

RAW MILK QUALITY. The total count test is applied to raw milk at all stages of handling. A system of checking every 6 months on factory laboratory operatives' testing procedures ensures that factory tests on farm supplies are accurate.

MILK LICENSING. The major activity involved applications for 1980 licences from existing vendors and applications from new owners.

The Margarine Act

Action under this Act was confined to limited sampling for analyses, mainly undertaken by Divisional staff.

Filled Milk Act

No activity was reported during the year under this legislation.

Code of Practice

The Australian Code of Practice for Dairy Factories has now become generally accepted throughout the State.

A second combined State-Commonwealth inspection was carried out in 1979-80.

One of the benefits of the Code of Practice is in having factories planning ahead for future alterations. Companies are more willing to do this than before the introduction of the Code, and many factories are now working on a 5-year programme towards compliance with the Code of Practice.

While on a State-wide basis much has been done to bring factories or processing sections up to Code of Practice standard, some factories or sections still fall short of Code of Practice requirements.

Objective No. 4

Objective No. 4 is 'to advise the Director-General on matters relevant to the dairy industry in Queenland.'

A considerable amount of time was spent by officers in collating data on milk production and usage together with the value of returns to suppliers. Factories are required to forward monthly details of milk and cream receivals and production statistics. A computer programme has been written to collate this information and so expedite collection of any data by the Director-General or Marketing Division.

Co-ordination in the collection of statistics was discussed during the year. As a result, the Branch is currently supplying production statistics to the Australian Bureau of Statistics. Discussions are continuing with the Queensland Milk Board and the Australian Dairy Corporation.

Objective No. 5

Objective No. 5 is 'to maintain the competence of staff by provision of appropriate training and recruitment of qualified persons'.

The training programme for 1979-80 included the attendance of Branch staff at communications skills workshops, management development courses, extension methods schools, an Animal Genetics Training Course at the University of Queensland and dairy technology refresher courses. A legal proceedings workshop was conducted for selected officers.

In addition, the Director attended a National Extension Workshop on labour use efficiency, and other officers qualified or began working towards higher degrees. Technical training activities were conducted in each region. Individual training programmes, based on the concept of 'self-directed learning', were developed for three new appointees.

Dairy Cattle Husbandry Branch

TO achieve its objectives and discharge its responsibilities, the Branch operates the sub-programmes Dairy Cattle Research, Dairy Herd Production Services and Artificial Breeding Services, together with Branch Administration.

Dairy Cattle Research

The aim of the Dairy Cattle Research sub-programme is to conduct applied research in dairy cattle production technology, and provide information for direct application by Queensland dairy farmers.

In the year under report, endeavors were in the three main subject areas of milking herd nutrition—

- Improvement in forage production in autumn, winter and spring.
- Fertilizer studies.
- Supplementation studies.

Two activities concerned with herd replacement rearing were also undertaken.

The major nutritional problem facing Queensland dairy farmers is the marked decline in productivity of tropical and sub-tropical pastures during the cool dry season, that is, late autumn-winter-spring. Farmers have to look to alternative feed sources to maintain production over this period.

Research trials in north Queensland since 1975 have shown that irrigated, annually-sown areas of ryegrass and/or clovers, even when grown in truly tropical areas, provide excellent grazing over this feed shortage period. The variable feed costs of milk produced from such pastures are 3 to 5c per L, which compares more than favourably with the cost of milk produced from grain of 8 to 12c per L. Industry acceptance, particularly in north Queensland has been rapid and widespread.

From Rockhampton north, the area sown has increased from nil in 1975 to more than 2 000 hectares in 1979. Initially, ryegrass was much more popular commercially, undoubtedly because of bloat fear with clovers. However, trials both at Ayr Research Station and on commercial farms in the Atherton, Mackay and Rockhampton areas have shown a number of important advantages to clovers including—

- A lower requirement for nitrogen. Nitrogen costs of ryegrass systems represent 25 to 35% of the total costs.
- A longer productive season. A combination of early (for example, Clare subterranean) and late (Ladino white) clovers planted in April can provide excellent grazing from May until January. Ryegrass pastures are usually finished by the end of November.
- Higher quality. When grown in the tropics, clovers have a higher quality than ryegrass. In many trials, this has been reflected in higher milk production.

The use of clovers in annual temperate pasture systems on Queensland farms is expanding rapidly.

Consequently, research work with annual temperate systems over the past year has concentrated mainly on evaluating further the potential of clovers.

Milking herd nutrition

A trial was designed to quantify and compare milk production from irrigated tropical pastures oversown in April with either ryegrass, ryegrass-clovers or clovers. In this trial, all pastures received regular bag nitrogen. Winter-spring milk production was 11 000 to 17 000 L per hectare (11·7 to 13·3 L per cow per day) with clover pastures outproducing ryegrass pastures by 10% in the first year of the trial and 20% in the second year.

The trial also evaluated molasses as a supplement to temperate pastures and found responses to be consistent at 0·9 L milk per kg of molasses.

The effect of extent of land preparation on the establishment and milk production of annual temperate pastures was studied. Both ryegrass and clover pastures were established with either thorough cultivation (rip, disc, rotary hoe) or minimal cultivation (light discing only). Results showed that milk production was increased by 5 to 15% with thorough cultivation.

However, results also demonstrated that both ryegrass and clover pastures can be successfully established with minimal cultivation. This is important on farms where lime problems, erosion worry or fear of damage to existing pastures restricts cultivation.

Clover species comparison

At Ayr Research Station, some 18 clover and medic varieties were compared under grazing. Varieties which showed most promise were New Zealand red clover, Clare, Bacchus Marsh and Seaton Park subterranean clovers, Ladino and Haifa white clovers, Strawberry Palestine clover, Berseem clover and Jemalong medic.

All of these are being evaluated further in several large scale grazing trials on commercial properties in 1980.

Fertilizer studies

Over recent years, considerable emphasis has been placed on the researching and extending correct fertilizer practices for use on improved pastures.

Several recent trials at Ayr Research Station have been designed to evaluate responses to nitrogen fertilizer on irrigated tropical pastures and at Kairi Research Station on rain-grown pastures.

In one trial, there was no advantage to winter-spring milk production when nitrogen fertilizer applications in this period were increased from 56 kg N per ha per month to 112 kg N per ha per month.

A further trial is to study the relationship between milk production and nitrogen fertilizer level. Three nitrogen levels (28, 42 and 56 kg N per ha per month) have been used on irrigated couch grass pasture over 2 successive years.

A preliminary analysis of results available to date suggests that, while milk production responses fall off over the above fertilizer range, milk production responses achieved when N fertlizer was increased from 42 to 56 kg per ha per month were still economic. More detailed results of this trial will soon be available.

The third and final year of a stocking rate experiment at Kairi was completed in October 1979. Milk production and milk composition data averaged for the 3 years are presented in Table 1.

TABLE 1

AVERAGE MILK YIELD AND COMPOSITION DATA FOR EACH STOCKING RATE x NITROGEN LEVEL

Nitrogen (kg N ha^{-1} yr^{-1})	Stocking Rate (cows ha^{-1})	Milk Yield (kg cow^{-1} $lactn^{-1}$)	B'fat %	Solids not Fat	Lact. Length (days)
200	2·0	2 949	3·81	8·41	279
	2·5	2 644	3·79	8·48	257
	3·0	2 558	3·75	8·45	247
	3·5	2 433	3·70	8·58	247
400	2·0	3 076	3·91	8·62	264
	2·5	3 146	3·72	8·45	270
	3·0	2 873	3·89	8·54	272
	3·5	2 744	3·74	8·41	258
Grass–Legume	2·0	2 710	3·86	8·47	252

Cows received no supplements during lactation other than a sodium-phosphorus lick. Milk yields show an interaction between stocking rate and nitrogen level, with milk yields increasing at a faster rate per unit increase in stocking rate at the 400 N level. There was no difference between treatments in butterfat percentage or solids-not-fat percentage. Lactation length decreased with stocking rate and increased with nitrogen level.

A simple economic analysis (Table 2) of the experiment indicates that grass-nitrogen pastures have to be stocked above 2·0 cows ha^{-1} to make the use of nitrogen economic above that of a grass-legume (GR-LEG) system. However, stocking rate above 2·5 cows ha^{-1} on an annual basis led to problems of cow liveweight loss during the dry season which could not be tolerated.

The requirement to supplement with hay annually in spring above 2·5 cows ha^{-1} precludes a higher stocking rate. The higher nitrogen level would be recommended in most circumstances because of its effects on increasing lactation length, decreasing the need for dry season supplementation and better cow liveweight gains in spring.

TABLE 2

A Simplified Economic Analysis—Milk Income less Fertilizer and Hay Costs equals Margin ha^{-1}

Nitrogen (kg N ha^{-1} yr^{-1})	Stocking Rate (cows ha^{-1})	Milk Production (kg ha^{-1})	Milk Income ($ ha^{-1})	Fertilizer Costs ($ ha^{-1})	Hay Costs ($ ha^{-1})	Margin ($ ha^{-1})
200	2·0	5 898	914	158	21	735
	2·5	6 610	1 025	158	52	815
	3·0	7 674	1 189	158	68	1 063
	3·5	8 516	1 320	158	85	1 077
400	2·0	6 152	954	278	19	657
	2·5	7 865	1 219	278	34	907
	3·0	8 619	1 336	278	65	993
	3·5	9 604	1 489	278	89	1 122
Grass–Legume	2·0	5 420	840	38	48	754

Milk = 15·5c/kg Super = $120 t^{-1} Potash = $150 t^{-1} Nitram = $200 t^{-1} Hay = $80 t^{-1}

To study recovery of overstocked pasture, four grass-legume (Gatton panic—Tinaroo glycine—Greenleaf desmodium) pastures were stocked at 2·0 cows ha^{-1} for 3 years. This is an overstocking situation for twining legumes and the pasture data indicated legume yield and percent composition declined each year of overstocking. All pastures had been fertilized at the rate of 250 kg superphosphate ha^{-1} year^{-1} and 50 kg potash ha^{-1} year^{-1}.

Four treatments were imposed on these pastures to determine an optimal method of recovering legume content.

Pasture	Stocking Rate (cows ha^{-1})	Superphosphate (kg ha^{-1} year^{-1})	Potash (kg ha^{-1} year^{-1})
A	2·0	250	100
B	1·0	250	100
C	1·0	500	100
D	0·0	250	100

Pastures are sampled twice a year in the same way as in the previous 3 years. A comparison is given below of legume yield and percentage in autumn of each year.

Pastures were stocked at 2·0 cows ha^{-1} from November 1977 to November 1979 with the new treatments imposed in November 1979.

Pastures that were destocked for 6 months have returned to their former legume level while pastures that have been kept stocked at 2·0 cows ha^{-1} have degenerated further (Table 3). Reducing the stocking has produced a slight recovery in legume yield and composition but is far from complete. There is no advantage from the extra superphosphate so far.

TABLE 3

Changes in legume yield (kg D.M. ha^{-1}) and legume per cent of grass-legume pastures from 1977 to 1980

Pasture	Component	Autumn 1977	Autumn 1978	Autumn 1979	Autumn 1980
A	Legume yield	1 048	1 233	603	284
	Legume %	31·5	24·9	15·2	8·2
B	Legume yield	1·168	1 423	978	752
	Legume %	37·3	31·3	23·1	12·6
C	Legume yield	981	1 484	632	780
	Legume %	29·0	29·5	16·3	11·7
D	Legume yield	1 025	1 246	701	1 538
	Legume %	25·9	25·2	17·0	27·5

Supplementation studies

Supplementation with concentrates or conserved feeds is assuming a greater role in Queensland dairying as stocking rates increase. Two projects examining feeding strategies were implemented during the year.

Maize silage feeding in winter-spring is employed by 10% of dairy farmers on the Atherton Tableland. Silage is used on those farms which have high stocking rates and are unable to provide adequate levels of pasture.

Silage was fed to a group of 20 cows grazing green panic-glycine pastures at 2·5 cows ha^{-1}. Treatments were as follows:—

1. Low silage no meatmeal (3 kg dry matter)
2. Low silage plus meatmeal (3 kg dry matter)
3. *Ad lib.* silage no meatmeal
4. *Ad lib.* silage plus meatmeal

Meatmeal was fed in the ratio silage (5): meatmeal (1) on a dry matter basis. Cows on treatments 1 and 2 were returned to their paddocks in the morning after consuming their supplement while cows on treatments 3 and 4 had access to their supplement from 0800 to 1300 hours each day and grazed pasture at night. After 8 weeks of experimental feeding, all cows grazed as one herd on grass-legume pasture with no further supplements. Milk yield and composition data are presented in Table 4.

TABLE 4

MILK YIELD, MILK COMPOSITION AND LIVEWEIGHT CHANGE

Treatment	Milk Yield (kg cow^{-1} day^{-1}) Weeks 1–8	Milk Yield (kg cow^{-1} day^{-1}) Weeks 9–16	B.F. %	S.N.F. %	Weight Change (kg) Weeks 0 to 8
Low Sil no MM	14·4	13·7	3·66	8·38	— 15·0
Low Sil plus MM	15·0	14·0	3·38	8·42	— 15·4
Ad lib. Sil no MM	15·3	14·9	3·56	8·54	+ 2·0
Ad lib. Sil plus MM	16·6	14·9	3·23	8·49	+ 11·4
Significance Silage	*	*	n.s.	*	**
Meatmeal	*	n.s.	*	n.s.	n.s.

** P 0·01; * P 0·05; n.s. P 0·05.

A significant response in milk yield was recorded in weeks 1-8 (supplement feeding) to both levels of silage and meatmeal supplement. Feeding a small amount of silage with meatmeal produced nearly the same level of milk yield as twice as much silage without meatmeal.

Feeding meatmeal was economic (meatmeal $290 t^{-1}) at the *ad lib* level of silage feeding where supplement intakes averaged 7·4 kg D.M. cow^{-1} day^{-1}. Meatmeal feeding was not economic at the low level of silage feeding although there was a strong carryover effect in the first 4 weeks after feeding stopped, which reduced the loss.

Rearing dairy replacements

These experiments form part of our programme to define nutrition and management requirements for improved growth of dairy replacements on tropical pastures. Our earlier research has found that, if milk yields are not to be reduced by continued growth of the animal, Friesian heifers should reach 450 kg liveweight before calving. Lifetime productivity of the dairy cow and the economics of dairying are greatest if heifers first calve at 2 years of age.

Milk feeding of calves is labour-intensive and expensive and early weaning is practised. However, the low nutritive value of tropical pasture does not permit satisfactory growth by weaner and yearling cattle. Concentrate supplementation is necessary for dairy replacements to maintain a desired growth rate of 0·57 kg per day.

To maintain adequate growth post weaning, the young calf requires high levels of digestible energy and protein. The inherent low nutritive value of tropical pastures restricts the growth of these animals to between 0·15 and 0·30 kg per day (well below our desired 0·57 kg per day).

An experiment examined two levels of concentrate supplementation, 1·0 and 1·5 kg per day for A.F.S. (Australian Friesian Sahiwal) weaner calves between 70 kg and 130 kg liveweight. To determine whether additional protein would further improve animal performance, maize and a ration of 5 parts maize, 1 part cottonseed meal were compared in a 2 x 2 factorial design.

This experiment demonstrated the value of a small amount of extra protein in supplements for weaner calves. At 1·0 kg per day, there was a small improvement in calf growth up to 110 kg liveweight, with no further benefit above this liveweight (Table 5). However, when supplementation level was increased to 1·5 kg per day, maize only had no effect on growth rate.

In contrast, inclusion of the protein allowed the calves to utilize the higher level of digestible energy provided. These animals responded to additional protein right up to 130 kg liveweight.

Animals fed maize did not grow at the desired 0·57 kg per day until they reached 110 kg liveweight. If a higher level of supplementation were to be used to raise this, a protein concentrate should be used. This would increase rearing costs by $1 to $2 per calf from weaning to 6 months, but this cost is offset by a 15% improvement in growth over the period when animals are at greatest risk.

Response to protein may be greater on commercial farms where quality of pasture may be lower than our irrigated, nitrogen-fertilized couch, parasite control less stringent, or if calves are younger and lighter at weaning. The 5:1 grain protein supplement is recommended as a precaution at 1·0 kg per head per day and essential if higher levels of supplementation are to be used.

TABLE 5

EFFECT OF MAIZE OR MAIZE PLUS COTTONSEED MEAL ON GROWTH OF A.F.S. WEANERS

Supplement/Calf Weight	70–100 kg	110–130 kg	70–130 kg
	Liveweight Gain/day		
Maize			
1·0 kg	0·52	0·64	0·54
1·5 kg	0·51	0·63	0·54
5M : 1CSM			
1·0 kg	0·55	0·58	0·55
1·5 kg	0·63	0·73	0·63

Beyond 120 kg liveweight (approximately 6 months of age) only energy supplementation is needed for weaners grazing green tropical pastures. For most Queensland dairy farms, molasses can be delivered for less than half the cost of grain. If similar growth rates can be achieved, the cost of rearing dairy heifers may be reduced by using molasses in place of maize.

An experiment compared maize and molasses-M.A.P. as supplements for Friesian weaners above 120 kg liveweight. These feeds were at three equivalent dry matter levels: 0·5, 1·0 and 1·5 kg per head per day. To determine the level of supplementation necessary to achieve a growth rate of 0·57 kg per day by animals grazing tropical grass pastures, a control (unsupplemented treatment) was included to measure animal performance on pasture alone, a practice normal on many dairy farms. Pastures were stocked at 12 weaners per ha.

Unsupplemented animals gained 0·41 kg per day and weighed 228 kg after 245 days. At this rate of gain, heifers would not reach sexual maturity until about 18 months of age.

Animals at all levels of supplementation exceeded 250 kg by 15 months of age, but gains at the lowest level were below the desired level. Optimal growth rates were achieved with 1·0 kg maize or 1·2 kg molasses per day. Growth rates were further increased at the highest level of supplementation, though animals did not respond to the highest level of molasses until over 220 kg liveweight indicating a negligible response when levels exceed about 25% of total ration dry matter.

Initially, animals on maize grew faster than the molasses treatments, suggesting an adaptation period of about 10 weeks to molasses. However, slightly higher growth rates subsequently resulted in identical performance from maize or molasses at equivalent dry matter levels. Molasses is therefore a cheap energy supplement which can be fed at levels up to 1·2 kg per day to achieve desired growth rates of dairy yearlings.

Dairy Herd Production Services

The aim of the Dairy Herd Production Services subprogramme is, in common with all national and State Departments of Agriculture, to make available to dairymen production recording systems, herd management information services and facilities for genetic improvement of herds and breed development.

Herd recording and field activity

During the year, 42 628 cows completed lactations in 663 recorded herds. Their average yield was 2 869 L of milk and 111 kg butterfat with an average butterfat percentage of 3·8.

SERVICE OPERATORS. The trend to replacement of herd recorders with contractors has continued. There are now seven recording officers providing a field service to 680 producers. The operating cost increases faced by contractors are reflected in the projected fees for service for the forthcoming year.

The cost to the Department of providing contractors is approximately half that of employing recorders. In situations where recorders operate with less than full groups, this margin is significantly greater.

FARMER-OWN SAMPLING. This service was introduced on 1 July 1979 and has attracted approximately 90 members (14% of total recording members).

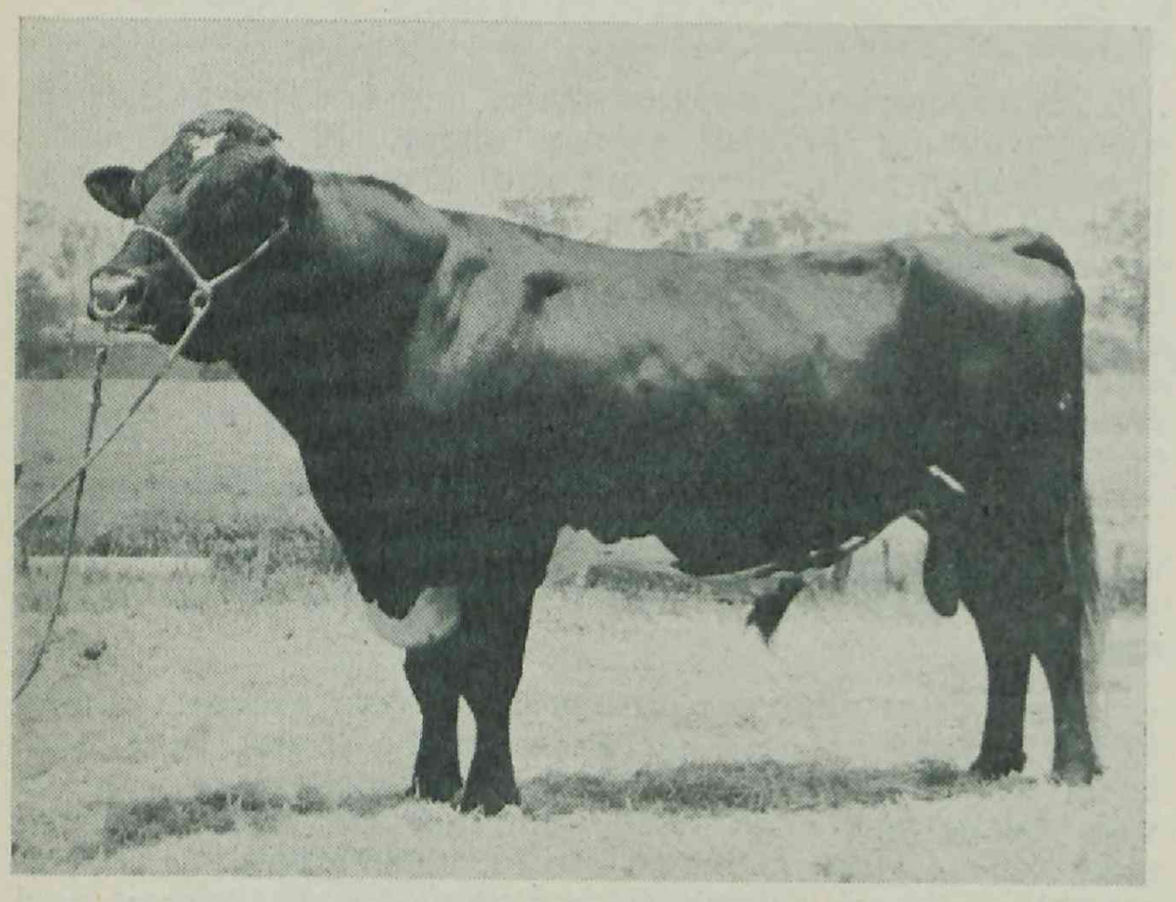
SAMPLE PRESERVATIVE. An investigation of the composition of preservative tablets, particularly in relation to solubility and micron size of the filler material was undertaken. A new type of filler material which promotes solubility is now included in samples.

METER TESTING. The need to monitor the efficiency of milk meters has been recognized. A meter testing service is now proposed and will be developed in the near future.

CLERICAL SYSTEMS. A revised fee structure was introduced. This relates the fee charged to the service provided and recognizes the minimum unavoidable cost of providing service in small (<40 cows) herds. The new structure involved a doubling of per-cow charges for producers requiring a recorder service. There was no decline in membership through this rise. A further 35% rise will take effect from 1 July 1980.

The introduction of a Herd Registration system membership in the scheme has functioned effectively. Provision has now been made for this membership and related payment arrangements to continue from year to year without endorsement until cancelled.

Computer procedures relating to the recording accounting function have been developed. The debit to be raised against each member is recorded on each Herd Production Sheet.



The A.I.S. sire 'New Park Gay King' was designated A.I. Proven in Queensland and the U.S.A. in 1979. Progeny of this sire have won many show ring awards including the All American Junior Yearling Bull for 1979.

Proving dairy bulls

The following bulls have been determined as A.I. Proven from matings carried out in 1975.

Breed	Bull	Milk Index	Butterfat Index
A.I.S.	New Park Gay King ..	106	108
Jersey	Nindethana Spotted Prince	110	109
Friesian ..	Doro Park Sweet Neil	114	109
	Lawes Priscilla Greypad	114	106

This year two Proven Bulls have been delineated in the Friesian breed. When type considerations are allied to the performance result it is not possible to separate these two animals as likely herd improvers. The production of both bulls compares favourably with that of proven bulls from earlier years.

This year, 5 993 cows have been mated to the 21 bulls in 186 co-operating members' herds. Only 29% of these inseminations have been conducted by inseminating organizations. An important new innovation here has been the earlier arrangement of nominations for these matings and an increase in stringency in cow selection.

Co-operation with the New South Wales Department of Agriculture and the New South Wales Dairy Industry Authority in proving dairy bulls has continued. This year bulls of the Jersey and A.I.S. breeds are being used in a joint bull proving scheme.

SPECIAL FRIESIAN CATTLE CLUB PROOF. Twenty-five Club members are involved in this scheme, matings for which were conducted in 1979. Two specially selected M.M.B. bulls together with two members of the proving group provided semen for these matings. Currently, 28 daughters of M.M.B. Cherry Lane Reflection Pilot and 21 daughters of M.M.B. Sunny Lodge Preceptor are in co-operators' herds.

BONUS INCENTIVES. Entitlements amounting to $5,200 with respect to the 1978 year were paid to co-operators, and $5,771 submitted for payment with respect to the 1979 group.

A new system of payment has now been approved. This will enable payments to be more closely aligned to actual lactation records which are used in the Proof, and will provide a more equitable distribution of the incentive.

Development of the A.F.S. breed

A.F.S. BULL SELECTION. This group was selected from 21 progeny of the 1978 bull group. The procedure first selected 12 bulls on growth rate and dam production records. After testing, two of these 12 were culled (at a basis of 98% resistance) and six selected from the remainder on semen donorship ability.

One thousand five hundred doses of semen have been placed in storage from each bull in this group. A test and slaughter campaign is presently in consideration.

A.F.S. CO-OPERATORS' PROJECT. Under this project, appropriate terms and conditions have been developed to allow controlled introduction of A.F.S. cows to co-operators' herds. This is an important phase in the total project and provides industry exposure for the breed with proper protection for all parties. At present 199 head of A.F.S. and 55 Friesians are located on 28 and 5 co-operators' properties respectively.

Tick resistant dairy herds

Eight dairymen are currently participating in this project. Two co-operators on the Atherton Tableland, and one each in the Wide Bay and East Moreton area have withdrawn. These withdrawals were due to farm development and herd dispersal problems.

Transfer of some 13 project cattle will help to retain some of the value of early work on the farms which have withdrawn.

All co-operators have been provided with crushes, inseminating, vaccinating and drenching equipment.

Artificial Breeding Services

The aim of the Artificial Breeding Services sub-programme is to provide for the requirements of livestock producers (except insemination services) to undertake artificial breeding programmes in their herds.

Summary of activities

LIVESTOCK—NUMBERS ON A.I. CENTRES. At 31 May there were 112 dairy and 12 beef sires at the licensed premises. Five hundred and fifty-five head, mainly A.I. training cows, passed through the Herd Improvement Laboratory.

FARMING PROGRAMME. The revised farming programme, put into operation 3 years ago began to fulfill expectations. Almost all of the A.I. Centres' roughage was produced locally and a grain sorghum crop was planted for the first time. Also, for the first time, forage sorghum was totally replaced with harvested improved pasture.

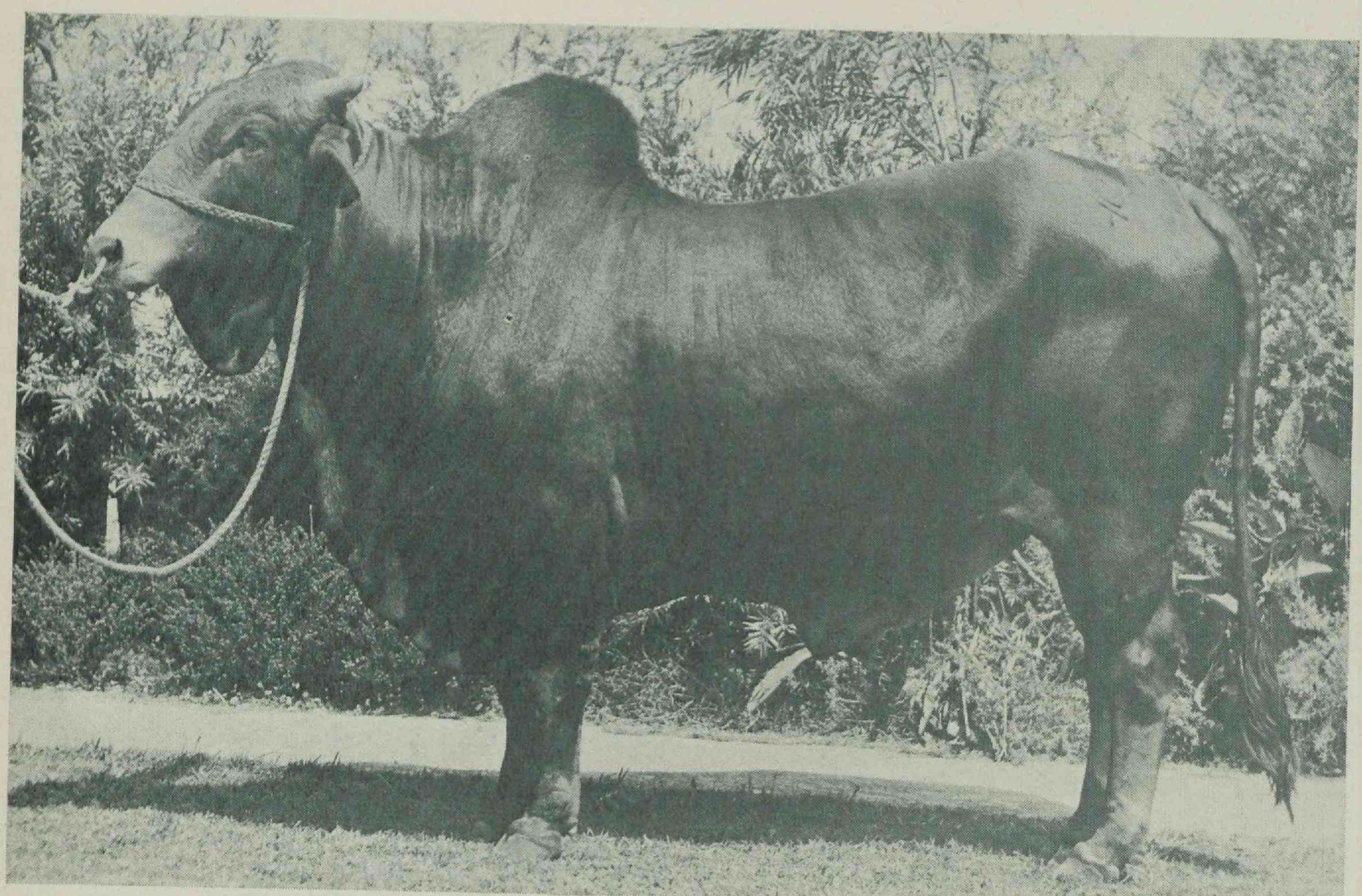
Installation of the Harvestore feeding system in 1980-81 will see the culmination of planning over several years to improve A.I. Centre farming.

PRODUCTION—LICENSED SEMEN. During the year, 287 500 doses were stored at Wacol and Ormiston including 57 900 from 16 privately owned bulls.

TABLE 6

SUMMARY OF SEMEN SALES AND TOTAL MOVEMENTS (MAY 1979—APRIL 1980)

Distributed from		Class of Semen (owner)	QUEENSLAND		INTERSTATE		OVERSEAS		TOTAL	
			1979–80	1978–79	1979–80	1978–79	1979–80	1978–79	1979–80	1978–79
Sales	Wacol	D.P.I.	44 748	49 318	10 042	19 508	27 826	33 428	82 616	102 254
		Private	6 212	4 636	2 972	1 365	1 775	100	10 959	6 101
		Consignment	17 417	12 520	1 026	837	44	276	18 487	13 633
		S/T	68 377	66 747	14 040	21 710	29 645	33 804	112 062	121 988
	Depots	D.P.I.	5 788	5 209	..	..	..	..	5 788	5 209
		Private	205	345	..	..	..	..	205	345
		Consignment	817	412	..	..	..	..	817	412
		S/T	6 810	5 966	..	..	..	..	6 810	5 966
	Agents	D.P.I.	5 748	7 000	3 264	2 516	828	2 084	9 840	11 600
		Private	328	109	138	910	Nil	Nil	466	1 019
		S/T	6 076	7 109	3 402	3 426	828	2 084	10 306	12 619
	TOTAL SALES		81 263	79 549	17 442	25 136	30 473	35 888	129 178	140 573
Other Movements	Wacol	Bull Proving—D.P.I.	16 738	16 479	1 404	600	..	..	18 142	17 079
		Bull Proving—C.S.I.R.O.	48	Nil	2 888	3 607	..	..	2 936	3 607
		Sent to Depots	..	..	..	..	..	..	..	..
		Less Sales	−258	144	..	..	..	..	−258	144
		Sent to Agents	..	..	..	..	..	..	..	..
		Less Sales	2 517	797	2 783	444	42 399	3 882	47 699	5 123
		Research Projects	320	560	Nil	Nil	Nil	Nil	320	560
	TOTAL MOVEMENTS (ALL PURPOSES)		100 628	97 529	24 517	29 787	72 872	39 770	198 017	167 086



A Sahiwal bull standing at the A.I. Export Centre, Ormiston. Semen from this sire is being used to breed Friesian x Sahiwal calves in New Zealand for export to Malaysia. These animals will provide the foundation stock for future Malaysian dairy herds.

UNLICENSED SEMEN. Demand for this service increased by 64%. A total of 22 000 doses was stored and 21 private veterinarians used the service.

INSEMINATOR TRAINING. The training of 208 people was undertaken at 20 'on farm' and four Wacol courses. Fourteen Inseminator Certificates were issued. Eighty-eight people attended refresher training courses on the Atherton Tableland.

MARKETING—DOMESTIC MARKET. The total movement of semen from sires at Wacol and Ormiston increased by 17% to 178 700 doses. Combined with semen sold on consignment and the movement of unlicensed semen, 210 700 doses were despatched from Wacol. This represented an increase of 19% on 1978-79 figures.

Because of the method of reporting, actual sales appear to have declined by 8% to 129 200 doses. In excess of 40 000 doses sent to New Zealand and known to have been distributed will not appear as sales until 1980-81.

The demand for semen in Queensland rose by 2·2%. An 8·5% fall in local sales from Departmentally owned bulls was offset by sales of privately owned and consignment semen. Sales from the Rockhampton and Mackay depots rose by 14% to 6 810 doses.

A summary of semen sales and total movements is given in Table 6.

Compared with the previous year when equipment retailing was introduced, sales increased by 93% to a total value of $18 500.

EXPORT MARKET. Interstate and overseas distribution remained a significant part of the operation accounting for 49% of total movements. Excluding Sahiwal exports to New Zealand, 24 000 doses were exported to Brunei, Cuba, India, Indonesia, Malaysia, New Zealand, New Hebrides, Papua New Guinea, Republic of Panama, El Salvador and Zambia.

Total sales, both domestic and export, amounted to nearly $500,000.

PUBLICITY AND PROMOTION. An intensive promotional campaign featuring the Silver Jubilee of artificial breeding in Queensland was launched with new A.I. Centre and Jubilee logos. Expenditure on advertising increased significantly and all promotional material was updated.

Visitors from overseas included diplomats, scientists and farmers from the Argentine, France, India, Jamaica, Japan, Kenya, Korea, Malaysia, Malawi, Mexico Netherlands, New Zealand, Philippines, Solomon Islands, Swaziland, Thailand, Uganda, United Kingdom, Uruguay, Western Samoa and Zambia.

Several hundred cattlemen, students and other members of the public visited the Centre.

Research Branch

THE closure of the Murgon Dairy Research Laboratory and rationalization of the testing frequency for some dairy products resulted in reduced throughput of dairy products for bacteriological and chemical evaluation.

	1979–80		1978–79	
	Samples	Tests	Samples	Tests
Bacteriological ..	16 376	46 932	29 000	61 000
Chemical ..	18 871	51 893	23 000	60 000

This demonstrates the changing role of the Dairy Research Branch from one of a complete laboratory service for dairy factories to a monitoring and reference laboratory. It is pointed out, however, that the Branch still performs all bacteriological and chemical work required by the Queensland Milk Board, bacteriological work and some analyses for the Butter Marketing Board, and provides technical laboratory expertise for the advisory and regulatory officers within the Division of Dairying.

Contacts with the manufacturing sector of the dairying industry are becoming more frequent with technical trouble shooting, analytical, developmental and advisory work being carried out when required. Furthermore, most of the research undertaken in the Branch is funded in part by the dairying industry by means of the Dairying Research Committee.

Dairy product evaluation

Raw Milk

—	1979–80	1978–79
Bacteriological analyses		
Farm-to-farm tankers		
Total Count—No. of samples ..	1 582	
% less 150 000/mL	93·5	92·1
Factory to factory tankers		
Total Count—No. of samples ..	1 747	
% less 150 000/mL	79·0	76·1
Chemical analyses		
All tankers		
No. of samples	3 450	
Solids-not-fat—% Unsatisfactory	7·2	
Freezing Point—% Unsatisfactory ..	6·7	
—% > 1% added water	3·4	

The bacteriological results reflect the success achieved within the Divisional programme to continually reduce bacterial counts at all stages of raw milk handling. Milk composition problems were in part related to the lack of good rainfalls during the year.

Four legal samples were analysed.

Pasteurized milks and creams

Approximately 100 samples of cream and flavoured products were of interstate origin. The remainder were of Queensland manufacture. Generally, quality of pasteurized products was satisfactory though inefficient pasteurization, post pasteurization contamination (coliforms), and compositional irregularities occur as indicated hereunder.

All products—Phosphatase test—		
No. of samples	7 581	
— % Fail	0·3	(23 samples)
Coliform test—No. of samples ..	7 724	
— % Fail	14·3	
Whole milks—Freezing point—		
No. of samples	4 121	
— % unsatisfactory ..	6·3	
— % > 1% added water	3·4	
Skim-milks—Composition—		
No. of samples	450	
— % Substandard solids-not-fat	14·9	
— % Substandard fat ..	12·8	
Creams—Composition—		
No. of samples	1 174	
— % Substandard fat ..	2·2	

The pre-incubated methylene blue test for keeping quality was replaced on 1 May 1980 by the Moseley count which should give a more reliable assessment of storage life. This test can be applied for all products.

Regular analyses of UHT milk and pasteurised goat milk started in 1980.

Seven legal samples were analysed.

Butter

An improved sampling procedure was introduced during the year to account for dwindling Queensland butter manufacture and the consequent importation of Victorian supplies. Regular monitoring of both pat and bulk butters ensures that chemical and bacteriological quality are satisfactory.

Some pat butters failed the psychrotroph test and were of poor bacteriological quality.

Interstate bulk butter was again analysed this year with 253 being sampled compared with 203 last year. The number of Victorian butters found to be overmoisture for the year was 13·1% (33) of those tested. Of the 141 official samples tested, 129 were of Victorian origin and, of these, 74 were found to be overmoisture.

Cheese

A total of 23 cheeses was tested for export, compared to 122 during 1978-79. The decline was probably related to drought conditions in many parts of the State and also to the overall trend within the dairy industry to fewer manufactured products.

A survey of the bacteriological and chemical quality of imported cheese is under way and locally manufactured non Cheddar cheeses are analysed regularly.

Yogurt

Yeasts and moulds continue to be the cause of quality problems in yogurts. Analytical checks for compliance with Food and Drug Regulations revealed that 9% of the samples as compared with 16% last year did not meet the fat requirements for their particular type of yogurt.

Dried milk products

Only three milk powders were analysed during 1979-80 for N.A.T.A. certification. This represents a marked reduction in the chemical analyses compared with the previous 12 months, when there were 26 samples, and reflects the declining export market for certain manufactured dairy products.

Eleven out of 80 caseins sampled at one factory were positive for salmonellae. Consequently, this manufacturer has ceased manufacturing casein.

Junex

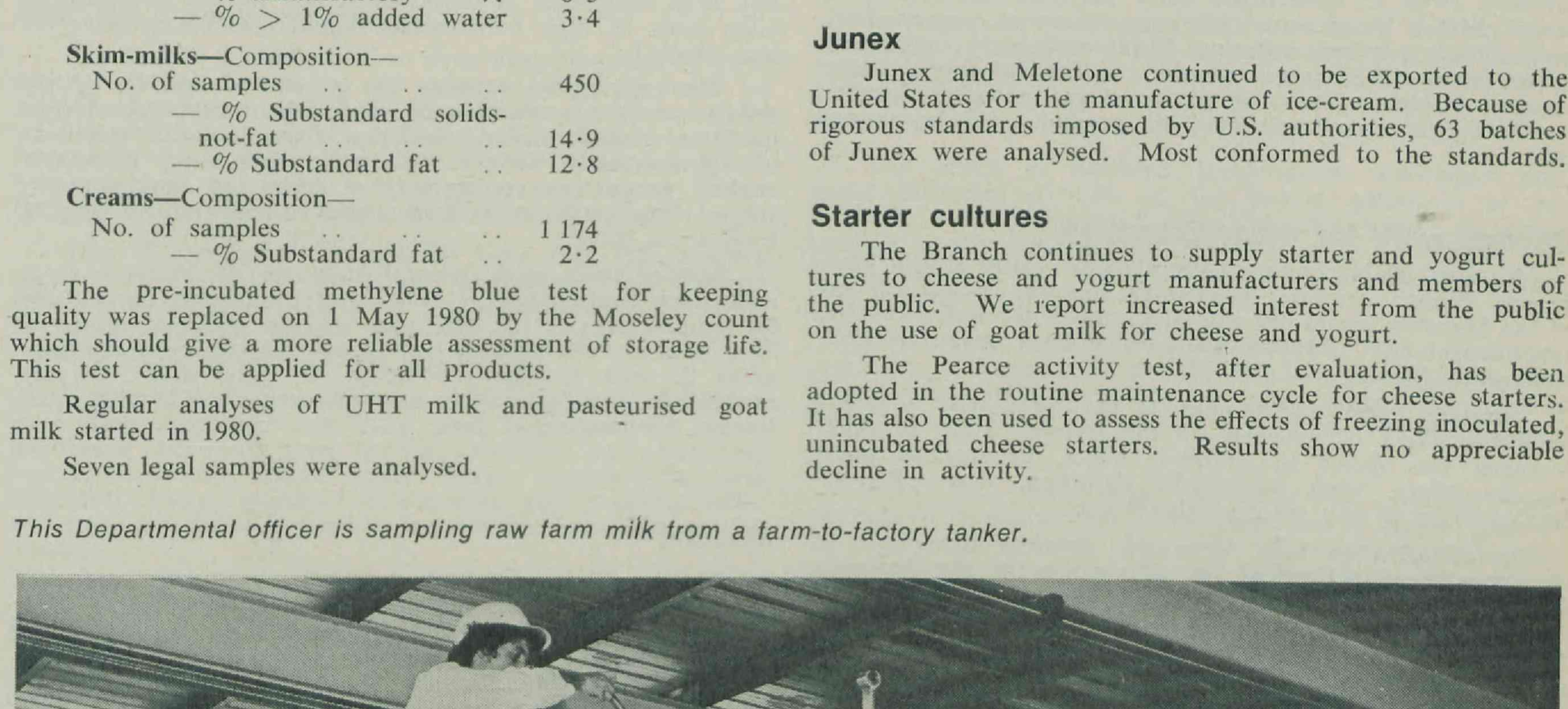
Junex and Meletone continued to be exported to the United States for the manufacture of ice-cream. Because of rigorous standards imposed by U.S. authorities, 63 batches of Junex were analysed. Most conformed to the standards.

Starter cultures

The Branch continues to supply starter and yogurt cultures to cheese and yogurt manufacturers and members of the public. We report increased interest from the public on the use of goat milk for cheese and yogurt.

The Pearce activity test, after evaluation, has been adopted in the routine maintenance cycle for cheese starters. It has also been used to assess the effects of freezing inoculated, unincubated cheese starters. Results show no appreciable decline in activity.

This Departmental officer is sampling raw farm milk from a farm-to-factory tanker.



Residues monitoring

ANTIBIOTIC. Of 4 637 samples submitted for inhibitory substance analysis, 8 (0·17%) contained penicillin, 6 (0·13%) contained inhibitory substances but not penicillin, and 4 (0·09%) contained both classes of residues. This indicates a very high standard of care by farmers in the use of antibiotics.

PESTICIDES. A total of 203 samples of raw and pasteurized milks was tested for the presence of pesticides. Eighteen samples contained more dieldrin than the maximum level recommended by the NHMRC. Twelve samples contained more BHC isomers than the maximum level recommended by NHMRC.

The decrease in the number of samples tested during 1979-80 as compared with the previous 12 months was due to extensive modifications of apparatus and procedures to fall in line with confirmation techniques approved by the International Dairy Federation. Assistance in this venture was provided by officers from the Animal Research Institute, Yeerongpilly.

IODINE. Throughout Queensland, 4 120 samples of pasteurized milks, skim-milks and raw milks were tested for residual iodine level. Overall, there has been a continued maintenance of the high quality of milks with respect to iodine contamination. Results show that 98 to 99% of all raw milk samples (as do pasteurized milks) comply with the Food and Drug Regulatory Standard of less than 500 μg of iodine per litre.

Many interlaboratory trials (both intra and interstate) have been carried out in order to standardize existing procedures and also to assist in developing new ones. In this regard, officers at O.M.D.R.L., Hamilton, have been very active in developing both electrode and chemical methods in conjunction with other laboratories throughout Australia for finalization of suitable Australian Standard Procedures for Determination of Iodine Residues in milk.

HEAVY METALS. Nineteen samples of casein were examined for mercury content. Eight samples contained in excess of the maximum allowable level of 0·03 p.p.m. These high levels were all recorded by the one factory and the source of mercury contamination was traced to the acid used in casein manufacture.

A year-long survey of trace metals in a range of dairy products from 33 Queensland dairy factories has been completed. Metals tested were cadmium, chromium, copper, iron, lead, mercury, nickel and zinc. Most levels were satisfactory except for zinc in skim-milk powder and Cheddar cheese, where results of higher than 40 p.p.m. were recorded. Further monitoring of zinc levels in these products will be carried out.

Service work for other Branches

Various trials conducted by staff of Dairy Cattle Husbandry Branch required laboratory support. Hence officers of the Malanda laboratory analysed samples for Kairi stocking rate-nitrogen trial (DH-90), Kairi maize silage trial (DH-136), Kairi grain feeding trial (DH-156).

Analysts tested 184 samples as part of a trial to determine the effect of molasses on the freezing point of milk. Molasses was shown to adversely affect the freezing point but the effect, while statistically significant, was not considered to be of any practical significance.

In co-operation with Veterinary Services Branch, milk ring tests were performed on all supplies to the Malanda factory each quarter. In the last two quarters, all herds were brucellosis-free. On behalf of Field Services Branch, the Toowoomba staff tested 59 samples of cereals. Chemists assisted Field Services Branch solve problems with Caboolture's skim-milk. Fat standards for check testing of Milko testers were prepared for officers of Dairy Cattle Husbandry Branch and of Field Services Branch.

Service work for other organizations

Several 200 kg drums of ginger syrup were concentrated on the APV Junior plate evaporator on behalf of the Buderim ginger factory.

Lactose hydrolysed cottage cheese whey was concentrated to 60% total solids on the plate evaporator, for use by Q.U.F. in yogurt and ice-cream mixes.

Senior staff continued to serve on committees of the Standards Association of Australia and other technical committees.

Margarine

Twenty-two brands of margarine are now collected for testing, many of these being interstate lines. Six samples were of unsatisfactory bacteriological quality.

Research

Milk enzymes

The major concern in this area is lipolysis in raw milk or in manufactured products caused by natural milk lipase and microbial lipases respectively. The latter occur during storage.

Lipolysis problems occurred in milk from one area in south-east Queensland as evidenced by complaints by cafe proprietors of failure of the milk to foam in coffee-making machines. Farm, tanker and factory milks were regularly monitored for free fatty acids in a programme carried out in conjunction with officers of Field Services Branch. The problem subsided following rainfall in spring 1979, but subsequent drought raises the likelihood of its reappearance.

Lipolysis in butter caused by heat-stable microbial lipases can produce rancid off-flavours during storage. To understand the conditions under which such problems are likely to arise, the growth and lipase production characteristics of a range of lipolytic psychrotrophs have been studied. The properties of the lipolytic enzymes, lipase and phospholipase, have been studied to devise sensitive assay techniques and promote control measures.

The physical and biochemical characteristics of these enzymes vary with the type of parent micro-organism. The lipases were all most active at alkaline pHs and retained appreciable activity in the presence of levels of salt comparable with those in butter. None was completely destroyed by pasteurization, and those from *Pseudomonas fluorescens* and *Moraxella* organisms were particularly heat stable.

These enzymes retained considerable activity after heating at 130°C for 1 minute and are probably the ones that cause flavour problems in stored dairy products. Very active phospholipases were produced in cultures of psychrotrophs. These showed considerable heat stability but less than the corresponding lipases. These enzymes through their action on the milk fat globule membrane can cause the release of free fat in products such as UHT and whole milk powder.

Gas chromatography methods have been devised to measure the products of lipase and phospholipase action in butter. Experiments with butters made from creams containing heat-stable lipases have found a correlation between butter flavour and the level of butyric and other short-chain free fatty acids. Techniques for determining the types of free fatty acids produced in butter by different microbial lipases have also been developed. A sensitive method for the detection of fatty acids by high performance liquid chromatography was also studied.

The relationship between the growth of and the extracellular enzyme production by several lipolytic psychrotrophs has been studied. It was found that, from an initial inoculum of approximately 10^4/mL in sterile skim-milk, detectable enzyme production commenced at counts of approximately 10^8/mL when cultures were incubated at temperatures ranging from 4° to 20°C.

Similar trials with natural mixtures of bacteria from milk were confounded by lactic acid production particularly at temperatures >10°. Because of the different bacterial flora present, considerable variation occurred between these milks in their enzyme production. In some milks, enzyme production was particularly marked even at 4°C, the usual storage temperature of milk.

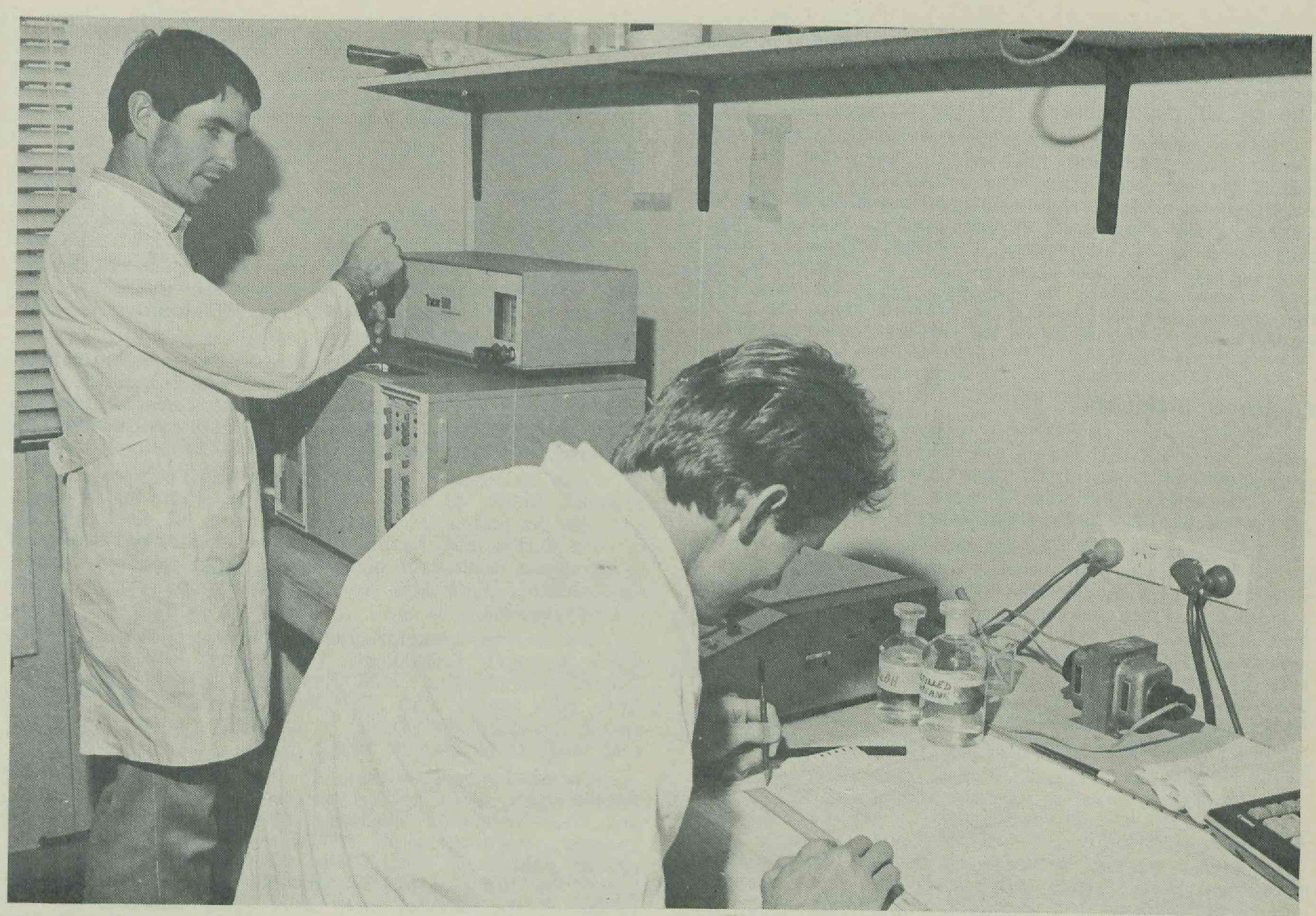
Mastitis

This work is aimed at developing new improved procedures for diagnosing physiological changes in the bovine udder. One enzymatic test (NAGase test) has been fully automated and it is now operating in a trial involving four commercial dairy farms. Results show that this new test is equal to currently-used procedures in its ability to diagnose infected quarters or cows. Sample throughput is high (up to 100 samples per hour) and the cost of the instrument would be far less than that of other automated equipment now available for mastitis diagnosis.

Other aspects of NAGase test, such as the effect of early and late lactation and the effect of diurnal variation have been investigated at the Kairi Research Station by officers of the Malanda Dairy Research Laboratory. Results have confirmed that the NAGase test can be used effectively in large scale monitoring programmes.

Alternative rapid diagnostic procedures for diagnosis of mastitis have been examined. These include the determination of lactate dehydrogenase (LDH) levels and glucose levels in milk. Both of these procedures appear to have a good correspondence with incidence of mastitic infection, and rapid cow-side diagnostic tests are currently being developed.

Microbiological analysis of 1 381 sets of individual milk samples showed that the predominating primary pathogens were *Staphylococcus aureus* (25%) and *Streptococcus agalactiae* (10·6%). This was a uniform trend over all farms and contrasted with the previous year where predominance varied.



A gas chromatograph being used to determine fatty acid contents of a raw milk sample from the Kairi Research Station in north Queensland.

Milk fat globule membrane

The aim of this project is to determine the effect of 'cow' and 'processing' factors on the composition of the milk fat globule membrane and how this relates to flavour and stability problems in dairy products. A lipo protein complex, formed by the extent of heat treatment of the cream before butter-making, has been isolated from commercial butter. Its composition and properties have been determined.

One of the major findings has been that this complex can act as a substrate for lipases originating from bacteria which grow in cream stored at low temperatures. The level of the complex in butters may play an important role in determining its storage stability and flavour.

New methods for isolating the milk fat globule membrane have been developed and these have been used to isolate membrane material from normal, mastitic, early-lactation, late-lactation and heated milks. Major compositional and structural changes occurred in abnormal and processed milks and these are being related to certain physical tests on the cream.

Early detection of psychrotrophic spoilage

Previous work showed *Pseudomonas fluorescens* as the dominant extracellular protease-producing psychrotroph. Currently, south-east Queensland raw milks are being surveyed to ascertain type and frequency of other proteolytic psychrotrophs which can be used for antigenic studies.

Scaled-up production of *Pseudomonas fluorescens* to 10^{14} cfu/mL was achieved by aerobic growth on a reciprocating shaker. After centrifugation, cell-free supernates were extracted by fractionation and chromatography to collect the bacterial protease. The final homogenous enzyme was antigenic enough to raise antisera in injected rabbits. This antisera is able to detect levels of 10 ug protease per mL of raw milk in 4 hours using an immunoelectrophoretic technique. The method is being improved to increase sensitivity to <1 ug/mL and reduce time to 1 to 2 hours.

Methodology for liquid milk analysis

A modified phosphatase reactivation test for cream suggested by Murphy *et al.* (1975) was evaluated and found to be superior to the previous method of MacFarren *et al.* (1961). The latter method is now adopted in the fourteenth edition of APHA Standard Methods.

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Investigations were made to determine if a 3-day pre-incubation of samples could be substituted for the normal 7-day or proposed 4-day Moseley count. This would have aided testing schedules, especially for Tuesday samples. Results were inconclusive because of generally low counts.

The effect of elevated temperatures associated with home deliveries of milk on the storage properties of the products were investigated using Moseley counts to assess keeping quality. Storage of samples at 5°, 10°, 15° and 20° C for 5 hours did not appear to significantly affect the Moseley count.

Experiments with two incubation conditions for psychrotroph counts (21° for 24 h and 7° for 10 d) demonstrated acceptable correlation if count ranges are ignored but poor correlation if results are grouped into broad count ranges.

Work on thermoduric psychrotrophic isolates from pasteurized products was completed and a paper written. Of 200 psychrotrophs, 14 (7%) were thermoduric and caused organoleptic defects in milk. Thus, thermoduric psychrotrophs do exist in Queensland pasteurized products and contribute to spoilage. Work on isolates from raw milk is current to determine the source of the organisms detected after processing.

Thermization

Effects of this process on chemical properties of milk were negligible and shelf life was extended 2 further days, because of reduction in enzyme production.

DESIGN OF SAMPLING PROGRAMMES FOR LIQUID AND POWDERED MILKS. A comparison was made of three methods of bacterial clump disruption in milk samples and in pure cultures of *Streptococcus cremoris, Escherichia coli, Pseudomonas aeruginosa* and *Staphylococcus aureus* in order to apply the best of the methods to the study of the effect of commercial agitation and transportation on microbiological development in milk and subsequent recovery on plating medium.

Results indicate that blending of a 1:10 dilution of sample at 10 000 r.p.m. for 2 min leads to a significant increase in both total and psychrotroph counts. This method gives higher counts than syringing or sonication, both of which generally increase counts compared with untreated samples. Sonication reduced counts of gram -ve bacteria.

Microscopic examination confirmed that clump or chain size was altered with the techniques. Current investigations include studies of viable staining techniques to aid in interpretation of the treatments and the standard procedure.

Fifteen sets of line samples were taken during commercial powder production and analysed for microbial flora. In bakers' powder production, the emulsifying agent, glyceryl monostearate, made no significant contribution to the bacterial content of the concentrate or final product. With the higher heat treatment in this process, it proved possible to achieve final counts below 500 per g from raw skim-milk with total counts exceeding 2m per mL. Statistical analysis of the powder data is currently in progress since the experimental work on this phase of the project is now complete.

Cultured products

MANUFACTURE AND KEEPING QUALITY. Preliminary investigations were carried out on the manufacture of fermented acidophilus milk, goat milk yogurt, propioniyogurt and egg-yogurt mixtures. Preliminary work was also commenced on the effects of yeast contamination of yogurt shelf life.

Yogurt made with Danish and Dutch starters, reported to be good extra-polysaccharide producers, was compared with TS2 and LB used locally, to study the effects on viscosity. Variables included temperature, time of incubation, stabilizer addition, sugar concentration, pasteurization temperature and time. The Dutch starters RR and IST were less satisfactory, but the Danish starters B3, B37 and CH1 produced good viscous yogurt when incubated at 43 to 44° for 4 to 6 h using 2% inoculum and 4% sugar. Sugar concentration affected viscosity. Currently, the effect of stabilizers is being studied.

Cheese

COTTAGE CHEESE. Before work on two projects relating to cottage cheese yields and manufacture defects could be attempted, methods for manufacturing cottage cheese were refined and the effect of curd moisture on cottage cheese studied.

USE OF *b*-GALACTOSIDASE IN MANUFACTURE. A series of eight, two-vat trials was carried out to measure accurately any yield and quality differences between cottage cheese from untreated milk and that from lactose hydrolysed milk.

The final results, set out below, show no differences in yields.

MEAN OF 8 REPLICATIONS (MAXILACT 20 000)

—	% Yield	% Solids Recovery	Milk Solids Yield Factor	Casein Yield Factor
Control	14·6	33·0	1·65	5·60
Lactose Hydrolysed	14·7	33·0	1·65	5·52

Trials were later carried out using Novo Lactozym 750L, and Maxilact L2000, both showing similar results. The rate of acid production was not significantly increased with either of the enzymes.

Other minor investigations related to this research include the effect of the size of the cut yield and moisture, the acidification of wash water, the accurate measurement of yields, manufacturing methods and quality assessment with a trained taste panel of Dairy Research staff.

CURD SHATTERING IN COTTAGE CHEESE. This project was designed, firstly, to study the cause of shattering of curd and the formation of excessive amounts of fine particles of curd during manufacture of cottage cheese, and secondly, to develop a method of manufacture which would overcome the problem. Work this year was centred on the first part of the project.

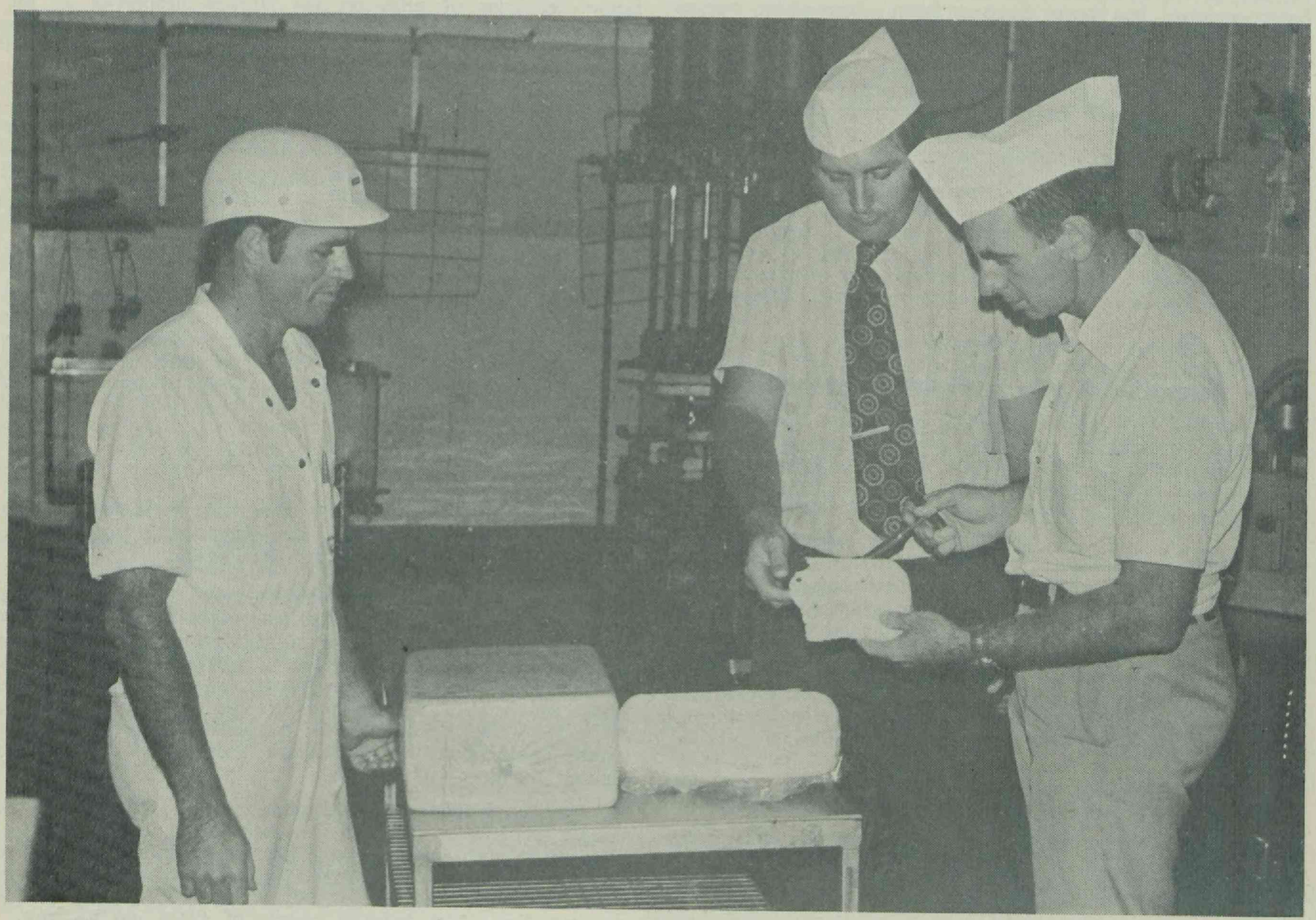
Cheese was manufactured on laboratory scale in the Dairy Research Laboratory, Toowoomba. Milk for manufacture was obtained from Jersey and Friesian herds and from bulk tanker milk. We have established that cottage cheese manufactured from Jersey milk shatters less than that made from Friesian milk.

Chemical characteristics of the milk used for manufacture have been related to the amount of shattering and fines obtained. Shattering appears to be caused by lowered concentrations of several constituents, viz. calcium, citrate, phosphorus, total solids. Genetic differences between breeds, as displayed by the different proteins found in the casein of the samples, may have some influence on the amount of shattering, but further work is required before definite conclusions can be made.

Cheddar cheese

CHEESE RIPENING (ENZYMOLOGY). The objective of this project is to develop methods for both accelerating the rate of development of mature flavour in Cheddar cheese and measuring the flavour compounds present.

Departmental officers showing an industry representative characteristics of two new cheeses for Queensland.



One method involving the addition of extracts from the yeast *Kluyveromyces lactis* to cheese milk was shown to rely on proteolytic enzymes in the extract for its accelerated ripening effect. Therefore baker's yeast, which contains similar enzymes, has been used as a more economic source of proteolytic activity. Increased proteolysis in the cheese, together with an acceleration of flavour development, has been observed in small scale trials.

Large amounts of a non-acid producing mutant starter have also been shown to accelerate ripening. To allow for large-scale confirmation of this finding, a large batch of frozen mutant starter concentrate has been prepared with commercial assistance.

The success of these accelerated ripening techniques appears to be related to proteolytic breakdown in the cheese. The addition of the sulphur amino acids, methionine and cysteine to cheese curd causes much more rapid flavour development, together with the production of increased levels of methanethiol which has been implicated as a major component of cheddar cheese flavour.

Eye-type cheese

CHEESE WITH IRREGULAR EYES. A Queensland Co-operative Dairy Association has started to manufacture Cooloola cheese, and at their request, Pilot Plant staff developed procedures for the rindless packaging of this cheese.

CHEESE WITH REGULAR EYES. Trials have continued to determine parameters needed for consistency of eye formation and flavour production in this type of cheese. Average values of all manufacturing parameters were estimated for cheese manufactured in the Pilot Plant during the last 2 years. The average values of these parameters for cheese grading 9/10 for flavour were employed in the manufacture of approximately 20 vats of cheese.

Use of these formulae did not improve cheese flavour gradings. Because of commercial interest, trials were designed to compare cheese manufactured with Marshall's OP starter with that made with Hansen's lactic ferment. OP2 appears to influence specific acid flavour characteristics to a greater extent than does the Hansen's starter. Small differences in eye formation and body of the cheese were also apparent.

Salting trials are also planned.

Other cheese

Preliminary work relating to the dry salting of cheddar cheese, the technology of cheedam cheese and processed cheese is underway.

Low fat spread

The development of a low fat spread reached virtual completion during the year and a final report has been prepared. Formulation, manufacturing procedures and keeping quality have all been investigated.

The product is a water in oil emulsion containing 40% milk fat and about 50% moisture. It also contains skim-milk powder, salt, emulsifier stabilizer, B-carotene colouring, flavours and an antifungal agent. It can be prepared using equipment which is available in most dairy factories, a jacketed mixing vat, an homogenizer and a packaging machine.

Some final development work on this product, particularly on flavours, has been purposely left as it would best be handled with the co-operation of any potential marketer of this product.

Goat milk composition

Because of the large number of consumer enquiries concerning goat milks, together with the expansion of the number of registered goat dairies, a project aimed at obtaining additional information on the variation in the composition of goat milk in south-east Queensland was commenced.

Overall, goat milk had a similar composition (with respect to the major components) to cows' milks with an average of 3·4% fat, 8·3% solids-not-fat, 11·7% total solids and 3·2% protein. The freezing point, −0·563°C, was slightly lower than cows' milk.

At the request of some goat milk producers, an investigation into the possibility of storing frozen goat milks during periods of high production for use during lower production periods has been commenced. Testing of goat milks from registered dairies and commercial factories is now carried out routinely at the Otto Madsen Dairy Research Laboratory.

The cheese-making story being explained to secondary school girls in Brisbane. This is part of the Dairy Research Branch's programme to provide vocational guidance for, and to broaden the education of, young Queenslanders.



Division of Marketing

THE main function of the Division of Marketing is to provide necessary advisory and regulatory services relating to the economics and marketing of Queensland primary produce.

This involves the provision of marketing intelligence, financial and economic advice, management planning and quality control services, all of which are supported by appropriate research.

The Division is composed of three Branches—Marketing Services, Economic Services and Standards. These are responsible for the policy, extension, research, and regulatory functions of the Division. As at 31 May 1980, 181 officers were employed in the Division of Marketing. During the year Mr W. Moorhouse was appointed Assistant Director of Economic Services. Mr Moorhouse is currently on special leave to complete a Diploma in Business Administration course at the Queensland Institute of Technology.

Organized marketing

Among the important activities of the Division of Marketing in the year has been the continued provision of advice on agricultural marketing to the Department and to statutory and non-statutory primary producer marketing organizations in Queensland.

Stress has again been placed on initiatives to assist rural marketing organizations to improve their effectivness in meeting their aims and objectives. A 2-day seminar on 'Finance in Agriculture: Options for the 80s' organized in conjunction with the Council of Agriculture met with keen response from industry organizations with over 80 delegates attending.

A comprehensive administration manual for rural marketing organizations has been prepared. This manual provides guidelines on legal aspects, financial planning and management, responsibilities of directors, and other areas of management. This has been prepared on the basis of needs established during discussions and seminars over the previous 2 years.

Officers of the Division were also involved in discussions within the heavy produce industry which subsequently resulted in these growers seeking to provide for the organization and administration of their industry within the structure of the Committee of Direction of Fruit Marketing.

The Division was also involved in the formation and subsequent early activities of the Bread Industry Committee. This body has the responsibility for developing and recommending policies in relation to aspects of bread marketing in Queensland. A major development during the year was the release of the Preliminary Code of Trading Practices for the Bread Industry in October 1979.

Legislation

Following a poll by heavy produce growers in favour of joining the Committee of Direction of Fruit Marketing, amendments to the Fruit Marketing Organisation Act were passed by the Queensland Parliament to allow these growers representation on the Committee.

A new Wheat Marketing Act was passed to allow the new 5-year Wheat Agreement to proceed. This legislation replaced previous complementary Commonwealth-State legislation and was the result of lengthy negotiations at the national level. In particular, the new legislation provides for revised financing arrangements agreed to by the Commonwealth and States.

An Act was passed to validate the objects of the Upper Burdekin Co-operative Association Limited following legal opinion that questioned whether the special objects of the Association were covered by the standard objects of the Primary Producers' Co-operative Associations' Act.

The Division has been involved with discussions within the fruit and vegetable industry and interstate Departments on the amendments considered necessary to the Farm Produce Agents' Act.

Industry inquiries

There was again substantial Divisional involvement in preparing submissions to Commonwealth bodies such as the Industries Assistance Commission inquiries into the apple and pear industry and into fruit and fruit products.

Officers of the Division were major contributors to an investigation into the production, handling and marketing of horticultural and agricultural produce in the Northern Territory. The results of this investigation will form a blueprint for the development of agricultural development and marketing in the Territory.

Expertise in organized marketing is also being used extensively in the investigations into matters relating to fish marketing and the operations of the Queensland Fish Board.

A study involving Horticulture Branch officers, the Department of Commercial and Industrial Development and Divisional officers is being undertaken to provide guidelines for producers and processors involved in horticultural development in north Queensland centred in the Bowen-Burdekin region.

Economic and marketing studies

A comprehensive survey of bread manufacturing costs in Queensland was undertaken on behalf of the Bread Industry Committee by officers of the Division. Survey results covering 70% of bread manufactured in Queensland were taken into account by the Committee when determining regional minimum wholesale prices to apply within a code of trading practices designed to stabilize marketing within the industry.

Acting on requests by industry and from needs assessments by various officers, economic and marketing surveys were conducted by the Division.

Major repair and maintenance costs of farm machinery were collected by officers of Economic Services Branch in a survey of 300 grain farmers on the Darling Downs and adjacent regions. This survey was financed by the Queensland Wheat Industry Research Committee to provide needed information on certain aspects of ownership and operating costs of farm machinery.

Management practices and farm machinery investment by peanut growers in the South Burnett were studied in a survey supported by the four local Shire Councils.

Flood damage on horticultural farms was assessed following a serious flood in the Don River delta in January 1980. This survey was part of an overall study to examine engineering and land use options for flood mitigation.

Cost of production studies were undertaken in the tobacco and egg industries to assist the respective marketing boards in price determinations.

A Benefit-Cost analysis was completed of the Barker-Barambah irrigation project in the South Burnett. The scheme was subsequently approved by State Cabinet with the support of the majority of landholders affected by the scheme.

Officers of the Division have also been working with the Queensland Meat Industry Organization and Marketing Authority in analyses of carcass classification trials, computerization of the Livestock Market Reporting Service and in examination of owner-account export marketing.

Extension activities

Economic Services Branch extension programmes in the use of beef and wool futures have met with an enthusiastic response from producers, bankers and stock agents in southern Queensland and are being extended to other parts of the State. Prepared information on regional costs and returns for major agricultural and horticultural crops and livestock activities continued to meet a keen demand.

Considerable interest is evident in micro-computers for on-farm use. At this stage, there is a shortage of suitable software programmes for them to be used effectively. Economic Services Branch officers have been participating in a national programme to improve understanding of appropriate computer technology for on-farm use. Progress is also being made in farm management accounting and in strategic farm planning in areas such as machinery investment.

During the year, Divisional agricultural economists participated in more than 200 industry organization meetings, producer discussion groups and field days. This is indicative of the growing awareness of economic problems confronting primary producers.

The Fruit and Vegetable Marketing Extension Service, as one of its activities, has focused attention on the need for greater emphasis to be placed on post-harvest handling and marketing practices in the fresh fruit and vegetable industry in Queensland.

In conjunction with wholesalers and other Government personnel, specific attention has been given to handling practices for produce moving from the Brisbane Market. It is considered that this has resulted in a greater quantity of precooled produce being shipped from the market and much higher quality produce being available at country centres.

The Marketing Intelligence Service is being brought into line with the demands of the 1980s. A comprehensive evaluation of its functions was undertaken during the year. A number of initiatives is now to be taken, including the introduction of a telephone answering service for market news and various commodity prices. Conversion to computer technology is currently being investigated. Detailed consultations are also taking place with the other eastern States to arrive at a common terminology in fruit and vegetable price reporting and to improve compatibility between reporting systems.

A commodity wire service is also under consideration which will give commodity officers up-to-date access to overseas developments in the marketing of farm produce.

Economic Services Branch has organized a study involving 65 farmers in southern and central Queensland to examine the extension value of Departmental farmnotes using the AGDEX filing system. The results of this trial will have a significant effect on the development of the AGDEX system of storage and retrieval of agricultural extension information.

Agricultural chemicals

During the year, 31 notifications of complaint on damage under the Agricultural Chemicals Distribution Control Act were received and investigated by Standards Branch. This is a slight reduction in the number of complaints compared with the previous year. Seven of the complaints were for damage caused to ornamentals and home gardens, three related to honey-bees and 21 to agricultural and horticultural crops in south-east Queensland and coastal areas in the north of the State.

A total of 1 419 licences was issued during the year. These included unrestricted and restricted commercial operators' licences and pilot chemical rating licences. A computer-based filing system for recording licence details has now been adopted. Renewals of licences will be greatly facilitated by this new system.

Seed testing and seed quality

Demands placed on the Seed Testing and Certification Services continue to increase. Of particular significance during the year has been the application into bean seed production programmes in the Burdekin of previous research into low seed vigour.

Investigations by Standards Branch officers into dormancy problems of hybrid sunflower seed suggests that it may be possible to reduce the level of seed dormancy with chemical treatment. Research in this area is continuing.

Following earlier initiatives aimed at improvements in seed quality, a film on factors to consider in purchasing seed has been prepared. A weed seed identification manual for use by commercial seed cleaners, as well as farmers, is also in preparation. A workshop on the principles of seed preparation, grading and cleaning met an enthusiastic response from seed industry representatives.

Marketing Services Branch

THE role of Marketing Services Branch has been defined as follows—'To service the agricultural marketing requirements of the rural sector in Queensland in the first instance and also the non-rural sector to the extent that it is affected by, or has an interest in, developments in the marketing of rural products.'

Servicing is taken in its widest sense to include the provision of information; interpretation and advice in the areas of agricultural policy; legislation; product marketing economics; market intelligence; and market research to ensure an efficient utilization of resources.

Such servicing must involve an effective extension programme incorporating internal and external training in the field of agricultural marketing and resource use.

In order to fulfil this role within the Departmental context of programme management, the organizational structure of the Branch has been adjusted slightly to provide for three sub-programmes in addition to the normal function of administration which include the clerical-typing services required to carry out the various tasks. These sub-programmes now form part of the total Departmental Programme Management.

The Marketing Economic Research sub-programme has the following objectives—

- To research and evaluate current marketing systems and to co-ordinate Branch resources used in research projects.
- To maintain a Research Register.
- To provide advice and act as a resource base on macro and micro economic issues affecting the economy generally and the rural sector in particular. This incorporates a watching, advisory and co-ordinating brief in a variety of special interest areas including trade, energy, fertilizers, tariffs, finance, currency movements and rural adjustment.
- To provide a financial management advisory service.
- To design, co-ordinate and conduct internal and external training programmes in rural marketing.

The Marketing Intelligence Services sub-programme has the following objectives—

- To provide rural and commercial recipients with up-to-date and accurate information on crop prospects.
- To provide marketing information to as wide a cross-section of the public as needed.
- To provide market situation reports on the fruit and vegetable market at Brisbane.
- To maintain a rural statistical data bank.

The Organized Marketing Services sub-programme has the following objectives—

- To provide advice to the Department and to statutory and non-statutory primary producer marketing organizations on agricultural marketing policies.
- To administer the *Primary Producers' Organization and Marketing Act* 1926–1979 and other State Statutes relating to the marketing of primary produce of Queensland origin.
- To assist in the administration of the various industry stabilization schemes and, in this context, to provide an appeals tribunal secretariat for the egg, tobacco and milk stabilization schemes.
- To provide a registration facility for vignerons.
- To provide an inspection service for farm produce agents.
- To provide marketing advice to primary producers' organizations, growers and commercial interests.

In working towards meeting the above objectives the Branch engaged in a wide range of activities during the year. Some of these activities, under the respective sub-programme headings, were as follows.

Marketing Economic Research

As part of the Department's contribution towards rationalization in the bread industry, a study into the regulatory control of bread in Australia was completed in July 1979.

In the same month, the Branch published 'Impact of Taxation Law on Primary Producer Co-operatives' This study deals with a subject of considerable influence on the operations of co-operatives and has been well received by such bodies.

Overview statements were published for the passion-fruit and rice industries.

Two major projects absorbed a considerable part of the resources of the Branch during the year. Officers were major contributors to 'An Investigation into the Production, Handling and Marketing of Horticultural and Agricultural Produce in the Northern Territory' which was completed and published in September 1979. A number of recommendations resulting from this Report has been considered by the Northern Territory Government.

The Branch was also closely involved with the work carried out by the Committee of Enquiry into matters relating to fish marketing and the future of operations of the Queensland Fish Board. At the end of the year, a preliminary report had been prepared for submission to Cabinet and the work of the Committee was expected to continue for some months.

Submissions were prepared and presented to the Industry Assistance Commission hearing on apples and pears in July 1979. At the end of the current year, submissions were in course of preparation for further I.A.C. hearings into ginger and fruit and fruit products. These were due to be presented in June 1980.

In conjunction with deliberations by the Brisbane Market Trust into the establishment of a flower market, a survey of florist shops in the Brisbane Region was completed in November 1979.

At the end of the year, a total of 21 separate research projects by Branch officers had reached various stages of completion. Industries covered included fruit and vegetables, oilseeds, cotton, dairying and eggs. In addition, a wide range of generalized aspects relating to the marketing of rural products was being investigated. These included the following: aspects of futures trading; export procedures and finance; an analysis of the legal parameters relating to Marketing Boards; techniques for capital expenditure analysis; operative criteria for the assessment of financial performance of agricultural marketing organizations.

A special assignment under the aegis of the Australian Agricultural Council was the compilation of a compendium of statutory agricultural marketing authorities in Australia by an officer of the Branch. This compendium will be printed by the C.S.I.R.O. as part of that organization's Technical Report series. A similar compendium has been proposed for Australian primary producer co-operatives. This assignment will also be undertaken by the Branch. Work is expected to commence in 1981.

Training

As in previous years, the Branch conducted an external and internal training programme.

In 1979-80, the two components of the external training programme underwent changes. Firstly the programme of courses conducted on behalf of the Australian Development Assistance Bureau has been wound down due to policy changes in the method of funding by the Commonwealth. Secondly, the training of directors and management of rural marketing organizations underwent a change in orientation. The new policy is for the Branch to provide specific training activities upon request from the rural sector.

Following the publication of the Branch study 'Queensland's Marketing Board System: An Evaluation', the Council of Agriculture requested that the Branch join with the Council in conducting a 2-day seminar on finance. Entitled 'Finance in Agriculture: Options for the 80s', the seminar was held on 20 and 21 November. Papers on a range of issues relating to capital and operating finance were presented and discussed.

Towards the end of the year, again in response to a request articulated in the Evaluation study, the Branch had almost completed the compilation of an 'Administration Manual for Rural Marketing Organisations'. This Manual will be presented for discussion and evaluation at a series of workshops attended by grower members of marketing boards and Directors of primary producer co-operative associations commencing in July 1980.

The Branch has stepped up its internal training programme. This expansion consists largely of having Branch personnel attend seminars, workshops and short courses run by various professional bodies. The aim of the programme is to keep officers abreast of the latest professional developments so that they may better advise rural organizations.

Marketing Intelligence Services

The Branch has continued to disseminate marketing information ranging from daily market reports on fruit and vegetable trading at the Brisbane Market to periodic crop forecast reports on the State's major agricultural crops.

With changing user requirements, the need has been recognized for this service to be kept up to date with the needs of the rural community, particularly in the timeliness of the way in which information is disseminated. With this realization in mind, an officer of the Branch undertook a study tour of England, Canada and the United States of America in June and July 1979 to study the collection, evaluation, dissemination and uses of marketing information for agriculture in those countries.

Following from that study tour, a complete evaluation of the Market Intelligence Services Sub-programme was undertaken and a number of innovations has been introduced. These include the installation of recorded market news facilities which can be assessed by telephone. A major re-arrangment and upgrading of printed publications is under way and the Branch has plans to install a commodity wire service which will be of considerable assistance in keeping commodity officers up to date with overseas developments in the marketing of farm products.

The monthly 'Marketing Newsletter' continues to provide comprehensive coverage of events of importance in the marketing field in Queensland, Australia and from overseas.

The need for an improvement in the timeliness of information and intelligence disseminated by the Branch has led to an extension of the computerization of the work done within this sub-programme. With the recent installation of computer equipment at Comalco House, conversion to computer handling will be speeded up. This facility will enable a large volume of data, in part presently manually processed, to be handled much more efficiently, accurately and quickly.

Early in the year, following introductory work towards the establishment of a Livestock Market Reporting Service, responsibility for the Service was transferred to the Queensland Meat Industry Organization and Marketing Authority. With this arrangement, three officers of the Branch were seconded to the Authority.

The Branch had previously convened an Advisory Committee on livestock market reporting and this forum proved a useful means of solving many problems associated with the introduction of the service. With the transfer of the Livestock Market Reporting Service to the Queensland Meat Industry Organization and Marketing Authority, the work of the Advisory Committee terminated.

Some progress was made during the year on the problem of standardization of terminology in fruit and vegetable market reports between the various States. As prime importance is being given to achieving common terminology in the eastern States, a meeting of officers of the Queensland, New South Wales and Victorian Departments is proposed for early 1981.

Following an approach from the C.O.D., it was agreed that officers of Marketing Services Branch and the Committee of Direction of Fruit Marketing would undertake a feasibility study to determine whether a banana production forecasting system should be established in Queensland. One of the initial tasks of the study was to examine the work being done in New South Wales on this topic. By the end of the year, progress had been made on the study and a report was expected early in 1980-81.

The fruit and vegetable market reporting service conducted by the Branch since 1947 aims at supplying timely and accurate information on market prices and comment on the quantities and quality of produce in the Brisbane Market on a day-to-day basis principally to producers.

While operating quite satisfactorily to date, a number of developments has occurred in recent times which indicated that the time was opportune to review the service. These developments include moves among the States to adopt a common language in reporting and the need to update the technology used in the handling of information generated by the Service.

In the light of these developments, the Branch convened a Consultative Committee on Fruit and Vegetable Market Reporting. This Committee, which comprised representatives of all interested parties, met on a number of occasions during the year. As a result of these meetings, several recommendations were made which will be taken into consideration by the Branch in the overall review of its marketing reporting service.

Organized Marketing Services

The sub-programme has long been a high priority area within the Branch, largely because of the network of statutory marketing authorities for rural products in Queensland. Marketing Officers in the Branch act as Deputies for the Director of Marketing on most of the State's commodity Marketing Boards. In this capacity, they attend meetings of the Boards and provide input on all relevant matters pertaining to the marketing of the products handled by the Boards.

In addition, the Branch has a responsibility to the many primary producer co-operatives which assist their members in the marketing process. In this regard, two assessments were made of applications by co-operatives for Government Guarantees. These involved viability analysis of the proposals and reports to the Treasury. This procedure is now a mandatory part of the process of Government guaranteed finance for Local Bodies.

Early in the year, the Branch, in association with the Queensland Meat Industry Organization and Marketing Authority, commenced a further review of a range of proposals which had been suggested for stabilization of the beef industry. Work was also undertaken on owner 'open trading' systems for livestock and on the practicability of live animal export trading under certain circumstances.

Following a long period of discussion within industry circles, the Minister for Primary Industries approved the conducting of a poll of heavy produce growers to determine whether these growers wished to be included in the Vegetable Sectional Group Committee of the C.O.D. The Branch produced background information papers leading up to this poll and officers attended many meetings and delivered radio talks on the subject.

The poll was conducted by the Department and although only 50% of eligible producers voted, an overwhelming 91.3% were in favour of joining the C.O.D.

In line with the services provided by this sub-programme, the Branch was closely associated with the work of the Bread Industry Committee in providing a Secretariat and supportive research services. As a result of this work, the Committee released its preliminary Code of Trading Practice in October 1979. Subsequently, the Secretariat of the Bread Industry Committee was transferred to a private firm of chartered accountants.

Following a decision of the Australian Agricultural Council, the Commonwealth Department of Trade and Resources appointed one of its officers in Canberra as States Liaison Officer. This officer maintains surveillance on events of importance overseas which might affect Australia's trade in products of rural origin. Marketing Service Branch Officers maintain close liaison by telex and telephone with the Department of Trade Resources so that items of importance can be passed on promptly to primary producers through various publications and weekly radio talks on the A.B.C.

As part of its perceived role in having responsibility for the wider aspects of rural product marketing, the Branch maintains a watching brief on energy, exchange rates, fertilizers, interest rates, taxation policies, tariffs, trade agreements, transport and domestic monetary and fiscal policies. A regular feature of the 'Marketing Newsletter' is the 'Macro Economic Comment' which is designed to offer commentary on national and world-wide movements in major macro-economic indicators such as rates of inflation, oil prices, interest rates and trade barriers.

Branch personnel provide, in an on-going manner, papers on energy, grain storage, the marketing of dairy products and market milk, and egg marketing in order to assist policy formation. The Branch continued to undertake financial analyses to assist rural organizations in their applications for Government guaranteed loans.

Legislation

Following the overwhelming vote by heavy produce growers to join the Committee of Direction of Fruit Marketing, amendments to the Fruit Marketing Organization Act have been made so that representation can be given effect.

The previous complementary State legislation relating to wheat marketing was repealed and a new Wheat Marketing Act was passed to enable the new 5-year Wheat Agreement to proceed in accordance with Commonwealth legislation and marketing arrangements. In particular, the new Agreement brings in the revised financing arrangements agreed to by the Commonwealth and State Governments.

Staff

Branch staff numbers were reduced by three during the year. Messrs J. Jeffrey, L. Hughes and R. Wilson were seconded to the Queensland Meat Industry Organization and Marketing Authority with the transfer of responsibility for the Livestock Market Reporting Service to that body. Positions occupied by those three officers were abolished.

Mr A. F. Connor, Supervising Marketing Officer, undertook an overseas Study Tour to England, the United States of America and Canada to investigate aspects of marketing intelligence services for agriculture in those countries.

Two officers completed in-service training courses in Management Development conducted by the Department. Other officers attended short courses and seminars conducted by professional organizations during the year. These included two courses offered by the Australian Society of Accountants and the annual meeting of the Australian Agricultural Economics Society. One officer attended the National Agricultural Outlook Conference in Canberra.

The Branch wishes to pay a special tribute to its stenographers-typists who have provided a consistently high quality supporting service during the year. A recent Public Service Board survey supports that position.

Standards Branch

THE purpose of Standards Branch is to benefit primary industries by maintaining appropriate standards and control systems for agricultural requirements and agricultural products.

Its objectives are—

1. To ensure that agricultural chemicals, stock foods and veterinary medicines offered for sale are effective.
2. To ensure that agricultural chemicals, stock foods and veterinary medicines and seeds, offered for sale are true to label and/or up to standard.
3. To facilitate the marketing of agricultural produce by ensuring that commodities—
   (a) comply with prescribed domestic, interstate and overseas requirements;
   (b) agree with their trade description;
   (c) are acceptable to consumers;
   (d) are packed, handled and transported economically.
4. To ensure that the commercial distribution of agricultural chemicals is carried out in a safe, responsible and competent manner and to assist people whose crops and stock are damaged as a result of accidental drift.
5. To maintain a seed technology unit to service objectives (2) and (3) above and to provide information on seed quality to farmers and seed merchants.

Staff

Redeployment of some inspectorial staff has been undertaken. An inspector is now stationed in central Queensland, resident at Gladstone, primarily to service the inspection of export grain from the bulk terminal.

An appointment of a resident inspector has similarly been made at Warwick to supplement the Darling Downs inspectorial staff at Toowoomba, and for more effective surveillance of Granite Belt fruit.

An officer has been transferred to Mareeba to provide Branch inspectorial services and to assist in developing seed testing facilities at the new seed testing laboratory at that centre.

Agricultural Standards

An important aim of the *Agricultural Standards Act* 1952–1972 is to ensure that Queensland buyers of agricultural chemicals receive materials which, when used as directed, will be effective for the purposes for which they are sold.

Registrations

Registration under the Act is required before an agricultural chemical may be offered for sale in Queensland.

A total of 4 520 applications for registration was processed. This represents a decrease of 637 on last year's figures. This decrease reflects the rationalization of product ranges for some primary dealers and, particularly for stock foods, the merger of companies' interests. Approval was also granted for the supply of seven special mixtures of pest destroyers, two special mixtures of stock foods and 23 special mixtures of fertilizers.

The Technical Committee on Agricultural Chemicals referred to its member in Standards Branch 69 submissions for clearance of new pesticides and new uses of pesticides already being sold. Recommendations on these submissions were made following recepit of advices on the effectiveness of the subject pesticides from consultants from within and outside the Department.

The expansion of Standards Branch Pamphlet No. 74 was continued during the year.

Information on the approved uses, methods of application, limitations on use and toxicology for 30 pesticides was added. Similar information on 47 pesticides already in the Pamphlet was updated.

Agricultural Requirements Board

The Agricultural Requirements Board considered the claims made by manufacturers regarding the efficacy of 2 052 preparations. The backlog of applications for registration of veterinary medicines reported in the previous annual report has now been overcome. The consideration of applications for reregistration of pest destroyers submitted in early 1979 is also completed.

The following table provides an indication of the Board's activities—

—	1976–77	1977–78	1978–79	1979–80
Pest destroyers ..	1 111	509	830	1 195
Veterinary medicines	282	919	924	757
Stock foods ..	88	162	117	47
Fertilizers ..	16	47	43	15
Growth regulating materials	17	37	30	38
TOTAL ..	1 514	1 674	1 944	2 052

The Board also considered requests for approval of 27 Departmental recommendations.

The beginning of 1980 saw the commencement of the 3-year registration period for stock foods and fertilizers. Recent amendments to the Poisons Regulations under the Health Act prohibit certain antibiotics for growth promotion in stock foods offered for open sale. This will result in the reformulation of a significant number of stock foods and the submission of applications for approval of these reformulations.

Inspection of agricultural requirements

The following table sets out details of action taken with agricultural requirements not complying with legislation—

ACTION FOLLOWING NON-COMPLIANCE WITH LEGISLATION

Particulars of Action Taken	Packages			
	Pest destroyers	Veterinary medicines	Stock foods	Seeds
Initial action—				
Seized by Inspectors ..	2 642	65	761	2 321
Otherwise Withdrawn From Sale ..	..	..	15	9 502
Subsequent action—				
Destroyed ..	..	..	34	1 620
Recleaned/ Fumigated	..	..	..	4 237
Reformulated/ Fumigated	402	..	471	..
Processed for Stock Food	..	..	..	2 427
Registered and/ or Relabelled	2 152	..	..	2 665

Quality control over stock foods has continued to be a problem for some time. The more intensive programme of sampling whereby more analytical work is performed on fewer overall samples seems now to be producing worthwhile results. In some cases of non-compliance, difficulties are still being experienced in seizing all articles of the offending line as turnover of these materials can be rapid and original stocks are rarely accessible for more than a few days after manufacture. Constant surveillance of persistent offenders seems, in part, to be meeting this problem situation.

To a lesser extent, the problem of rapid turnover also applies in the seed trade, particularly among pasture seeds. Here again, attention is closely paid to habitual offenders and seizures are often made, where possible, on suspicion of non-compliance.

With the provision in the Agricultural Standards (Seeds) Regulations of 'restricted seeds' and prescribed counts thereof, more attention to labelling has continued to be necessary. Continued failure by some seed vendors to declare adequately the contents and quality standards of seed lots containing restricted seed is still a matter for concern and calls for a considerable amount of extension effort on the part of inspectorial staff.

Seed certification

There was a significant increase in seed certification activities during 1979-80. The production of certified seed of hybrid maize, French beans, pasture cultivars and tomatoes increased markedly.

With further increases in registered areas of the Callide and Samford cultivars of Rhodes Grass, and new registration of *Leucaena leucocephala* cv. Cunningham, *Stylosanthes guianensis* cvv. Oxley and Graham, and *Stylosanthes scabra* cvv. Seca and Fitzroy, total registrations for basic and certified pasture seed areas increased from 501 ha in 1978-79 to 833 ha in 1979-80. This is in line with a healthy recovery of the pasture seed industry after some years of depression caused by low beef prices.

Other highlights in the seed certification area were—

- Decentralization of testing of certified seed and issuing of certification labels with the opening of the new seed testing laboratory at Mareeba.
- Adoption of a separate seed certification scheme for navy bean varieties, involving varietal purity as well as freedom from seed transmissible diseases.
- Improvements in facilities for cleaning and grading certified (and approved) navy and French bean seed at C.O.D. in Brisbane.
- Development of new dry conditioned packaging for certified tomato seed.
- With the discontinuance of the Seed Certification Standing Fund, increased attention is being paid to planning the production and acquisition of prebasic and basic seed for long-term storage to ensure continuity of availability of suitable seed for the establishment of new areas for the production of certified seed in future years.

A total of 109 hectares of Stout oats was accepted as approved seed. The certification of hybrid maize seed continued its most important role in north Queensland with a silght increase in 1979. Problems were encountered with Hybrid Sweet Corn QK467S, related to this being a single-cross hybrid with the commercial certified seed being produced on inbred lines of comparatively low vigour.

Seed production from areas registered for Seed Certification is tabulated as follows—

Certified Seed	1977	1978	1979
	kg	kg	kg
Hybrid maize ..	144 946	160 699	185 500
Hybrid sweet corn ..	..	150	..
French beans—Certified	43 030	57 723	78 800
French beans—Mother Seed	8 767	9 892	3 900
Navy beans	47 416	18 000	8 900
Pasture species ..	1 704	5 880	10 100
Tomato	358	29	365
Oats	..	..	1 400

Fruit and vegetable quality

Inspections under the provisions of the *Fruit and Vegetable Act* 1947–1972 embraced the surveillance of fruit and vegetable quality at both wholesale and retail levels throughout 1979-80.

This year, 2 620 inspections were made of retail fruit and vegetable outlets in Brisbane as well as the Gold and Sunshine Coast regions. Regular inspections were also made of retail outlets in other districts and provincial centres.

Good supplies of most fruits and vegetables were maintained throughout the period, with some fall off during the autumn of 1980 due to the unseasonal drought conditions throughout central and southern Queensland.

The following table outlines the total quantities of fruit and vegetables on which inspectors at the Brisbane Market took action—

ACTION ON FRESH FRUIT AND VEGETABLES NOT COMPLYING WITH LEGISLATION

Commodity	Number of Actions Taken	Quantity Seized and Destroyed		
		Packages	Bins	Calculated Total Weight
				kg
Fruit	2 342	49 148	127	799 037
Vegetables ..	1 037	17 625	118	273 203
Heavy Produce	197	6 497	..	341 108

Rockmelons again attracted greatest attention with 529 lines seized and 8 549 packages (170 tonnes) lost. Apples, mandarins, pears, tomatoes and watermelons also suffered heavy losses, while papaws and avocados showed substantially greater losses than in the previous season.

In vegetables, cucumbers, capsicums, carrots and broccoli also suffered badly. Of the 7 951 packages of cucumbers and capsicums destroyed, 2 782 were from the northern region. Increased use of refrigeration for the handling of these commodities from this area will be required if these losses are to be reduced.

Of the heavy produce lines, potatoes accounted for 325 808 kg of produce seized and 180 of the actions taken. This loss represents 31% of the potatoes directed for reconditioning and 2·7% of the total potato throughput of the Brisbane Market.

In addition to taking action as above, Inspectors gave advice and performed associated extension tasks, as follows—

- 372 'Infringement Notices' were sent to growers advising of non-compliance with regulations.
- 99 'Market Reports' were issued, advising on better marketing practices.
- 160 samples were taken by Brisbane Market inspectors for pest and disease identification.

During the year, inspectors tested 829 samples of fruit for compliance with maturity standards. Of the 772 samples tested in Brisbane, 163 were grower samples while the remainder (609) were samples taken by Inspectors from lines offered for sale on the Brisbane Market. Details of fruit maturity testing at the Brisbane Market are set out below—

Commodities	Inspector Samples	Grower Samples	No. Failed
Mangoes ..	230	..	66
Plums	8	..	..
Rockmelons ..	87	..	28
Pineapples ..	19	..	3
Citrus	82	61	29
Avocados ..	57	76	30
Grapes ..	126	26	28

Fumigation

Supervision of fumigation with ethylene dibromide was carried out to meet both export and interstate requirements for fruit fly disinfestation of citrus, mangoes and capsicums. The following fruit were fumigated at Clapham and the four country centres available for this purpose—

Fruit Fumigated	1978–79 (Packages)	1979–80 (Packages)
Mangoes	23 465	34 084
Oranges	38 834	46 036
Lemons	385	3 652
Mandarins	64 836	160 368
Grapefruit	2 098	4 070
Capsicums	43 543	43 954

Straw used for packing watermelons in transit to southern markets is required to be fumigated and 186 certificates to this effect were issued on behalf of the Stock Inspectors. Stone fruit and grapes from interstate were checked in Brisbane and other provincial centres for certificates required under the Diseases in Plants Act in respect of *Sclerotinia laxa* and *Phylloxora*.

The effects of the amended Fruit and Vegetable Grading and Packing Regulations which came into force in February 1979 have been studied and their application discussed with industry. It would appear that a number of minor changes may be necessary.

Fruit and Vegetable Marketing Extension Service

Attention has been focused on post-harvest handling and marketing practices by the activities of the Marketing Extension Service. Within Queensland and through interaction with other State Departments, greater emphasis has been given to these aspects of the fresh fruit and vegetable industry.

Improvements in techniques in handling and storage in the distribution chain suggest an increasing demand for technical input in this area. Future activities by this Branch will be concentrated on providing market information to growers and district Extension Officers, as well as advice to wholesalers and retailers within the market chain.

Market Quality Advisory Service

There was more communication with growers on the quality of produce placed on the Brisbane Market during 1979-80. Greater emphasis is now being given to this service, which involves the assignment of specific crops to individual officers at Rocklea. More detailed information on major crops should now be available for use by field extension officers.

Co-ordinated extension services

Activities in this area have been confined primarily to a C.E.S.G.-funded project on post-harvest handling, in conjunction with officers of Horticulture Branch.

Considerable attention has been directed to improving handling practices for produce moving from the Brisbane Market. The outcome has been a greater quantity of precooled produce leaving the Market and consequent better outturns at country centres.

Packaging and handling

Through market reports and association with industry groups, attention has been directed to the need for rationalization of packages. Of significance has been the acceptance of the basic concepts of package rationalization by the newly formed Australian United Fresh Fruit and Vegetable Association at their 2nd Annual Convention in Brisbane in May 1980.

Agricultural chemical distribution control

An important objective of the 'Agricultural Chemical Distribution Control Act 1966–1978' is to give the owner of damaged crops and livestock some assurance of obtaining recompense when the damage has been caused by the drifting of agricultural chemicals from aerial spraying and of herbicides from ground spraying.

The Agricultural Chemicals Distribution Control Board is responsible for the administration of some of the requirements of the Act and the Standards Branch provides the Secretariat.

The Board is responsible for the licensing of agricultural pilots and commercial weed control operators, the issuing of statements on investigations into cases of damage alleged to have been caused through the commercial distribution of agricultural chemicals and recommending controls on the use of these chemicals in Queensland.

Branch activities included the issue and renewal of licences for agricultural pilots and commercial weed control operators; ensuring that contractors held adequate security as a source of recompense in the event of accidental damage or injury to crops and stock; the investigation of complaints of such damage; and the consideration of requests for permits to use restricted chemicals in Hazardous Areas.

Licensing

Sixty-three examinations for unrestricted licences were held in 18 centres during the year. A total of 160 applicants for commercial operator's licences and eight for pilot chemical rating licences was examined. From these and earlier examinations the following licences were issued or renewed—

159 unrestricted commercial operator's licences issued
59 restricted commercial operator's licences issued
1 129 commercial operator's licences renewed
11 pilot chemical rating licences issued
61 pilot chemical rating licences renewed.

Investigations

Thirty-one notifications of complaint or damage were received and investigated during the year. Seven of these related to injury to ornamental plants and shrubs growing in home gardens, three related to honeybees and the remainder involved agricultural and horticultural crops in south-east Queensland and coastal areas in the north of the State.

Permits

Ten applications for the issue of permits for the distribution of herbicides in Hazardous Areas were received. Four of these applications were for the ground distribution of ester formulations of 2,4-D and 2,4,5-T onto approximately 800 ha of forest in Hazardous Area No. 1. Another four applications were for the use of ester formulations of 2,4,5-T in 400 ha of forest in Hazardous Area No. 2.

Of the remaining two applications, one related to the aerial distribution of an ester formulation of 2,4,5-T onto brigalow suckers growing in approximately 240 ha of pasture in Hazardous Area No. 2. The other application is under consideration.

Computer programme

A computer-based filing system for recording details of commercial operator's licences and pilot chemical rating licences has been adopted by Standards Branch. The system was developed by Biometry Branch in consultation with Standards Branch.

Information on licence holders, licence restrictions, employers, insurance held by owners of equipment is recorded. Lists of operators and related information will be compiled by a computer for distribution to inspectors.

It is expected that the handling of renewals by this system will be quicker than in previous years.

Export supervision

Standards Branch inspectors are involved with the export of fresh fruit and vegetables, grain and other field crops and plants, and are also responsible for issuing Phytosanitary Certificates when required by overseas countries.

A significant increase in all inspectorial activities occurred this year. Record quantities of fruit, together with cereal and coarse grains, birdseed grains, oil seeds, seeds and nuts for culinary purposes, seed for sowing and plants for propagation purposes were inspected prior to export.

Other duties included the regular inspection of stock foods accompanying livestock shipments to overseas countries. Phytosanitary Certificates were issued for these consignments, as well as for a record quantity of 2 984 tonnes of rice from the Burdekin area.

This year 119 ships were inspected at the port of Brisbane and 25 ships at Gladstone. Regular inspections are also carried out at the two grain terminals at Pinkenba and the one at Gladstone to ensure that hygiene standards are properly maintained.

Duties also include supervision of fumigation, heat treatment and other disinfestation of exported commodities.

During the year, 3 486 containers were inspected at metropolitan Container Depots for suitability for export purposes. Of these, 144 containers were rejected and 1 872 withdrawn pending fumigation, spraying, cleaning or repairs.

On 31 December 1979, the Commonwealth Government repealed the Commonwealth (Flour) Regulations. Before this, flour exports comprising 83 shipments, mainly to the Far East, New Guinea and Pacific Islands, were inspected, totalling 19 041 tonnes. A gift shipment of 4 600 tonnes of flour was also inspected for Phytosanitary Certificates.

Seed and grain

Total shipments of cereal and coarse grains under Export (Grain) Regulations were a record 2 069 879 tonnes, comprising wheat shipments of 1 189 512 t, barley 335 756 t and sorghum 544 529 t.

Details are set out below—

Destination	Wheat	Barley	Sorghum	Oats
	tonnes	tonnes	tonnes	tonnes
Japan and Far East	83 368	181 275	535 217	32
South-East Asia	337 506	..	..	..
New Guinea and Pacific Islands	67 033	18	9 312	51
Near and Middle East	236 933	43 982	..	..
Central Africa ..	157 991	..	..	..
Russia	163 976	96 481	..	..
Southern Europe	..	14 000	..	..
China	142 705	..	..	..
TOTAL ..	1 189 512	335 756	544 529	83

Carpet grass (*Axonopus* spp.) and *Panicum maximum* were again the two main pasture species exported. Sorghum was the major seed for grain crop production.

A major increase occurred with birdseed grains inspections due primarily to the insistence by Japanese Quarantine Authority that these grains be accompanied by Phytosanitary Certificates. Of interest were increased shipments of safflower seed to Taiwan for birdseed purposes.

Peanut exports of 11 082 t were also a record. Overall shipments of other legumes, mung beans, cowpeas and navy beans for sprouting and other culinary purposes, totalled 3 741 t.

A small but valuable market is being developed for macadamia nuts in Europe, North America and Japan.

A gift shipment of 1 203 t of maize to East Timor was inspected and fumigated on behalf of the Commonwealth Department of Administrative Services.

Inspections under Export (General) Regulations and/or for phytosanitary certificates are summarized below—

Destination	Seeds Sowing	Seed Culinary	Bird Seeds	Peanuts	Malt	Stockfoods and grains	Maize Culinary	Rice	Miscell-aneous
U.K. and Northern Europe	10	1 765	..	3 725	..	..	..	900	..
Southern Europe	..	432	1 582	..	..	..	..	..	..
North America	152	412	14	..	..	..	..	55	..
South America	140	..	..	..	..	..	..	..	..
Central America	44	..	..	..	..	..	..	..	..
New Zealand	36	550	725	2 183	..	..	..	227	..
New Guinea and Pacific Islands	94	18	299	150	2 539	18	..	1 208	35
South-East Asia	51	36	1 235	452	..	66	1 203	..	..
Near and Middle East ..	38	52	71	673	..	..	..	..	..
Far East—Japan	21	476	8 426	1 554	91	481	..	..	51
Far East—Taiwan ..	..	..	6 068	..	..	13	..	..	..
Far East—Korea	..	..	..	2 040	..	..	..	..	..
Far East—Others	..	..	18	305	..	..	..	2	..
Africa	12	..	..	..	..	..	..	594	..
TOTAL	598	3 741	18 438	11 082	2 630	578	1 203	2 986	86

Fruit and vegetables

Citrus exports almost doubled last year's figures to an all-time record of 11 861 t. This increase was due to an above-average crop, the ready acceptance of Queensland citrus by overseas buyers, and the general reliability of a well presented pack.

Early apple export orders gave promise of a busy season, but drought conditions reduced the crop drastically. Nevertheless, approximately 979 t were exported, compared to last year's approximate of 1 183 t.

Air freight of both fruit and vegetables continued at a steady rate to New Guinea and Pacific Islands, Near and Middle East and New Zealand. Substantial quantities of pineapples were exported almost weekly by air to New Zealand.

Plants for propagation purposes and cut flowers were inspected under Export General Regulations and for Phytosanitary Certificate purposes. Altogether more than 200 consignments were exported, mostly by air freight.

The following table summarizes approximate tonnages of fruit and vegetables exported during 1979–80—

Citrus Fruit	tonnes
Oranges	4 346
Lemons	378
Grapefruit	543
Mandarins	6 594
TOTAL Citrus	11 861

Other Fruit and Vegetables	Tonnes
Apples	979
Other fruit	665
Heavy vegetables	893
Light vegetables	668
TOTAL Other Fruit and Vegetables	3 205
TOTAL All Fruit and Vegetables	15 066

Quarantine

Sampling and inspection of imported seeds for sowing was carried out on behalf of Commonwealth Department of Health, Plant Quarant'ne Service. Ryegrass (*Lolium* spp.), followed by clover (*Trifolium* spp.) and lucerne seed (*Medicago* spp.) were the main seeds imported. Overall inspections of all seed imported totalled 419 t.

Seed testing

The Seed Testing Service supplies information for regulatory purposes and to verify seed quality for research purposes. In addition, the service provides assistance to intending purchasers of seed in the selection of an appropriate quality for planting. Tests on seed submitted by an owner for his own sowing are carried out free of charge.

The following table indicates the extent of general seed testing carried out conjointly during the year by the Queensland Seed Testing Station at Indooroopilly, the Seed Testing Sub-station at Toowoomba, and the North Queensland sub-station at Mareeba.

Source of Samples	No. of Samples
Inspectors	
Survey/Official samples	2 902
Samples of seed for export	2 315
Samples of imported seed	60
Government Seed Certification Scheme	203
Samples submitted by—	
Farmers	809
Merchants	6 825
Departmental	343
Other Departments and Scientific Institutions	195
TOTAL	13 652

Samples received at Indooroopilly during the year were again predominantly pasture grass seeds, the main species being *Panicum maximum*. By contrast the Toowoomba Sub-station analysed the bulk of cereal, birdseed and oilseed samples. The Mareeba Sub-station handled mainly field crops.

Research and publications

A joint programme of investigation of low seed vigour and allied problems in bean seed produced in the Burdekin Valley culminated in 1979 in the formulation of a blueprint for production of high quality seed in the Burdekin area. Research conducted within Standards Branch played a significant part in defining the problem and in formulating improved seed production, handling and storage techniques. Standards Branch was involved in this programme of research with Horticulture Branch, and Engineering Services Section.

Post harvest dormancy in sunflower seed has presented problems in establishment of hybrid sunflower in recent years. Dormancy is present in hybrid sunflower seed to a far greater extent than in open-pollinated varieties and frequent accounts have been received of inadequate or non-uniform establishment of some of the newer hybrids.

A research programme was initiated by Standards Branch in 1979-80 with assistance from the Oilseed Research Committee to investigate the effects of various laboratory treatments on dormancy and of seed dormancy on sunflower establishment. Promising results were obtained in reducing the level of seed dormancy by treating seeds with 'Ethrel' (R). This programme is continuing.

The Branch continued to provide a germination testing service to projects of other branches involving seed quality. This covered species such as *Paspalum plicatulum, Panicum coloratum, Setaria porphyrantha, Trifolium semipilosum, Helianthus annuus* and *Phaseolus vulgaris.*

Investigations into the germination requirements of a range of native and weed species have been conducted on behalf of officers of Agriculture Branch. Many of the small seeded species have shown marked responses to the presence of light and/or potassium nitrate.

An important feature of this year's activities has been wide involvement with both local and overseas representatives of the seed industry, as well as University of Queensland. This has involved the provision of advice on seed quality and seed testing practices, providing lectures, and supervising post-graduate research projects.

Staff of the subsection have been involved in national and international committees dealing with seed quality. Mr Beavis commenced a Master of Science (Seed Technology) course at the University of Edinburgh in September 1979. The course will last 1 year.

Publications during the year include six research papers, mainly on germination problems concerning pasture legumes. In addition there are two papers in press, covering a purity problem in *Chloris gayana* and a rating proposal for vigour assessment in *Phaseolus vulgaris.*

Substantial agreement was reached between State seed regulatory authorities and the Seed Industry Association (S.I.A.A.) on the introduction of seed truth-in-labelling legislation. At a meeting of State and S.I.A.A. representatives held in Sydney in 1978, the principle of labelling seed was accepted by the S.I.A.A. and agreement was reached on minimum quality statements which should appear on labels.

A continuing extension campaign to prepare for truth-in-labelling continued during 1978-79. Assistance from the Commonwealth Extension Services Grant enabled a start to be made on preparation of a weed seed identification manual for use by commercial seed cleaners. An extension film on factors to be taken into consideration in purchasing seed was produced by the Departmental Film Unit and a successful workshop dealing with principles of seed separation, grading and cleaning was staged at the Queensland Agricultural College, Lawes, for seedsmen and will be repeated in other parts of the State.

Economic Services Branch

ECONOMIC Services Branch performs an educational role in farm business management. Agricultural economics research is undertaken to provide advice to primary producers, industry organizations and agri-business, and to government in rural policy matters.

To fulfill these functions the Branch has 21 regional agricultural economists in 16 centres with a support staff of 11 graduates and six clerical staff in Head Office involved in research and administration.

Extension activities

While relatively favourable market prices and prospects were maintained in the major rural industries, severe drought was experienced in southern and western Queensland.

Primary producers sought advice in farm business management in a wide range of topics from property purchase and investment in farm machinery and improvements to drought management strategies. While increasing emphasis is being placed on the applied research role of regional economists and in providing specialist back up support for extension staff, regular contact was maintained with individual primary producers. On average, each economist received 60 enquiries from farmers and industry organizations, made more than 30 farm visits and completed 20 detailed farm budgets.

Regional agricultural economists are actively involved in departmental extension activities, particularly through industry committees at a district level. Guidelines were developed for procedures to be followed in situation analyses when determining extension priorities based upon practical experience in the horticultural, dairying and beef industries in the Near North Coast region.

Timely advice in fields such as taxation was given in more than 200 articles published in the country newspapers and departmental newsletters. A comprehensive budget guide of farm costs and returns was published in an annual supplement in *Queensland Country Life*. Feature articles on financing farm machinery purchase were also included in this handy reference.

Group activities of economists included participation in more than 200 industry organization meetings, producer discussion groups and field days. This involvement indicates a growing awareness of the need to involve agricultural economists to consider economic aspects of primary production.

Agri-business liaison is fostered in all regions through seminars and personal contact with bankers, accountants and other business organizations serving agriculture.

Schools for primary producers

Economists, as trainers in farm business management, organized and participated in almost 100 schools and workshops for farmers and departmental extension officers.

Considerable interest is evident by primary producers in commodity futures trading, particularly as a price insurance mechanism to be reasonably assured of meeting financial commitments. Twelve courses conducted in cattle futures on the Darling Downs and adjacent regions attracted an attendance of 250 producers. Very few of these producers had any previous understanding of futures.

A new initiative was taken by inviting a group of 20 young farmers from Goondiwindi, Roma, Miles and Jandowae to a farm management workshop at Dalby Agricultural College in September 1979. The purpose of the workshop was to give participants incentive to place greater emphasis on farm business management. Economists from the farmers' respective regions conducted the workshop and have initiated follow-up activity with course participants on a discussion group basis on their return.

Farm management publications

A major thrust of the Branch's work is in producing a comprehensive range of farm management publications particularly to support training activities.

Eight thousand extension series publications were distributed during the year, with more than 80% going to primary producers. The remainder were distributed mainly to educational institutions and agri-business firms. Extension publications released included estimated costs of soil erosion, economics of acquiring farm machinery, guides on use of cattle and wool futures and an estate planning workbook. In addition, 45 farmnotes were prepared including cost and returns for major crop and livestock activities throughout the State.

A trial to examine the extension value of departmental farmnotes using the Agdex-based filing system has been initiated with 65 farmers in various industries in southern and central Queensland. Property visits were necessary to introduce farmers to the filing system and arrange for them to receive farmnotes regularly. The outcome of this trial, to be evaluated by mail-in questionnaire, will have a significant influence on the development of the Agdex storage and retrieval system of agricultural extension information.

Farm Management Accounting Service

An annual computer processing fee of $25 was introduced to cover this mail-in monthly recording farm management accounting service without a significant loss of membership, which stands at around 75. In addition, 60 dairy farmers participated in a dairy farm management accounting scheme to monitor production costs and assess performance.

In a joint project with the Bureau of Sugar Experiment Stations, the University of Queensland and the Rural Management Information Centre at the Queensland Institute of Technology the B.S.E.S. farm management accounting programme was converted to run on the University's computer for student training.

The programme was also re-written to run on a microcomputer. It was successfully demonstrated at the Australian Agricultural Economics Society Conference in Adelaide in February 1980. The programme produces three basic reports, namely, cash flow, transaction listing and account balance. Further testing and development of this system will be undertaken in association with rural accountants.

This programme should have wide application as is apparent from the growing interest of large producers in purchasing a micro-computer for on-farm use, particularly in the areas of farm management accounting and strategic planning. While a range of micro-computers is available, there is currently a shortage of appropriate software programmes for them to be used effectively. The Branch is developing programmes in fields considered likely to be in demand such as in farm machinery replacement decisions.

The second edition of the 'Inventory of E.D.P. Programmes used in farm management and agricultural extension in Australia' was published and used as a background paper for an interstate seminar on inter-active computer programming in Melbourne early in 1980.

Irrigation studies

A benefit-cost analysis and regional impact study was undertaken of the Barker-Barambah Irrigation Project in the Burnett region. The assessment was based on increasing the intensity of existing dryland grain cropping by irrigating mainly soybeans and barley. Allowance was made for the value of production forgone from cropping and livestock activities in the area to be inundated by the dam.

The Barker-Barambah irrigation project was approved by State Cabinet with the support of the majority of landholders affected by the scheme.

The 1977 economic assessment of the Lower Mary Irrigation Project was revised in the light of changing price and cost structure.

A paper on economic aspects of the Burdekin Irrigation Project was presented to a symposium on Burdekin Basin Development conducted by the Water Research Foundation of Australia (North Queensland Regional Committee) at Ayr in August 1979. The economics of the scheme were again reviewed in March 1980 when the Queensland Water Resources Commission presented a report on the 'Establishment of the Burdekin River Project' to Parliament. Authorization was obtained for the extension of the Burdekin River Irrigation Area as required under the Irrigation Acts.

An irrigation handbook guide on the economics of on-farm systems has been prepared. Rising oil prices have significantly affected the choice between diesel and electric power for irrigation. For example, electric power at 4c a unit costs 4·4c a kilowatt-hour of work, whereas diesel at 26c a litre costs 9c. This difference is important for travelling irrigators with their high energy requirements.

A study in the West Moreton region demonstrated the potential of farm dams to increase farm income.

Soil conservation

A bulletin was published on the costs of soil erosion to assist producers in deciding upon appropriate soil conservation measures. Economic aspects of conservation tillage were also examined for the Darling Downs.

A report on soil structure degradation on the Atherton Tableland was presented to the Kairi Research Station Industry Consultative Committee in April 1980. It was concluded that the pasture rotation phase between successive crops was uneconomic and the maintenance of soil structure should be achieved by other means such as growing cover crops and minimum tillage.

Surveys

A comprehensive survey of bread manufacturing costs in Queensland was undertaken on behalf of the Bread Industry Committee during October-November 1979.

The survey covered over 50 bakeries representing about 70% of the bread manufactured in Queensland. Detailed information was obtained on relative differences in average costs of production between various geographical regions.

The Bread Industry Committee took the survey results into account in its determination of regional minimum wholesale prices of bread to apply within a code of trading practices designed to stabilise marketing within the industry.

The survey delineated the major costs components in bread manufacture to develop a price model to monitor cost changes as a basis for future adjustments to the minimum wholesale prices for bread.

A wheat farm machinery cost survey was undertaken on the Darling Downs and adjacent regions with financial support from the Queensland Wheat Industry Research Committee. A representative sample of almost 300 wheat growers was interviewed during December 1979 and January 1980.

Information was obtained on major repair and maintenance costs of individual items of farm machinery such as tractors and headers. Additional data were obtained on speed of farming operations, fuel usage and methods of financing farm machinery purchase. The results of this survey will provide a factual basis for a farmer training programme in farm machinery selection and management.

At the request of the Peanut Sub-committee of the Queensland Graingrowers' Association a survey of management practices and farm machinery investment by peanut growers in the South Burnett was undertaken late in 1979 with financial support from four local Shire Councils.

Considerable structural changes have taken place in the peanut industry since the last industry survey in 1966. Peanut farms in the South Burnett are now solely arable holdings with growers following a 2-year rotation. The average property size is 300 hectares of which approximately half is suitable for peanut cultivation. Peanut farms are highly mechanized with capital investment up to $1,000 per hectare. Average equity on peanut farms is also high at around 90%.

Production practices differ significantly among peanut growers, which, in financial terms, represent almost $10,000 difference in net income between average farms in low and high yield groups.

Low returns to capital investment by South Burnett peanut growers may be attributed to the high ratio of capital to output (in tonnes of peanuts), high operating costs of farm machinery and the high cost of land.

Preliminary results of the survey have been discussed at meetings of the J. Bjelke-Petersen Research Station Industry Consultative Committee and Q.G.G.A. Peanut Sub-committee in March 1980. Further discussions will be held with local producer groups to derive maximum benefit from the survey.

A survey of flood damage on properties inundated by a major flood in the Don River was undertaken in February 1980. This economic assessment was incorporated in a report to the Queensland Water Resources Commission prepared by a firm of engineering consultants. The consultants examined future engineering and land use options to mitigate future flood damage in the Don delta region.

A Statewide survey of milk production costs in 1979–80 has been initiated on behalf of the Queensland Milk Board. The survey is being undertaken to revise the milk costs of production index used by the Board to monitor changes in producers' costs. These changes are taken into account when apportioning milk price increases among producers, processors and vendors.

Farm energy

A practical demonstration on how to achieve greater fuel economy in farming was conducted at Farmfest 79 on the Darling Downs in association with the Agricultural Engineering Section. Further farm notes are being prepared to illustrate the difference in fuel economy of recent models of tractors.

A survey of fuel usage on 120 grain farms throughout the State was conducted in association with the Queensland Graingrowers' Associaton. The average fuel consumption on all grain farms was around 70 litres per hectare.

Production costs are being determined on an ethanol production project on a Darling Downs property. The Branch is also working with the Department of Commercial and Industrial Development and the University of Queensland in assessing the impact on the State's economy of producing ethyl alcohol from agricultural products.

The impact of 50 000 kilolitre ethyl alcohol plants in the Far North, Northern, Mackay, Fitzroy and Wide Bay-Burnett regions is being assessed.

Industry studies

Agriculture

The tobacco cost index was updated to account for movements in the cost of growing tobacco between 1978 and 1979. This study was undertaken for the Australian Tobacco Board when establishing the 1980 price schedule for tobacco leaf.

Studies at Mareeba included economic aspects of multiple planting, mechanical harvesting and bulk curing with results being published as farm notes. Alternative energy sources for curing, as well as the feasibility of conversion of conventional curing barns to bulk curing, are being examined.

A regime of economic conditions in the tobacco industry and their research implications was prepared for the Queensland Tobacco Industry Advisory Committee.

Reports were prepared on the economics of the rice industry in Queensland and effect of increasing export tonnages of paddy rice.

In a record year for Queensland production in 1979-80 a review was made of all quotas allocated under the *Rice Industry Stabilisation Act* 1973. A new system of allocation was devised resulting in a considerable cost saving to the industry in the administration of the rice stabilization scheme.

Returns from the expanding rice industry at Mareeba were determined along with economic aspects of rotational cropping for advice to local rice growers.

In addition to the Burnett Survey discussed previously, further economic studies were conducted in peanuts in north Queensland, now the most important crop on the Atherton Tableland.

In conjunction with the Agricultural Engineer a comparison was made of the economics of various systems for drying peanuts. The material was presented at a growers' meeting.

In a report to the Peanut Marketing Board on the economics of on-farm pre-cleaners, it was shown that, at the current levels of penalties-bonuses and intake cleanings, farm investment in this equipment was not justified. The problem could be overcome by improved management techniques.

A report was also prepared for the Peanut Marketing Board on the cost of various options for the disposal of shell from the Tolga factory.

A detailed study of product prices, productivity levels and costs associated with grain cropping and livestock activities was published in a report entitled 'Farming Costs and Returns on the Darling Downs.' This publication assists prospective farm purchasers and provides general information on the financial structure of grain properties on the Downs.

A study was also undertaken on the comparative economics of a range of on-farm grain storage facilities.

Economists in each region now prepare costs and returns data for major crops on a seasonal basis which are in much demand from primary producers as a guide in crop selection. Where necessary, farm surveys are conducted to obtain the information required as in the case of lucerne and dryland cotton production in the Callide and Dawson Valleys of central Queensland.

Research assistance was provided for the Atherton Tableland Maize Marketing Board covering pricing policy, accounting procedures and crop forecasting.

A series of gross margins for grain and livestock activities on the South Eastern Darling Downs was prepared for incorporation in regional models of local farming systems. These models will be subject to linear programming analysis to illustrate the effect of variation in key parameters such as commodity prices on optimum enterprise combinations.

Horticulture

As in the case of agricultural crops, a major commitment has been the preparation and updating of a wide range of costs and returns farmnotes for horticultural crops on a regional basis. In the strawberry and passionfruit crops, this information was also used in a departmental submission to the Industries Assistance Commission enquiry into fruit and fruit products in June 1980.

A detailed study is under way with the Department of Commercial and Industrial Development and Horticulture Branch officers to provide guidelines for both producers and processors involved in future horticultural development in north Queensland centred in the Bowen-Burdekin region.

A paper highlighting the importance of Queensland as a supplier of fresh tomatoes along the eastern seaboard was presented to a tomato industry review workshop organized by the Vegetable Advisory Committee. Price movements over the past 10 years have favoured the 'ground' grown production of tomatoes at Bowen compared with the more intensive production practices in southern areas. Improvements in yields, labour efficiency and marketing practices will have a significant impact on the future viability of the tomato industry in Queensland.

The economics of precooling fruit and vegetables has been revised based upon information obtained in the Near North Coast region.

A detailed examination was undertaken of costs of production of peas, beans, carrots, and beetroot in the West Moreton region. Discussions were held with growers, processors and Committee of Direction of Fruit Marketing staff. Information obtained provided a sound basis for subsequent price negotiations. It will also be used to develop a cost index to apply in future years.

Work continued in the Burnett region to develop a suitable recording system for fruit and vegetable growers. Farm office schools were held at Gayndah and Mundubbera.

A study of returnable plastic crate systems has been commenced. These systems should provide a means of reducing the relatively high marketing and distribution costs of fruit and vegetables in Queensland.

Livestock

Through the varied fortunes of the beef industry, economists were involved in assessing the economics of drought feeding strategies in southern and western Queensland through to cattle fattening on improved pastures in the Wet Tropics.

Physical and financial recording for performance assessment and planning have been introduced on an individual and group basis with graziers in the Coastal Burnett region. Results from this in-depth management approach involving 20 properties are being widely disseminated to the benefit of the local graziers through the publication of an industry newsletter.

Benefit cost analysis is being used in individual trials to evaluate carcass classification as part of an overall national assessment programme. The Branch has also been responsible for computerization of the livestock market reporting service being conducted by the Queensland Meat Industry Organization and Marketing Authority.

A report was prepared for the Atherton Shire Council to assess the economics of introducing liveweight selling at the Tolga saleyards.

Articles have been prepared on fluctuations in beef cattle prices and margins in fattening store cattle for publication in the *Queensland Agricultural Journal*.

Linear programming was used to determine optimum herd structures and age of turn-off in a model of beef production systems for the central sub coastal speargrass zone of Queensland. This work will be presented in a paper to the forthcoming conference of the Australian Society of Animal Production in Perth in August 1980.

The economics of low key pasture development for increased beef production in the south-east Moreton region were discussed at an R.N.A. Pasture Improvement Field Day. Investment returns for tractor seeding ranged from 25% on previously cleared heavy basalt soils to 4% on timbered country with light duplex soils. Returns on aerial seeding were slightly lower for each type of country.

In addition to extension advice and training in beef futures, research is being undertaken to examine the relationship between saleyard prices and beef futures.

An economic assessment of tick control measures in the dry tropics, undertaken in association with C.S.I.R.O. research officers, has been submitted for publication in a scientific journal.

Economic constraints to the beef industry in the dry tropics were also discussed in a paper presented to a seminar conducted by the Australian Institute of Agricultural Science in Townsville.

Despite increased prices, poor seasonal conditions depressed returns to wool growers. Property build-up on sheep properties in the semi-arid grazing country around Charleville was the subject of a research thesis for a Masters degree completed at the University of Melbourne. Graziers' reasons for wanting more land, their descriptions of suitable additional areas and reasons for failure to buy more land were ascertained.

Substantial economies of scale have been realized by graziers who have expanded their holdings. Properties which on average had been running about 5 000 sheep equivalents per man found they needed only about one man month of casual labour per extra 1 000 sheep equivalents.

Economists at Charleville have played an important educational role in expanding the operation of the wool futures market to producers, stock agents and bank managers in central and south-western Queensland.

An economic analysis of the effects of the development of an export market for aged sheep from north-west Queensland on sheep husbandry and flock structures was undertaken with Sheep and Wool branch.

While higher prices for aged sheep would improve profitability of sheep enterprises in north Queensland, they would have little influence on flock structures in terms of proportion of wethers in the flock. Sheep culling strategies are influenced more by low reproduction and lack of replacement stock than by lack of a market for old sheep.

Further work will be undertaken to assess optimum culling strategies in situations where breeding performance could be improved sufficiently to allow culling. The effect of changing sheep prices on culling strategies will also be examined.

Further survey work has been undertaken to monitor production costs, capital investment and land management practices on properties in each of the major land zones in the south-west of the State.

A management philosophy is being developed for western lands which recognizes the characteristics of different land systems. It provides a basis for a stocking and managerial system that minimizes damage to the soil and vegetation under drought and other adverse circumstances while still providing an economic livelihood for land holders.

The 'Mulga Line', with a distribution of around 1 000 graziers, is a highly successful extension medium. Economists contributed around 50 articles to this newsletter along with contributions to the local press and radio. Principal topics discussed were taxation, income equalization deposits, futures trading and drought relief measures.

Economists continued to assess the economics of different management strategies for milk production particularly to meet winter feed requirements. For example, in the East Moreton, the economics of grazing irrigated ryegrass was compared with irrigated berseem clover. Although berseem production ($200 per ha) was considerably cheaper than ryegrass ($500 per ha), it was more profitable to graze ryegrass where irrigated land was scarce and where berseem yield was less than 80% of the yield of ryegrass.

Contact with dairy farmers through the operation of the dairy farm accounting service and in intensive survey work on the Near North Coast generated a strong demand for economic advice in property management and development.

For example, the replacement of labour by capital was discussed at a field day in the West Moreton where herringbone shed designs enable one man to milk 120 cows in 75 minutes. A dairy farm survey in the West Moreton demonstrated how labour intensive irrigation methods could have an inhibiting effect on the dairy industry.

A detailed report on why dairy calves brought low prices on the Atherton Tableland was widely distributed in mid 1979. It is believed to have played a significant role in the large rise in calf prices which followed shortly after its publication through establishing a better informed market.

An evaluation of dairy farm office schools held on the Atherton Tableland early in 1979 proved valuable in assessing the benefit of this training and in providing back up assistance with farm recording and the preparation of loan applications for rural credit.

Eight cost of production reports were prepared for the Egg Cost of Production Committee for subsequent consideration by the Egg Marketing Board in price determinations. The cost of production model is being revised to reflect changes in technology in the industry.

A survey of egg marketing costs was carried out in south, central and north Queensland in September 1979 to establish a basis for a hen levy rebate in areas disadvantaged by higher production and marketing costs. The matter was unresolved as sections of the industry could not accept the results obtained nor could agreement be reached on the terms of reference for a further study.

Substantial increases in feed prices and a fall in bacon prices have reduced profitability of pig production.

The major evolvement in the pig industry was in developing the Piggery Performance Analysis Scheme involving groups of producers in Atherton, Kingaroy, Murgon and Toowoomba. The scheme is being computerized to facilitate group comparisons.

Fish

The Branch has been involved in the enquiry into matters relating to fish marketing and the future operations of the Queensland Fish Board. Following an interim report to State Cabinet, further detailed investigations are required to clearly define the role of the Board and to restructure its functions and operations.

General

Research has been undertaken in association with the Department of Lands and the Rural Reconstruction Board to assess the feasibility of establishing a young farmer establishment scheme to assist experienced young farmers with insufficient equity to acquire their first viable property. A seminar on this topic sponsored by the National Farmers' Federation was attended in Canberra in May 1980.

Staff

Appointment

Mr W. Moorhouse, B.Com., B.Econ., Dip.Inf.Proc., A.S.A., was appointed Assistant Director in May 1980. Mr Moorhouse is a highly qualified officer with expertise in farm management accounting, computer programming and systems analysis. He has more than 15 years' service in the Branch and was Supervising Agricultural Economist (Research) before his appointment as Assistant Director.

Post graduate training

Mr W. Holmes, Agricultural Economist, Division I, resumed duty in Charleville in September 1979 after 18 months' study leave at the University of Melbourne to complete a Masters Degree in Agricultural Science under a studentship from the Australian Wool Corporation. Also Mr L. G. Clarke, Agricultural Economist, Division I, will resume duty in Brisbane in August 1980 after completing the same degree course at Melbourne with Commonwealth financial support.

Mr L. E. Williams, Supervising Agricultural Economist, Brisbane, should complete the post graduate Diploma in Business Administration Course at the Queensland Institute of Technology in July 1980 after 18 months' full and part time study. Mr W. Moorhouse, Assistant Director is also undertaking this course due for completion in July 1981.

Study tours

Mr R. L. Ada, Agricultural Economist, Atherton, the Branch's tobacco industry specialist, undertook a study tour with Agriculture Branch personnel to the tobacco growing areas in Victoria and W. D. and H. O. Wills tobacco manufacturing company in Sydney.

Mr J. Sloane, Agricultural Economist, Toowoomba, the Branch's pig industry specialist, visited the Agricultural Business Research Institute at the University of New England to assess progress being made with the Fielders' scheme for monitoring physical and financial performance of piggeries.

Inservice training

An inservice training workshop for regional agricultural economists in central and north Queensland was held in Townsville. Technical training was provided in microcomputers, commodity futures trading and extension methodology in situation appraisal for determination of extension priorities.

In addition, appropriate officers attended a range of training courses from induction training for new appointees to management development courses for senior staff. Technical skills training was provided in computer programming and statistical analysis.

To keep abreast of developments in farm management and agricultural economics, the Branch was represented at six interstate conferences.



Returns from the expanding rice industry at Mareeba were determined during the year by Economic Services Branch.

Division of Land Utilisation

THE main function of the Division of Land Utilisation is to assist in achieving sound utilization of the State's land resources. The Division also provides agricultural engineering services including drafting to the Department and the farming community.

In carrying out its land utilization function the Division collects and interprets information on land resources, evaluates development opportunities, carries out research to assess land degradation problems and to develop practical solutions to them and provides soil conservation extension, planning and implementation services to landholders.

These activities are organized into five sub-programmes: Land Resource Assessment, Development Planning and Evaluation, Land Management Research, General Soil Conservation Services and Areas of Erosion Hazard Services. These are reported separately here. Engineering services activities are organized into two sub-programmes: Agricultural Engineering Research and Environment and Resources Research. These are reported jointly under Engineering Services.

With a few minor exceptions, Development Planning Branch is responsible for the sub-programmes on Land Resource Assessment, Development Planning and Evaluation and Land Management Research, while Soil Conservation Branch is responsible for the General Soil Conservation Services and Areas of Erosion Hazard Services sub-programmes. Engineering Services Section is responsible for the engineering sub-programme.

Progress in soil conservation

A total of 51 757 hectares of land was protected with contour banks or other contour measures during the year. This is 18% more than was achieved in the previous year and 20% more than the average area implemented annually during the previous 5 years. The most dramatic increases occurred in the Darling Downs Region, followed closely by Capricornia and Near South-West Regions.

Almost half (24 047 ha) of the total area protected is located in the declared Areas of Soil Erosion Hazard on the Darling Downs and Burnett Regions. Subsidy payments during the financial year to landholders in these areas totalled $193 694. A further $7 879 was paid in subsidies to Local Authorities in these areas for road cross-drainage works required as part of a gazetted Project Plan. Details of subsidy payments in recent years are set out below.

AREA OF EROSION HAZARD—SUBSIDY PAYMENTS

Year (Financial)	Subsidy Payments to Farmers	Section 58 Agreements with Local Authorities	Total Subsidy Payments
	$	$	$
1976–77	190,476	9,175	199,651
1977–78	261,494	10,349	271,843
1978–79	184,730	50,393	235,123
1979–80	193,694	7,879	201,573

Soil Conservation Act amendments

The Soil Conservation Act was amended during the year. The amendments provided for—

- Reconstitution of the Soil Conservation Authority from a corporation sole (Director-General) to a body corporate.
- Elimination of conflict between the Local Government Act and Soil Conservation Act on levee banks.
- Streamlining of project planning procedures.
- Introduction of a procedure for landholders to object to the Authority's determination on their objections to a Project Plan.
- Undertaking of community works by Local Authorities and other statutory authorities.

Commonwealth–State Collaborative Soil Conservation Study

The main report of the Commonwealth-State Government Collaborative Soil Conservation Study 1975-77 was tabled in the Federal Parliament on 27 February 1979 by the Minister for National Development. It was also tabled in the Queensland Parliament on 14 March 1979.

On 23 August 1979, the Federal Minister for National Development gave a statement to the House of Representatives outlining the Commonwealth's response to the report. The Commonwealth has agreed in principle to assist the States financially with their soil conservation works programmes and to provide finance for a National Soil Conservation Research Programme. Guidelines for Commonwealth involvement in the works programme outlined by the Minister for National Development are:

- a total catchment approach to the planning of soil conservation and the progressive implementation of projects in a technically and economically sound sequence;
- priority funding for projects in areas of declared soil erosion hazard, protected water catchments, or areas otherwise formerly designated as being of particular significance;
- the full participation of State and Local Governments and landholders in the funding and maintenance of projects; and
- an equitable distribution of costs between all the parties concerned.

It is hoped that funds will be allocated in the 1980-81 Federal Budget for both the proposed National Soil Conservation Works Programme and the National Soil Conservation Research Programme.

Land resources and research

Highlights of the year's activities in land resource assessment and land management research included:

- release of caneland suitability studies for the Moreton and Rocky Point Mill areas in south-eastern Queensland;
- completion of a State-wide assessment of the distribution and seriousness of soil salting;
- publication of reports on the serious land degradation in the Bremer and Lockyer Catchments in south-eastern Queensland;
- completion of a study on strip cropping on the Darling Downs;
- measurements of soil loss and run-off under extreme storms on the Darling Downs showing the value of crop residues and crop cover as erosion control measures.

Development planning and evaluation

Highlights of the year's activities in development planning and evaluation included:

- completion of a report on the irrigation potential of the Wide Bay-Burnett Region;
- completion of the Barker-Barambah Irrigation Report;
- publication of a report on the Land Resources of the Wide Bay-Burnett Region.

Drought and natural disaster administration

The Drought Secretariat continued to play an effective role in co-ordinating the administration of relief measures for primary producers affected by a wide range of natural disasters. During 1979-80, a number of natural disasters affected primary producers in Queensland. A severe drought emerged in southern parts of the State, while cyclones 'Paul' and 'Simon' caused damage to small groups of farmers in north and central Queensland respectively. Farmers in the Clifton, Allora and Cambooya Shires on the eastern Darling Downs were affected by a succession of severe storms.

DROUGHT CONDITIONS. Following the very dry winter experienced by much of Queensland, significant areas of central and southern Queensland were officially declared drought stricken during the latter months of 1979. Good summer rain in central Queensland brought relief to most of the drought-affected areas including the Central Highlands. However, abnormally high temperatures which prevailed over much of the State during the summer contributed to the continued deterioration of conditions in southern Queensland.

Seasonal conditions deteriorated throughout 1979-80 and, by April-May, drought conditions existed over most of southern Queensland with the exception of coastal areas and the eastern Downs. Seventeen local authority areas were officially declared as at 30 June 1980. The areas worst affected were the western Downs and border river districts, the Maranoa, Warrego and the Far South West.

The increasing severity of the drought has resulted in a number of extensions to the relief measures available to drought-affected primary producers.

In the early stages of the drought, relief measures consisted of road and rail freight concessions for the movements of stock, fodder, water and water piping. In April 1980, a drought relief loans scheme was introduced through the Agricultural Bank. On 12 May 1980, Cabinet approved the introduction of a number of additional assistance measures including transport concessions for fuel; on-property cartage of water; cartage of essential equipment and machinery, and cartage of equipment necessary to provide water to drought-affected stock. The maximum amount payable on the concessions for transport was increased by 25% from 40c to 50c for a cattle deck per km and from 4c to 5c per tonne per km for fodder and water. A concession for droving cattle on stock routes and reserves was also made available.

In addition, Cabinet decided, subject to Commonwealth approval, to increase the rate of concession applicable to all movements of fodder, water and stock from 50% to 75%. At the time of preparation of this report, the Federal Government had not indicated its reaction.

Expenditure on relief measures available is as follows:

Assistance Measure	Expenditure to 30–6–80
	$
Road transport—	
Concessions on fodder, water and stock ..	1,644,553
Rail transport—	
Concessions on fodder, water and stock ..	518,000
Drought relief loans—	
For carry-on purposes	614,295

The Drought Liaison Group continued to function effectively during the year and met more frequently as drought conditions worsened. A significant amount of discussion centred around the topic of how to integrate good land use management with drought assistance measures. A proposal to relate drought declarations of individual properties (IDPs) to the condition of nearby properties was formulated.

CYCLONES 'PAUL' AND 'SIMON'. In January 1980 cyclone 'Paul' caused destructive flooding in the Bowen and Proserpine areas. Estimates of the damage caused to horticultural enterprises, sugar-cane farms and cattle properties totalled approximately $1,400,000. A scheme of low interest loans was implemented through the Agricultural Bank to assist affected farmers to recover. Approvals under this scheme totalled $260,345 as at 30 June 1980.

In February 1980, cyclone 'Simon' caused severe damage to a relatively small number of tropical fruit growers in the Byfield and Targinnie-Yarwun areas. Officers of the Drought Secretariat joined with Horticultural officers from Rockhampton to assess the damage and likely demand for carry-on finance. The value of losses sustained was assessed at $440,000. This cyclone was not considered to be a 'major' natural disaster due to the small amount of expected expenditure on approved relief measures and the loans scheme implemented through the Agricultural Bank did not include a concessional interest rate.

STORM DAMAGE—DARLING DOWNS. During the period of 26 January to 5 February 1980, a series of severe storms caused extensive and serious flood erosion, wind and other property damage in the Clifton, Allora and Cambooya Shires. Preliminary assessments resulted in estimates of damage of approximately $1m to farm properties. Expenditure on approved relief measures to farmers and local authorities was expected to exceed $400,000 making it a 'major' natural disaster in terms of the Commonwealth-State financing arrangements and a scheme of low interest loans for affected farmers was implemented. Approvals to farmers under this scheme totalled $21,700 as at 30 June 1980.

A fallow paddock stripped of topsoil to the depth of cultivation. This type of damage exceeds 75% of the surface of some paddocks.



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General Soil Conservation Services

UNDER this sub-programme, soil conservation extension, planning and implementation services are provided outside the declared Areas of Soil Erosion Hazard on the Darling Downs and in the Burnett.

In addition to the whole of the arid zone, approximately two-thirds of all the non-arid lands requiring conservation treatment are covered by this sub-programme.

An increasing level of soil conservation activity was undertaken in the Mackay canelands and in the grain growing areas of the Dawson-Callide Valleys, the Central Highlands and on the Atherton Tableland.

Land degradation incidence

There was no general erosive rainfall during the year, except for isolated storm events such as those that occurred in the Boyneside-Goodger area causing the worst soil erosion in the Kingaroy district for a decade.

Extension and landholder interest

Soil Conservation Branch staff initiated 132 group extension activities and 58 published items in this sub-programme during the year. Some of the technical and educational material was produced for Statewide distribution as part of an information services project commenced in 1978–79 and funded through the Commonwealth Extension Services Grant.

Technical and information publications were produced on such topics as soil conservation in canelands and the role of trees in conserving soil. A major part of the information services project involved the development of resource material on land degradation and management for teaching use in schools. This was done in co-operation with the Department of Education. In addition, a caravan was equipped as a display van for use at country shows and field days to present soil conservation displays.

A comparison of landholder interest in soil conservation in non-statutory areas during 1978-79 and 1979-80 is summarized in the following table.

LANDHOLDER REQUESTS FOR SOIL CONSERVATION SERVICE IN NON-ARID AREAS DURING 1978-79 AND 1979-80

Year	No. of Requests for Service		No. of Property Visits	No. of New Co-operators
	Initial	Follow-up		
1978–79	414	1 695	2 931	248
1979–80	497	1 611	2 666	234

Initial requests from landholders with no previous soil conservation experience were 20% higher than in 1978-79. Most of this was attributable to interest being shown in north Queensland as a result of cyclone 'Peter' in January 1979 and in the horticultural areas of the Near North Coast following the Horticultural Land Management Survey in that area.

Fewer than half of the initial requests actually required the surveying and implementation of soil conservation measures, thereby resulting in a lower number of new co-operators.

Soil Conservation Branch officers serviced the remaining requests with advice or extension material, with no ready means of recording any resultant implementation. Requests from existing co-operators for follow-up service were at similar levels to the previous year, with the number of property visits down slightly.

Planning

Soil conservation planning at the farm or catchment level involves the assessment of the capability of the land for long-term production; the identification of the drainage network; and the design of the works and practices necessary to use the land within its capability.

During the year, whole-farm plans were prepared for 59 farms with a total area of 185 266 ha. These plans contain maps showing for each land unit its agricultural capability, its limitations and management requirements, and recommended type of use.

These plans are extremely useful for property planning and management purposes and find greatest application with landholders developing properties for agricultural use. This is reflected in the fact that 95% of the area planned was in the Capricornia Region where a considerable amount of agricultural development is being undertaken.

Although individual farm plans account for most of the planning carried out by Soil Conservation Branch, there has been increasing acceptance of the need for planning at a sub-catchment level in order to overcome problems of co-ordination of run-off. This is reflected in moves to have group or catchment projects initiated at Ross Gully, Wandoan; Cherry Creek, Atherton; Gindie Catchment, Capricornia; and at Kalbar in the Moreton Region.

The property planning project in the arid zone, commenced last year by Development Planning Branch, continued this year. The project is funded by the Wool Research Trust Fund. It aims at demonstrating the use of land resource maps and property plans as a management tool in the arid lands. The plans show the development opportunities and management needs for each land type or paddock unit. Plans for 10 holdings covering approximately 400 000 ha were prepared during the year.

Soil Conservation Branch staff co-operated with staff of other Branches in the development of management requirements for horticultural areas of the Near North Coast, peanut growing in north Queensland and co-ordinated soil and water conservation in the Moreton Region. All of these projects are financed by the Commonwealth Extension Services Grant.

Implementation

Of the 33 370 ha of extensive cropping land (Category I) treated during the year, some 97% was treated with contour banks; the remaining 3% was treated with other contour measures such as strip cropping or grass strips. This strongly reinforces a trend evident in recent years for increasing farmer acceptance of contour banks over other contour measures. Last year, some 82% of Category I works were contour banks. This trend results largely from the promotion by Soil Conservation Branch officers of the benefits of contour banks over the other less effective contour measures.

Implementation of contour banks in this sub-programme was by far the greatest in the Capricornia Region, with 22 377 ha treated. This reflects the rapid development of cropland in the Central Highlands and an active Soil Conservation Branch extension and implementation program in that area.

Just over 1 000 ha of intensive cropping land were protected with contour banks during the year. This was mainly tobacco and sugar land in north Queensland, sugar land in coastal Capricornia and horticultural land in the Burnett Region. The increased activity in sugar lands in recent years is attributable to good co-operation with the Bureau of Sugar Experiment Stations, which is referring cane farmers with soil erosion problems to Soil Conservation Branch officers for advice.

SUMMARY OF TOTAL SOIL CONSERVATION TREATMENT NEEDS AND PROGRESS FOR NON-ARID LANDS IN THE GENERAL SOIL CONSERVATION SERVICES SUB-PROGRAMME

—	Non-Arid Grazing Lands	Extensive Cropping Lands		Intensive Cropping Lands
		Cat. I†	Cat. II‡	
Area requiring protection (ha) ..	2 639 200*	760 570	428 500	140 190
Progressive total area treated (as at 31–5–80) (ha) ..	56 075	413 371	131 334	14 032
Area treated as % of area requiring protection	2	54	31	10

* Area of grazing land requiring treatment does not include information for the Burnett, Capricornia and Far North Queensland Regions.

† Category I land needs intensive treatment for long-term cultivation.

‡ Category II land requires simple practices.

Areas of Erosion Hazard Services

THE statutory soil conservation sub-programme operates in declared Areas of Soil Erosion Hazard under the terms of the *Soil Conservation Act* 1965–1980.

The Darling Downs Shires of Wambo, Chinchilla, Jondaryan, Millmerran, Pittsworth, Allora, Clifton, Rosalie, Cambooya, Crow's Nest and Glengallan and the Isis and Gin Gin cane growing areas in the coastal Burnett are declared as Areas of Soil Erosion Hazard.

Although the declared areas contain only one-third of the non-arid land requiring protection in Queensland, their agricultural importance combined with their serious erosion problems make these areas the highest priority for protection.

The Areas of Soil Erosion Hazard sub-programme concentrated during 1979-80 on improving the efficiency of administration of this sub-programme, on maintaining the high level of soil conservation activity within the extensive cropping lands of the Darling Downs Areas of Soil Erosion Hazard; and increasing the level of soil conservation activity in the intensive cropping lands of the Burnett Region.

Land degradation incidence

Dry conditions prevailed during most of the year, with only isolated storm events causing severe erosion. A series of intense storms occurred in the Clifton area of the Darling Downs in the last week of January and first week of February and caused severe sheet, rill and gully erosion to some 38 000 ha of cultivated land. Some of the erosion was among the worst ever experienced on the Darling Downs. The estimated cost of repairing damage to waterways, fencing and contour banks was $1m with the cost of road repairs estimated at $500,000.

Rainfall intensities were high and in some cases exceeded the 1 in 100-year frequency. Such storm events provided ideal opportunities to assess the performance of soil conservation structures under extreme conditions. Well maintained waterways and contour banks generally performed satisfactorily particularly when the cultivated land was protected by crop residues. Where failures did occur they were usually attributable to the lack of proper maintenance of these structures or inadequate surface protection by crop or crop residues. Unco-ordinated run-off from upland catchments onto lower sloping plains caused major problems and reinforced the need for the implementation of whole-catchment schemes in intensively farmed areas.

Extension and landholder interest

One hundred and twenty extension items during the year covered a range of subjects although emphasis was given to the maintenance requirements of soil conservation structures, conservation tillage and the role of Advisory Group Committees in project planning.

The display caravan was used to present a farm planning display initially at Farmfest and subsequently at six shows/field days in declared Areas of Soil Erosion Hazard. The display was developed jointly with the Department of Mapping and Surveying.

Landholder requests for service were considerably higher than in the previous year. The large increase in requests from existing co-operators was attributable to the Clifton District of the Darling Downs following the severe storms and erosion there in January-February 1980. Virtually all the initial requests for service resulted in the implementation of works (that is, new co-operators). A comparison of landholder interest in Areas of Soil Erosion Hazard during 1978-79 and 1979-80 is summarized in the following table.

LANDHOLDER REQUESTS FOR SOIL CONSERVATION SERVICE IN THE AREAS OF SOIL EROSION HAZARD DURING 1978–79 AND 1979–80

Year	No. of Requests for Service		No. of Property Visits	No. of New Co-operators
	Initial	Follow-Up		
1978–79	123	1 158	3 636	127
1979–80	140	1 776	4 031	136

Planning

During the year, 10 Project Plans covering 12 694 ha and involving 81 landholders were prepared and advertised. Five of these Plans were gazetted during the year together with nine other Plans advertised during 1978-79. Two of the Project Plans advertised for the Darling Downs Region, Tabletop No. 1 in Allora Shire and Back Plains No. 2 in Clifton Shire, covered parts of Plans originally gazetted in 1976 and 1978, respectively. The new Plans were prepared in order to overcome unresolved objections by affected land users.

Although the majority of the Project Plans advertised or gazetted simply specified run-off and erosion control requirements, some planning was undertaken in broader land management areas. Potential on-farm dam sites were identified and investigated for all Project Plans in the Darling Downs Region as part of a project, funded by the Commonwealth Extension Services Grant on co-ordination of soil and water conservation. Planning was commenced in one catchment near Cambooya on the Darling Downs in order to prepare whole-farm plans, involving soil and water conservation, and crop and animal management requirements. A project was commenced in the Darling Downs Region to establish conservation management requirements for solodic soils. This information is required to facilitate project planning aimed at ensuring safe use and development of these fragile soils.

Implementation

During the year, 12 219 ha of extensive cropping land and 485 ha of intensive cropping land were treated. All of the extensive cropping land treated was in the 11 declared Shires of the Darling Downs. All the intensive cropping land treated was sugar land in the Gin Gin and Isis areas. The areas treated are approximately 30% greater than in 1978-79 and reflect the advantage taken by farmers of the extended dry period to complete works.

Financial assistance to land users

In the Areas of Soil Erosion Hazard, subsidies on a dollar-for-dollar basis up to a ceiling of $1,500 per farm on the Darling Downs and up to $1,000 per farm in the Burnett are payable to landholders for measures associated with approved soil conservation schemes.

Subsidies totalling $193,694 were paid to 296 landholders during the year for 956 km of contour banks, 66 km of diversion banks and 133 km of waterways constructed at a total cost exceeding $400,000. This brings the total subsidy paid to landholders since the scheme began in 1974 to $979,610. In addition, $7,879 were paid under Section 58 of the Soil Conservation Act 1965–1980 to local authorities for road cross-drainage structures required in approved Project Plans in declared Areas of Soil Erosion Hazard.

The basis of financial assistance to land users in soil conservation schemes was reviewed during the year and is being considered in the context of possible Commonwealth financial assistance to the States under a proposed National Soil Conservation Programme.

Three landholders obtained approval for advances from the Agricultural Bank under Section 80 of the Soil Conservation Act 1965–1980. The total amount approved was $24,777. Two of these landholders were outside Areas of Soil Erosion Hazard.

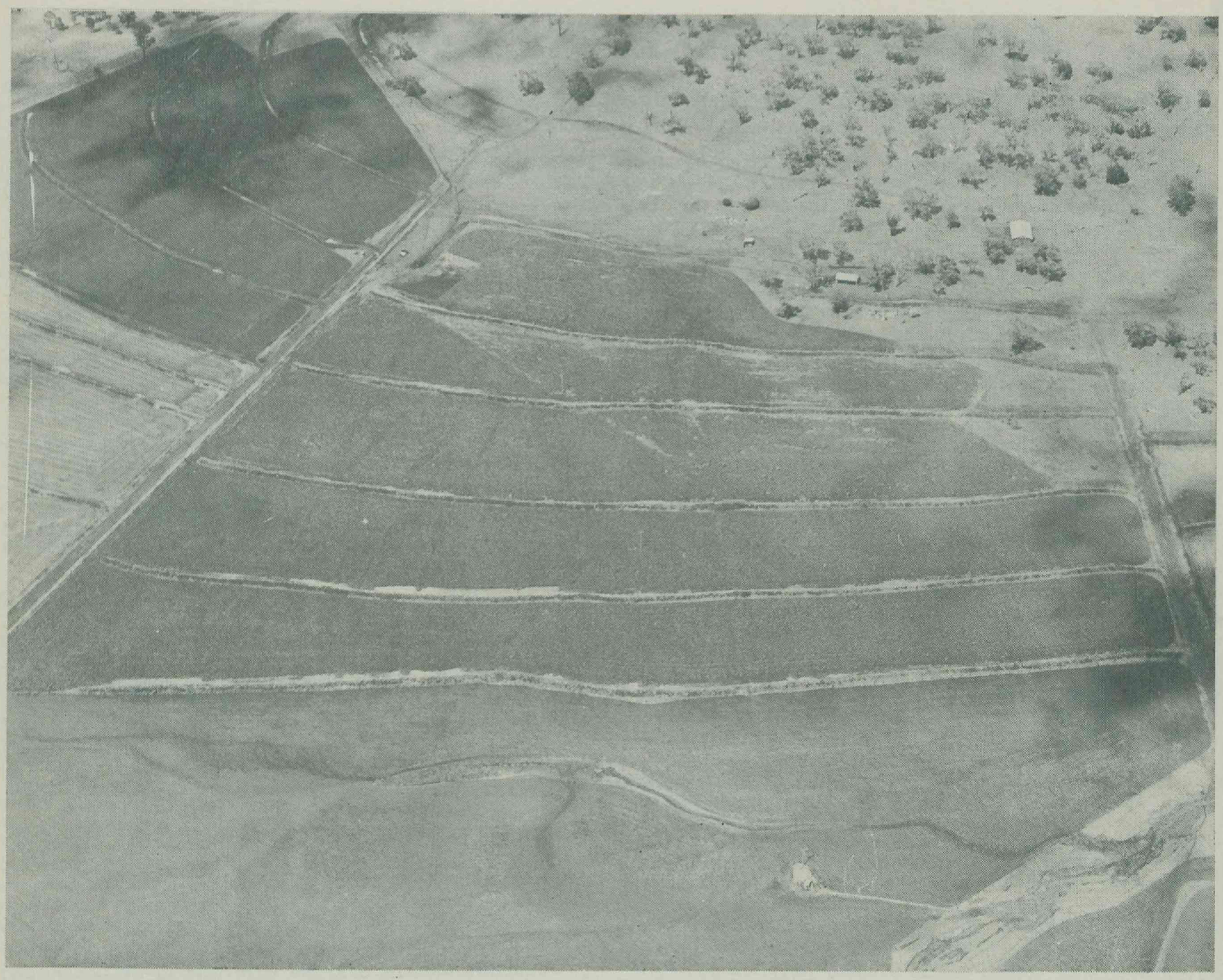
Liaison

Advisory Group Committees comprising landholder and Local Authority representatives provide advice to the Soil Conservation Authority on the development and implementation of the Soil Conservation Programme in the Darling Downs Areas of Soil Erosion Hazard. The four Advisory Committees set up on the Darling Downs assist the Soil Conservation Authority by considering landholder objections; recommending on contentious issues which involve landholders, assistance to land users; investigating landholder concerns; recommending on policy issues, for example, bases for financial or landholders and local authorities; and by encouraging soil conservation activity within their areas of responsibility.

In 1979-80, the Advisory Group Committees were further involved in the recommending of Project Plan priorities. Recent amendments to the soil Conservation Act enable Advisory Group Committee members to serve on a body set up to hear landholder appeals to Soil Conservation Authority determinations on landholder objections to Project Plans.

It is intended to review the role of Advisory Group Committees in 1980-81 to coincide with the expected initiation of catchment schemes financed under the proposed National Soil Conservation Programme.

In the Isis and Gin Gin Areas of Soil Erosion Hazard, Soil Conservation Branch staff have co-operated with the Queensland Water Resources Commission in the Isis and Gin Gin Irrigation Schemes, and the Lower Mary River



Potential damage to sloping cultivation areas by high intensity rainfall has been minimized by the implementation and maintenance of contour banks, well-grassed waterways (left and right), and ground cover by crops or crop residues, or both.

Irrigation Schemes. Assistance was provided to Isis Central Mill in planning the location of the Cordalba-Gregory River tramway extension in order to ensure compliance with future project planning requirements.

Information on land use zoning was provided to the Gin Gin Land Use Committee, to facilitate the reallocation of sugar-cane assignments from unsuitable to suitable land. Special finance was obtained for Queensland Railways Department to enable drainage structures to be upgraded within Atherton Shire. These works were associated with an agricultural drainage scheme undertaken by Atherton Shire Council in the Tolga-Kairi area. Within the Darling Downs Area of Soil Erosion Hazard works associated with Emu Creek on the main railway line and the Allora branch line in Hendon No. 2 Project Plan were completed.

Land Resource Assessment

A thorough knowledge of the land resources of the State is an essential pre-requisite for sound land use planning, a need which has been long recognized in Queensland. Land resource assessment, which aims at providing a land data base for planning purposes, is a major activity of the Development Planning Branch.

There have been considerable representations from rural industry organizations, Local Authorities, Government Departments, soil conservation officers and other Departmental officers for land resource information including land capability and land suitability maps at a scale of 1:50 000 to 1:100 000. These maps are used to plan future agricultural development, to identify valuable agricultural land and to provide details on the management needs of particular land types.

A significant stage has been reached in Queensland agriculture now that much of the best agricultural land, namely areas with few limitations to use, has been developed. Agricultural development is expanding onto soils which require intensive management practices to maintain them in a productive state. These marginal soils are identified in resource studies and their management needs, in terms of soil-water management, soil conservation, soil fertility and maintenance of soil structure, are defined.

Sugar industry land use studies

An important milestone was reached with the release during the year of two land suitability reports for the sugar lands close to Rocky Point and Moreton Central Mills. A significant feature of these studies has been the ready acceptance of the reports by local authorities and the sugar industry. They are the first of a series of studies in the sugar industry which will document land resources and land suitability for sugar production. Maryborough and Mackay Districts, and Far North Queensland Districts will be covered by other studies in the series.

The studies show the location of areas of prime agricultural land, indicate their relative production potential and identify those areas where production costs could be kept to a minimum. Local Authorities are using the studies as a basis for zoning in shire town planning, the preparation of strategic plans and the setting of minimum subdivision sizes on valuable agricultural land.

ROCKY POINT. The Rocky Point District has land available with the potential to lift mill production substantially. In the district, there are 9 000 ha of land suitable for canegrowing. Of this total there is potential for about 7 500 ha to be utilized, including the 4 300 ha of land currently producing cane in 1979. Sugar output could be lifted from the 1979 mill peak of 30 400 t to up to 50 000 tonnes. The Albert Shire Council is attempting to protect this area from housing and hobby farm development by zoning the land as Rural Zone C. This zoning ensures that existing blocks of land cannot be subdivided into blocks smaller than 20 ha.

MORETON MILL. The Moreton Mill report shows that there are 15 000 ha of non-assigned land within 35 km of the Moreton Central Mill which is suitable for sugar production. However, only 10 000 ha will be available for use by the sugar industry. The findings of this study have resulted in the Maroochy Shire Council amending the subdivision By-laws to increase the minimum subdivision size to 30 ha in areas with slopes below 10% and zoned Rural A. Recommendations are being incorporated into the Maroochy Shire Town plan which is currently under review.

MACKAY. In the Mackay District, field mapping and sampling have now been completed on 45 000 ha of land, north of the Pioneer River. Detailed sampling of sites has been completed over the remainder of the district and this will form the basis for land suitability mapping due for completion in mid 1981.

An assignment map has been prepared and information on other land uses is being collected. Regional planning data should be available at the same time as the survey is completed. A land use co-ordinating committee comprising representatives from local authorities, millers and canegrowers has been formed to advise on follow-up action once the study is completed. The co-operation and support of such groups has assisted in the progress of the study and this is leading to a high level of public awareness.

The Plane Creek Mill area to the south was excluded from the initial study but work will commence in this area in 1981. Data from the study are already being used to provide advice on new cane assignments and regional planning.

WET TROPICAL COAST. On the wet tropical coast competition for land for agriculture, forestry, mining and urban development in the Ingham to Mossman area has led to a number of approaches for land suitability studies. Drainage problems, soil erosion and poor land use on the hillsides have resulted in the need for such studies to be given high priority.

A project was started during the year which will identify lands suitable for agricultural development and determine land suitability and land management requirements. One officer has been transferred to Ingham and another officer will be transferred to Innisfail next year. Liaison with local industry groups and government personnel has been established and survey work has commenced.

MARYBOROUGH. A land suitability study of the steep, stony and eroded assigned land within the Maryborough Mill area was undertaken at the request of both the Queensland Canegrowers' Council and the Maryborough District Canegrowers' Executive. Field work on 70 affected farms was completed by March. Data collation and map drafting are now completed for the Hervey Bay and Bauple districts. Work is well advanced for the Yerra-Pilerwa district. The area of assigned land deemed unsuitable for canegrowing for reasons of steepness or stoniness is as follows:

Hervey Bay	(27 farms)	287 ha
Yerra-Pilerwa	(12 farms)	(being assessed)
Bauple	(13 farms)	208 ha

Liaison with the Land Administration Commission has been established both at Head Office and the local level as the Land Administration Commission would be involved should a land transfer scheme onto vacant Crown land be initiated as a consequence of this study. Farmer interviews, carried out in conjunction with the Bundaberg Land Commissioner, have been completed on the 10 farms eligible for transfer in the Hervey Bay District. Four growers have indicated strong interest in the proposed transfer to an area of vacant Crown land. This area of vacant Crown land was set aside for the cane industry as an outcome of a previous Development Planning Branch activity, the Maryborough-Elliott River Land Use Study (1976).

Horticulture land use studies

In the absence of irrigation, the distribution of first class horticulture land is restricted to a few locations where specific soil, climate and topographic conditions suit particular crops. In many cases these are favoured sites for urban development or subdivision into rural residential land. Studies close to Brisbane aim to provide maps of these prime agricultural lands so that local authorities have this information for policy planning.

NEAR NORTH COAST. Field work to establish the suitability of land for horticulture in the Maroochy Shire and the eastern sectors of Landsborough and Caboolture Shires is in progress. The areas of current horticultural land use have been mapped and 92 farms visited. Data on land areas, land use and erosion characteristics are being stored on computer file.

BURNETT. Management practices and layouts for horticultural crops were studied in the Near North Coast and South Burnett with the aim of determining those methods best suited to overcoming soil erosion and drainage problems. In the Mundubbera-Gayndah area, experimental drainage measures were implemented in the problem areas. Underground drainage has been installed in a citrus orchard and a vineyard with drainage problems resulting from irrigation in association with soil conservation layouts. Monitoring of these demonstration sites will continue.

Agricultural land use studies

WIDE BAY-BURNETT. The Wide Bay-Burnett region produces nearly 13% of the gross value of Queensland rural production. Even though a broad assessment of the land resources of the region was made for a study conducted by the Co-ordinator-General's Department last year, detailed studies of the agricultural land resources and their potential for development projects have not been undertaken. This situation is now being rectified.

The total area is being mapped in a number of stages. The first stage involves the mapping, description and assessment of the important land resource types in the South Burnett. Field work has been completed and the preparation of a land unit map and the current land use map has commenced. A total of 64 mapping units has been delineated.

DARLING DOWNS. On the Darling Downs, resource studies are being undertaken to provide resource information for catchment planning activities associated with the Area of Soil Erosion Hazard programme. Studies on small key areas, representative of larger areas, are providing information on how to identify the important soils and the agricultural management practices required.

The basaltic soils supporting softwood scrub near Pittsworth were one of the first resource areas studied. The report on soils and land use of the area was published during the year. The soils were traditionally regarded as behaving differently from those of the mountain coolibah woodlands. This study found that there are no significant differences in morphological factors (that is, colour, texture, structure, consistence and aggregate size distribution) between the scrub and forest soils.

The forest soils had significantly greater infiltration under simulated rainfall but further investigation into the reasons has not been undertaken. The scrub soils were significantly higher in extractable phosphorus and in potassium than the forest soils. In the short term, these differences are of little agricultural importance due to the already high levels of phosphorus and potassium in the forest soils.

Several reasons were advanced for these differences including the effects of geology and different land-forming processes and, more importantly, the difference in rates of accumulation of organic matter and nutrient recycling under the two vegetation communities.

The parent material and geology of an area can have a significant effect on the agricultural land use and the management practices required. In conjunction with the previous study, detailed investigations were carried out to ascertain the soil and land use differences which can be attributed to geology. Detailed geological investigations revealed several aspects of the basalts north of Pittsworth which had not been reported in previous geological studies. This relates mainly to the scrub area being a zone of major fissure flows and intrusions.

Several main vent sites and more than 40 dykes were detected in the area. These have had geomorphic significance by acting as thresholds in landscape development. Valley slope retreat has been inhibited by these thresholds, thus maintaining narrow, steep-sided valleys and more of the earlier, high plateau surface. This has allowed the survival of the depauperate rain-forest and scrub communities, by isolating the area from processes operating in the surrounding forest basalt land.

A report providing soils information for approximately 15 000 ha of scrub basalt soils in the Jandowae-Bell-Toowoomba area of the eastern Darling Downs was prepared. Five soil series are described in the report and these are grouped into three Agricultural Management Units. The agricultural and soil conservation management requirements are defined for each unit.

A current study will provide soil information for 110 000 ha of the Brigalow-Belah Walloons land resource area of the eastern Darling Downs. The study is based on three representative areas—Moola, Acland and Millmerran. So far, five agricultural management units have been recognized.

WESTERN DOWNS. On the western Darling Downs, 972 000 ha of land in the Millmerran-Moonie-Tara area were mapped and described using the land system land unit approach. Mapping units were based on major soil properties, geology and vegetation. Such mapping units are readily recognized in the field by examining the major soil properties. The mapping units were grouped into 32 agricultural management units and their agricultural and soil conservation management needs defined. The land system and land use maps have been published and the report is ready for publication.

Land use studies—grazing lands

The Western Arid Region Land Use Study aims at mapping and describing the land resources of 60m ha in Western Queensland's arid and semi-arid zone and to provide information on land types needed for the determination of land policy. Field work on this project has been finalized. Approximately 230 land systems and 550 land units were described. Detailed data on soil physical and chemical properties as well as the structure and composition of vegetation are available for approximately 1750 sites. These data and the working maps are available to users on request.

Published maps and reports are used by the Department of Lands, the Valuer-General's Department, National Parks and Wildlife Service and other planning bodies at the State and Commonwealth level and landholders. Field data and map compilation dyelines for various parts of the Western Air Land Use Study were used by Botany Branch for the preparation of the 'Vegetation of Queensland' mapping series (1:1 million scale). These reports will provide basic data for the further development of policy on the management of grazing lands and for the planning of Departmental research and extension in Western Queensland.

A climatic analysis of the Western Arid Region has commenced. It will contain a general climatic description and an agroclimatic analysis, oriented towards rangeland management and drought strategies.

The Western Arid Study identified a problem of land degradation or desertification on the hard mulga country and frontage country. A joint project with the Economic Services and Sheep and Wool Branches titled 'Improving the Biological and Economic Efficiency of Sheep Production in south-west Queensland' was commenced to study this problem. A map of the resource regions of south-western Queensland to establish sites on selected land types to monitor land degradation is being prepared by Development Planning Branch as part of the project.

The resource map defines geographic areas in which properties have a similar mixture of land types, similar rainfall patterns and a relatively uniform enterprise type. Management options are similar. These regions provide a sound base for the examination of the outcome of various alternative management decisions. The monitor sites will provide objective data on the long-term trend in condition of sensitive land types. They will also be used to evaluate the suitability of Landsat or other remote sensing techniques in assessing condition in these arid lands.

Overhead photographs of 3 m square ground quadrats together with vegetation transects using the wheel point method and harvesting techniques are used to provide a permanent record of ground cover, basal area, species composition and dry matter yield at the monitor sites.

With the co-operation of the Bureau of Meteorology, the Japanese Geostationary Meteorological Satellite GMS-2 is being investigated as a tool in assessing trends in pasture conditions. Night time thermal infra-red imagery shows up temperature differences to an accuracy of 1°C. These temperature variations appear to be related to known land types and surface conditions.

A workshop was held in Charleville in October 1979 to establish land and stock management guidelines for the major land types in the arid zone. The workshop was attended by officers from several Branches of the Department including Agriculture, Beef Cattle Husbandry, Development Planning, Economic Services, Sheep and Wool, the Extension Services Section and officers from Lands Department. There was general agreement on the major problems and land management needs of each of the land types. Sandplain mulga, hard mulga and alluvial plains were identified as the land types of major concern.

Computing

The land resource assessment sub-programme is supported by an efficient computing team. The land resource surveys generate an enormous amount of detailed information on soil fertility, soil types, vegetation, land use tenure and land suitability. Before 1970, much of this data was lost once surveys were completed but now this information is stored on computers for use as needed.

The computing group has developed collation and retrieval systems for both site and area data. These computer programmes are now used by a number of Branches in the Department of Primary Industries. They are also being used by other Departments and Universities both in Queensland and other States. This year saw the development of eight new computer programmes for use in the sugar industry studies. These will allow pieces of land with specific land and tenure characteristics to be located and their areas calculated. The provision of a digitizer system will improve the efficiency of this procedure.

The computing group has developed, in collaboration with soil conservation field officers, an information system for the Darling Downs Area of Soil Erosion Hazard (ASEH) programme. The system will be used to record all programmed and implemented works in Project Plan and to process and check subsidy claims for such works. The data base language 'FORDATA' was used to structure the computer files in a way which reflects the natural breakdown of information and administrative functions of the ASEH programme.

Development Planning and Evaluation

THE demand for investigation of land development and irrigation projects declined, with the Barker–Barambah Creek investigation being the only study completed this year. However, work on regional planning and water catchment protection has continued.

New project programmes to provide information on the potential land available for energy crops were initiated.

State evaluation of irrigation lands

This project, carried out in co-operation with the Water Resources Commission and the Agriculture and Agricultural Chemistry Branches, is evaluating the long-term potential for irrigated agriculture in Queensland. It is being undertaken on a regional basis starting with the Wide Bay Region.

The report for the Wide Bay-Burnett Region was released during the year. It discusses the areas with irrigation potential, their existing land uses and expansion possibilities. Several areas of uncertainty related to soil suitability for irrigation, condition of catchments and the economic and physical limitations of growing exotic or specialist crops, have been indicated by the study. These matters are proposed as research and demonstration tasks which should be incorporated into Departmental work programmes.

With increasing emphasis on the provision of water for mining, power and urban developments, it is very important that the areas with irrigation potential be indentified so that use of total catchment water can be planned. A thorough investigation of soils in those areas where there are significant amounts of underground water not being utilized is needed throughout the State.

Irrigation investigations

BARKER-BARAMBAH. Land resource and economic investigations of the proposed Barker-Barambah Creek Irrigation Scheme were completed during the year. A joint Report by the Department of Primary Industries and the Queensland Water Resources Commission was submitted to Cabinet and approved in principle in December 1979.

LOWER MARY RIVER. A further examination of the lands to be irrigated in the Lower Mary River Irrigation Scheme was completed during the year. Maps showing property boundaries, assignments and suitable land in the 0-2% and

2-8% slope categories were compiled at a scale of 1:25 000. Data on the need for clearing land on cane farms and changes in assignments on land holdings since 1977 were assembled for a re-evaluation of the economics of the project by Economic Services Branch. Material prepared for the land suitability study together with contour information provided by the Water Resources Commission has been used to indicate the soil conservation planning needs of the irrigation scheme.

LOGAN VALLEY. Following a request from the Logan Valley Irrigation Advisory Committee, a study was conducted by officers from Agriculture, Development Planning and Soil Conservation Branches to determine the additional area of land in the Logan Valley capable of being used for irrigation. Following a reconnaissance survey and aerial photography interpretation it was determined that adequate land is currently available for irrigated crop production without the need for expensive drainage or soil conservation works.

WOLFDENE DAM. The proposed Wolfdene Dam on the Albert River, near Tamborine Village, is a potential future water supply for Brisbane. The trends in land use and land values in the inundation area were examined to provide advice to the Local Government Department.

Regional and catchment planning

BURDEKIN. A land capability classification of the Northern Burdekin was undertaken in 1977-78. The study indicated that, of the total area considered, 41% was climatically suitable for sorghum cropping with expected yields of 1 000 kg per ha. Only 1% of the area climatically suitable has soils suitable for annual cropping, while another 8% is suitable for cropping on an irregular basis.

MACKAY REGION. A report prepared by Development Planning Branch officers on the potential of the Mackay Region for development indicated that land development has progressed at a rapid rate with major expansion being associated with the sugar industry, the Nebo district, the northern section of the Brigalow Land Development Scheme, and coastal pasture development.

There is still considerable potential both on the coast and inland for crops and pastures. On the coast, there is an additional area of between 50 000 and 70 000 ha which is suitable for agricultural development but intensive soil conservation measures or drainage will be needed on approximately 50% of this land. There are 400 000 ha of land suited for tropical pastures and of this, 60 000 ha have been sown. The inland area is marginal for cropping but all estimates indicate that there are more than 250 000 ha with soils and climate suitable for summer or opportunity cropping.

WIDE BAY. A catalogue of the resources of the Wide Bay-Burnett Region, prepared under the auspices of the Co-ordinator-General's Department, was published during the year. Development Planning Branch contributed a section on Soils and Rural Land Use as part of Volume 2, Land Resources.

COOKTOWN-DAINTREE. Development Planning Branch is represented on the Cooktown-Daintree Land Use Committee which aims at preparing land use and tenure guidelines for two Timber Reserves in the area. Following a field inspection, draft land capability maps and reports were prepared. The maps will form a basis for discussion with other Departments. The potential for agricultural development is limited to the flat alluvia and gently undulating areas but the scenic potential of the mountainous areas indicates that most of the area should be reserved for National Parks or State Forest. Development of steep areas for pastures along the Daintree River to the south has led to a number of land use problems including landslip and soil erosion. The development of areas with slopes greater than 18% is not recommended.

RURAL-URBAN LAND USE. It is desirable that the principles of sound agricultural land use be adopted by local authorities for use in Town Planning and Land Use Zoning. Comments were provided to the Local Government Department on Draft Town Planning Schemes and draft by-laws for four whole Shires and the City of Warwick. Subdivision applications were inspected in most regions, and where necessary, advice was given on soil conservation requirements.

Water supply catchments

WIVENHOE. Development Planning Branch continued to be represented on the Wivenhoe Dam Management Advisory Committee. The Inter-departmental Committee chaired by an officer from the Co-ordinator-General's Department is investigating the possible future uses for the area adjacent to the ponded area of the dam. During the year guidelines were formulated for the development of the land for agricultural and pastoral purposes.

Environmental impact assessment

In accordance with the procedures set out in the Procedural Manual for Environmental Impact Studies in Queensland, 12 Preliminary and Final Impact Assessments were processed. The development proposals covered eight power transmission lines, an aluminium smelter, a power station water supply system, an open-cut coal mine and a railway connection.

During the year, several applications for Authorities to Prospect in sugar areas were referred to the Department for comment. The loss of existing or potential sugar-cane land to other uses is often irretrievable and can limit mill viability. Gross value of product from a hectare of sugar-cane land can be in excess of $2 000 a year and the capital investment in mills and infrastructure is very high.

Energy crops

The potential for growing crops for the production of liquid fuels is high in Queensland. However, there is a danger that any uncontrolled development would cause expansion on to poor and erodible soils and lead to serious erosion and degradation of the land. Therefore, studies have been initiated to locate accurately the suitable and available lands for sugar-cane, cassava and other energy crops and to indicate their management needs before development occurs.

Fielders-Gillespie have been granted a development lease on Crown land north of Maryborough for the development of a cassava industry. The company is now seeking to convert the tenure to a more secure lease. Because of the inherent erodibility of the soils under cultivation to cassava, agreement was reached with the Land Administration Commission on inclusion of lease conditions which will help to prevent soil erosion.

Land Management Research

THE land management research sub-programme is aimed at determining the extent and significance of land degradation in Queensland, describing the mechanisms involved and developing practicable management systems to ensure long-term land productivity and stability.

Soil erosion by water is the major natural causal agent of land degradation in the State, accounting for 98% of degradation in cultivated lands and 75% in grazing lands. Pasture degradation due to overgrazing and dryland salinization are further important forms of degradation in grazing lands.

The land management research sub-programme is directed mainly at soil erosion by water as this is the major form of land degradation. Research is carried out in two main streams: land degradation investigations (degradation assessment and erosion system research) and land management investigations.

Land degradation investigations

DEGRADATION ASSESSMENT. Degradation assessment projects aim at establishing the cause and magnitude of land degradation under various systems of land use and land management in Queensland. This information is used to establish priorities for projects in research, extension, planning and implementation.

WATER EROSION ON INTENSIVE CROPPING LAND. Combinations of high intensity rainfall, intensive cultivation practices, highly erodible soil, and steep slope are causing serious erosion on soils growing horticultural crops and sugar-cane. The application of soil conservation measures on these lands has been limited due to the specific requirements of the crops or established management practice. Factors such as adequate drainage to prevent disease, row length and the block system of sugar land assignment have limited the application of soil conservation measures.

NAMBOUR. At Nambour, soil loss and the relationship between soil loss and rainfall intensity, crop cover, land slope and row gradient are being investigated on a commercial pineapple farm. Results for the period from April 1979 to February 1980 show that the average soil losses from slopes of less than 10%, 10% and 15% were 29·2, 30·7, 105·4 t per ha respectively. Hydraulic design and field observations indicate that row gradients below 5% are necessary to avoid channel

scour on these slopes. By eliminating channel scour, soil loss would result mainly from raindrop splash and sheet erosion of the pineapple beds and channel sides.

MACKAY. At Farleigh and Pleystowe in the Mackay district soil loss from an area of sugar land treated with a parallel row layout approximately on the contour is being compared with soil loss under an up-and-down the slope layout. The comparisons are being made on two different soils. Field observations indicate that parallel layouts greatly reduced soil movement and were effective in controlling soil erosion.

There was some change in the furrow shape in the parallel layout, as well as local soil movement along the furrow to produce a levelling effect. This may have an important bearing on hydraulic design of layout. In another trial, an additional late season cultivation increased soil loss by between 52 to 100% over a range of soils and slopes.

GRANITE BELT. The state of erosion of the Granite Belt was assessed using a randomized property survey technique. The survey indicated that 10% of the horticultural area is satisfactorily protected from erosion. Approximately 70% is affected by slight or moderate sheet and rill erosion, 4% has significant gullying and 16% has severe sheet and rill erosion.

Total soil loss rates of 6 to 7 t per ha were recorded on those areas with slight to moderate erosion but between 25 and 40 t of soil per ha were disturbed and redistributed within paddocks. This significantly affected production and profitability.

Results indicate an expenditure of $140 000 is needed to cover the short-term soil conservation needs on the Granite Belt. A further $210 000 would be required as replanting progresses.

WATER EROSION ON EXTENSIVE CROPPING LAND. Water erosion is of major concern in grain-growing areas of the State. Although the causal factors are generally known, quantitative data are limited. Soil types, rainfall pattern and management practices all significantly influence the erosion processes. The relative importance of each of these factors under Queensland conditions is being investigated.

DARLING DOWNS. The effect of soil surface conditions on run-off, soil loss and moisture accumulation are being studied at two sites representative of the major soil types on the Eastern Darling Downs. Surface management practices implemented include zero tillage, stubble mulching (sweep cultivation), stubble incorporation (disc cultivation) and stubble burnt.

Two significant run-off-soil loss events were recorded at both sites during the year. After an extended dry period, a 50 mm storm resulted in 40% of the rainfall running off in the stubble burnt bay on both the grey clay and the black earth. Subsequent intense rainfall on the black earth resulted in greater than 100 t per ha soil loss on the bare soil compared with less than 5 t per ha where stubble or crop protection was present. An inverse linear relationship was exhibited between percentage surface cover and run-off. Initial results from this trial have shown consistently the beneficial effects of surface cover.

A road which was damaged by silt deposits and the stripping of gravel surfaces.



SOUTH BURNETT. At the J. Bjelke-Petersen Field Station, the effectiveness of stubble mulching on run-off and soil loss on a peanut-barley rotation is being studied. Peanuts were sown into mulch or into incorporated barley stubble. The 1979-80 summer was the first time that the run-off instruments were field tested.

BREMER LOCKYER. Reports relating to land degradation studies in the Bremer and Lockyer Catchments were published this year. The total area of land degraded is estimated at 114 000 ha—28% of the two catchments. Most of this degradation occurs on the more valuable agricultural land. More than 60% of the better agricultural lands are affected.

WATER EROSION ON GRAZING LAND. Erosion and pasture degradation in grazing land have received little attention in Queensland, but the problems are increasing, particularly where clearing has taken place on the more susceptible soils. Often a lag occurs between development and soil erosion and pasture decline. The length of this lag phase varies with climate and management. The most serious soil erosion is occurring on the texture contrast soils association with the eucalypt woodlands.

MEDWAY. At Medway station west of Emerald, a soil loss and a pasture monitoring programme aims at assessing the effects of grazing on soil loss. Initial results of the soil loss experiment in a badly gullied area showed that the soil loss measured at the flumes is largely a function of the stage of gully erosion and not of catchment cover. Large amounts of soil are being eroded from gullies, but deposition in the immediate valley bottoms resulted in a low delivery ratio through the flume in the heavily grazed catchment.

Approximately 10 t of soil per ha have been lost through the flume outlet. It appears that the run-off per unit area is significantly greater from the heavily grazed catchment. The control of gully erosion on upland valley floors and increased grass cover on the hillslopes are essential to reduce sediment delivered to the main channels.

BRIAN PASTURES. At Brian Pastures near Gayndah, soil loss measurements are being made on a long-term grazing trial. The objectives are to measure soil loss under seasonally grazed, burnt and unburnt plots with varying stocking rates; and to measure soil movement in relation to slope position and type.

DRYLAND SALINITY INVESTIGATIONS. A Statewide assessment of secondary salinization in dryland areas of Queensland was carried out to establish the extent of the problem and provide data to determine priorities for salinity investigations. A Queensland contribution to a national assessment of secondary salinization, commissioned by the Commonwealth-State Standing Committee on Soil Conservation, was made using these data.

The survey identified 7 300 ha of land affected by salinity associated with rising saline groundwaters, and 590 000 ha affected by scalding resulting mainly by erosion of saline or sodic soils. These affected areas represent losses of $7.7m in land value and $2.0m in lost productivity a year. The areas affected are increasing in size and number and, unless preventive action is taken, losses will increase.

A serious indirect consequence is the contamination of surface water supplies, affecting on-farm and urban water quality. All occurrences of water-table salting in Queensland are associated with cleared areas with poor quality groundwater and poor drainage. Vegetative cover is required in these areas to lower water-tables and restore bare areas. Scalding is widespread in most of the drier parts of the State. Overgrazing of susceptible areas predisposes them to erosion and subsequent scald development. Maintenance of vegetative cover is an important preventive measure on scalded areas but it is difficult to maintain cover on these areas when they are in large paddocks.

BREMER-LOCKYER. Detailed investigations on selected dryland salting occurrences in the Bremer and Lockyer catchments showed that—

- Occurrences of salting are associated with saline groundwater at shallow depth and valley with poor drainage.
- Clearing of trees, particularly in valley floors, results in rising water-tables and consequent outbreaks of salting.
- Land management has a pronounced effect on salting outbreaks.
- Prediction of salt-susceptible land is practical at a broad scale.

DARLING DOWNS. A regional appraisal of dryland salinity on the Eastern Darling Downs is in progress. The aims are to provide a more accurate estimate of salt-affected lands, to investigate the extent of salt-susceptible areas and to determine processes involved in salting development in cultivation in basalt areas. Trends in salinity development are being investigated using old air photography.

An extension leaflet titled 'Salt is Spreading' was prepared by Development Planning and Agricultural Chemistry Branches. This leaflet which summarizes data on salinity in Queensland will be used for extension purposes.

EROSION SYSTEMS RESEARCH. Methods of estimating or predicting soil loss for specific soils, climates, slopes and management conditions are necessary for the development of soil conservation management systems. Techniques developed overseas—such as the Universal Soil Loss Equation—have been used to assess the relative effectiveness of soil conservation measures in Queensland.

These techniques are accurate only in the environment in which they were developed. To obtain similar data for Queensland, investment of enormous resources over many years would be required. Instead, the infiltration-runoff-erosion process is being studied in detail. It is planned to develop a mathematical model which can be applied to any soil-climate environment based on an understanding of run-off and erosion processes.

INFILTRATION PROCESSES. The infiltration capacity of a soil determines when run-off will occur and hence has a marked influence on the erosion process. Infiltration rate is related to water movement through the surface and down the profile. Studies are being undertaken to examine surface run-off effects using disturbed soil samples in a laboratory rainfall simulator. The profile effects and the influence of farming practices on infiltration are being examined using a small field rainfall simulator.

Infiltration processes were studied on a range of grey clay and black earth soils from the Darling Downs using the laboratory rainfall simulator at Indooroopilly. The soils were ranked according to their infiltration capacities. This ranking agreed with those values which had previously been assessed using soil properties such as clay type, texture and Exchangeable Sodium Percentage.

EROSION PROCESS. Development of a process-based erosion model requires information on the four factors: erosion processes, the rates of sediment transport, the conditions under which these processes operate and the effects of various management treatments. Detailed studies on these aspects are being carried out using a 22·5 m x 4 m field rainulator. Plot lengths, rainfall rates and run-off are being manipulated to create a range of conditions with the rainulator.

Results to date demonstrate that the rill erosion rate is independent of slope length and tillage methods. The rate of rill erosion depends on rill stability. Stubble levels as low as 1 t per ha reduced sheet erosion by 75%. Contour cultivation delayed run-off by up to 20 min and reduced total run-off and soil loss.

Field work was carried out to determine the effects of changes in rill discharge on sediment loads. Results from krasnozem and black earth sites have shown that the rills can incise only the plough layer and consequently their depth is limited. Increases in discharge initially increase the depth of rill flow, but rills subsequently widen and depth of flow decreases as sediment is eroded from the banks of the rill.

CATCHMENT RUN-OFF AND EROSION. Run-off and soil movement from two upland catchments near Pittsworth on the Darling Downs are being monitored. Significant flows occurred in both catchments in February 1980. A complete hydrograph was recorded in Galligan's Gully and a peak discharge in Rocky Creek. The rating of flows to date has yielded some Manning 'n' values for different flow depths and some preliminary soil loss figures. When sufficient rainfall and run-off data are available, the aim is to generate unit hydrographs for peak discharge and for total run-off.

Soil loss monitoring was started during the summer at three brigalow catchments on the Brigalow Research Station near Theodore. Run-off from these catchments has been recorded for several years. Due to the malfunction of some equipment, soil loss samples from only two catchments were obtained last summer.

The short-term objective of this study is to measure soil loss and water quality before the brigalow scrub is cleared. In the long term, it is planned that two catchments will be cleared with one being farmed under conventional rotations and the other sown to pastures. Run-off and soil loss will be measured from both of the developed states and compared with the original.

Land management investigations

There is considerable scope for research into the development and extension of appropriate land management practices for effective erosion control. Within existing forms of land use, considerable erosion control can be achieved by adopting management practices which provide greater surface protection and result in less surface run-off.



Large quantities of stubble retained as a mulch and reduced tillage help to minimize erosion even when severe storms occur.

Cropping land management

SOUTH BURNETT. In the South Burnett, experience gained from other projects has been integrated into a conservation cropping system. This crop rotation system is based on the common crops of the region: peanuts, navy beans, soybean, winter and summer grain crops. The aim of the system is to provide maximum ground cover during the periods when rain is most erosive. This system has been successfully implemented by two farmers under commercial conditions. Crop yield has been satisfactory and soil conservation benefit has become apparent.

DARLING DOWNS. There are considerable soil conservation advantages in developing no till or limited tillage systems. A programme being carried out on the Eastern Darling Downs is aimed at assessing the feasibility of replacing mechanical weed control fallows with chemical weed control fallows. It also aims at developing suitable practices and machinery for the operation. Wheat yields under chemical fallow conditions compared very favourably with that of two other treatments, and it appears that chemical weed control has a potential for minimizing soil erosion and maximizing production.

CENTRAL HIGHLANDS. Observation in the Central Highlands indicates that soil erosion is severe on the long, low slopes encountered on the cropping lands and it is apparent that contour banks alone do not reduce soil loss to an acceptable level. Broad-based banks in combination with stubble mulch systems are probably the most convenient method of achieving soil erosion control.

However, the implementation of a stubble mulch system would require a substantial reduction in the present income of farmers at least in the short term, and especially those concentrating on summer sunflower production.

Estimates of the potential soil losses for a range of crops and cropping systems in the Central Highlands are—

Cropping Treatment	Estimated Soil Loss (t/ha)	
	Conventional tillage with no banks	Stubble mulching with banks
Continuous wheat	22	11
Continuous sorghum	32	17
Continuous sunflower	39	23
Sorghum-sunflower	37	20
Sunflower-sorghum-wheat rotation	35	19
Sorghum-wheat rotation ..	26	14

Grazing management practices

Grazing management is often the only economical method of erosion control in grazing land. Grazing can affect erosion in at least two ways, by the removal of vegetative cover and by trampling.

CENTRAL HIGHLANDS. At 'Medway', near Emerald, a study of the effects of different stocking rates on the floristic composition, projective foliage cover (PFC) and litter continued. Twelve thousand wheel point transect readings were obtained in July 1979. There are indications in the exclosure (non-grazed) that there is a build-up of litter, a decrease in PFC and a loss of vigour in the pasture. This may be due to the high litter component restricting seedling establishment.

Overall, the difference in PFC between lightly grazed and ungrazed situations is minimal, but the litter component is noticeably higher in the non-grazed exclosure. The trend for a lower PFC, basal cover and poorer growth as well as a predominance of annual grasses continues on the heavily grazed transect.

TREE DENSITY. At Kingaroy, a co-operative study with officers of the C.S.I.R.O. Woodland Research Unit aims at determining the relationship between tree density and pasture productivity. The long-term effects of commercial grazing pressures and trees, and fire on environmental stability, are also being monitored. Data on ground layer biomass yields, shrub density and tree girth increases have been collected periodically since August 1977.

Waterway and land stabilization

Lack of suitable vegetative cover is the most important cause of waterway failure in Queensland. At a black earth site near Amberley, six strains of *Bothriochloa pertusa* and six other grass species were grown in plots to determine their suitability for waterways.

After 2 years, *B. pertusa* appears to be the most promising species. Although growth habit varies between strains, they all possess most of the desirable characteristics of a waterway species. Among the three kikuyu strains tested, Breakwell appears to be the best species.

In conjunction with the selection trial, adaptability trials were initiated on farm waterways in the Kalbar and Clifton districts. Breakwell and the Bowen strain of *B. pertusa* were used. Soil types range from yellow podzolics to deep black earth.

To promote early establishment of grasses on farm waterways, 'Holdgro' (a paper and synthetic yarn surface stabilizer), 'Curasol' (a chemical surface stabilizer) and bare soil were compared in a replicated trial on a cane farm near Bundaberg. Germination and establishment under 'Holdgro' were far superior to that under 'Curasol' and the bare soil treatments. This is attributed mainly to better moisture retention under the 'Holdgro'.

Another beneficial effect of 'Holdgro' is the protection of the soil surface from early run-off and especially farm machinery compaction. Due to its high cost ($0.95 per m^2) the application of 'Holdgro' is limited. However, it is highly recommended for these uses: establishing waterways in horticultural areas and canelands; stabilizing steep slopes and batters; protecting vulnerable spots on waterways such as contour outlets; and repairing damaged areas of waterways and drainage channels.

A modified Ellinbank Pasture Meter (EPM) is being tested as a substitute for the dropboard in measuring grass retardance of waterways. Results to date are encouraging and a high correlation was obtained between dropboard and EPM readings.

Following requests from the Main Roads Department, the Queensland Electricity Generating Board and the Brisbane City Council, techniques of stabilizing both cut and fill batters were developed for the metropolitan and Moreton areas.

Results so far indicate that topsoiling of at least 15 to 20 cm is necessary. For slopes less than 1:4, only hydroseeding is required. On slopes greater than 1:4, hydromulching is required on large areas. 'Curasol' or 'Holdgro' can be used on smaller areas.

Management practice evaluation

STRIP CROPPING. The performance of strip cropping being practised on the uplands of the Darling Downs and the flood plains of the Condamine River has been reviewed and evaluated. The study concluded that, in general, strip cropping systems are working effectively. There is a need for narrower strip widths, stricter crop rotations and better stubble management in all areas, but particularly in the critical outlet areas.

It has been recommended that all obstructions to uniform flow such as high roads, fence lines, gullies and poorly sited culverts should be eliminated. Some changes in planning strip layouts and in implementing the change-over to strip cropping are necessary.

District land management guides

The preparation of soil conservation field manuals documenting the soils' base and management specifications and recommendations for each of the major agricultural areas of Queensland has commenced. This project will provide direct benefit both to the farm planner and the land user. A draft manual for the Crows Nest district was produced during the year.

Engineering Services

THE principal functions of the Engineering Services Section are to provide technical services to those Branches of the Department requiring specialist advice of an engineering nature, to undertake research and development, and to undertake extension activity for primary producers requiring farm engineering advice and guidance.

The Section's work is based on two sub-programmes—1. Agricultural Engineering Research, which has the objectives of carrying out research, development or modification of farm machinery to meet particular needs of Departmental research workers and farming industry groups; and 2. Environmental and Resources Research, which has the objectives of collecting statistical and performance data for intensive animal industries, and of applying engineering principles and practices in developing designs and systems which both rationalize and economise the engineering components associated with these industries.

An extension engineer was appointed during the year to Atherton in Far North Queensland, and approval has been given for an Extension Engineering position in the Dawson-Callide area of central Queensland. Both positions have resulted from a growing awareness of the need for the extension of engineering technology to the farming community.

Agricultural Equipment Advisory Committee

A five-member Agricultural Equipment Advisory Committee was set up in October 1979 to provide a forum for producers, manufacturers and dealers to discuss disputes over farm equipment performance. The Executive Engineer is acting as the Committee's Executive Officer.

The Committee is made up of representatives from Tractor and Machinery Association of Australia, Queensland Grain-growers' Association, Queensland Farm Machinery Dealers' Association and Council of Agriculture. It has two major duties—

1. Monitoring of complaints regarding machinery performance and quality, and dealer service-spare parts availability.
2. Mediating in any disputes between farmers and manufacturers-dealers within the limits of the terms in 1 above.

Workshop facilities and activities

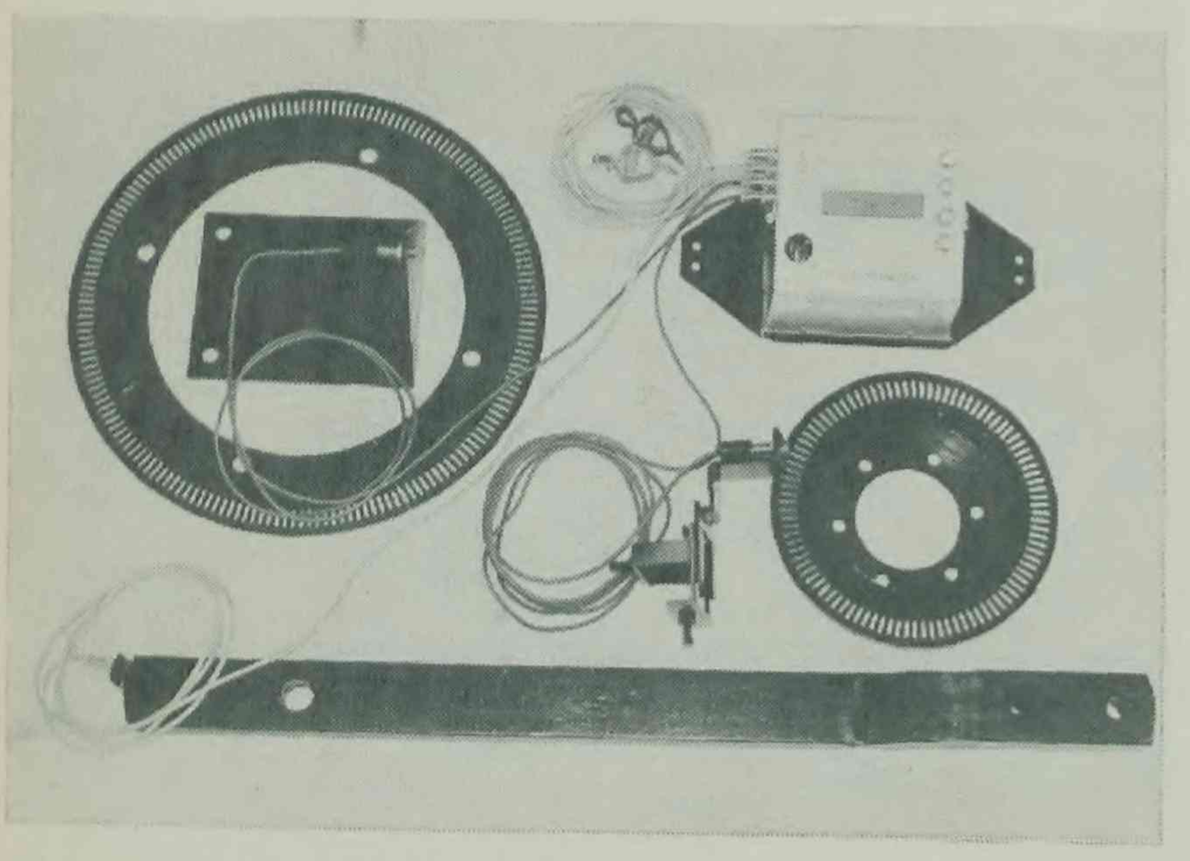
The production capabilities of the workshop in Toowoomba have once again been demonstrated this year and the wide range of machines and equipment are well maintained and in good condition. The skills of the staff employed have also been demonstrated by the valuable contributions they have made in the development of machinery and equipment.

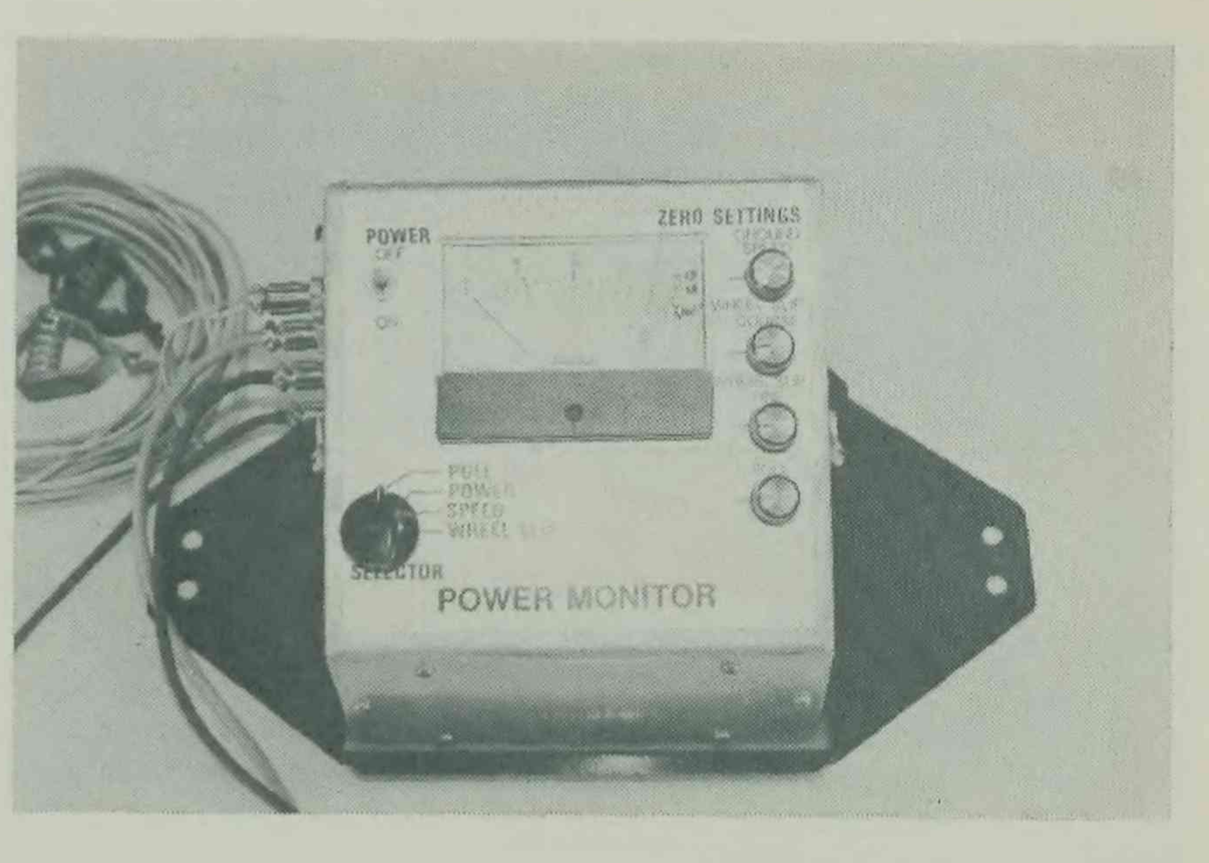
Agricultural Engineering research

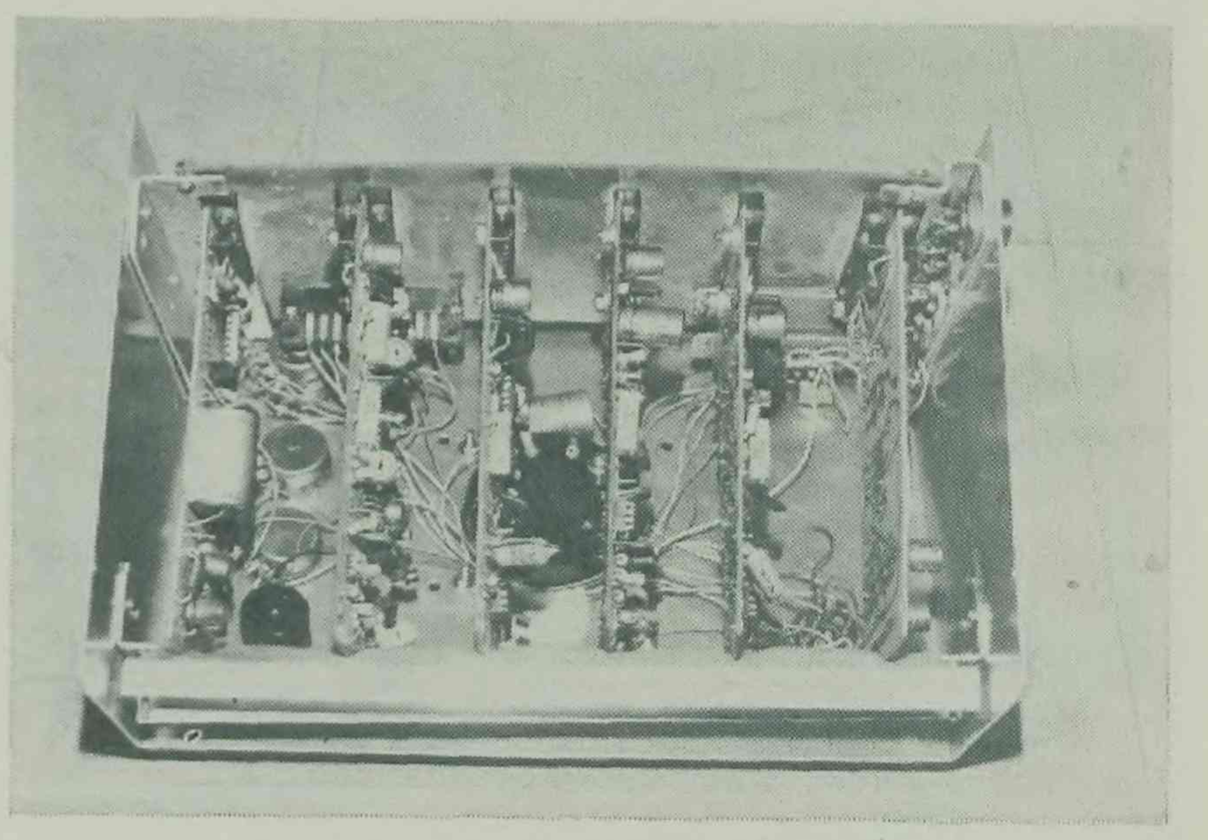
A report has been prepared for the Wheat Industry Research Council—the sponsor of the Tractor Power Monitor project. The report indicates that all of the project's objectives have been met, and recommends that copies of the report, including drawings, should be sent to those firms who have indicated interest in manufacturing the monitor on a commercial scale.

The engineering-harvesting aspects of the Reserve Bank's Rural Credits funded project to adapt modern technology to the State's bean seed industry appear to be drawing to a satisfactory conclusion. Trials using a modified pea viner as a bean seed harvester were successful in the Gatton and Burdekin districts. After additional modifications further successful harvesting demonstrations were undertaken in the Biloela district. Growers in each area were enthusiastic about the results.

A C.E.S.G.-funded project to examine the performance of Planting Units is drawing to a close. Additional data have been collected from trials undertaken as part of another C.E.S.G. project, on the development of the Peanut Industry in north Queensland. Results of all the field and workshop trials will be published as two papers: a technical paper covering the performance aspects of many types of planters; and a report covering development of a seeding unit to overcome adherence problems in heavy clay soils.







A power monitor suitable for use by farmers displays drawbar pull, drawbar power, ground speed and wheelslip to a suitable level of accuracy on tractors with trailed implements.

ABOVE. The current model monitor complete with transducers for fitting to a tractor.

TOP RIGHT. Processing and display module.

RIGHT. Processing electronics.

Three new spraying techniques were initiated by the Engineer involved with a C.E.S.G.-funded project which is examining chemical spray application methods and techniques. A controlled droplet applicator boom spray was constructed and test results indicate better 'coverage' when using only 50% as much fungicide and 20% as much water as when using a standard nozzle boom spray. An air duct was added to the top of an orchard sprayer to direct chemicals into the top-centre of trees and excellent coverage was recorded in field trials. A portable, compressed air powered boom sprayer was designed and built for plot trials and the concept is now being extended since it appears to have application to horticultural crops grown on small areas.

Miscellaneous projects included—

- A prototype electronic strawberry runner counter which was designed, constructed and successfully trialled. Further work to improve the reliability and ruggedness of some electronic components will be necessary before the next season.
- An hydraulically-operated fresh bean picker has been designed and is being constructed for use by Departmental plant breeders in their plot trials at Redlands.
- A water injection unit was added to a plot seed planter used by officers of the Queensland Wheat Research Institute at Toowoomba. A single row rod weeder for use in field trials was also manufactured for the same group.
- A powered rod weeder was manufactured and an inter-row cultivator toolbar designed for use by Soil Conservation officers at Kingaroy. A lysimeter weighing device was also manufactured for a Soil Conservation officer. A larger and stronger coulter arrangement was designed for Soil Conservation officers for use with the minimum tillage planter.

The Engineer based in Atherton has been active in two aspects of the peanut industry project—planting and curing. A trial plot was planted for calibration effectiveness using several planter types which had been bench-tested. Germination trials were carried out with seeds used in these experiments.

In conjunction with farmers, matched sets of motor-fan-burner units have been developed for various sized peanut curing or drying installations. Several other installations have been instrumented to collect data. Fan performance information has been obtained so that farmers can undertake and experiment with their fans within design limits. The peanut crop spraying section of this project has been handled by a Toowoomba-based Engineer through visits to the area and demonstrations of several types of sprayers.

Purchase of the p.t.o. dynamometer completed the instrumentation set up for data collection associated with the C.E.S.G.-funded tractor-implement management project. In trials which have been conducted under different conditions at Kingaroy, Warra, Warwick and Dalby, use has also been made of both models of the tractor power monitor. Co-operating farmers have received advice on matching implements with their tractors.

Crop storage and handling, including drying and metering, and conditioning of animal feeds have provided another avenue for major engineering input. The metering and conditioning work has been a relatively new area of activity. Work to date has concentrated mainly on data gathering and interpretation.

Engineering appreciation and cost-benefit predictions regarding alternative methods for moving various wool lines from wool room temporary storages to the wool press for baling will form part of a report to the Australian Wool Corporation. A study tour of three eastern States was made by an Engineer for the collection of data.

Miscellaneous projects included—

- A cassava dryer has been designed and is being constructed for use by officers of Animal Research Institute at Yeerongpilly in their feeding studies with livestock.
- A sheep conveyor was designed for the chemical defleecing experiments being undertaken by officers of the Sheep Husbandry and Husbandry Research Branches.

Environmental and resources research

Additional sets of drawings, complete with details and layouts, for three different sized piggeries have been added to the library of standard reference plans. A ready reckoner for sizing timber rafters and purlins for use in non-cyclonic areas has been produced.

Environmental data have been collected from five piggeries fitted with fan ventilation and space heating, while automatic control for naturally-ventilated buildings has been investigated.

Influences and responses are being monitored at three properties where piggery wastes are being used as fertilizer. Use of liquid manure tankers to distribute effluent on land has also been investigated.

Construction of a low-cost greenhouse for ornamental flower production, and the installation of a day-length control chamber for control of photoperiod effect within the greenhouse has been funded by C.E.S.G. This experimental structure has been designed using readily-available materials which are competitively priced. The design criteria adopted included a functional factor which will enable the greenhouse to be extended if growers wish to adopt the design for commercial production.

The soil erosion control by retention and usage of run-off water project has continued with hydrological studies in Hodgson's Creek catchments and has included run-off studies to assess values in determining water resource usages.

A survey of soil sampling machines in use throughout the State was undertaken. A high clearance machine, which uses hydraulic power for self-propulsion as well as to operate the sampling head, was designed for the Bjelke-Petersen Research Station at Kingaroy.

Drafting Services

THE Drafting Section performs a most important function in preparing land resource maps and plans to accompany reports prepared by the Division of Land Utilisation and to service the preparation of farm plans and associated needs of Soil Conservation Branch.

About 20% of the drafting and mapping activities are undertaken on behalf of Agriculture, Botany and Agricultural Chemistry Branches of the Department.

The Drafting Section of the Division published 25 resource maps during the year and is preparing an additional 15 maps. Most of these maps are in colour and they are used extensively throughout the State. A key map showing the location of studies where maps have been prepared is available.

One of the important successes of this mapping is the way in which the resource surveyors and the Drafting staff have co-operated to present a number of different types of resource maps which cater for the different user needs. In the future, the inclusion of map information in the resource data bank files (site information) will make field data more accessible to users.

There has been a downturn in the time spent on land resource mapping. Drafting activities in this area have returned to the level of 1977-78 with 52% of total work time devoted to technical services. This is not due to a decrease in the demand for land resource mapping but rather to a significant increase in 1:10 000 topographic mapping for the Darling Downs area.

Technical services included 1:10 000 topographic mapping; soil conservation plans (Moreton, Burnett and South Burnett regions); technical bulletin covers and diagrams; map displays; posters; brochures; property plans for the Western Arid Region; and general drafting.

Land resource mapping included: Moreton Region vegetation; Linthorpe-Darling Downs basaltic scrub soils; Bremer Catchment land degradation; Lower Burdekin-Barratta Creek-Houghton River soils; Millmerran-Moonie-Tara land use technical guide; Kalbar soils; Round Hill Head-Tin Can Bay estuarine inventory; Caboolture Shire Handbook; Gilruth Plains (Cunnamulla) vegetation.

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ROCKY POINT MILL - CANE GROWING AREA

LAND SUITABILITY

by G.K. Holz

Class I Suitable with no restrictions
Class II Suitable with slight restrictions
Class III Suitable with moderate restrictions
Class IV Suitable with severe restrictions

Suitability Class		Limitations		Dominant Soil Type
I - II, II		w2	wetness	medium textured humic gleys
II		w2	wetness	fine textured humic gleys
III		w3	wetness	peaty gleys
III		m3	moisture availability	siliceous sands
		n3	nutrient leaching	
III		f3	flooding	fine and medium textured humic gleys
		w3	wetness	
IV		w4	wetness	peaty gleys saline gleys
		s3	salinity	
		m3	moisture availability	
IV		e3	erosion	red-yellow podzolics
		e4		
		m3	moisture availability	
		m4		
Unsuitable			lowlands	peaty gleys saline gleys solonchaks
Unsuitable			uplands	lithosols red-yellow podzolics
Currently Assigned Land				

SCALE 1:50 000

Metres 1 000 0 1 2 3 4 Kilometres

LAND SUITABILITY REPORTS prepared by the Division of Land Utilisation in the sugar lands are being used by Local Authorities, Millers and Farmers to plan future expansion and prevent the loss of prime agricultural land, particularly in those areas close to mills.