QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

Annual Report 1978-1979

Presented to Parliament by Command

Soybean harvest in the Emerald irrigation area. Cotton, grain sorghum and sunflower are other major summer crops farmers are growing under irrigation. Wheat and safflower make up the bulk of the winter plantings.

An aerial view of the Emerald Field Station, just north of the town. Here, Department of Primary Industries research workers are assessing the profitability of summer and winter crops irrigated from the Fairbairn Dam.

A rice crop in head at Millaroo on the Burdekin, about 60 km upstream from Ayr. The Millaroo and Mareeba districts together produce Queensland's rice crop to almost 15 000 tonnes a year.

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Contents

Organization of the Department

as at 30 June 1979

MINISTER FOR PRIMARY INDUSTRIES .. Hon. V. B. Sullivan, M.L.A.

CENTRAL ADMINISTRATION AND CLERICAL AND GENERAL DIVISION—

Acting Director-General and Under Secretary	E. O. Burns, B.Com., F.A.S.A.
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Deputy Directors	B. A. Woolcock, B.V.Sc.; L. Laws, M.V.Sc.
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Husbandry Research Branch	—
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)
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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.
Dairy Cattle Husbandry Branch	I. H. Rayner, B.Econ. (Director)
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Queensland Department of Primary Industries

Annual Report 1978–79

To the Honourable the Minister for Primary Industries.

Sir,

I have the honour to submit the following report on the operations of the Department of Primary Industries for the year ended 30 June 1979.

Yours faithfully,

E. O. BURNS,
Director-General.

General Comments

MOST of Queensland's rural industries experienced an excellent season during 1978–79. The gross value of rural production increased by approximately 28% over last year to an estimated $1,814m.

Record and near record production was obtained from both the winter and summer grains and other seeds. The peanut, navy bean and soybean crops yielded well and the cotton planting was a record. Most horticultural industries also had a favourable year.

In addition, as a result of increased export market opportunities, cattle prices increased significantly and gave fresh incentives to producers.

Wool prices also improved in comparison with the previous year and good conditions in the dairy industry resulted in high levels of milk production being obtained.

Unfortunately, the sugar industry went through a depressed phase with very low world prices and restrictions on Australian exports by the International Sugar Agreement. Indications are, however, that prices should improve in 1979–80.

Weather conditions

Queensland's grain growing areas had excellent conditions during the winter season. Above-average falls were recorded during the first 3 months of the financial year. This, together with good pre-planting and planting rains in May and June of the previous year, enhanced the prospects for the record yields which were eventually realised. However, rain at harvest time in November and December provided an excess of moisture for a number of crops and a higher than normal proportion of lower quality grain resulted.

The rain in November and December, while being untimely for the winter crops, ensured a good start for the early-sown summer-growing crops. With the exception of the Atherton Tableland and adjacent areas, January and February were relatively dry and a number of crops suffered from moisture stress. The north, on the other hand, was drenched by rain from cyclones Peter and Greta in January and this also resulted in damage to a number of crops.

Conditions reversed somewhat in March. Most southern and central districts received above normal falls while the Atherton Tableland and associated areas experienced a beneficial period of cloudless warm days. These conditions resulted in good to excellent yields being obtained from summer crops in most districts.

At the beginning of the financial year, 33 Local Authority Areas were listed as drought affected. Good rain during July resulted in 12 of these being deleted from the list and, by the end of October, only seven shires on the north and north-west of the State remained in drought. Five of these were deleted during February and Etheridge and Flinders, the remaining two shires, were removed from the list in March.

Except for the south-west corner of Queensland and some dry pockets in the south-east, all districts in the State were experiencing good weather conditions towards the end of the year.

Fodder crops and pastures

Lucerne growth was generally good in most districts during the year and this resulted in satisfactory hay cuts being made. Aphid activity was high in most growing districts early in the year, but with spraying these pests were kept under control,

High cattle prices, especially in the second half of the year, gave fresh incentives to producers.

The winter grazing crops of oats and ryegrass reacted favourably to the good seasonal conditions and provided excellent forage. Also, because of the excellent growth of wheat and barley planted for forage, several areas of these crops were saved for grain production.

As a consequence of the improved prices for cattle, most graziers reduced their cattle numbers and grazing pressure on both native and sown pastures was reduced. Interest in pasture improvement increased throughout the year and significant new pasture plantings can be expected in the future in the more favourable areas.

Native and sown pastures in all Queensland districts, except those affected by drought, carried a fair body of forage at the beginning of the financial year. As the year progressed and drought districts received adequate rain, the quality of pastures improved. By the beginning of May 1979, pastures generally were in a satisfactory state with the exception of those parts of the Far South-West affected by lower than average rainfall.

Beef

Many areas of the State experienced excellent winter and spring conditions. However, rainfall was patchy during the latter part of the period and in the southern half of the State good general rain was needed in many areas.

Queensland's beef herd at 31 March 1979, estimated at 10 489 000 head, was 5% down on the 11 059 000 head recorded at 31 March 1978.

Since June 1978, cattle prices continued an upward trend as a result of short supplies in southern States, increased demand from Australia's major export markets and a decreasing national herd. Live-weight prices at Cannon Hill saleyards towards the end of the period reached a peak of 100·6c per kilogram for top quality bullocks and 101·4c per kg for top quality yearlings. A record $1.20 a kg liveweight was paid for an 18-month-old Santa Gertrudis milk tooth steer at the Miles Show.

The gross value of Australian cattle slaughtered or exported live for 1977–78 was estimated to be $1,205m which was a substantial increase on the 1976–77 value of $1,010·8m. Queensland's share, estimated at $289·1m for 1977–78, increased from the 1976–77 value of $252·7m.

Australian cattle and calf slaughterings increased from 11·98m in 1976–77 to 12·6m in 1977–78. Beef and veal production increased from 1 987 800 tonnes in 1976–77 to a record 2 129 500 tonnes in 1977–78. Net shipped weight of beef and veal exported increased from 645 900 tonnes in 1976–77 to 757 700 tonnes in 1977–78.

The number of cattle and calves slaughtered in Queensland increased from 2·83m in 1976–77 to 3·15m in 1977–78. Beef and veal production increased from 531 900 tonnes in 1976–77 to 594 600 tonnes in 1977–78. Beef and veal exports increased from 246 700 tonnes in 1976–77 to 271 500 tonnes net shipped weight in 1977–78.

The sale of selected cuts of packaged frozen meats in local retail outlets other than registered butcher shops was approved and introduced in July 1979.

The Australian Meat and Livestock Corporation introduced a simplified export control scheme for 1979. Entitlements to export beef and veal to the United States, Canada and Japan were based on the exporter's total performance in all markets during the preceding calendar years. There also was provision for entry to quota control markets by new exporters during their first year of operation. Late in the year, the provision of the scheme with respect to the Japanese market was removed.

The first shipment for 4 years of live cattle to Japan left Australia late in August.

President Carter vetoed legislation which potentially threatened to reduce U.S. beef imports from Australia and other countries in times of high U.S. domestic supplies. However, a further approach to the U.S. Congress is proposed for 1979–80.

The Queensland Meat Industry Organisation and Marketing Authority commenced a carcass classification trial on beef at the Bundaberg Public Abattoir and preparations were under way to commence an additional trial at a private meatworks at the end of the period.

Future developments in carcass classification will be assisted through the approval of the Commonwealth Government on the recommendation of the Australian Agricultural Council that—

- a once-only grant of up to $50,000 be made available to each state and the Northern Territory to assist in trials of manual beef carcass classification
- a supplementary grant of $190,000 be made available to Western Australia to extend manual beef carcass classification trials on a State wide basis
- a further amount of up to $50,000 be made available to Victoria to assist in achieving full operational status of semi-automatic beef carcass classification at Donald.

The Prices Justification Tribunal Report on the enquiry into beef marketing and processing was released in January 1979. The Report's main conclusion was: 'that the existing marketing system copes reasonably well with handling a difficult commodity'.

The Tribunal also found 'there was wide competition at all stages of the beef marketing chain' and 'discovered no significant areas of excessive margins or abnormal profits'.

The Tribunal took the view that there was considerable scope for improving the present marketing system and effecting cost and price reductions.

With respect to beef industry stabilization matters, the Bureau of Agricultural Economics, in a paper prepared for Agro 79 in Perth, stated that, although buffer fund schemes offered the best prima facie prospects for smoothing cattle prices, any such scheme would only smooth prices around the basic market trend.

The Bureau said that price stabilization and market intervention schemes did not appear to offer significant economic benefits at this stage in the development of livestock and meat marketing.

The main avenue for improvement in livestock selling was the refinement of direct selling systems and, in the longer term, the development of sight unseen trading methods.

Nevertheless, the Department in conjunction with the Queensland Meat Industry Organisation and Marketing Authority is continuing its research into beef marketing and stabilization matters and proposes to encourage significant industry discussion on these topics during 1979–80.

Trading in boneless beef futures began on the Sydney Futures Exchange towards the end of the period with contracts of 16 330 kg consisting of 600 cartons of boneless beef. These were packed according to United States Department of Agriculture and Australian Department of Primary Industry standards.

Three officers from the Queensland Department of Primary Industries and one officer from the Queensland Meat Industry Organisation and Marketing Authority began training in April for the new Meat and Livestock Market Reporting Service.

This new Service will report prices paid at saleyards for clearly defined types of animals described mainly in terms of their sex, age, weight and fat cover.

The Service will be introduced initially at Cannon Hill saleyards and will be expanded as soon as possible to other significant saleyards throughout the State.

The Department is collaborating closely with the Queensland Meat Industry Organisation and Marketing Authority in the training and developmental stage. The operation of the service will be the responsibility of the Authority.

Sheep

Pastoral conditions in Queensland's sheep producing areas generally were favourable. However, in many areas late summer rains did not produce substantial pasture growth and useful winter rains will be needed.

Preliminary figures released by the Australian Bureau of Statistics showed that the number of sheep and lambs in Queensland at 31 March 1979 increased by 1·3% on the number recorded 12 months previously.

Although the number of sheep (1 year and over) decreased from 11 085 000 to 11 030 000, the number of lambs increased from 2 353 000 to 2 581 000 during the period.

Lamb prices continued in an upward trend with one pen of prime lambs selling for $38·95 per head towards the end of the period. Prime light lamb prices increased markedly from between 90 and 95c to between 163 and 172c per kg dressed weight during the period.

The number of sheep and lambs slaughtered in Queensland decreased from 1 506 000 in 1976–77 to 1 480 000 head during 1977–78.

Mutton and lamb production also decreased from 26 190 tonnes in 1976–77 to 25 915 tonnes in 1977–78.

The upsurge in demand was reflected in a steady increase in wool prices during the year.

Wool

Wool prices at the end of the period generally ended on a high note although the Market Indicator had fallen from the seasonal high of 371c per kg clean in March to around 364c in May. Nevertheless prices were higher than those at the beginning of the period when the Market Indicator was around 310c per kg clean.

Due to an easing in demand for coarse wools the Market Indicator price fell in May but a firm demand for 19 micron wool pushed prices for this category to a new seasonal high of 469c per kg clean.

The dominant feature of the period was the significant increase in wool auction prices during the last 4 months especially during February and March when the Market Indicator rose from 320c to 371 cents per kg clean.

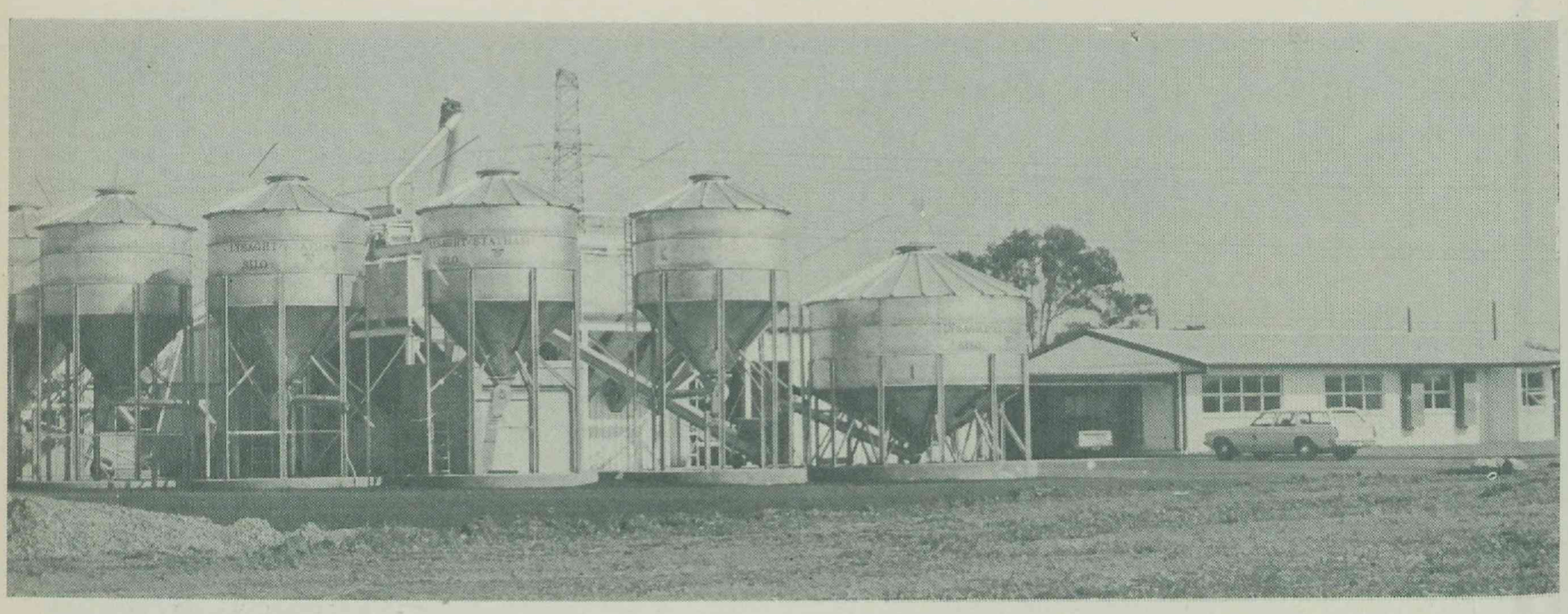
Reasons advanced for the upsurge in wool buying were—

- a possible new world oil crisis because of the Iranian situation. This would cause shortages of oil for heating and for synthetic fibre manufacture as well as rises in the prices of synthetic raw materials
- the end of the Japanese wool spinners' production cutback cartel.
- an exceptionally cold northern hemisphere winter had caused a firming in consumer demand for wool
- a threatened shearers' strike in most Australian States
- the continued devaluing of the Australian dollar against the yen and most European currencies, making wool relatively cheaper for overseas buyers.

Because of the increased demand, Australian Wool Corporation stocks fell from around 900 000 bales in June 1978 to around 400 000 bales at the end of May 1979.

Japan was Australia's main wool customer during the period.

Open mulga country in the Charleville area during the 1972 drought carried no forage, but made a remarkable recovery following good seasons and light stocking.



Feeding facilities at the Pig Research Centre, Wacol.

The Federal Government announced in June that the minimum floor price would be raised to a Market Indicator level of 298c per kg clean for the 1978–79 season and that the floor price scheme would be continued in 1979–80 at not less than 298c.

In a report early in the period to the Wool Industry Policy Committee, the Australian Wool Corporation recommended that the Corporation be the sole seller of wool to export markets. This would have meant acquisition of between 80 and 85% of the Australian clip. However, before the end of the period the Corporation had announced the pigeonholing of its acquisition plans because of industry division, political pressure and the heavy work load on Corporation staff. The whole acquisition debate is to go before the National Farmers' Federation Wool Council when it becomes operative.

The Australian Wool Production Forecasting Committee estimated Australian shorn wool production for 1978–79 to be 630·4 m kg and dead and fellmongered plus skin wool to be 65 m kg. Preliminary forecasts for 1979–80 was for shorn wool production to be 645 m kg and total wool production 710 m kg.

China applied for a Woolmark licence for permission to use the international wool symbol for marketing its textiles.

Due to the improved supply/demand situation for worsted yarn, the 21-month-old Japan Wool Spinners' Association's cartel was discontinued after the end of January.

Auction sales were held in Brisbane during 1978–79. A total of 323 454 bales was sold for an average price of 185·76c per kg.

The Australian Bureau of Statistics reported that Queensland wool production in 1977–78 at 59 272 000 kg was 8% less than the 64 395 000 kg produced in 1976–77. The number of sheep and lambs shorn decreased from 13 041 000 in 1976–77 to 12 913 000 in 1977–78 and average fleece weight fell from 4·54 kg in 1976–77 to 4·20 kg in 1977–78.

A trial involving a complete Brisbane catalogue was sold on a sale-by-separation basis in Sydney during March. A decision on the future of sale-by-separation had not been made by the end of May.

An analysis by the Bureau of Agricultural Economics into the implications of price stabilization by the Australian Wool Corporation indicated growers lost about $250 each per year between 1974 and 1978. These losses arose from larger operating costs of the reserve price scheme and in interest and storage charges which outweighed the small trading surpluses derived from the sale of stocks.

The two main conclusions were—

- the reserve price scheme and build-up of buffer stocks had reduced auction price variability
- the reduction in variability was achieved at a cost of loss of revenue from wool sales of $91m and possibly more over the 4-year period.

Another Bureau report dismissed suggestions that private wool buying had upset the pricing efficiency of the overall wool market and pointed out that in many cases growers would have been better off selling their wool privately.

Pigs

Queensland's pig population, estimated at 485 000 at 31 March 1979, increased 4·7% on the 463 000 recorded at 31 March 1978.

The number of pigs slaughtered in Queensland increased from 703 000 in 1976–77 to 747 000 in 1977–78. Pigmeat production increased from 17 265 tonnes in 1976–77 to 21 199 tonnes in 1977–78.

Estimated gross value increased from $43·121m in 1976–77 to $46·874m in 1977–78.

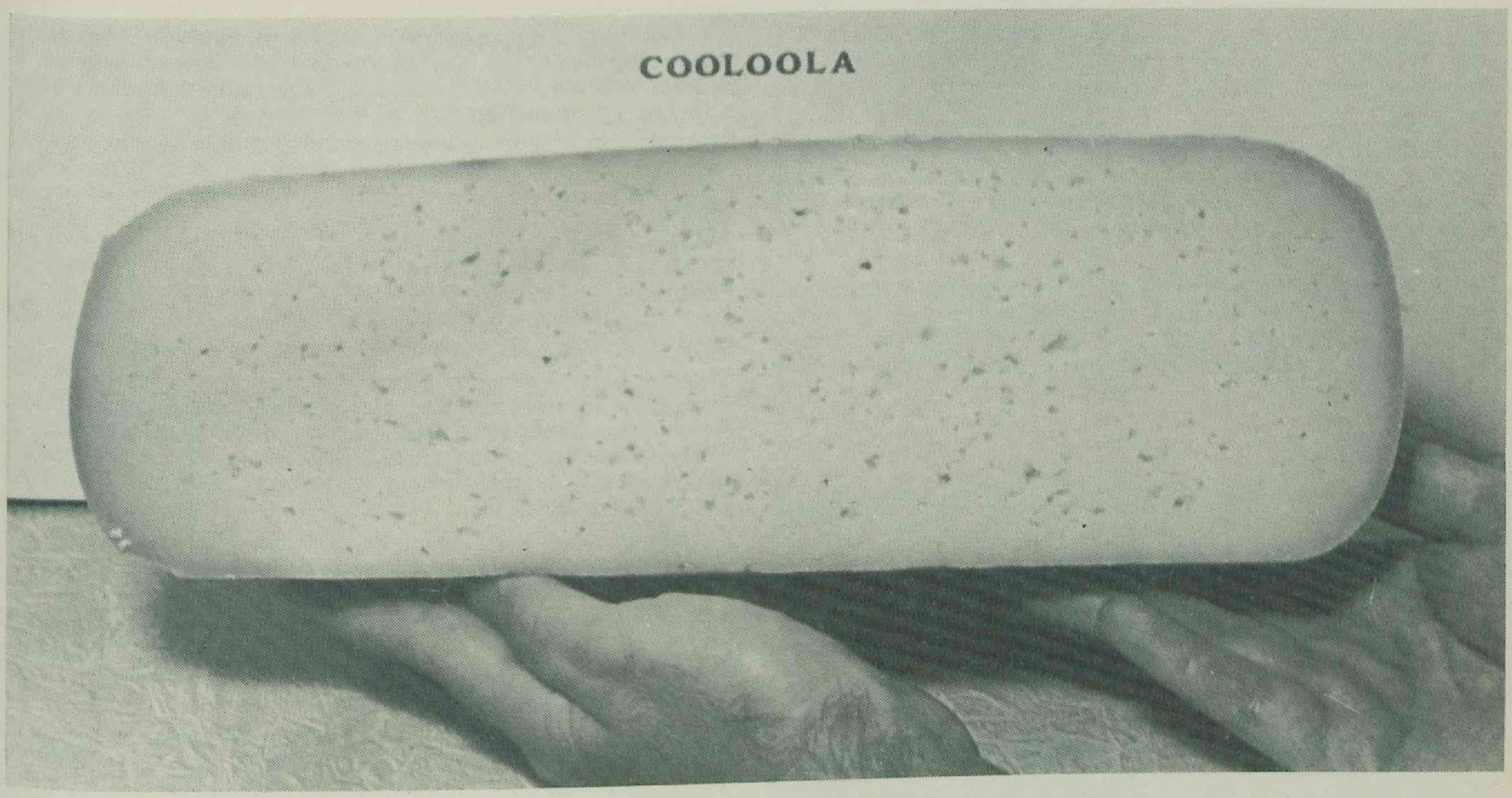
Although wheat and barley feed supplies were short at the beginning of the period, record crops in both grains during the period ensured more than adequate supplies were available in the latter half of the period.

First advance payments for prime baconers by one processor rose from 104c per kg dressed weight at the beginning of the period to around 144c per kg near the end of the period. First and final payments by other processors increased to around 151c per kg while auction prices for prime light baconers rose from between 116 and 120c per kg to between 155 and 159c per kg by the end of the year. The increase in production which occurred during the 12 months resulted chiefly from expansion in established piggeries.

Dairying

Production of wholemilk for all purposes increased during the year, indicating a recovery from the severe drought conditions of the previous year. Butter production increased to an estimated 5 750 tonnes compared with 4 839 tonnes in 1977–78. Cheese production increased from 9 503 tonnes in 1977–78 to an estimated 12 500 tonnes.

Camembert cheese in the ripening room at the Warwick factory.



Cooloola cheese, a new product developed at the Otto Madsen Dairy Research Laboratory.

The export markets for most manufactured products have improved somewhat, particularly in relation to cheese. With the decline in Australian butter production, less reliance has had to be placed on bulk export markets. World dairy surpluses of butter and skim-milk powder continue to persist and E.E.C. stocks are particularly high.

Marketing arrangements for prescribed manufactured products operating for 1978–79 involved a system of selective underwriting of manufactured products by the Commonwealth Government. A ceiling was placed on the quantity of butter on which underwriting payments would be made. Production quotas were allocated to factories. Production in excess of quota would receive only the average export price. Some Queensland factories have been substantially affected by these arrangements.

In its first year of operation, the Milk Entitlements Committee will have distributed approximately 37 000 litres of market milk entitlements to below-average processors in South-east Queensland. The available milk has come from 'drop-out' milk and from market growth. The State Government has assisted in the transfer scheme by making available $1·75m in low interest loan funds to enable eligible processors to purchase entitlements.

Poultry

Egg production controls continue to be the most important influence on the industry's outlook.

Improvements in farm management and investment in new technology have continued to increase egg production per hen. Despite a quota cut in southern Queensland during

Portion of the Poultry Section's display at the Rocklea Poultry Research Farm's Jubilee Field Day. Staff member Mr Ken Orange (third from left) is demonstrating equipment for checking ammonia levels, air movement and temperature in poultry buildings.

the year, production in the area increased by about 2% over 1977–78. Egg sales by The South Queensland Egg Marketing Board increased by about 2% over the previous year.

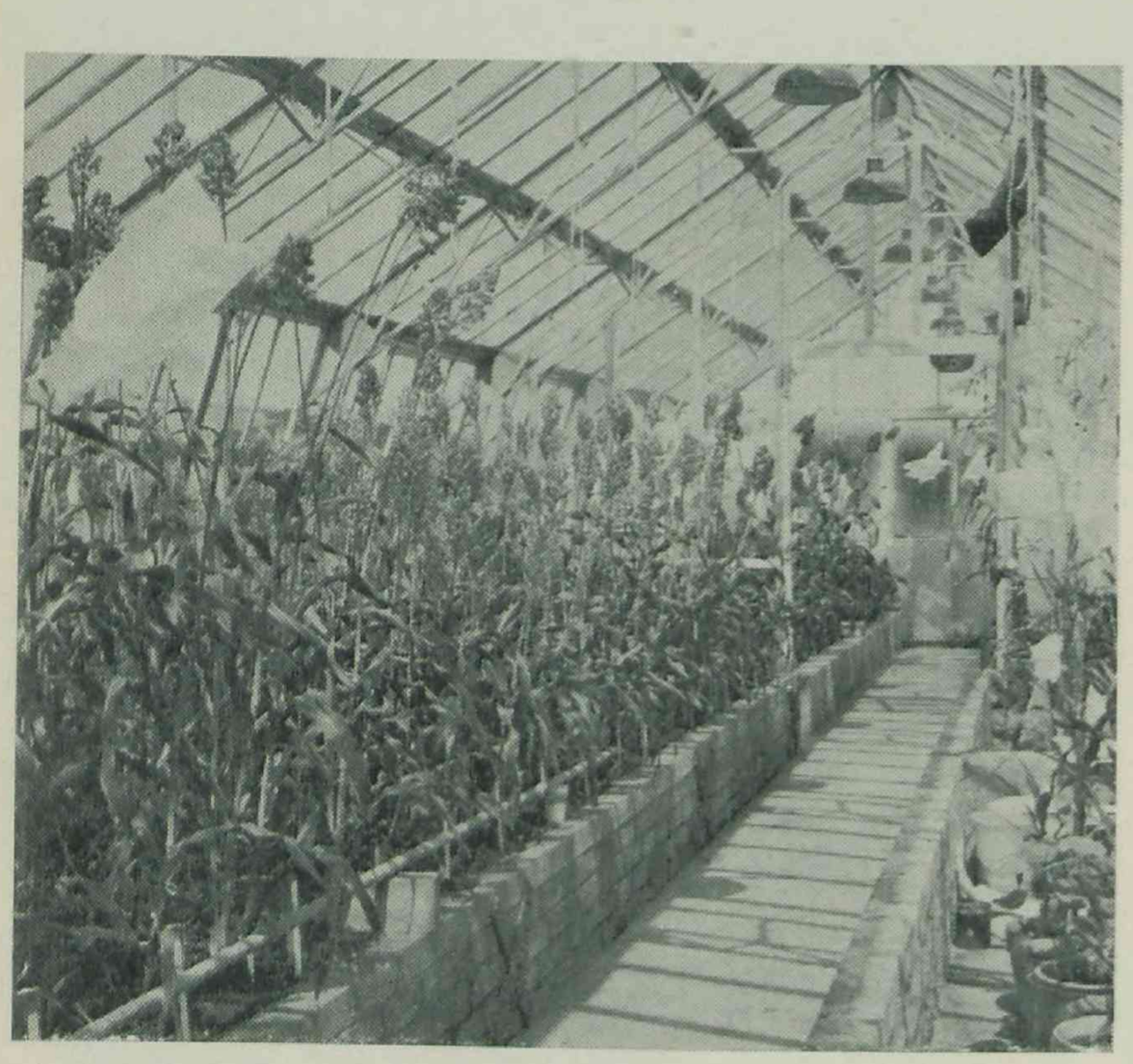
With the continued upward trend in egg production per hen, the industry has announced a quota reduction of some 150 000 hens for a 6-month period from 11 August 1979 in South and Central Queensland and from 14 July 1979 in North Queensland.

A controlled transfer of quota scheme was introduced during the year. This gives most 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.

Poultry meat

The Chicken Meat Industry Committee completed its third year of operations during 1978–79. The Committee has proved to be a valuable forum at which the interests of both broiler growers and processors can be discussed.

The value of slaughterings during 1978–79 was estimated at $38·1m compared with $28·6m in 1977–78.



The sorghum breeding programme at the Hermitage Research Station continues in the glasshouse during the winter.

Grain crops

During 1978–79, excellent growing conditions were experienced in all grain producing districts and resulted in record wheat and barley crops. However, rain at harvest had an adverse effect on wheat quality.

WHEAT. Wheat production in 1978–79 is estimated to be a record 1·95m tonnes from a planting of 722 000 ha. This is 77% higher than the previous record harvest of just over 1·1m tonnes in 1968–69.

The distribution of receivals at State Wheat Board depots by grades in 1978–79 was—

Classification	Percentage
Prime Hard	6·4
No. 1 Hard	22·2
Australian Standard White	29·0
No. 2 Hard	7·9
General Purpose	33·6
Seed	0·9
TOTAL	100·0

The export market remained relatively strong throughout the season. Despite Australia's record harvest of over 17m tonnes, Australia is unlikely to export more than 11m tonnes before the commencement of the next intake and therefore Australia's record harvest has had little effect on international prices.

Growers' returns from the 1978–79 crop are expected to be above last season's estimate of $85 per tonne, port basis.

BARLEY. Production of the 1978–79 barley crop was forecast at a record 500 000 tonnes from a sowing of 235 000 ha. This compares with 216 305 tonnes from 200 235 ha in 1977–78.

The large crop resulted in record receivals by The Barley Marketing Board of 486 000 tonnes and record exports of 388 000 tonnes. The following Table shows Barley Board receivals by grade for the 1978–79 season.

Grade	Percentage
Malting	24·5
Manufacturing	49·5
Feed	24·6
Seed	1·4
TOTAL	100·0

GRAIN SORGHUM. Due to excellent weather conditions during the growing season, grain sorghum production in 1978–79 was estimated at 629 000 tonnes from 292 000 ha. This was a vast improvement on the 1977–78 crop of 503 992 tonnes from 293 145 ha.

Because of its current intake, The Queensland Grain-growers' Association has the potential to export in excess of 250 000 tonnes compared with 68 000 tonnes in 1978.

The Central Queensland Grain Sorghum Marketing Board estimates receivals in 1978–79 to reach 170 000 tonnes of which 150 000 tonnes will be exported. Last season 180 000 tonnes were exported from receivals of 194 000 tonnes.

MAIZE. From estimated sowings of 32 000 ha, maize production in 1978–79 was estimated at 99 000 tonnes. In 1977–78, 28 733 ha produced 79 594 tonnes. Production on the Atherton Tableland is expected to approximate last year's level of 25 000 tonnes.

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

Oilseeds

Due to improved seasonal conditions, production of safflower in 1978–79 was estimated at 32 000 tonnes from 40 000 ha. This compares with the 1977–78 crop which produced 18 540 tonnes from 23 466 ha. Returns to growers in 1978–79 are expected to approximate $180 per tonne delivered processors' plant, compared with $190 per tonne in 1977–78.

Production of linseed in 1978–79 is estimated at 3 000 tonnes from 3 000 ha compared with 6 539 tonnes from 13 225 ha in 1977–78. Returns to growers are expected to approximate $200 per tonne delivered processors' plants, compared with $210 per tonne in 1977–78. Improved prices for wheat and barley were probably a factor in the reduction of area planted to linseed.

Because of the switch from grain sorghum especially in central Queensland, the area planted to sunflower in 1979 is estimated at 164 000 ha compared with 133 610 ha in 1978. Production is estimated to reach 128 000 tonnes compared with 101 572 tonnes in 1978. Returns to growers are expected to approximate $200 per tonne delivered processors' plants compared with $220 per tonne in 1977–78.

The area planted to soybeans in 1979 is estimated at 40 000 ha compared with 36 708 ha in 1978. Production is estimated to reach 63 000 tonnes compared with 51 263 tonnes in 1978. Returns to growers in 1979 are expected to average $220 per tonne delivered processors' plants compared with $240 per tonne in 1978.

Sugar

Crops in north Queensland responded well to excellent growing conditions and, at the commencement of the harvest, it was expected that substantial over-peak tonnage would be available. The crop also grew well in irrigated regions around Mackay and the Burdekin but from the Bundaberg region to the border excessively wet conditions retarded growth.

Crops around Maryborough and Isis were hardest hit. Rain on an intermittent basis delayed harvesting and depressed the C.C.S. content in most areas. Winds which accompanied the rain also caused some crop damage.

Large amounts of cane were left unharvested as a result of the restrictions of the International Sugar Agreement (I.S.A.) and young and ratoon crops were either destroyed or damaged as a result of floods from cyclone Peter which struck far-northern areas in early 1979. Overall the year could be described as difficult after an encouraging start.

In Queensland during 1978, 20·136m tonnes of cane were harvested for milling from which 2·75m tonnes of 94 net titre sugar were produced. This compares with the record results in 1977 when 22·331m tonnes of cane harvested produced 3·209m tonnes of 94 nt sugar.

The productivity values were 84·38 tonnes of cane and 11·52 tonnes of 94 nt sugar per ha. In the previous year, the corresponding values were 79·63 tonnes of cane and 11·44 tonnes of 94 nt sugar per ha.

The weighted average C.C.S. content in Queensland during the 1978 season was 13·47% which was 0·86 of a point less than the 1977 result of 14·33%.

Total Australian cane production for the year was 21·458m tonnes which produced 2·902m tonnes of 94 nt sugar. This was well below the 1977 record level of 23·493m tonnes of cane and 3·343m tonnes of 94 nt sugar.

Queensland's gross industry income fell during 1978–79 due to continuing low world prices and restrictions on exports under the obligations of the I.S.A. Gross income is estimated at $342·5m compared with $410·7m in 1977–78. The No. 1 Pool price is expected to be above the final price of $196.40 for the 1977 season as a result of a $30 per tonne increase in the domestic price granted in May 1978. No. 1 Pool price is estimated to be in the range of $200 to $210 per tonne and the excess sugar price at between $130 and $140 per tonne.

Exports during the calendar year 1978 totalled 1·89m tonnes raw sugar compared with 2·80m tonnes raw sugar for the same period in 1977. Australia's obligations under long term contracts accounted for approximately 1·2m tonnes of total raw sugar exports.

The marketing scene has been dominated by the restrictions imposed under Australia's obligations to the International Sugar Agreement. Despite the delay in the U.S.A. ratifying the Agreement most I.S.A. members fulfilled their obligations during the year. In Australia this resulted in an estimated 2·5m tonnes of cane remaining unharvested.

While I.S.A. restrictions continue to dominate the production aspects of the industry, the Report of the Committee of Inquiry on the Sugar Industry had significant long term repercussions on the industry.

The Industries Assistance Commission's Committee of Inquiry of Mr W. A. McKinnon (Chairman), Mr C. L. Harris and Mr R. S. Livingstone was established in May 1978 to inquire into various aspects of the industry including the appropriate level of the domestic price, the method of price adjustment and the terms of an agreement to replace the Sugar Agreement 1975 which expires on 30 June 1979.

The Inquiry followed an industry submission for an increase of $80 per tonne in the domestic price of sugar. Negotiations between the State and Commonwealth Governments resulted in an interim increase of $30 per tonne and the initiation of the Inquiry.

The Committee's Report was tabled in the Queensland and Federal Parliament on 5 April 1979. Among other things it recommended an $80 increase in the domestic price of sugar and the establishment of a three-man Committee to review the domestic price at least annually. Important changes were also proposed for the Queensland/Commonwealth Sugar Agreement. However, the important section of the Agreement including the sugar embargo and crop acquisition was not changed significantly. The recommendation of an $80 per tonne increase in the price of sugar sold on the domestic market was implemented in May 1979.

In the course of its investigation, the Committee received submissions from growers, millers, manufacturers and consumers. Its report drew particular attention to the rebate system presently operating for domestic users of sugar. Overall, it is expected that the report will be of long-term benefit to the industry.

Peanuts

The area planted to peanuts in Queensland for the 1979 season is estimated at 37 000 ha which is some 7 000 ha or 24% above the previous season's level. This increase reflects an expansion of peanut plantings in north Queensland and good seasonal prospects at planting time in south Queensland.

The Queensland peanut crop for 1979 is forecast at a record 54 000 tonnes. This is based on the area estimates and expectations of above normal yields in the major producing area and compares with 38 295 tonnes harvested in 1978 and the previous record of 45 774 tonnes in 1972.

Receivals by The Peanut Marketing Board during 1979 are estimated at between 40 000 and 45 000 tonnes of nut-in-shell. Based on these estimates, the exportable surplus of whole kernels this season could total between 7 000 and 8 000 tonnes. Prospects for the export trade are currently good, with Hong Kong and New Zealand being prominent buyers. The Board is also concentrating on the United Kingdom and the continental markets which offer an assured trade in high-quality peanuts on a continuing basis. Exports to the Middle East may increase significantly as consumer requirements in these countries have risen considerably this year. Average returns to growers in 1978–79 are expected to approximate last season's level of 40c per kg.

Pulling scrub in ironbark-box-sandalwood country at Brigalow Research Station, Theodore.

Navy beans

For the 1978 season, production of navy beans is placed at a record 8 060 tonnes from a record planting of 10 089 ha. With a lower first advance for the 1978 crop and an expected carryover of beans by The Navy Bean Marketing Board growers curtailed their plantings to an estimated 5 000 ha which is expected to produce 4 400 tonnes in 1979.

Returns to growers for the 1978 season are expected to reach 40c per kg, slightly less than the 1977 season's expected return.

Rice

The rice industry continued to expand in 1978–79 due to the availability of adequate land and water supplies, generally favourable weather conditions and the stable returns for rice compared with alternative crops in both the Burdekin and Mareeba districts.

The 1978 winter rice harvest produced a final tonnage of 5 500 tonnes from a planted area of 1 382 ha, which represented a yield of 3·98 tonnes per ha. This was a significant improvement on the previous winter crop of 3 012 tonnes of paddy from 1 212 ha with a yield of 2·48 tonnes per ha. Weather conditions were satisfactory during the planting, growing and harvesting periods and this fact, together with a reduction in intake moisture levels, resulted in higher yields and an improvement in overall crop quality. Final payments to growers are estimated at $160 per tonne compared with $138 per tonne in 1977.

Studies on long-grained rice at the Millaroo Research Station.

Harvesting of the 1978 summer crop commenced in mid November, a month earlier than at the previous summer harvest. This was due principally to earlier plantings as a number of growers planted in late May rather than June. The total intake reached 9 000 tonnes of paddy from a planted area of 1 880 ha to give an average yield of 4·79 tonnes per ha.

Production and yields could have been higher but for adverse climatic conditions which hampered the late harvest. Production was significantly up on the previous summer harvest which produced 6 727 tonnes from 1 370 ha, although yields were higher in 1977. The expected final payment to growers at $150 per tonne is similar to that for the previous season.

The 1979 winter harvest is expected to yield around 8 000 tonnes of paddy from a planted area of 1 600 ha.

Tobacco

Sales of tobacco leaf during the 1978 Queensland selling season amounted to 7 579 537 kg of leaf at an average price of 358·4c per kg and a gross value of $27·2m. This compares with 7 870 884 kg sold at the 1977 sales for a gross value of $27·8m and an average price of 353·4c per kg.

The Queensland Marketing Quota for the 1978 sales which represents 53% of the Australian quota was shortsold by approximately 9·6% following a decision by the Australian Tobacco Board to reduce the Australian marketing quota. This follows a continuing decline in the consumption of tobacco products and resultant stock increases, which resulted principally from increases in excise on tobacco products and a substantial increase in the import of certain manufactured products.

The 1979 selling season will be the first year of the newly re-negotiated Tobacco Industry Stabilisation Plan. Under this Plan the Australian quota will be 15·3m kg for 1979. The minimum average reserve price has been increased from 362c per kg for 1978 to 377c per kg for 1979.

Both the quota level and price movements are reviewed each year in accordance with movements in consumption, stock holdings and farmers' costs of production.

Cotton

Except for 1975–76, cotton production in Queensland has consistently increased since the 1974–75 season. During this short span of over 5 years, production of ginned lint cotton has increased by more than 50% from the 26 427 bales produced in 1974–75 to 41 522 bales in 1977–78. Production is expected to set a new record in 1978–79.

The output of ginned lint cotton in Queensland in 1978–79 is estimated at 58 000 bales compared with the previous peak of 41 522 bales in 1977–78 and 31 196 bales in 1976–77. By 1979–80 the Queensland cotton crop may be up to 65 000 bales, as cotton plantings are expected to expand further in the Emerald Irrigation Area.

Nearly three-fifths of the 1978–79 cotton crop in Queensland is expected to be produced in central Queensland. In the Emerald Irrigation Area, cotton production has increased dramatically to an estimated 18 000 bales, compared with the 7 580 bales harvested in 1977–78. Increases in production are also expected in the Biloela and Theodore districts where the combined output is projected at 16 000 bales, almost 50% more than the previous season's output of 10 360 bales.

Cotton production in south Queensland is expected to increase by about 3% to 24 000 bales in 1978–79, mainly because of improved yields per ha.

In south Queensland, the yield of cotton during 1977–78 ranged from 719·04 kg per ha in the Lockyer Valley district up to 1 099·63 kg per ha on the Darling Downs. This compares with 952·4 kg per ha and 868·5 kg per ha respectively in 1976–77. Yields of cotton during 1978–79 are expected to average 945 kg per ha on the Darling Downs and 1 112 kg per ha in the St. George district.

The average yield in the major cotton growing regions of Queensland is estimated at between 1 028 kg per ha and 1 112 kg per ha in 1978–79.

Regarding prospective production in Australia for the 1978–79 season, the output of ginned lint cotton is expected to reach 247 000 bales, comprising 189 000 bales in New South Wales and 58 000 bales in Queensland. If realized, Australian production this season would be about 27% more than the previous record 196 633 bales in 1977–78.

On the basis of the production estimates of the Australian crop, the current assessment is that sales of Queensland-grown cotton on the Australian market may total about 15 000 bales, leaving around 43 000 bales for export in 1978–79. In 1977–78, Queensland exported 24 000 bales of cotton.

One reason for the upward trend in cotton exports has been the decline in the mill use of raw cotton in Australia. Mill consumption in Australia has been restricted by increasing demand for man-made fibres, particularly through a higher ratio of polyester staple in blends, as well as by intensified competition from textile imports. This included 17 362 bales of Australian imports of high grade, strong cotton with staple length of over 1⅛ inch. For 1979, Australian requirements are estimated at only 88 000 bales of raw cotton.

World market prospects are encouraging. The world's consumption of cotton during 1978–79 is projected to increase by between 1m and 1·05m bales from the previous season's level of 60·5m bales. The increase in consumption will be concentrated in Asia, with Japan, the Republic of Korea, Thailand and India accounting for much of the expansion in trade. This increase in demand for cotton should ensure a relatively high level of expansion in trade for Queensland grown cotton, which is expected to reach 43 000 bales, nearly double that in 1977–78. The export business will be largely with South East Asia.

Prices on the world cotton market strengthened towards the end of 1978 in response to strong demand and some concern over supply. The Liverpool C.I.F. Index for Strict Middling 1 1/16 inch cotton rose to U.S. 80·60c per lb (Aust. 166·07c per kg) in December 1978. This was the highest level for 1978. After declining throughout January and early February 1979, the Index again displayed an upward

Young emus thrive on recently cleared brigalow country. All D.P.I. research stations participate in fauna studies.

trend, increasing to U.S. 77·05c per lb (Aust. 159·11c per kg) in mid February. However, prices fell in March and the downturn continued into April with most of the decline occurring in the second half of the month. The lowest weekly average price was U.S. 73·20c per lb (Aust. 155·54c per kg) on 20 April. The price has since increased to U.S. 76·20c per lb (Aust. 162·22c per kg) for the week ended 4 May 1979.

The average return to Queensland cotton growers during 1977–78 was $237 per bale or $1.05 per kg, including 13·33c per kg from oil milling proceeds. For 1978–79 the average return to growers is estimated at around $260 per bale or $1.16 per kg.

Ginger

Production of ginger from the 1978 crops totalled 3 570 tonnes from 125 ha. This compares with 4 151 tonnes from 115 ha the previous season. Adverse seasonal conditions reduced the harvest during 1978 and some difficulties were experienced in meeting orders from local and overseas markets.

Production is expected to recover to around 5 800 tonnes in 1979 from a planting of about 150 ha.

The Buderim Ginger Growers' Co-operative Association has experienced a record of profitability for several years which reflects the strong growth in both domestic and export sales that has occurred. This trend is expected to continue in 1979.

Fruit and vegetables

Special relief measures were provided for fruit and vegetable farmers whose properties were damaged by cyclone Peter and the resultant adverse weather influences experienced in the far north of the State from late December to mid January. Assistance was provided in the form of low interest rate loans. More than 400 farmers experienced moderate to severe damage to their crops and losses were estimated at approximately $6·4m.

Farmers in the Gayndah area also suffered crop losses ranging from 10% to 100% of individual crops when a hail storm accompanied by strong winds hit the area on 1 December 1978. Low interest rate loans also were made available to farmers affected by the storm.

The level of apple prices in the first six months of 1978–79 was substantially higher than for the same period in the previous year. Apple production from this year's crop is estimated at 2m cases compared with a pick of 1·6m cases last season. Overall, the prospects for exports to the U.K.-Europe market in 1978–79 have declined due to the heavy European crop harvested in late 1978. However, the suspect quality of the European harvest may enable better quality exports from southern hemisphere countries to fetch reasonable prices.

Redlands Long White cucumber, a new variety recently released to the industry, has high mildew resistance coupled with a flavour similar to that of Crystal Apple. The variety is in keen demand by growers and consumers.

Cassava varieties in the Burdekin district have potential for stock fodder, starch and alcohol production.

The intake of pineapples for processing during 1978 totalled 88 855 tonnes compared with an intake of 81 735 tonnes in the previous year. Despite the increase in production, supplies were insufficient to satisfy completely Australian market requirements for canned pineapple products. Consequently, plantings have shown an increase during 1977 and 1978 and, given normal seasonal conditions, supplies should be adequate from 1979 onwards.

An officer of the Department attended the inaugural convention of the Australian United Fresh Fruit and Vegetables Association held in Sydney in May. The Association represents all industry sectors concerned with the production and marketing of fresh produce and, through increased communication and co-operation, hopes to provide a national forum for the various sectors of the industry to promote policies that will benefit the industry throughout Australia. The General Manager of the Committee of Direction of Fruit Marketing was elected to the position of National President at the convention.

The Federal Government announced a decision in March this year following consideration of the Industries Assistance Commission's Report on the Australian Citrus Industry. The Government decided that the industry could be assisted by way of a variable tariff on imported orange and tangerine (including mandarin) juices. The duty on other citrus products is to remain unchanged.

A Potato Research Conference held in Victoria in March, and which was attended by representatives from all States, examined various production and marketing aspects associated with the distribution and sale of potatoes in Australia.

The Department continued to be represented at meetings of the National Vegetable Panel during the year. The Panel has kept the imports of processed vegetable products under close surveillance especially in the light of the rising level of frozen pea imports from New Zealand.

General

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 or studies 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.

Acknowledgement is made to the many organizations and private firms who have 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 each year, the opportunity is taken 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.

Technical sections which follow in this report are necessarily restricted in the amount of data which can be presented. Persons seeking greater detail are invited to contact the appropriate Branch of the Department.

Clerical and General

THE total clerical staff of the Department at 30 June 1979 was 565 officers, of which 373 were stationed in Brisbane and 192 were stationed in country centres. While there was an overall reduction of three positions in Brisbane staff during the year, Public Service Board approval was obtained for an additional three positions in country centres.

A total of 72 officers resigned or were transferred to other Departments during the year. Of these, 49 were in Brisbane and 23 in country centres. All have been replaced or will be replaced in the near future.

The Department's policy of transferring clerical staff to gain further experience has been given further effect, and 84 officers were either transferred or promoted during the year.

Study Assistance Scheme

During the 1978 academic year, 294 officers were undertaking approved study courses ranging from Senior to Doctor of Philosophy. Of these, 49 officers completed or discontinued their course. An additional 50 officers have submitted applications for course approval commencing in the 1979 academic year, and 76 officers have amended their previously approved course.

During the financial year 1978–79, reimbursement of fees totalling $3 578 was made to 98 officers.

Resignations and retirements

It is noted that Mr A. A. Ross, former Director-General who retired last year, was awarded the Imperial Service Order in the Queen's Birthday Honours.

During the year, six officers retired on reaching 65 years of age. In addition, 60 officers took advantage of alterations to the superannuation provisions and resigned before reaching age 65.

Two notable retirements were those of Messrs L. G. Newton, Director, Division of Animal Industry; and V. R. Smythe, Director, Division of Dairying.

Mr L. G. Newton joined the Department as a Cadet in 1934 and pursued a career in both the field and laboratory before spending the last 20 years in veterinary administration at Branch and Divisional level.

Mr V. R. Smythe commenced duty as a graduate bacteriologist during the war years. He played a major role in the development of dairy research in the State. He specialized in quality assurance programmes for the cheese and market milk industries.

Other senior officers who retired included Messrs H. J. Evans (Assistant Under Secretary), A. T. Bell (Director of Sheep Husbandry), K. McD. Grant (Director of Veterinary Services), H. M. Groszmann (Director of Horticulture), J. L. Groom (Director, Information and Extension Training Branch), H. S. Pink (Director, Soil Conservation Branch) and S. W. Ivers (Assistant Director, Marketing Services Branch).

Fifty-two other officers who have given many years of service to the Department have also retired.

They were—Messrs S. C. Royes, A. Hopsick (Administration); Miss U. V. Webster (Dairy Research); Messrs N. McCabe (Beef Cattle Husbandry Branch); D. W. N. Jackson (Information and Extension Training Branch); J. E. Bean, A. A. Clarke and T. O. Mulhearn (Standards Branch); R. G. Bonser, M. McD. Dick, A. Gibson, F. F. Nimmo and S. E. Powell (Veterinary Services Branch); L. J. Browning (Dairy Cattle Husbandry Branch); M. R. Buck, I. J. L. Wood, G. F. Filet and R. G. Wilson (Agriculture Branch); R. E. Chancellor, C. E. A. Langberg, G. T. Schlecht, W. F. Snewin, E. S. Wilbraham and A. V. Young (Slaughtering and Meat Inspection Branch); V. T. Clow, D. A. McDonald, C. L. W. Morey, M. Mowry, P. J. O'Sullivan and W. A. C. Ross (Pathology Branch); J. C. Elich, M. J. Hurley, R. F. Lovelady, J. J. Ludlow, E. E. Neilsen, A. E. Smith, K. E. Wade and M. J. F. Varendorff (Horticulture Branch); A. G. Colborn, R. R. Fanning and J. Stephenson (Dairy Field Services Branch); E. J. H. Glavimans, N. L. Howarth, R. F. Kelsey and A. F. Skinner (Soil Conservation Branch); E. J. McDonald and G. Short (Marketing Services Branch); G. V. Ricketts (Agricultural Chemistry Branch); J. E. L. Robb (Accounts Branch); A. J. Griffin (Research Stations Section); and Mrs S. E. Fitzgerald (Plant Pathology Branch).

There were 145 other resignations during the year.

Accommodation

Head Office staff from the old William Street Building occupied five floors of modern office accommodation in Mineral House, 41-59 George Street, Brisbane. The Departmental Library, Photography Section, Duplicating Room, Carpenter and Stores have, of necessity, remained in the old building. This ended an 81-year old association with the William Street address.

The new Biochemistry Building at the Animal Research Institute, Yeerongpilly, was completed and occupied late in 1978.

Construction of Stage 1 of the Office-Laboratory Complex at Mareeba was finalized in April and staff have since been located at the new centre. The completed buildings house laboratory facilities of a standard equal to any in Australia. Completion of the first stage makes it possible to achieve better co-ordination of the range of services offered by the Department to north Queenslanders.

A Conference and Training Centre has been built at Toowoomba and will become operational soon.

Finance

The year saw another determined effort by staff to retain existing services in an atmosphere of financial constraint. Fortunately no new areas of financial activity were necessary.

The acaracide subsidy scheme operated on a reduced rate in the final months and was ceased on 30 June.

Assistance to the cattle industry under this scheme amounted to $906,877 for the year.

Natural Disasters again placed heavy demands on State finances and assistance to the rural sector reached $2,373,659.

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

Service	1977–78	1978–79
	$	$
Payments authorized by Special Acts—		
Grant in aid of the Stock Fund	445,536	..
Grant in aid of Banana Industry Fund	36,452	34,980
Department of Primary Industries—		
Salaries	20,170,339	21,328,355
Contingencies	18,072,257	20,017,601
TOTAL	$38,724,584	$41,380,936

Trust and Special Funds

The following table summarizes expenditure from Trust Funds as compared with 1977–78—

Name of Fund	1977–78 Expenditure	1978–79 Expenditure
	$	$
Department of Primary Industries Special Standing Fund	8,570,988	11,628,587
Banana Industry Fund	90,642	62,259
Commonwealth Agricultural Services Extension Fund	2,255,357	1,929,395
Commonwealth Poultry Industry Assistance Fund	1,125,897	1,399,040
Commonwealth Soil Conservation Fund	14,185	70,964
Dairy Pasture Subsidy Fund ..	69,161	45,344
Meat Inspection Account	1,907,375	2,172,572
Meat Research Trust Fund	421,567	379,660
Potato Marketing Fund	..	..
Poultry Industry Fund	456,459	454,864
Stock Compensation and Stock Improvement Fund	11,494	10,461
Stock Fund	9,399,021	9,849,985
Sugar Cane Prices Fund	1,101,057	1,188,574
Swine Compensation Fund	26,496	9,301
Tobacco Research Fund	546,819	533,849
TOTAL	$25,996,518	$29,734,855

Receipts credited to Trust Funds amounted to $30,504,738 as against $25,792,418 in 1977–78.

Information and Extension Training Branch

INFORMATION and Extension Training Branch has the following principal functions—(1) to disseminate agricultural information to the community, with special emphasis on the rural sector; (2) to undertake training activities for the development of departmental staff in both management and extension methods; (3) to provide photographic, art, duplicating and library services for the Department.

In the Information Section of the Branch, the major effort was again directed towards increasing the mass media coverage of agricultural information. The principal target was the rural sector, but information of general interest to the whole community was also provided.

In the Training Section, the trend towards greater emphasis on management development training, which was evident the previous year, was further developed. At the same time, training in extension methods has been actively continued.

Organization and staff

At 31 May 1979, the total staff of the Branch stood at 65. Of these, six were officers of Public Relations, Government News and Information Services, Premier's Department, 14 were librarians from the State Library and one was a printer from the Government Printing Office.

Information section

EDITORIAL. The *Queensland Agricultural Journal* remains the Department's principal extension publication. Six issues were published in 1978–79.

The articles prepared by Departmental officers are circulated on a distribution list of more than 8 000 who are made up of primary producers, private and public companies, libraries, educational institutions and the public.

In the last 12 months, 106 articles were published.

The *Queensland Journal of Agricultural and Animal Sciences* was issued on a six-monthly basis. All papers submitted for publications are now assessed by external referees, mostly from Australian Universities and C.S.I.R.O.

Editorial staff co-operated with Branches in editing and producing a total of 133 Farmnotes and 67 Refnotes during the 12 months.

These leaflets are proving the most efficient, speedy and economical method yet employed by the Department in conveying written agricultural information to producers.

Editorial staff was also involved, with Branches, in producing books for use by farmers. A two-volume *Handbook of Plant Diseases* was completed during the year and is being eagerly sought by farmers, agribusiness firms, and research and extension workers. The *Weeds of Queensland* was ready for the printing press at the end of the year. Another book, *Ferns of Queensland,* was typeset by the end of the financial year.

The editorial section also had major commitments in publishing the Department's Annual Report to Parliament, and providing speech and background notes and special articles for the Governor, the Treasurer, and the Honourable the Minister.

PRESS. The weekly press items bulletins issued to all provincial and metropolitan newspapers must be considered a success.

Agricultural news is now appearing in newspapers that formerly carried none and the Department's advice and achievements are reaching a wider audience.

This bulletin of agricultural news and views is sent to 96 press outlets each week. The newspaper clipping service shows that it is filling a gap in the news sources of the provincial press particularly.

RADIO. During the year, 300 items were recorded for radio. A weekly 15-minute programme made up of four topical interviews was distributed to 17 country A.B.C. and commercial radio stations.

The subject matter covered supported the extension and information activities of the various branches within the Department.

TELEVISION. It is regretted that a regular television programme similar to the radio programme has not yet been produced. However, television coverage has been provided from time to time and plans have been made to increase the coverage next year.

REGIONAL INFORMATION. Regional Information Officers at Toowoomba and Rockhampton continued to provide the public with information on the Department's research and extension programmes.

A weekly flow of press, radio and television news items was released to all media outlets in central Queensland and the Darling Downs. This information supported the work of research and extension officers in the various districts.

ART. In 1978–79, the Art Section produced 214 pieces of artwork for printing. The Art Section is now at full strength and is once again capable of handling most of the Department's artwork requirements.

New ground was broken during the year with the appointment of the Department's first-ever display artist. This appointment fills a long-standing need and should greatly lift the standard of the Department's major display of the year—the R.N.A. exhibit.

IN-PLANT DUPLICATING. The in-plant duplicating operation continues to be a major and controversial undertaking by Information and Extension Training Branch.

As funds of other Branches become tighter through the adverse economic climate, pressure is put on this Branch to supply unlimited printing at no cost. Demands of client Branches have on occasions reached alarming levels—up to half a million printed pages.

This has resulted in the Government Printer directing his supervisor in the Duplicating Room to screen out work that is beyond the capacity of his staff. Branches then have the opportunity of taking the work to the Government Printer (and paying for it) or dropping the project.

Production from the duplicating unit continues to increase. The 1977–78 figure of 10·4m printed pages was raised to 12·75m printed pages in 1978–79. The reason for this is the greater efficiency resulting from screening out work beyond the capacity of the plant. In the past, these caused severe bottlenecks and delays.

Photography

In 1978–79, officers of Photography Section assisted many Branches of the Department with their professional photography requirements. Photographers travelled extensively throughout the State giving on the spot assistance in both still and cine photography.

Still photography output for other Branches exceeded 25 000 enlargements, 200 murals and 1 100 contact prints. A total of 4 000 black and white and 5 500 colour exposures was made during the year.

The Photography Section was responsible for the R.N.A. display in 1978 using large coloured prints based on young 'growing things'. This display received much favourable comment from the public.

Black and white and colour pictures were supplied regularly to metropolitan and provincial newspapers during the year and also to specialist and national magazines.

The section completed two 16 mm documentary films on agricultural topics during the year. These had a total viewing time of 25 minutes. A further five are at an advanced stage of production. The greatest need in this area is for an experienced scriptwriter/producer to co-ordinate cine production.

Major photographic support for displays was given to Entomology and Horticulture Branches during the year. Extension Services Section again made heavy demands on the Section in producing its display on consumer education.

The film library made 820 loans during the year and also produced a catalogue of films available.

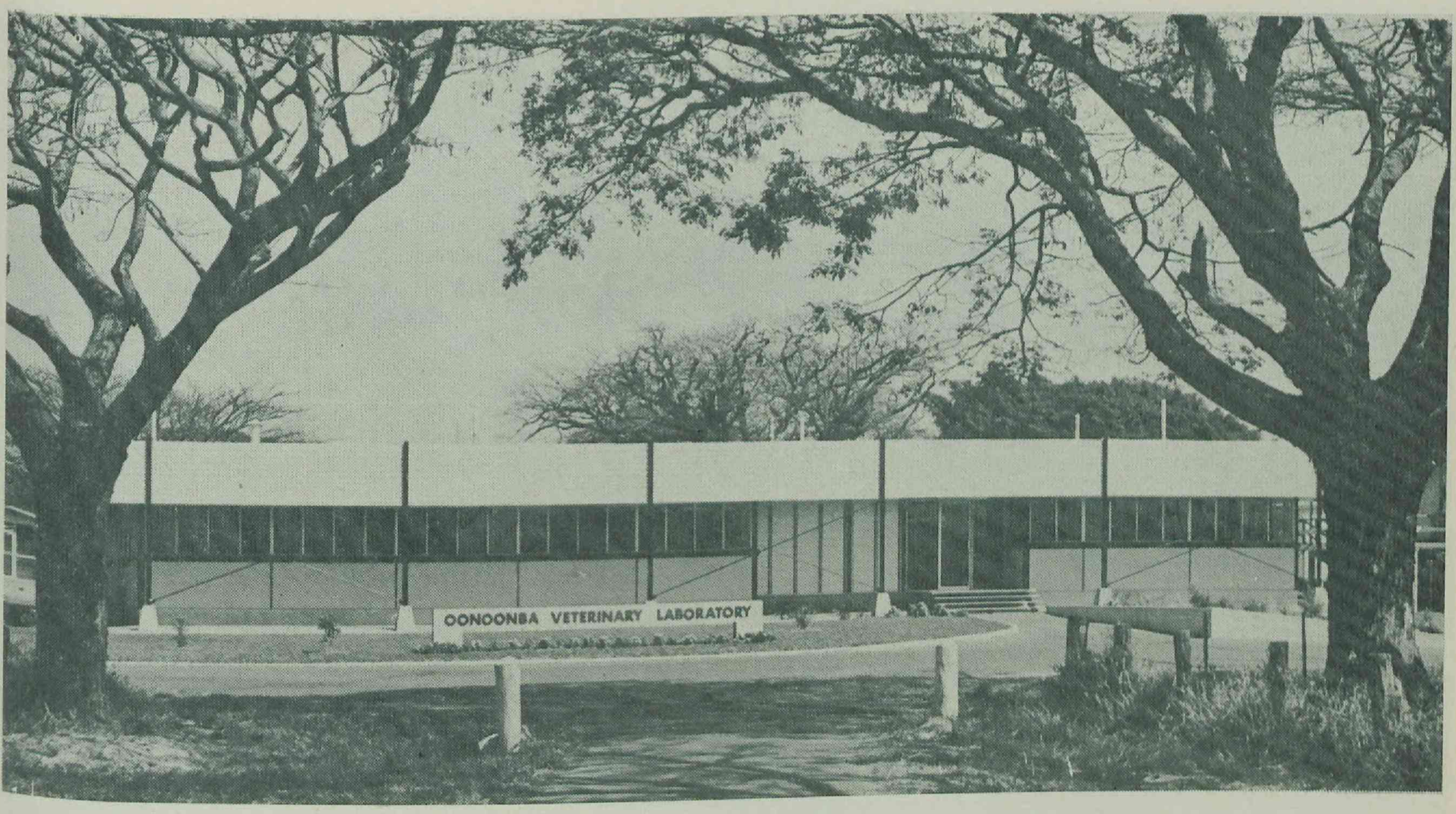
Training

MANAGEMENT DEVELOPMENT. The programme launched last year of training Departmental managers with supervisory responsibilities has continued. A further three Management Development Courses were completed.

MANAGEMENT PERSONAL IMPROVEMENT PROGRAMME (M.P.I.P.). A series of follow-up courses for managers who had attended Management Development Courses has begun. These courses are 1 or 2-day workshops which provide an opportunity for managers to study individual topics in greater depth.

EXTENSION PLANNING. A 1-week Special Extension Planning Workshop was conducted in north Queensland to develop officers' skills in planning and executing extension projects. The training was based on real situations in the dairy and beef industries.

COMMUNICATION SKILLS WORKSHOP. A break was made from the previous practice of combining groups of regulatory and research officers in one group for training in basic communication skills. Separate 1-week workshops were held for each group, enabling emphasis to be placed on those communication skills most relevant to their respective roles.



Oonoonba Veterinary Laboratory.

A.V. equipment loan service

Equipment held by the loan service in Brisbane was in constant demand during the last 12 months.

A special Treasury allocation of $12 000 in addition to the usual C.E.S.G. support of $3 500 was provided to buy equipment for field centres. This will enable obsolete and unserviceable audio-visual equipment to be replaced at many centres. It will also reduce the cost of constantly air freighting on-loan equipment from Head Office to country centres.

Library

Major projects undertaken by Central Library in 1978–79 were—

1. The Computer Usage Survey, designed by Biometry Branch to monitor use of journal titles over the previous 5 years, was completed. As a result of its findings, it has been possible to dispose of many titles which are not used.

2. Each librarian from Central Library has now assumed responsibility for re-organizing one metropolitan Branch collection. Collections at present being re-organized are Redlands Horticultural Research Station, Ipswich, Food Preservation Research Laboratory, Otto Madsen Dairy Research Laboratory, Horticulture Branch, D.L.U. (Comalco House), D.L.U. (Indooroopilly).

3. The Library is at present investigating the possibilities of on-line information retrieval systems for providing a more efficient means of bibliography compilation. Staff have attended seminars on this subject.

During the year, 1 900 books and 100 new journal titles were accessioned by Central Library. Loans exceeded 7 200 and Branch library loans 6 200. Photocopying in Central Library amounted to 140 000 sheets. In addition, the library circulated 27 000 contents pages and compiled 30 bibliographies.

Research Stations Section

RESEARCH STATIONS SECTION is responsible for the management and operation of 12 major research stations in the State and for the co-ordination of multi-disciplinary research programmes in the regions serviced by those centres.

These selected agricultural and pastoral properties with associated laboratories and facilities provide controlled conditions for experimental studies, especially those where research involves the integrated study of soil, plant and animal sciences.

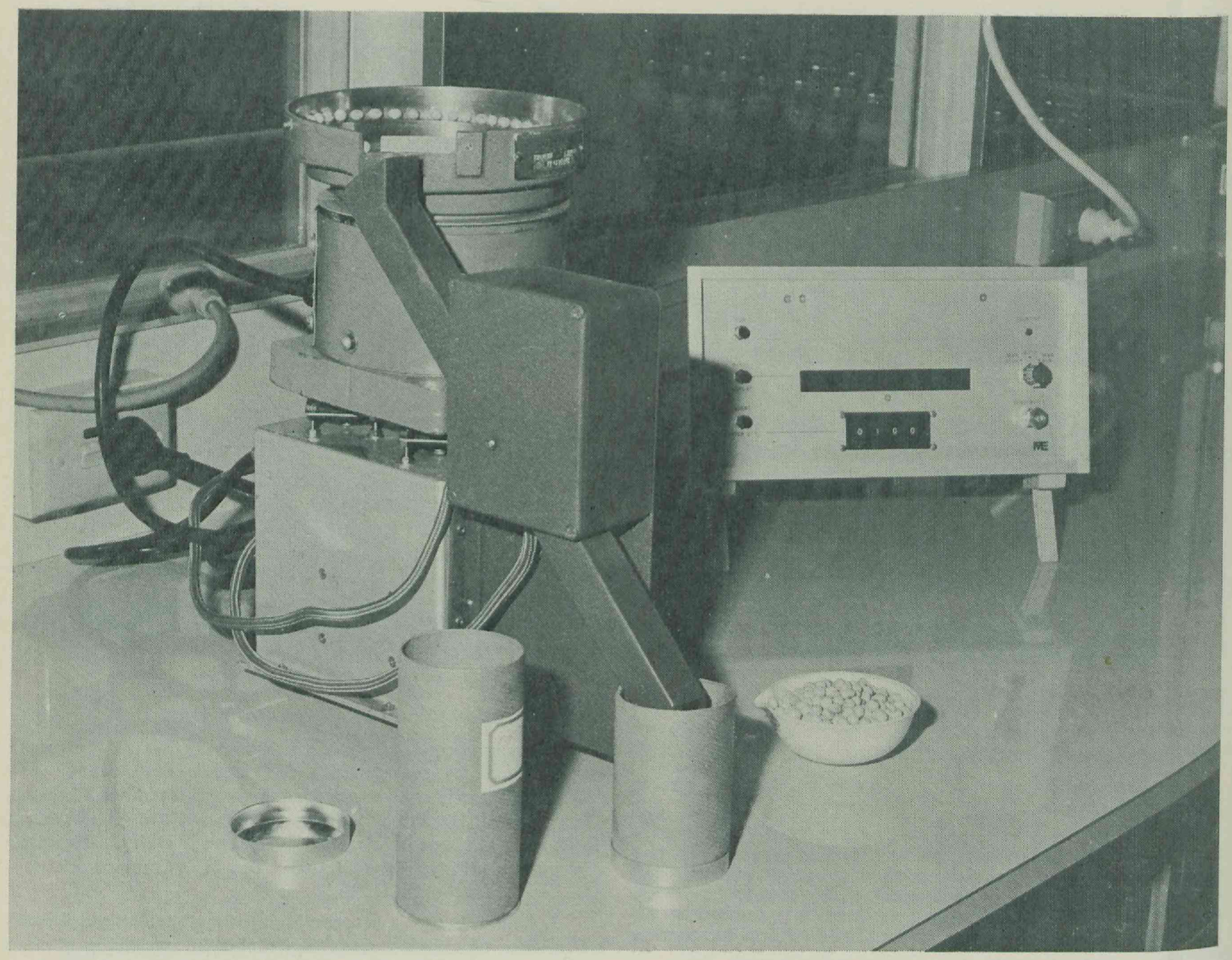
Investigations are directed to production problems and considerable progress has been achieved. The intensive on-station projects are being systematically combined into practical demonstrations on co-operating properties to ensure that producers will quickly apply research results, improved varieties or new technology.

Under continued financial limitations, it has been necessary to evaluate carefully all problems affecting production efficiency and to determine appropriate research policy and priorities.

In making these evaluations, formal industry involvement is achieved at the stations through consultative committees representing the primary industries. Committee members also have an important role in the dissemination and application of research results. The Departmental extension and advisory services are also represented in the planning and evaluation of research programmes. Still closer integration of research and extension activities on a regional basis is being planned.

The Research Stations Board is responsible for policy and the programme of work at each station. This Board, comprising the Deputy Director-General, the Director of each Division and the Executive Officer, met on 10 occasions to consider programmes and policies. The Board was also represented at all industry consultative committee meetings held at the Stations.

A sorghum plant affected by sugarcane mosaic virus. The breeding programme at the Hermitage Research Station has produced virus-resistant parents for hybrid grain sorghums.



A precision seed counter and electronic recorder in use at the Hermitage Research Station. It was manufactured by a Brisbane firm in consultation with D.P.I. staff.

Staff

Staff and wages employees of the section totalled 147 and 134 scientist and technical grade personnel of other Divisions were based at the research stations.

There were 97 visiting or part-time staff as specialists, and personnel from other organizations involved in the Stations' programmes.

Achievements

Detailed technical results of the research projects are presented under the industry or Divisional headings within this report. Some significant achievements during the year are briefly noted.

In northern Queensland, renewed confidence within the beef cattle industry has again stimulated development of extensive areas of native pastures. The work of the Walkamin Research Station is being applied by introduction of a range of *Stylosanthes* legumes and use of small quantities of superphosphate and/or sulphur to increase greatly the productivity of these pasture lands.

From the maize breeding programme at Kairi Research Station, seed of two hybrids, QK690 and QK694, was released in limited quantities, giving yield increases over the standard QK217 of 36% in 13 trials conducted over three seasons.

A new sweet corn hybrid was released from the Kairi programme as QK467S. This has effective resistance to sugarcane mosaic virus—Johnson grass strain.

Production of rice in the Mareeba area was evaluated by Walkamin Research Station 9 years ago. Additional commercial farms now established in the irrigation area will augment supply to the Burdekin rice mill where unavailability of irrigable land had limited local supplies of paddy.

The peanut industry was given special consideration to study production and quality problems. The crop can return high gross margins and is of significance in securing profitable agriculture in tropical areas. Plant breeding and nutrition studies based at Kingaroy have been integrated with related studies centred at Kairi and Walkamin Stations in the Far North. Additional research into planting, disease control, harvesting and curing of peanuts has been undertaken to further secure and expand the production area of 6 500 ha on the tropical tablelands.

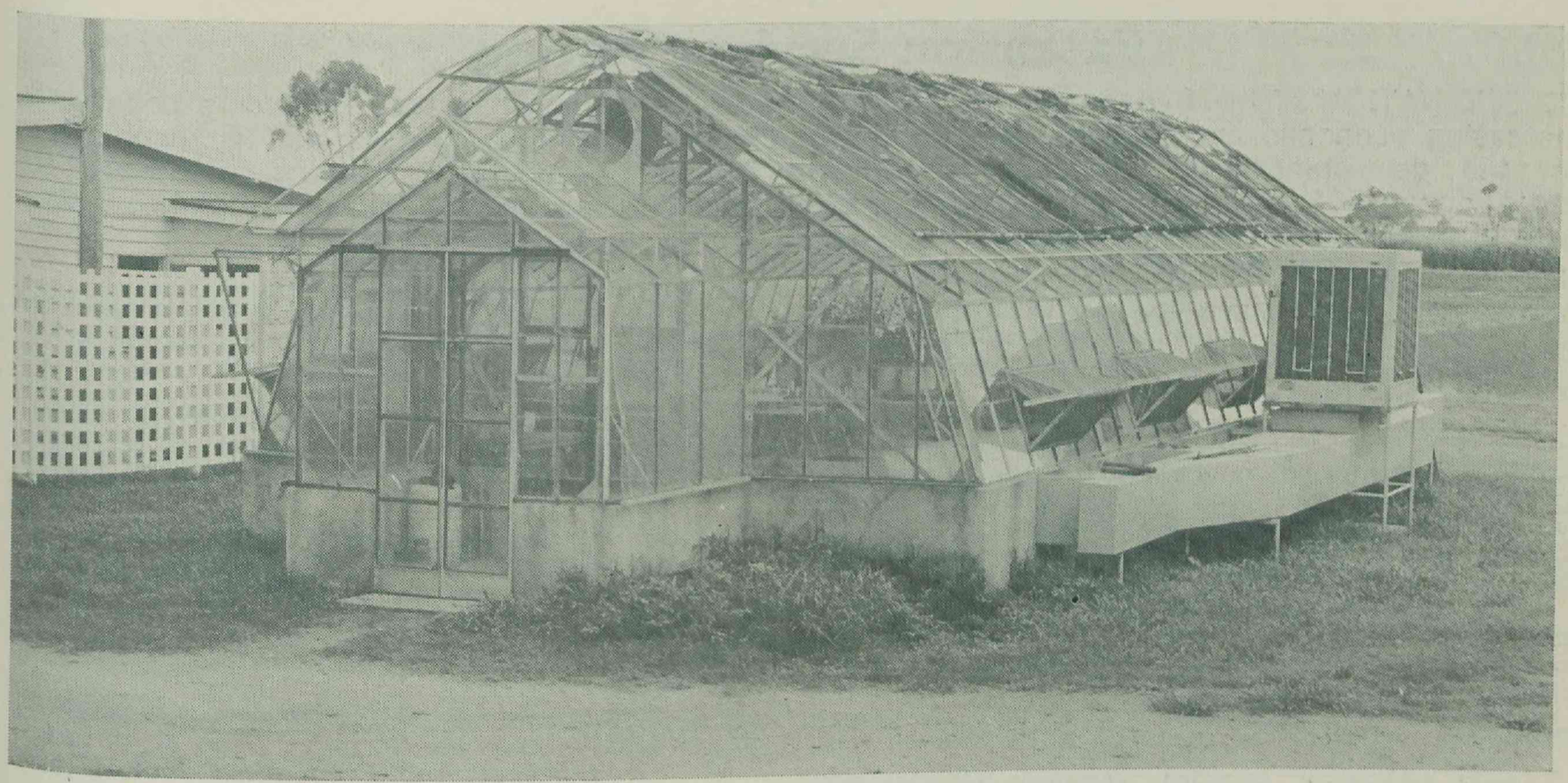
Work at the Burdekin 'Fort Site' for evaluation of commercial cropping systems on potential areas for irrigation has continued over the past 5 years, data being provided for the report on Resources and Potential of the Burdekin River Basin. These field site studies were terminated on 31 March.

In sorghum breeding at Hermitage Research Station, a forage type hybrid Sudan grass, QL18, was released as an extremely late flowering type suitable for late season grazing. Encouraging results were obtained in the development of sorghums with resistance to midge attack.

Five barley lines developed at Hermitage Research Station with similar malting quality to the current variety Clipper have consistently given more than 20% yield superiority and release of the best types is anticipated next year.

The work of the Brigalow Research Station in central Queensland is based on the evaluation of beef cattle breeds and exotic crosses, broad-acre agriculture and pasture productivity in the brigalow lands of the Fitzroy River basin. The search for a suitable pasture legume embraces a study of 68 species. The objective is to provide a higher protein source in the introduced grass pastures while also maintaining soil fertility by obtaining legume nitrogen in an integrated soil-plant-animal land use system.

Studies have continued in developing new crops, particularly those with agro-industrial use or prospects. Work with cassava was expanded on research stations and in conjunction with eight commercial firms involved in machinery manufacture and in starch, stock feed and future alcohol production. Other crops being studied included cluster bean (guar), chick peas, fenugreek, kenaf, sesame, niger and guayule (plant rubber).



A useful new facility at the Gatton Research Station. This glasshouse was originally used for quarantine and plant pathology work when it was located at the Brisbane Domain.

Co-operative studies

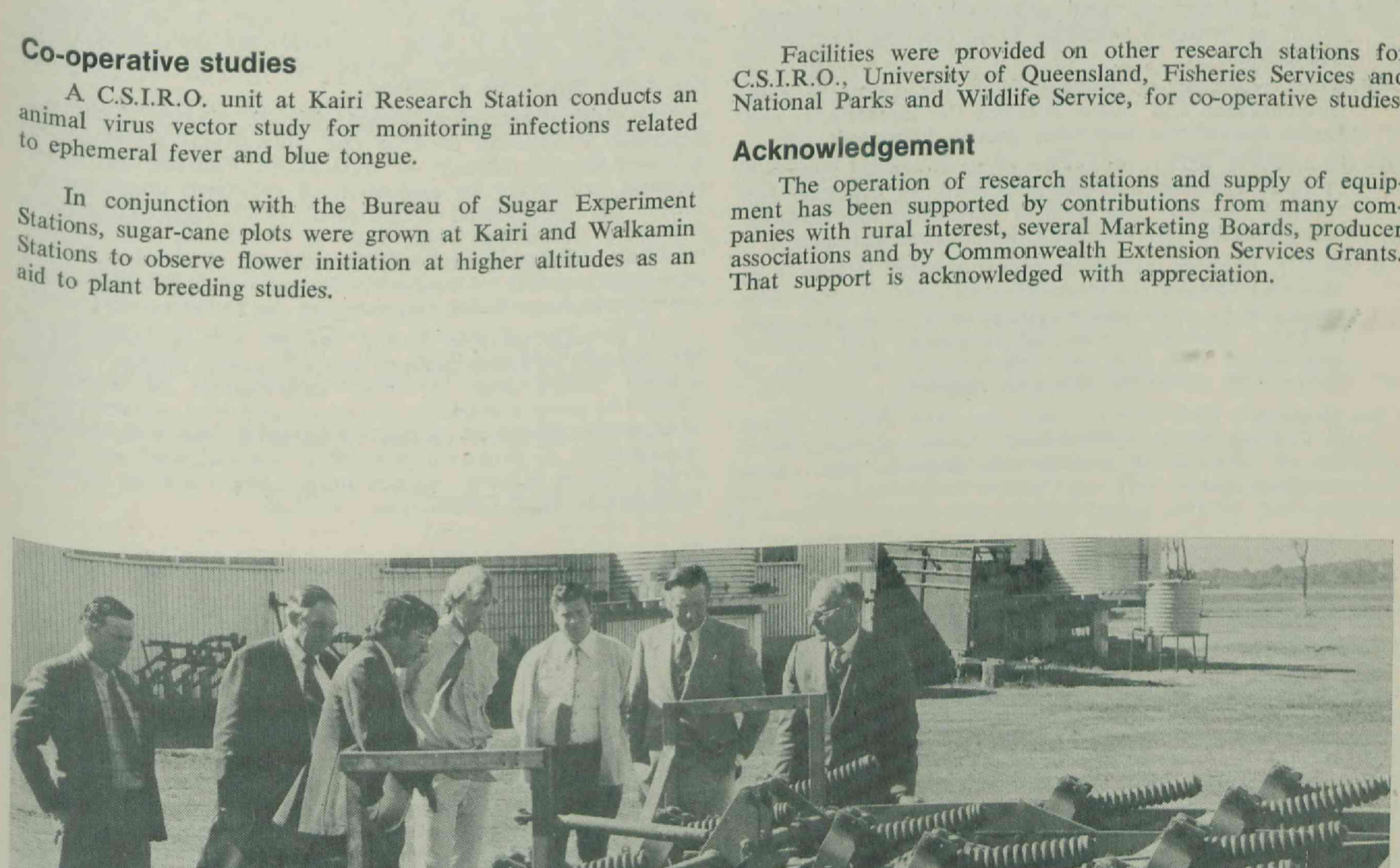
A C.S.I.R.O. unit at Kairi Research Station conducts an animal virus vector study for monitoring infections related to ephemeral fever and blue tongue.

In conjunction with the Bureau of Sugar Experiment Stations, sugar-cane plots were grown at Kairi and Walkamin Stations to observe flower initiation at higher altitudes as an aid to plant breeding studies.

Facilities were provided on other research stations for C.S.I.R.O., University of Queensland, Fisheries Services and National Parks and Wildlife Service, for co-operative studies.

Acknowledgement

The operation of research stations and supply of equipment has been supported by contributions from many companies with rural interest, several Marketing Boards, producer associations and by Commonwealth Extension Services Grants. That support is acknowledged with appreciation.



Machinery for stubble mulch farming is tested by staff at Kingaroy.

Extension Services Section

CO-ORDINATION of the Department's extension activities is essential to help producers cope with increasing economic and technological pressures. Extension Services Section staff is responsible for the development of co-ordinated extension campaigns aimed at helping producers to grasp opportunities and to overcome the problems that threaten them as individuals and as members of significant rural industries.

Within each of the 13 regions of Queensland, officers have been drawn from various Branches of the Department to establish groups capable of designing extension programmes tailored to meet the needs of industries and producers within the region.

The activities and composition of these groups are influenced by local requirements and, while some concentrate on the full spectrum of rural activities within defined geographical areas, others have concentrated on particular industries or particular fields of concern such as land use. These groups are supported by Regional Extension Leaders based at eight regional centres.

The Extension Services Board has continued to place emphasis on the training of field extension staff to better appraise the local rural situation, set extension objectives, clearly establish priorities and plan activities.

Projects

Since regionalized extension programme planning was introduced throughout the Department in 1973, there has been steady improvement in the quality of extension projects undertaken—

- Progress with the Brucellosis Eradication Scheme is well ahead of schedule, and the planned extension work associated with field activities has contributed to this success.
- Mastitis control has improved appreciably since the launching of an intensive campaign in all dairying districts of Queensland.
- Effective treatment of effluent from pig farms is now commonplace and liaison between the Department and Local Authorities has been greatly improved.
- In the Lockyer Valley, promotion of an integrated approach to farm drainage and the bed-system of cropping has resulted in more than 50% of all carrots and beetroot being planted on small hills to improve drainage.
- A poultry industry extension group formed in the East Moreton Region has proved its capacity to deal with management information, comparative cost data, and problems associated with the availability and effective disposal of litter that have emerged as major areas of concern in a rapidly changing industry.
- On Brisbane's Near North Coast, the dairy industry group is working closely with industry leaders and processors in an attempt to stabilize the manufactured dairy products sector.
- The Central Highlands District Extension Committee has assigned priorities to district problems and has estimated the resources necessary to successfully tackle these problems.
- Forced air cooling has gained rapid acceptance by tomato growers at Bowen where there are now 40 forced air cooling rooms in operation compared with only five in 1977.
- Engineers, economists and extension officers on the Darling Downs have recently launched a campaign aimed at assisting grain growers to make sound decisions in selecting farm machinery.
- Beef producers acknowledge the benefits from extension projects aimed at breeder selection, reduced dipping, teaching spaying skills and the introduction of improved electric fencing techniques.

Evaluation

The appointment of a new officer and the secondment of an experienced officer with specialized training have permitted the establishment of an evaluation unit. This unit will play a major role in determining the effectiveness of extension activities. Already the unit is working closely with passionfruit growers and horticultural staff in the Nambour area and has plans in hand to evaluate the developing Livestock Market Reporting Service and carcass classification trial being conducted at Kilcoy.

A visiting extension expert, Mr E. Dexter, from the Extension Evaluation Unit of the Agricultural Development Advisory Service, Ministry of Agriculture, Fisheries and Food, England, conducted an evaluation of extension programming within the Queensland Department of Primary Industries. Following discussions with staff at all levels, Mr Dexter travelled widely throughout Queensland to study present extension activities. Already Mr Dexter has highlighted some ways in which extension programming can be further improved.

It is expected that several changes will be made when Mr Dexter's recommendations become widely known. These changes should lead to clear identification of extension objectives, more disciplined setting of priorities, concentration of extension efforts on matters of major significance, stronger management of extension projects at regional level and more orderly liaison between regional project teams and the relevant Branches at Head Office.

Biometry Branch

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

Consultation between biometricians and research-extension officers on choice of experimental designs, statistical analyses and interpretation of research-extension data occupies two-thirds of the time of the 17 graduate biometricians and their three support staff. Other services provided include development and maintenance of computer programmes for repetitive statistical analyses, training of Departmental officers in use of statistical techniques and collaborative research into bio-economic systems.

Data processing services involve the development of computer systems to aid Departmental technical and administrative activity. Major emphasis was given to training non-graduate officers in systems design and programming techniques during the year in readiness for development of a Departmental accounting and budgeting system. Additional computer equipment was purchased and existing equipment was operated and maintained as an essential part of the data processing service.

Within the scope of the Branch purpose, 11 distinct areas of activity are reported upon for the year 1978–79.

Comparative activities

Branch administration was strengthened by the appointment of a Director and a Supervising Biometrician.

The Branch Director undertook a study tour of biometrical units in Departments of Agriculture in New South Wales, Victoria and South Australia. The scope of work undertaken by biometricians in Queensland was comparable with that of the other States. However, less collaborative research and more analyses for biological scientists occurs in Queensland than was observed in South Australia and New South Wales. Computing facilities available to biometricians in Queensland through the C.S.I.R.O. computer network are superior to those provided by State Government Computer centres in each of the other States. This applies particularly to the distributed access available from Toowoomba, Townsville and Rockhampton. Within the constraints of present Departmetal research organization, Queensland biometricians are working to capacity.

A National Workshop on Agricultural Information was also attended by the Branch Director in February 1979. The aim of the workshop was to enable research and extension officers from State Departments to meet with librarians to discuss ways and means of improving the flow of agricultural information within and between organizations nationally and internationally.

Decentralization of services

A programme of decentralizing Biometry Branch to provide closer contact between biometricians and research-extension officers commenced in 1976. Two biometricians and a cadet (technician) transferred to Toowoomba to be responsible for biometrican work emanating from the Darling Downs, south-west Queensland, Gatton and the South Burnett.

Three biometricians and a technical assistant were located at Townsville in 1978 to further the objective of decentralization. This group is responsible for biometrical work initiated in a region stretching from Bowen in the south to Mt Isa in the west.

Transfer of a third unit comprising two biometricians and a technical assistant to Rockhampton has been delayed because of staffing constraints and inadequate vehicle support.

In the south-east of Queensland, biometrical services are provided by staff located in Brisbane. Major laboratory complexes in the metropolitan area were visited regularly by biometricians for consultations with laboratory staff during the past year.

Consulting services

Biometricians provide a consulting service to research and extension officers advising on experimental designs, by statistically analysing data and by interpreting statistical analyses for research and extension projects. The major component of the service is statistical analysis of data which accounts for three-quarters of the time spent on this work programme.

Experimental design

Research officers normally consult with biometricians before submitting projects for formal approval to ensure that the most appropriate experimental designs are used and that research measurements can be statistically analysed. The process of formal project approval by Branch Directors also enables assessment of research activity and the likely commitment required by Biometry in the ensuing year.

During 1978–79, a total of 436 new research projects was submitted to the Branch for comment on the experimental designs.

Changes in experimental designs for varietal testing of grain crops could result from current investigations in statistical problems of combining data across sites or across years. Statistical methods normally used for varietal trials are site specific for individual years. More complex methods are required to extend inferences from specific varietal trials to district and regional recommendations without substantially increasing the number of trials required each year.

Alternatives to traditional methods of cutting and weighing pasture samples to determine production are being investigated by biometricians.

Data analysis

The 621 data sets submitted to Biometry for analysis during 1978–79 were almost the same as for the previous year (619). The number of analyses completed rose by 7% to 631, allowing a small reduction in the carry over (32%) of data sets submitted. Details of work undertaken by the Branch during 1978–79 are summarized in the table below.

SUMMARY OF BIOMETRICAL WORKS 1978–79

—	Projects approved	Data submissions	Analyses completed	Analyses outstanding
North Queensland ..	129	184	200	40
Central Queensland	69	33	22	33
Darling Downs ..	89	198	196	13
South-east Queensland	149	206	213	113
TOTAL ..	436	621	631	199

Data analyses during 1978–79 were again diverse. Research projects reported here are representative of the scope of work undertaken.

Relationships between a number of plant characteristics and 31 different levels of light intensity were established for a gladioli light intensity trial at Redland Bay. The large volume of data was entered into the computer on cards to create a computer file which was merged with a regression programme to derive the relationships.

Results from a series of trials investigating aspects of a beef carcass classification scheme, particularly alternative methods of measuring fat thickness, were analysed for Slaughtering and Meat Inspection Branch. These trials were unusual to the extent that large amounts of data were available or could be obtained quickly. Rapid data processing was essential to facilitate incorporation of results with information from interstate. Particular attention had to be given to written interpretations of the statistical analyses to enable individuals with no statistical knowledge to readily understand the purpose and results of the research.

Analysis of variance was used to assess differences between chemical compositions of soil samples from 145 sites on six different soil types as part of a large agrostological trial at Gympie. Two determinations were made, 6 months apart. Time was used as replication and sites within soil types were used as duplication factors. For the same trial, linear regression was used to describe soil-plant and plant-plant relationships, ignoring soil type but with separate analyses for each time of determination.

Summary tables of plant measurements for 100 maize breeding experiments on the Atherton Tableland were listed against grain yields in descending order of magnitude in a new format for varietal testing data. Each experiment contained five or seven measurements taken over 25 different varieties. Overall, the screening process was applied to 1 000 half sib varieties used in the breeding programme. Successful use of the tabulation procedure is expected to be used widely throughout the State for plant breeding experiments on other crops.

Tabulation and graphing facilities in the programme package GENSTAT were used to calculate and tabulate cumulative germination percentages of pasture seeds for Agricultural Standards Branch. The large data set of 18 000 germination counts was collected over 3 years at 4-week intervals following seed harvest. Final germination percentages were graphed against the time from harvest for each seed type.

An analysis relating relative yields (control yields over treated yields) to soil sulphur was completed for 20 trials investigating yield responses to sulphur. The simplest and most commonly used approach of fitting an asymptotic regression using logarithmic transforms and linear regression was found inappropriate. Direct fitting of the asymptotic regression by the method of least squares and an alternative concept of potential yield gave more satisfactory relationships.

Development of statistical programmes

Development of computer programmes for repetitive types of statistical analyses is an objective being met by a small group of officers within the Branch. During 1978–79 the main activities were enhancements to existing programmes and development of several small programmes to assist data preparation before major statistical analyses.

Programming activity was reviewed during the year to determine priorities and resource requirements in the immediate future. The ranking of preferences canvassed among biometricians gave the priorities—

1. Lifting awkward restrictions in the balanced factorial programme BALF
2. Simplification of the field book programme FLDB
3. Investigation of better-alternative regression programmes to those currently in use
4. Extending facilities for summarizing data (including graphing).

The rate at which these needs can be met will depend on the time available among existing officers for activities apart from biometrical consulting. This is particularly critical in Brisbane where most programming activity has occurred in the past.

Training in biometrical methods

Provision of a knowledge of mathematical techniques necessary for drawing inferences from Departmental research is the objective of the Branch's in-service training programme in biometrical methods for Departmental officers. Biometricians provide the training for officers in other Branches but frequently need to seek assistance from outside the Department for their own training. The training programme, therefore, is split into two components, internal training for the biometricians and external training by the biometricians for officers elsewhere.

Use of a number of statistical programmes available on the C.S.I.R.O. computer network was demonstrated to a further 60 Departmental officers who participated in four workshops conducted by the Branch. Almost 150 officers have now been given practical experience in using the computer for analysis of the more common types of statistical problems encountered in research activity.

A third workshop for extension officers and research support staff in Branches responsible for livestock industries gave introductory training in experimental methods at Toowoomba. Biometricians emphasized the suitability of certain experimental designs for use on co-operating producers' properties and the need for accuracy in data recording. Guidance was given on how to interpret the statistical component of research publications.

Biometricians also conducted a workshop over 3-days for officers in the Dairy Research Branch. Emphasis was given to basic design principles, to sampling procedures, and to interpretation of statistical analyses. Participants were also introduced to several analytical techniques and the assumptions underlying their application to particular types of problems.

Senior officers in the Branch participated in management development courses conducted by the Department of the Public Service Board and by Department trainers. Organizational development within the Branch was enhanced and individuals were able to improve their own managerial skills. Use of these skills will be reinforced by follow-up training next year and through application to areas of work responsibility assigned to each senior officer within the Branch.

Biometricians received intensive training in multivariate methods during 3 days of the Branch workshop in April. Several officers contributed theoretical segments leading to practical demonstrations of the techniques using programmes available on the C.S.I.R.O. computer network. Valuable assistance in presenting theoretical components was given by Dr L. da Sia, Lecturer in Mathematical Statistics, Rutgers University, N.J., during her sabbatical study leave at C.S.I.R.O. Division of Mathematics and Statistics, Brisbane. A subsequent 1-day seminar concentrated on problems of analysing repeated measurement data.

Two biometricians extended their understanding of data base management and pattern analysis techniques during a refresher course conducted by the Australian Institute of Agricultural Science at Brisbane.

A short course on micro-computers and their use in data acquisition and instrument control was attended by a biometrician assisting with programme development for the Agricultural Chemistry Branch computer.

Two officers attended the 8th Australian Computer Society Conference in Canberra in August 1978. General and technical papers covered a range of topics relating to the general theme of the 'Impact of Computers on Society'. Workshops and short courses enabled participants to discuss more specific problems with colleagues from other organizations.

Systems research

Participation in bio-economic systems research and development of capability in this field among technical officers in the Department are the objectives of a work programme involving three biometricians.

Substantial progress was made in modelling a sheep breeding flock in north-west Queensland. A sub-model to predict clean wool growth and liveweight change of wethers was extended to include growth of the foetal lamb in pregnant ewes. Driving factors in the sub-model are dry matter intake, digestibility of dry matter and organic matter, intake of nitrogen, rectal temperatures and hours spent grazing. Financial assistance from the Australian Wool Corporation for this research project has enabled integration of research data collected at the Toorak Sheep Field Research Station, Julia Creek.

Methods for recording pasture and animal parameters were devised for a simulation of the utilization of pastures and forage, and of their conversion to animal products at the Coolum Research Station.

A mathematical model of apple bruising was developed during the year in a simulation of apple cartons being dropped. Reliability of the model was tested against columns of apples dropped from various heights and at varying frequencies. Results of this research will be extended to other fruit when better quantification is available for the bruising characteristics.

Data processing training

Training of Departmental officers for development of commercial type computer systems remained the main priority for data processing training during 1978–79. Here, Biometry Branch has the responsibility of co-ordinating training, in particular in arranging for Departmental officers to attend courses provided by the State Government Computer Centre. In the past year, 19 officers attended one or more of 12 different courses offered at the Centre.

Two officers were sent to a Structured Analysis Design Workshop in Sydney to develop further skills for applications in systems development. No similar courses are available in Queensland except over extended periods at tertiary institutions whose student quotas do not allow casual attendance of Departmental officers.

On-job training of trainee Programmers in Biometry resulted in completion of one small system and substantial progress towards completing two other small computer systems. LIBRA analyses requests to the Department's Central Library to produce a series of reports relating requests to centres, Branches, type of publication and language in which publications are written. Data for the 2 years 1976–78 have been analysed and last year's figures will be processed when preparation onto punched cards is completed. DPISPS was developed to enable analysis of livestock movement data contained in Stock Permits. New stock permit forms were designed and tested to ensure additional information relating to types of livestock could be adequately recorded and to facilitate data preparation for computer entry. A system outline and feasibility study were completed as first stages in developing a computer system for registration of operators, chemicals and vehicles under the Agricultural Chemicals Distribution and Control Acts.

Systems development

Systems analysis and design work was completed for two areas of Department activity during the year. A plant and inventory system (PIQUIP) required documentation of Departmental clerical and data recording procedures to enable use of the computer system designed by the Education Department's EDP staff.

Initial work on a proposed management information system for the Department progressed to the stage of defining a work programme structure for existing Departmental activity.

Computer hardware facilities

Additional computer equipment was purchased in 1978–79 to provide direct access to both the C.S.I.R.O. network and the State Government Computer Centre from Departmental centres in the metropolitan area.

Three suites of equipment—a teletype terminal, microprocessor and floppy disc storage units—were purchased for connection to the C.S.I.R.O. system. Two of these suites provide local data storage facilities for accumulating data generated by laboratory equipment. Remote terminal access at the two locations, Animal Research Institute, Yeerongpilly, and Tick Fever Research Centre, Wacol, enhance the research capabilities of both centres by allowing Departmental officers to analyse their own research results.

A third equipment suite is located in Biometry Branch, Mineral House, to enable investigation of alternative means of data entry into the computer to the punched cards which are used most commonly at present. Particular attention will be given to the feasibility of recording research data in the field on portable data capture devices from which data can be transmitted by telephone to the Biometry disc storage unit. This unit could also be used for local rather than on-line storage of large data sets.

Ten visual display terminals, including five during 1978–79, and two terminal printers have been bought for connection to the State Government Computer Centre. These will be located at eight different Departmental centres or laboratories in the metropolitan area. One terminal and printer will be located in the Queensland Meat Industry Organisation and Marketing Authority for their meat and livestock market reporting service. Installation of these terminals will allow development of a number of application systems which are essential if existing Departmental services to the public are to be maintained.

Computing equipment operations

An indication of data processing activity in the Department can be gained by the consumption of stationery during 1978–79 as follows—

Data cards	560 000 cards
1-part paper	170 000 sheets
2-part paper	79 000 sheets
3-part paper	15 500 sheets
4-part paper	1 000 sheets
8 x 8 in. paper	17 000 sheets
Stick-on labels	200 000 labels

Stationery is provided for both the Biometry equipment and the three Nova 3/12 minicomputers used for the National Tuberculosis and Brucellosis Eradication Scheme at Yeerongpilly, Rockhampton and Townsville.

Existing data preparation services are proving to be inadequate to meet Departmental needs in all centres. Additional casual staff were required for 9 weeks to prepare data for entry into the Area of Erosion Hazard Information System being developed by Soil Conservation Branch. Delays in the turn around of work through the Brisbane data preparation room deteriorated to more than 6 weeks for biometrical data as a result of the AEHIS job. Regular overtime was required towards the end of the year to restore turn around to more normal rates. Quite clearly, additional data preparation staff will have to be found to meet the demands of newly developed computer systems with large data input requirements.

Division of Animal Industry

THE seven major objectives of the Division of Animal Industry are listed below. These objectives are achieved through the activities of the eight Branches that go to make up the Division.

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 and/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.

These objectives are achieved by the activities of the following Branches—

Veterinary Services Branch

1. To investigate and control serious disease outbreaks affecting commercial animals and birds.
2. To conduct the field aspects of the bovine tuberculosis and brucellosis eradication schemes in Queensland and to develop other disease eradication programmes as these become necessary and practicable.
3. In co-operation with the Commonwealth Government, to maintain animal quarantine services to prevent the introduction of exotic animal disease, and to assist in the export of animals and animal products.
4. To exercise surveillance over stock movements as a disease control measure.
5. To promote field projects aimed at elucidating disease problems.
6. To promote extension activities in the disease control field with a view to increasing farmer awareness concerning animal disease matters and acceptance of Departmental programmes and policies.

Slaughtering and Meat Inspection Branch

1. To inspect animal carcasses for the presence of disease and to ensure that a high hygiene standard is maintained during processing and handling from the time of slaughter until the meat is delivered to the consumer.
2. To participate in the bovine tuberculosis and brucellosis eradication schemes and other eradication schemes which may develop in Queensland.
3. To attain standards specified in the Meat Industry Act and Regulations applicable to all premises licensed by the Queensland Meat Industry Organisation and Marketing Authority or registered by the Department.
4. To inspect and supervise all activities associated with the slaughter of prohibited animals and stock intended for use as petfood and to inspect all premises where flesh or meat is processed and offered for sale as petfood.
5. To collect information concerning disease detectable at slaughter and to trace affected stock to the property of origin.
6. To promote quality and facilitate trade by classifying and grading meat, promoting tenderstretch and other methods of improving meat quality and by extension to consumer groups.
7. To avoid waste, promote efficient stock handling and lower processing costs, for example, by bruising studies.

Beef Cattle Husbandry Branch

1. To undertake applied research in beef cattle husbandry and management, reproduction, nutritional deficiencies and in the transport and marketing of cattle.
2. To extend research findings to beef producers.
3. To provide advice, on request, on management and property development that is relevant to beef production.

Pig and Poultry Branch

1. To provide an advisory service to the commercial pig and poultry industries, to offer a least-cost ration formulation service, to conduct surveys to define industry problem areas and to develop appropriate extension programmes.
2. To take an active interest in product acceptance in the market place and to ensure that quality products reach the consumer.
3. To improve pig carcass quality and growth efficiency by on-farm performance testing.
4. To work closely with producers to improve the environment, health and general husbandry and to develop an awareness of the environmental implications of highly intensive systems.

Sheep and Wool Branch

1. To undertake research at research stations, properties and laboratories on problems aligned to industry priorities, including reproduction, nutrition, genetics, wool harvesting and ecto parasite control.
2. To extend the results of the Branch's research programme and other research findings to the industry. The extension programmes aim at servicing the needs of districts and by integration to service the needs of State-wide importance.
3. To provide information on wool characteristics for breeding programmes in many areas of the State by fleece metrology examination of samples sent from studs and commercial producers to the Wool Biology Laboratory.

Pathology Branch

1. To provide a diagnostic service for the animal industries from laboratories at Yeerongpilly and Oonoonba and undertake applied research into animal disease problems of significance.
2. To provide laboratory support in exotic diseases and disease eradication programmes. The latter relates to the brucellosis and tuberculosis eradication programmes at present and is provided from laboratories at Yeerongpilly, Oonoonba and Rockhampton.
3. To prepare and distribute from the Tick Fever Research Centre at Wacol, vaccines against tick fever and anaplasmosis and to conduct research into these diseases.
4. To monitor animal products and test animals and animal products involved in export and interstate trade.

Biochemistry Branch

1. To provide chemical services to the animal industries and to the advisory, regulatory and research groups within the Department servicing the animal industries.
2. To provide a resource reservoir in specialist areas of nutrition, metabolic disorders, toxicants and the regulation of agricultural chemicals in feeds, animal products and the environment.

Husbandry Research Branch

1. To collate relevant information from the sheep, cattle, horse, pig and poultry industries and elsewhere with the objective of defining problems and investigating them.
2. To test technical solutions at the Animal Husbandry Research Farm, Rocklea, or at regional stations.
3. To report all results in the scientific literature and transmit the practical application of scientific findings to extension staff or directly to industry, and to provide a reference source of specialised knowledge to extension staff and industry.

Notable events

Mr L. G. Newton retired as Director and Mr J. W. Ryley was appointed the fourth Director of the Division which has now been established for 32 years. Mr L. Laws, formerly Director, Husbandry Research Branch was appointed Deputy Director. Other senior appointments included Mr S. G. Knott as Director of Veterinary Services, Dr P. S. Hopkins, Director, Sheep and Wool Branch and Messrs G. F. D. Langford and I. D. Wells as Assistant Directors, Veterinary Services Branch. Among several retirements of Divisional staff were Mr A. T. Bell, Director, Sheep and Wool Branch and Mr P. J. O'Sullivan, Principal Parasitologist at the Animal Research Institute.

The Sheep and Wool Branch was restructured by an amalgamation of the research and extension sections. This allows a more direct effective progression of research results through extension officers to the industry and feedback of information to the research group for determination of research priorities.

Animal quarantine services were strengthened by additional staff appointments at Cairns and Brisbane and arrangements were finalized to appoint a Veterinary Quarantine Officer to Cairns to service the Cape York Peninsula and Torres Strait areas. A daily aerial coastal surveillance programme was instituted as part of a comprehensive programme of surveillance of the northern Australian coastline between Cairns and Port Headland.

A major study of screw-worm fly prevention and eradication policies and plans was made in conjunction with the Australian Bureau of Animal Health and a consultant veterinarian from the United States Department of Agriculture. This study formed part of a major effort to step up precautions against the spread of this serious parasite from New Guinea to Australia.

The spectacular recovery in beef prices caused a renewed interest in property development and more intensive management. It has also led to a spate of property sales: part of the ongoing process of rural adjustment. The indications are that most owners are running down herds to safe levels, are exploiting the high prices, and at the present time are little interested in herd build up. The rapidity and the extent of the change in fortunes emphasizes the need for the Department to be able to cater, in research and extension, for a tremendous range in economic conditions. A practice that is uneconomic today may be the most profitable tomorrow and vice versa.

The refusal of Commonwealth meat inspectors to work with State inspectors at the new Mt. Isa meatworks was referred to arbitration. The decision was that both parties abide by agreements negotiated in 1964 until the outcome of the report of a Committee of Inquiry into Meat Inspection in Australia is known. The Slaughtering and Meat Inspection Branch prepared a comprehensive submission to the Inquiry on behalf of the Department.

A long-standing debate led to allowing frozen meat packaged to prescribed standards to be sold outside of butchers' shops. As a quid pro quo to butchers, a list of perishable food items which could be sold in butchers' shops was prescribed. This broke with tradition that a butcher's shop could sell meat and meat only and other shops could not sell meat. Although a few processors produce packaged frozen meat, volume is not great and changes have caused no appreciable impact. Similarly, few butchers have shown interest in other food products.

The national brucellosis and tuberculosis eradication programme made further progress with the inclusion of an additional 12 Shires within the brucellosis eradication area. Testing activity reached a peak during 1978 when more than 3m cattle were tested for brucellosis. During the 9 months to 31 March 1979, more than 2·25m cattle were tested, including 737 000 cattle slaughtered at abattoirs. Some 60% of all breeding herds have been assessed, of which only 16% had an infected or suspect status at 31 March 1979.

Although progress with tuberculosis eradication has been much less spectacular, the year was featured by the approval of Animal Health Committee to declare southern and central Queensland east of the Western Barrier Fence as a Provisionally Free Area. This area comprises more than 85% of Queensland herds.

An air mist insecticide applicator was developed by staff of Sheep and Wool Branch with the assistance of Engineering Services Section and commercial engineering firms. This equipment results in the more economical and effective treatment of sheep for fly and lice control by reducing the volume of insecticide used and controlling the flow of sheep with reduced labour costs while allowing more efficient application of the insecticide.

The welfare of animals in 'factory farming' units was publicized in the media by 'anti-factory farming' and animal welfare organizations. Industry organizations are aware of this aspect of intensive animal production and industry sees an urgent need to become better informed about the animal welfare implications of modern production methods. To this end, the poultry behaviour specialist of the Poultry Section published a comprehensive review of the objective information available on animal welfare entitled 'A review of animal welfare and intensive animal production.'

Development of facilities

The land adjacent to Swan's Lagoon Research Station that was acquired in June 1978 has been fenced along the main boundaries with an electrified fence. Dam sites and plans have been prepared by the Water Resources Commission. There have been some problems in removing all the original cattle.

In the Brisbane Valley, land resumed for the Wivenhoe Dam has been leased from the Water Resources Commission. This is being used, in association with C.S.I.R.O., for trials on parasite control and tick fever vaccine testing. This facility has provided a degree of control over experimental cattle that cannot be achieved in co-operative trials without the high capital cost of a conventional research station.

The site development programme for the centralized laboratory services of the Division at the Animal Research Institute, Yeerongpilly was advanced significantly during the year. Stage II of the Biochemistry Laboratory incorporating a modern isotope laboratory was completed and occupied in November. Plans for the Administration complex at the site have been completed and it is anticipated that construction will commence during 1979–80.

Animal quarantine

In Queensland, the Commonwealth Quarantine Act is administered by Veterinary Services Branch.

COASTAL SURVEILLANCE.—Towards the end of 1978 aerial surveillance flights over the coastline from Cairns in Queensland to Port Headland in Western Australian commenced. The flights are designed to detect and/or prevent any illegal penetration of the quarantine barrier by sea vessels and illegal landings on the coast. Most of Veterinary Services Branch staff stationed in north Queensland have participated as observers in at least one of the flights.

FOREIGN FISHING VESSELS.—The incursion into Australian waters by overseas fishing vessels poses some quarantine risk to this country. During the past year, 13 vessels were apprehended, nine off Cairns and four off Mackay, by Navy patrol boats. Special quarantine precautions were observed with those vessels as food items aboard included pork, eggs and chicken of foreign origin.

EQUINE CONTAGIOUS METRITIS (C.E.M.).—A highly contagious genital infection of horses, characterized by vaginal discharge and infertility in mares, occurred in a number of thoroughbred stud farms in the Newmarket area of the United Kingdom during 1977. It has also occurred in the U.S.A. and Ireland. These events precipitated the establishment of a survey in a number of studs in Australia.

Cases were discovered in New South Wales, South Australia and Victoria. No cases were found in Queensland despite considerable laboratory testing. All horses imported into Queensland from the United Kingdom and those in the State having had contact with such animals are kept under surveillance.

Revised conditions for the importation of horses into Australia were designed to give a high degree of security against the importation of C.E.M.

RABIES-LIKE SYNDROME—THURSDAY ISLAND.—A diagnostic team of three veterinary officers including a veterinary pathologist was dispatched to Thursday Island to investigate a syndrome in dogs suggestive of rabies. Dogs were reported to be exhibiting signs of excess salivation, fits and there were instances of humans having been bitten. However, investigations revealed that distemper complicated in certain cases by lead poisoning was the cause of the syndrome.

SCREW-WORM FLY.—Sentinel animals located in the northern extremity of Cape York Peninsula were wounded periodically and monitored for screw-worm fly. No strikes were recorded.

The presence of screw-worm fly in the south western area of Papua New Guinea poses a threat of its introduction to Australia on animals being moved illegally across the Torres Strait.

ILLEGAL IMPORTS.—During the year, 376 kg of meat and meat products, 175 kg of dairy products and 172 eggs were seized from incoming passengers at the Brisbane International Airport. One person was convicted for illegally importing 12 game fowl eggs from the Philippines.

ANIMAL IMPORTS.—During 1978–79, 135 dogs and 19 cats were quarantined at Lytton (59 dogs came from the United Kingdom and the remainder came from the Pacific region not including New Zealand). During the same period, 304 dogs and 26 cats were introduced from New Zealand. Dogs arriving by or from the United Kingdom in approved containers undergo 90 days' quarantine while dogs and cats from the Pacific region (excluding New Zealand) are quarantined for 9 months. Dogs and cats from New Zealand are not required to undergo quarantine.

MEAT.—Canned beef is a permitted import from any country, provided it is accompanied by the prescribed documentation in regard to health and cooking temperature. Fresh meat may be imported from New Zealand only.

During the year, the following importations were made through ports in Queensland: China 1 457 kg (poultry mainly); U.S.A. 125 kg; U.K. 3 375 kg; Germany 889 kg and New Zealand 2 272 kg (100 lamb carcasses).

CHEESE.—A total of 291 912 kg of cheese was imported through ports in Queensland. Major suppliers were: Norway 118 291 kg; West Germany 54 662 kg; Denmark 51 478 kg; France 21 824 kg and Holland 23 425 kg. Other suppliers were U.S.A., U.K., Austria, Italy and Switzerland.

Cheese may be imported from the following foot-and-mouth disease-free countries without the necessity of obtaining a prior permit to import: U.K., U.S.A., Canada, Japan, Norway, Sweden, Finland, Denmark and New Zealand. Import permits for cheese from foot-and-mouth disease-infected countries are given only in respect of manufacturing establishments that satisfy requirements that ensure freedom of the product from foot and mouth disease virus.

Exports of live animals

During the past year, 44 865 cattle were exported to overseas countries. Of these 25 460 were slaughter cattle. The remainder was supplied for breeding purposes. Importing countries included: Hong Kong (25 355 slaughter cattle) and Brunei (105 slaughter cattle). Breeding cattle were exported to Indonesia (8 408); Malaysia (3 174); Japan (2 496); Philippines (1 170); Kuwait (1 106); Vietnam (594); South Korea (1 976); Papua New Guinea (398) and Burma (83).

Breeding pigs were exported to Singapore (63); Indonesia (60); Hong Kong (15); Papua New Guinea (5); Japan (4) and Solomon Islands (2).

Horses were exported to Japan (223); Philippines (21); Vietnam (9); Indonesia (2) and Papua New Guinea (1). Most of the horses sent to Japan were destined for slaughter.

Fifty goats for breeding purposes were exported to Indonesia and two were sent to Papua New Guinea.

Other exports included: 525 dogs; 145 cats and 135 birds and 26 595 queen bees. Day-old chicks were sent to the Solomon Islands (2 900); Norfolk Island (2 400); Papua New Guinea (44 750) and Indonesia (2 900) and 92 710 fertile domestic poultry eggs were exported to Papua New Guinea.

Amendments to legislation 1978-79

ACTS.—The Stock Act 1915–1976 and the Brands Act 1915–1975 were both amended in view of the High Court Decision that the levying of stock assessments was invalid. Sections of the Stock Act relating to the levy were therefore revoked and provision was made for closure of the Stock Fund as from 1 July 1979. As from that date, the activities of the Division of Animal Industry will be financed wholly from Consolidated Revenue. The Brands Section also operates on the Stock Fund and action was therefore taken to amend concomitant provisions of the Brands Act 1915–1975.

Other principal amendments to the Stock Act included—

- Revised compensation provisions where stock are ordered to be destroyed by the Minister or his delegate.
- New compensation provisions relating to disease eradication programmes where animals are ordered to be destroyed by a Government Veterinary Officer, including compensation for costs incurred in disposal of animals by burning or burying in closer settled areas.
- The application of eradication measures to any disease named by Order in Council. An appropriate Order in Council was therefore promulgated to ensure continuation of the then existing brucellosis and tuberculosis eradication measures from 18 December 1978 when the Act came into force.
- Amended conditions to allow the declaration of infected or declared areas of a specific classification by notification and to strengthen controls on the movement of stock into or within such areas.
- Revised conditions relating to the introduction of stock and the movement of stock in Queensland generally.
- Extended powers of inspectors to include powers of search, to inspect or test soil or biological preparations, and to test or treat stock to meet the import requirements of other States or overseas countries.
- Provision to control veterinary laboratories and the movement or manufacture of biological preparations.
- A clearer definition of the powers of the Chief Inspector of Stock.

REGULATIONS, ORDERS IN COUNCIL, NOTIFICATIONS.—In view of continually rising costs, fees for the issue or transfer of certificates of registration or of licenses or for services provided were increased by appropriate amendments to a number of Regulations including those under the *Brands Act* 1915–1975; the Pet Shops Regulations of 1966; the Poultry Industry Regulations of 1946; the Pullorum Disease Control Regulations of 1970; the Stock Regulations of 1935; and the Meat Industry Regulations of 1973.

In particular, the Stock Regulations were amended to provide for a general increase in the costs of semen and of services supplied by artificial insemination centres; for increased treatment fees for registered horses and vehicles or stock treated at Government-owned or supported dips.

Other amendments to the Stock Regulations included provision for the Chief Inspector to approve the entry of ticky hides to premises in clean country subject to conditions to prevent escape of ticks and to approve the introduction of stud stock at night through the Wallangarra border crossing place en route to the R.N.A. Exhibition Grounds.

Orders in Council were promulgated under the Stock Act to amend and subsequently to revoke the Bluetongue Infected Area, Cape York Peninsula; to amend conditions relating to entry of ruminants from the Northern Territory and Western Australia; to revoke the bovine brucellosis infected area; to declare bees and deer to be stock and to restrict the introduction of bees from New South Wales, South Australia and Victoria; to declare European brood disease (of bees) to be a disease and a notifiable disease.

Notifications were issued to amend the boundaries and the conditions applying to movements of cattle within the bovine brucellosis protected area; to amend the boundaries of the bovine brucellosis-infected area accordingly; and to amend certain assessments on milk and cream supplied to factories participating in the Veterinary Mileage Scheme.

Orders in Council were issued under the Meat Industry Act to declare packaged frozen meat to be a prescribed meat; to permit the Metropolitan Public Abattoir Board to raise funds by sale of debentures; to abolish the Rockhampton District Abattoir Board and the Rockhampton District Abattoir area. By notification, this area was then redefined as the Rockhampton Regional Meat Area.

Proclamations were issued concerning a pipeline and an area for disposal of effluent by the Toowoomba Public Abattoir and by-laws of certain Abattoir Boards were amended to provide for agreements with operators in regard to contracts and quantitative services.

By Proclamation, swine vesicular disease was included as a disease under the *Foot and Mouth Disease Expenses and Compensation Fund Act* 1958–1969.

Training programmes

Despite the general financial stringency, in-service training programmes were maintained at acceptable levels. Branch programmes have generally been better planned than previously and resources are being used more efficiently as a result.

The emphasis on management training was continued during the year with more senior staff being involved in centrally-organized management development courses. A senior officer of the Division attended the Advanced Course at the Australian Administrative Staff College at Mt. Eliza, Victoria. Staff of the Division who have received management training have been engaged in seminars aimed at improving management procedures throughout all Branches of the Division. An officer of Biochemistry Branch commenced a post-graduate course in management at the Queensland Institute of Technology.

Two officers completed post-graduate training in extension at Queensland University and a third officer commenced this course leading to a Masters Degree. Two officers commenced the Hawkesbury Graduate Diploma in Extension early in 1979. This will make a total of 10 officers of the Division to have completed this course since 1973.

Several Branches held staff workshops as part of their technical and internal management training programmes. Staff attended scientific conferences and short courses as part of their technical training and personal development. Interstate study tours were undertaken by several officers.

Cattle industry

While the recovery from the 1974–78 price recession began in 1977, it was comparatively slow until June 1978 when increases in values for slaughter cattle gained momentum and rose steeply for all descriptions. By the end of May 1979, values reached an all-time record in money terms and were 3, 3·5 and 4·5 times higher for yearlings, ox and cows respectively than at the same time last year, and 1·8, 1·6 and 1·7 times higher than at the previous peak period of late 1973.

To place the industry recovery in perspective, a study of movements of various price indices from December 1973 to March 1979 showed that the wage rate index for adult males had risen by 103 index points compared with 73 for the all foods price index and only 45 for beef. However, the price index for beef rose in the January-March 1979 quarter at a faster rate than did prices for other food items.

Mr Ron Moore, Manager of Anderson Meat Packing Co., Wallangarra, comments on cuts and yield of carcasses from the Stanthorpe Hoof and Hook Field Day earlier in the year.

Probably the strongest recovery has been in the store cattle market which, during the slump, attracted values significantly below the unit price of fat cattle. Store cattle, particulary young steers, are now commanding higher prices per unit of weight than fat cattle. Market values have been greatly influenced by demand from the southern States and competition from meatworks operators for conditioned store animals. The demand for breeding stock has strengthened dramatically. Females, which earlier attracted little market demand, are now selling for record prices. This applies particulary to young breeders with calves at foot.

The high cattle values have brought about a change in selling patterns. During the recession, there was a strong trend away from auction selling towards direct consignment for slaughter cattle and paddock selling for stores. Since the start of the recovery, there has been a marked return to auction selling.

The economic recovery in the industry is reflected in producer attitudes towards herd and property management. Cattlemen are showing renewed interest in capital development and property maintenance and Beef Cattle Husbandry Branch staff have received numerous requests for yard plans. The increased demand for herd bulls indicates a return to better breeding herd management.

There has been a renewal of interest in intensive fattening methods. This was first apparent in the winter-spring of 1978 when large areas were planted to grazing oats for fattening cattle. More recently, interest has increased in lot fattening on grain.

Beef industry statistics

During the slump in beef prices, the Queensland beef herd grew at an average of 5% a year over a 4-year period ending March 1977. From 1977, the State herd remained fairly static with only a minor increase, but from 1978 to 1979 beef numbers fell slightly for the first time since the drought in 1969. Provisional figures show beef numbers at 10·5m at March 1979, a 5% drop compared with 1978. This trend is in contrast with changes in the other major beef producing States where the liquidation stage commenced much earlier.

The Victorian and New South Wales herds declined during the price recession by a total of 38% and 31% respectively. As the result of the decline in the national herd, the Queensland herd now accounts for 44% of the Australian total. In the U.S.A. the liquidation stage of the national herd lasts for 2 to 4 years. With the return of favourable prices on the Australian scene, it appears that the liquidation stage in Australia is about to be terminated after 3 years.

Cattle slaughtering continues at record levels. During the 1978 season, a record 3·3m cattle were slaughtered. The slaughter rate during 1979 continues at levels still higher than the 1978 rate. The numbers of calves slaughtered is declining but the female slaughter rate continues at high absolute levels but at a declining rate relative to male slaughtering. During 1977, the female slaughter rate was 94% of the male rate. In 1978 this declined to 88% and during 1979 to 87%. Despite this high slaughter rate, the number of females at March 1979 (4·7m) was still higher than the peak of 1973.

Tuberculosis-brucellosis eradication

There was a further escalation of activity in the national campaign to eradicate brucellosis from Queensland herds. The peak of activity was reached in the June to October period when testing volumes exceeded all expectations. The State's objective of attaining provisionally free status by 1983 was given an added boost by the testing results.

Continued high levels of co-operation from industry and the dedication of Departmental officers continued to achieve the objectives and detailed forward plans that have steered the campaign to the present time. Further areas of the State were gazetted protected areas for the purpose of brucellosis eradication.

Advances in the tuberculosis programme have been less dramatic due to problems associated with the remote areas of the State. These problems are being investigated by State, Commonwealth and Industry personnel.

BRUCELLOSIS.—The Shires of Mirani, Pioneer and Sarina were included within the Queensland Brucellosis Protected Area in December 1978. In April 1979, the area was further enlarged to include the Shires of Cloncurry, Paroo, Tambo, Isisford, Murweh, Blackall and the portions of Quilpie, Barcoo and Bulloo east of the Western Barrier Fence. This meant that the whole of the State, except for the Central Coast, the Moreton region and the far west came under active eradication.

There was an increased volume of testing associated with the campaign due to the greatly expanded protected area gazetted in April 1978 and subsequent declarations. Stock owners were conscious of the need to have a clean brucellosis status to eliminate any disadvantage in their normal commercial operations. Statistics of eradication and abattoir monitor testing for the 1978 calendar year showed that 3 092 674 cattle were sampled in Queensland. The reactor rate in eradication testing was 0·94%. Of 934 822 cattle monitored at abattoirs, 1·2% were reactors.

When compared with the overall Australian performance, Queensland appears as the leader in brucellosis eradication.

In the 9 months to 31 March 1979, 2 234 795 cattle from all sources were sampled in Queensland. On a full year basis, the figure is expected to reach 3m. Abattoir monitoring tests increased to 737 277 for this period, an increase of 27% compared with the same period last year. The higher figure can be attributed to a general increase in collection at the 37 meatworks now engaged in brucellosis blood sampling. Three additional works have been added to the list since the previous year and a further two, Mt. Isa and Tolga, are expected to commence collections in the near future.

The laboratories at Yeerongpilly, Rockhampton and Townsville tested 2 438 755 samples during the year. The remainder was tested by staff at field centres and at certain meatworks. Field positives are all checked at the laboratories and periodic quality checks are made of all staff undertaking Rose Bengal tests.

The remaining dairy herds in the Moreton region were brought into the voluntary dairy brucellosis eradication scheme in December 1978. The number of infected milking herds in Queensland has dropped from 1 220 in June 1978 to 182 in June 1979. This substantial reduction in positive herds reflects the co-operation of dairy farmers generally and particularly those not in the Eradication Area. In the Brisbane area, the number of positive herds has fallen from 528 in July 1978 to 133 in June 1979. A system of notifying farmers of milk ring results through the Dairy Field Services computer print-outs for mastitis was commenced in July 1978.

In the June 1978 to May 1979 period there were 81 099 animals in 2 895 herds vaccinated with Strain 19. In the same period, there were 77 572 animals in 106 herds vaccinated with 45/20 vaccine. Use of vaccines is mainly restricted to infected herds up to 2 years following eradication of brucellosis.

Eradication progress within Queensland can be seen clearly from the following table which shows the number of herds and their status as at 1 July 1978 and the position as at 31 March 1979. Further substantial progress is expected by 30 June 1979 when, for example, more than 800 herds should be accredited free.

SUMMARY OF RESULTS OF BRUCELLOSIS TESTING (JULY 1978—MARCH 1979)

Herd Status	1–7–78 No. of Herds	%	31–3–79 No. of Herds	%
Not Assessed ..	23 659	59·6	15 499	41·9
Suspect	2 944	7·4	2 281	6·2
Infected	1 457	3·7	1 492	4·0
Restricted	476	1·2	634	1·7
Provisionally clear ..	201	0·5	687	1·9
Tested negative ..	9 106	22·9	13 365	36·1
Monitored negative ..	946	2·4	1 360	3·7
Confirmed free ..	635	1·6	1 251	3·4
Accredited free ..	281	0·7	444	1·2
Totals	39 705	100·0	37 013	100·1*

* Error due to rounding.

Two-thirds of Queensland herds within the eradication area have now been assessed and eradication testing is directed mainly at known infected herds.

Brucellosis reactors are now being slaughtered under supervision in abattoirs at Beaudesert, Kingaroy and Tugun. The abattoir at Kingaroy has been slaughtering about 100 a week for a Victorian market. The higher price now being paid for brucellosis reactors has encouraged producers to have them slaughtered rather than shot and buried on the property. Reactors are also being processed for pet food at a Brisbane knackery.

Research into problems arising in brucellosis eradication continued during the year. Activity was mainly directed at refinement of vaccination programmes and at the assessment of alternative serological tests. Trials were conducted into Strain 19 vaccination of entire actively infected herds. The results were rewarding: the infection cycles were broken and few problems were encountered with residual titres after an interval of 6 to 12 months.

The Brucella 45/20 anamnestic response was studied in association with the James Cook University of North Queensland. The aims of this investigation were as follows—

1. To examine by several serological methods the effect of 45/20 vaccination on clean heifers and those artificially infected with *Br. abortus.*
2. To determine the various classes of immunoglobulin associated with the antibody activity.
3. To observe whether previous exposure to leptospirosis may be responsbile for anomalous 45/20 anamnestic reactions.

Twenty non-pregnant, brucella-negative heifers were obtained from central Queensland. Half of the heifers had positive titres to leptospirosis. Ten of the animals were inoculated via the conjunctiva with virulent *Br. abortus.* All 10 animals developed a positive Rose Bengal reaction while four displayed positive and two suspicious complement fixation (CF) tests. Sixteen weeks after infection, the animals received 45/20 vaccine, and seven of the heifers produced a positive anamnestic response (titre greater than 1/16) 42 days after vaccination. 45/20 vaccination of the 10 non-infected heifers produced fleeting low grade Rose Bengal titres in four animals.

All animals were destroyed for culture 11 weeks after the 45/20 vaccination. *Br. abortus* was isolated from the supramammary lymph nodes of one heifer on primary culture. This heifer at the anamnestic test had a negative Rose Bengal result, CF test of 3/32 and Miller's antigen CF test of 4/256. Biological culture recovered *Br. abortus* from the parotid lymph node of a second heifer. This animal at the anamnestic test had '3+' Rose Bengal reaction, CF test of 2/32 and Miller's antigen CF test of 2/16. Further definitive study is required to evaluate the anamnestic test.

Brucella suis infection of pigs may be a potential danger to the Brucellosis eradication scheme. Infection of cattle with *Br. suis* was studied by administering approximately 2×10^7 *Br. suis* organisms in a 0·2 ml dose into the conjunctival sac of one eye of each of the six pregnant cows. Using *Br. abortus* antigen in the Rose Bengal and CF tests, all six animals gave a Rose Bengal response for periods of 3 to 11 weeks. Two of the cows which had '3+' titres also gave CF titres for 2 weeks in one case, with a maximum titre of 3/4, and for four weeks in the other case with a maximum titre of 2/8. The other four cows reached a '2+' titre in the Rose Bengal test but did not exhibit a CF titre. Three of the cows were vaccinated with brucella strain 45/20 about 6 weeks after calving. At 6 weeks after vaccination, one had a Rose Bengal titre of '2+' and a CF titre of 3/16, a second cow had a Rose Bengal titre of '2+' and a CF titre of 4/8 while the third cow is still in progress.

A comprehensive culture programme of the visceral organs of each calf, the placenta, and selected lymph nodes, spleen and colostrum from each of the cows failed to isolate any *Br. suis.* All six cows calved as full term and it was concluded that *Br. suis* produces only a transitory serological response and no clinical effects in pregnant cows.

TUBERCULOSIS.—Several changes have occurred during the year which should make the task of tuberculosis eradication more attainable, particularly in the more remote areas of the State. It is expected that the current state of the beef market associated with proposed measures for tuberculosis eradication in the remote areas of the State will give this section of the campaign a much-needed boost.

For the 9-month period to March 1979, a total of 2 086 522 cattle (62 220 bulls, 1 030 466 ox and 993 836 female) was slaughtered at Queensland meatworks. Carcasses affected with tuberculosis totalled 1 784 (0·09%) and 1 278 (0·06%) were condemned. This represented a reduction of 0·08% in the number affected compared with the previous year. These figures do not include reactors as only five were slaughtered at abattoirs: the remainder were destroyed on properties.

Tuberculosis-like lesions from properties not on the infected property list continue to be forwarded to the diagnostic laboratories.

The green tail tag for use by tuberculosis-affected properties has become a more common sight since the tail tag exemption was amended. It is proving useful in identifying cattle at meatworks from which tuberculosis lesions do not have to be sent to the laboratory for diagnosis.

SUMMARY OF TUBERCULOSIS INFECTED PROPERTIES BY DIVISIONS

Division	Infected Herds	Herds under Test	Herds not under Test
Brisbane	1 (1)*	— (1)	1 (—)
Toowoomba	2 (2)	2 (2)	— (—)
Roma	62 (66)	32 (37)	30 (29)
Maryborough ..	3 (4)	3 (4)	— (—)
Rockhampton ..	54 (55)	49 (48)	5 (7)
Townsville	43 (49)	21 (24)	22 (25)
Cairns	19 (14)	10 (10)	9 (4)
Mount Isa	77 (67)	58 (58)	19 (9)
State	261 (258)	175 (184)	86 (74)

* Numbers in brackets are for corresponding period 1977–78.

Progress with eradication will be jeopardised unless special measures are implemented quickly in the southern Peninsula areas and the far west. The improved state of the beef market if sustained will, it is hoped, stimulate more disease control activity and co-operation in these difficult areas. Renewed extension efforts will be directed at owners to undertake approved programmes with a view to eventual eradication.

There was a considerable reduction in the overall volume of testing with only Toowoomba Division showing an increase. The decrease (23%) was to some extent due to the new policy of selective tuberculin testing of 'at risk' and previously infected dairy herds, and of all herds indicated by epidemiological traceback.

The number of reactors has declined by 16·5% overall and this is attributed largely to the lower prevalences experienced in known infected herds.

During the year, 679 tissues in 279 batches were examined for tuberculosis. The involvement of mediastinal lymph nodes, lung and bronchial nodes indicates respiratory spread as very important. *Corynebacterium equi* infection has been found to cause a lesion microscopically identical with tuberculosis. However, the agreement between a microscopic diagnosis of tuberculosis and the cultural confirmation by isolation of *Mycobacterium bovis* is still about 95%.

Research activities into bovine tuberculosis included an investigation of the microbiological and pathogenic effects of infection with various non-specific mycobacteria. Work was started in conjunction with the C.S.I.R.O. on an investigation into optimal test intervals using 0·3 mg PPD tuberculin. With the co-operation of a number of pastoral companies, trials were also conducted to establish the efficiency of reading the tuberculosis test at an interval of 48 hours, as compared with 72 hours. Results are not yet to hand.

Staff at Bremer River Abattoir collected lesions from 150 carcasses over a period of 2 months to check normal lymph nodes for mycobacteria. Five lymph nodes were collected from each carcass as aseptically as possible. The retro-pharyngeal, sub-maxillary, prescapular, ischiatic and mesentric were the lymph nodes submitted to the Brucellosis Tuberculosis Laboratory for examination. Results are not yet to hand.

Extensive tail tag surveys have commenced at meatworks where permanent disease control staff are stationed. The object is to try to determine the causes of tag losses and to see whether there is a significant seasonal influence. Rather alarming losses of up to 16·9% overall were reported in the first 3 months of the survey. Tags are being lost before slaughter and, at some of the larger works, on the slaughter floor. Action is constantly being taken to upgrade tagging procedures. It has been shown that tags applied correctly will stay on through the most extreme conditions. Tags which have fallen off in holding yards and pens at meatworks are now being returned to properties of origin, with a view to improving the method of application.

Considerable trouble has been experienced with mixing of exempted property lines of tagged and non tagged cattle during spelling on the way to the meatworks. Action has been taken to have this situation corrected.

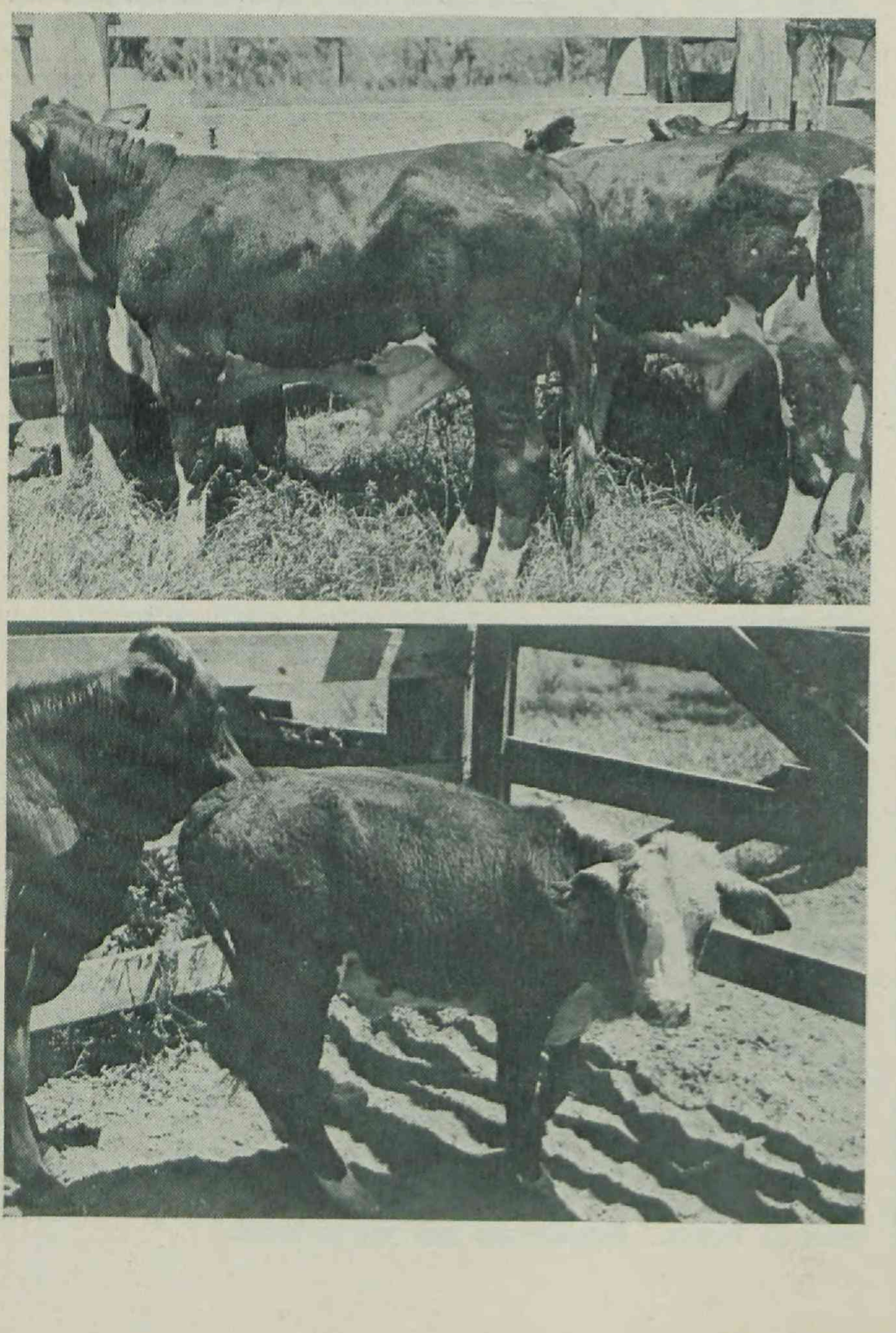
Ticks

A considerable proportion of Divisional resources were devoted to activities relating to ticks (*Boophilus microplus*).

These activities can be grouped into—

- Research to determine the effect of tick infestation on productivity in various genotypes and classes of cattle.
- Field investigation, demonstration and extension related to means of selection of bulls and breeders for tick resistance.
- Extension directed at the dangers of reliance on chemical control and the need for biological control, principally the use of resistant taurindicus cattle.
- Extension directed at reducing the frequency of dipping crossbred cattle.

Cobalt deficiency has been strikingly demonstrated on improved pastures near Bundaberg. In a trial conducted by the Department of Primary Industries animals were treated for cobalt deficiency and for parasites. Animals which were the same age and weight at the beginning of the trial are shown 12 months later.



In central and north-eastern Queensland, most producers have accepted the merits of crossbred cattle. For example, there are now no herds in the Nebo Shire that have not introduced Zebu or Zebu cross bulls, and only 33 pure British breed herds (5%) are left in the Central Highlands. The effort in these areas has concentrated on increasing the level of resistance through selection, and reducing the frequency of dipping. Three producers at Biloela are now ranking bulls on their level of resistance and using this as a basis for selection.

In north Queensland, a series of observations has been started on private properties with *Bos indicus*-infused herds to test and demonstrate the use of selection for tick resistance. To date, these studies have shown that allocation of replacement heifers to one of three tick resistance categories by visual assessment was satisfactory provided a sample of animals was tick-counted at the commencement of assessing each mob.

However, visual assessment was ineffective for ranking of bulls for selection. Artificial infestation with a known dose of tick larvae followed by actual tick counts was the only sufficiently accurate method of ranking of bulls. Selection within herds with low levels of *Bos indicus* infusion proved unsatisfactory.

The co-ordinated tick extension programme in south-east Queensland involving the Beef Cattle Husbandry and Veterinary Services Branches of this Department and C.S.I.R.O. has continued at a high level.

In this area, there are still many herds with no *Bos indicus* blood and the principal objective has been to induce these producers to consider the use of resistant breeds of cattle. Some effort has also been directed at producers who already have *Bos indicus* infused cattle and who have taken no advantage of their tick resistance by reducing the number of chemical treatments.

The advantages of environmentally-adapted cattle was demonstrated to some 35 cattlemen during a bus trip to central Queensland to see at first hand and discuss this subject with commercial producers. The information was well received and has resulted in several participants either introducing or increasing the level of *Bos indicus* blood in their herds; reducing the frequency of dipping and also using performance tested and tick rated herd bulls.

The attitudes of breed societies to selecting for tick resistance in cattle are being sought. This has aroused interest from some of the taurindicus breed societies and invitations were received to address their members on the subject. The use of performance tested, tick rated bulls as future herd sires will be promoted further.

Although there is increasing acceptance of Zebu-infused cattle in the south, a degree of reservation concerning meat quality still exists. With a view to further exploring this situation, the Department and C.S.I.R.O. held a symposium at the Cannon Hill Meat Research Laboratory, which was attended by 70 meat processors, retail butchers and producer representatives. Carcasses from *Bos indicus* crossbred and Hereford steers were tenderstretched or hung normally and participants sampled beef for taste and tenderness from each source and their views evaluated. The purpose of the exercise was to demonstrate that treatment of carcasses after slaughter affected eating quality much more than breed. The tasting evaluation supported this hypothesis.

A trial at Peak Crossing and Wivenhoe was terminated in June 1979 after 3 years. Undipped Herefords showed little evidence of ill effects from ticks at low levels of infestation and only a very minor effect at high levels over a short period. Herefords carried about two to three times more ticks than crossbreeds at the peak of infestation. On a composite treatment basis, the best crossbred group had a 60 kg liveweight advantage over the worst Hereford group. The trial suggests that even British breed cattle are probably being dipped more frequently than is necessary for economical tick control.

On Brigalow Research Station a project has commenced to measure the response to dipping and drenching at 3-week intervals in Hereford and Africander x Hereford steers. There was no response to dipping alone in Herefords but a response when dipping was superimposed on drenching. The crossbred steers failed to respond to dipping. Tick counts were low throughout the study but were higher in the Herefords than in the crossbred steers.

At 'Swan's Lagoon', the study on effects of tick control on performance of Droughtmaster breeders continued. During the past year, dipping has not affected weight gains of dry cows. However, undipped cows which calved during the period October 1978 to January 1979 performed better than similar dipped cows during this period. Nevertheless in March 1979, cows in the dipped group were 20 kg (cows with calves) and 14 kg (dry cows) heavier than cows in the undipped group. Dipping did not influence calf birth weight but calves from dipped cows were born 13 days earlier.

Overall, tick burdens were light with peak tick counts reaching only 25 to 30 ticks per side. Progeny from this trial, which were weaned in May 1978, have since been used in a dipped versus undipped study across pre-weaning treatment. Overall, both dipped and undipped groups have performed similarly post-weaning. Highest tick burdens were recorded during the 2 months following weaning and males carried twice as many ticks as females.

Artificial infestation of three-quarter Sahiwal, three-quarter Brahman and half Brahman yearling and 2-year bulls at 'Swan's Lagoon' produced mean counts of 10, 27 and 43 ticks per side respectively on the three genotypes. This supported earlier findings that Sahiwal has a higher Zebu content. The lower tick counts in three-quarter Brahmans than in half Brahmans demonstrates the increase in tick resistance with increase in *Bos indicus* content.

The use of acrylic polymers as a depot for the slow release of acaricides in the control of ticks was investigated. Results, although not as promising as hoped, have shown an extended period of protection against ticks. At the end of the trial, which was terminated because of animals losing condition due to tick burdens, the group treated with acrylic plus acaricide (dipofene) at twice recommended concentration had only dropped approximately half the numbers of ticks of any of the other treatments. The development of a more durable acrylic would seem to have considerable promise in extending the period of protection of acaricides.

A major cattle tick survey was completed by officers of Pathology and Veterinary Services Branches in conjunction with the University of Melbourne. It investigated methods of tick control being used and producer opinions. This has provided some basic guidelines on extension methods to be used in the control of this major parasite of cattle.

Tick control extension officers located at Townsville, Rockhampton, Maryborough and Laidley continue to give advice to producers on dip maintenance and construction. All reported cases where dipping has failed to give effective 'kills' are investigated thoroughly. Officers also supervise the distribution of Departmental dip moulds which allow producers to install efficient vats economically.

Organo-phosphorus acaricide resistance is continuing to spread. No evidence of promicide or amidine resistance has been encountered yet so that acaricides are available to control multi-resistant ticks. During the 12 months to 31 May 1979, a total of 86 tick samples was tested for resistance of which 75% and 20% were of the Biarra and Mt. Alford strains respectively.

Following widespread beneficial rains early in 1979, conditions were favourable for the propagation of cattle ticks in the normally free areas of the eastern Darling Downs and South Burnett. The numbers of properties quarantined in 1978–79 totalled 265 compared with 392 in 1977–78.

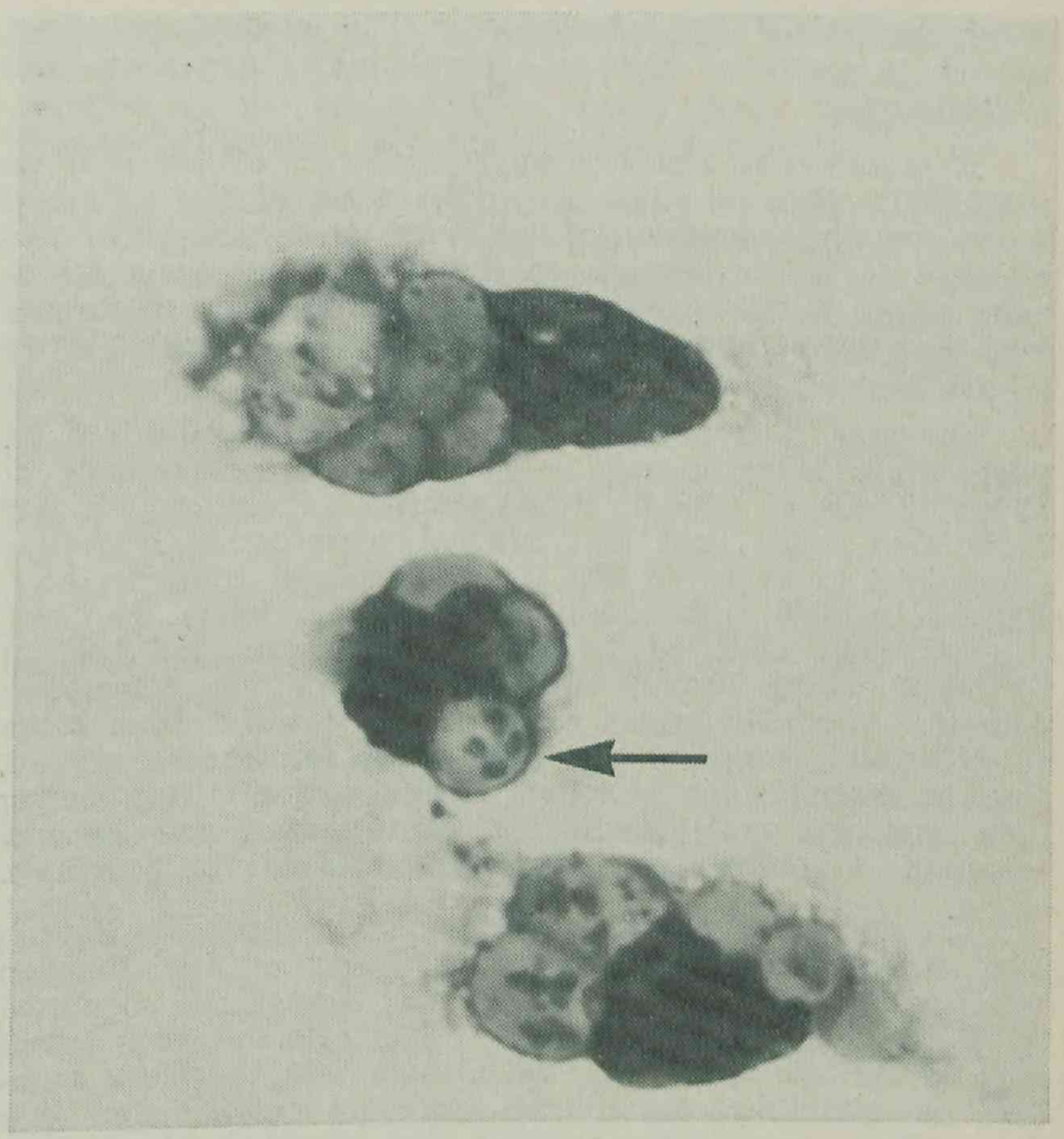
Tick fever

Of tick fever outbreaks investigated, 83% were caused by *Babesia bovis* with only three outbreaks by *B. bigemina.* Outbreaks of anaplasmosis were confirmed at Monto, Imbil, Beaudesert, Laidley, Kilkivan, Lawes, Moura and Hughenden. Significant deaths caused by *B. bovis* occurred at Prairie (40 deaths), Lake Nash (15), Rosedale (14), Biloela (12) and Hodgsonvale (9).

A total of 703 400 doses of vaccine was supplied from the Tick Fever Research Centre (T.F.R.C.) Wacol, during the 12 months. This represents an increase of 75 466 doses over last year's supply and may have resulted from the recent increase in the value of cattle. About 60% of the vaccine contained *Anaplasma centrale* as well as *B. bovis.* There was a relatively small demand for *B. bigemina* either mixed with the other two organisms (2 446) or with *B. bovis* alone (297 099). Vaccine containing *B. bigemina* was used for groups experiencing a disease outbreak due to this parasite, for valuable herds being introduced to the enzootic area and for cattle being exported from Australia.

Many enquiries were received both from within Australia and from overseas, concerning tick fever vaccination of cattle being exported from Australia and also regarding risks of tick-borne disease spreading from Australian cattle. Widespread ignorance of the epidemiology, clinical manifestations and immunology of babesiosis and anaplasmosis, compounded by lack of communication, continue to threaten programmes of livestock improvement in countries to which Australia exports cattle.

Research supported by Australian Meat Research Committee and Department funds continued at T.F.R.C., Wacol, the Animal Health Station, Oonoonba, and also in collaboration with Veterinary Services Branch at Isis and Townsville. The first experiment on property leased at the Wivenhoe Dam site is under way. This new facility will be used to test laboratory findings under field conditions.



Erythrophagacytosis. Ingestion and destruction of Babesia-infected red blood cells (arrowed) by tissue macrophages. This process is initiated by antibodies to Babesia *and is one of the major defence mechanisms operating against this organism.*

Another well-established collaboration is with the Walter and Eliza Hall Institute. A major aim is the biochemical identification of antigens of *Babesia,* to enable differences between strains to be evaluated *in vitro.* The project could help in improving the efficacy of vaccination.

The scope of the T.F.R.C. research programme is illustrated by the following highlights.

CELL-FREE DILUENT FOR VACCINE.—The diluent for vaccine has been further modified by changing its bovine blood component from 25% plasma to 10% serum. First, it was shown that viability of *Babesia* and *Anaplasma* was not affected by the change. Then the difficult task of efficiently preparing and filtering large volumes of bovine serum (up to 100 litres) was undertaken. This was achieved by collecting blood into 20-litre drums, defibrinating by stirring, separating by centrifugation, freezing and thawing to aggregate precipitate, and filtering, first through gauze to remove the precipitate and then microbiologically to sterilize. The sterilizing filtrations are with serum warmed to 35 deg C and forced with gas pressure through four Millipore cartridge prefilters followed by a sterile 0·22 μm filter in a 293 mm holder.

STORAGE OF *A. centrale* FOR VACCINE.—Because of uncertainty concerning the *in vitro* keeping qualities of *A. centrale,* parasites for vaccine have been collected almost daily by jugular bleeding. As a result of recent experiments testing *in vitro* survival of *A. centrale,* more efficient and hygienic bulk collection procedures from the carotid artery, followed by storage at 2 to 4 deg C, have been adopted for this organism.

In an experiment to simulate actual conditions, vaccine prepared to contain 10^7 *A. centrale* per dose was still infective after 9 days' storage (the longest period tested).

By incorporating an infectivity titration in the experiment and comparing responses of inoculated groups, it was estimated that almost 10^6 *A. centrale* were still viable after 9 days' storage. This is considerably higher than levels at which infectivity becomes deficient (10^4 to 10^5 parasites).

FROZEN VACCINE.—Because Trinidad authorities wish to purchase frozen vaccine, and in anticipation of demand from other quarters, 5 ml doses of vaccine containing all three parasites were frozen and stored, according to principles established over the years, but using a practical bulk processing procedure. On thawing, the vaccine was inoculated as in the field. All 24 animals inoculated became infected with the three parasites, indicating that the vaccine was still potent after freezing and thawing.

COUNTING OF PARASITES.—A fluorescent dye (Hoechst 33258) with affinity for DNA has been applied in a new, highly accurate method of counting parasites. After staining the parasites in a blood suspension, a measured quantity of a 1/1 000 000 dilution of the blood is placed on a glass slide. All the parasites in the preparation are easily counted with a fluorescence microscope, and the parasite count of the

blood determined by calculation. The method has been applied to counting *Babesia, Anaplasma, Plasmodium* and *Trypanosoma.*

REQUIREMENTS FOR TEMPERATURE DROP IN INFECTION OF TICKS WITH *Babesia.*—Just as studies reported last year had shown that the conversion of tick forms of *Babesia* into forms infective for cattle depends on the temperature being raised, more recent work suggests that bovine blood forms of *Babesia* require a temperature change to convert to forms infective for ticks.

However, this phase of the life cycle depends on the temperature being lowered. Blood forms are normally at 38 to 40 deg C (the body temperature of cattle). It was found that, when ticks that had fed on infected cattle were maintained at 37 to 38 deg C after removal from the host, *Babesia* ingested with blood did not always infect the ticks, whereas ticks collected from the same cattle and held at 30 deg C became heavily infected. The lowering of temperature that normally begins when *Babesia* transfer from cattle to ticks and continues when the ticks fall to the ground, may be essential for infection of the vector. This finding may help our understanding of how diurnal and seasonal variations in temperature affect the incidence of babesiosis.

CHANGE OF BREED STRUCTURE ON TRANSMISSION OF *Babesia* AND *Anaplasma.*—The epidemiology trial at Isis Junction being performed by Veterinary Services Branch and supported by T.F.R.C. is in its fifth year. The rate at which calves born in the late spring became infected with tick-borne parasites was established for animals averaging approximately 50% *Bos indicus* component, running with their crossbred dams possessing 20 to 50% *Bos indicus* component. At April-May weanings over 3 successive years, 64 of 76 calves had become infected with *B. bovis* and 72 with *A. marginale.* In 1978, high grade Sahiwal heifers (at least 75%) mated with the same 75% Sahiwal bull as used previously replaced the crossbred dams. None of 20 progeny of this mating had become infected either with *B. bovis* or *A. marginale* at the time of weaning in 1979, although *B. bigemina* had been transmitted to 15 of the calves. This marked difference in the transmission rate of *B. bovis* and *A. marginale* could have been due to higher tick resistance of the Sahiwal dams and possibly lower infectivity of their blood for ticks.

ANTIGENIC FRACTIONS OF TICKS.—The *in vitro* test for lymphocyte transformation has provided a sensitive assay for tick components with antigenic activity. The first material found to be stimulatory was tick saliva. Since then, stimulation has been produced with haemolymph and also crude extracts from unfed larvae, adult salivary gland, ovary and tick eggs. Of greatest interest is the activity in haemolymph. This component, which is readily available from adult ticks, produced strong stimulation, and should not be very difficult to fractionate with a view to identifying the antigen.

IN VITRO CULTURE.—A large number of experiments has now been performed testing conditions for short term culture. Three species of *Babesia* have now been grown *in vitro.* An intriguing aspect of attempts to culture *B. bigemina* is that of five different strains tried only one will multiply appreciably *in vitro.* The source of plasma for the medium is also important. Parasites will not grow in cultures containing plasma from certain animals. It is not known whether such plasma is nutritionally deficient or if it is parasiticidal, nor is there an estimate of the prevalence of the effect. Although long-term or continuous culture is a desirable aim, short-term culture has obvious applications in studying host parasite interactions and in testing for factors inhibitory to parasites.

INCREASED SUSCEPTIBILITY TO ENDOTOXIN DURING ACUTE BABESIOSIS.—Because of current interest in the possible involvement of bacterial endotoxins in the pathology of haemoprotozoan infections, an experiment was done to assess the effect of endotoxin on calves infected with *Babesia.* The findings indicate that babesial infections increase the susceptibility of calves to bacterial endotoxin.

TREATMENT WITH IMIDOCARB DIPROPIONATE.—Because 'Imizol' is likely to be marketed again, the new formulation, imidocarb dipropionate, was tested, and also compared with imidocarb dihydrochloride, the form in which it was previously available. The two compounds were equally effective in treating both *Babesia* and *A. marginale* infections. At 2·4 mg per kg the dipropionate salt exerted a strong prophylactic effect against *B. bovis* and *B. bigemina,* but not against *A. marginale.* The strain of *A. marginale* exposed to prophylactic levels of imidocarb was tested for drug resistance, but no evidence for this was demonstrated.

LONG-ACTING TETRACYCLINE FOR THE TREATMENT OF ANAPLASMOSIS.—A single dose of T-200, the long-acting form of oxytetracycline at 20 mg per kg was as effective in treating acute anaplasmosis as conventional oxytetracycline given twice at 10 mg per kg and imidocarb dipropionate at 3·5 mg per kg.

At the Oonoonba Veterinary Laboratory, research has been concentrated on anaplasmosis. Significant findings are reported in the following paragraphs.

EPIDEMIOLOGY OF ANAPLASMOSIS IN BEEF CATTLE IN NORTH QUEENSLAND.—A study on three groups of calves, two of 90 animals in the wet tropics and one of 120 animals in the dry tropics, has been completed. Samples were taken for haematology, parasitaemia and complement fixing antibodies, and bodyweights were obtained at regular intervals from all animals from berth to between 12 and 18 months of age.

Approximately half of each group was vaccinated with *A. centrale* at 3 to 4 months of age. The calves were dipped regularly and were subject to pasture rotation.

Evidence of transplacental transmission and the presence of material antibody was observed. Within 2 months of vaccination, most vaccinated animals showed a serological response which lasted approximately 90 days. Serological conversions in unvaccinated calves occurred throughout the year. However, a peak was observed after the wet season. Severe anaemia was observed in some of the calves. No differences in growth rate between vaccinated and unvaccinated calves were observed. All animals were infected with *Theileria mutans* by 6 months of age.

ANAPLASMA MARGINALE, DURATION OF INFECTION, AND COMPLEMENT FIXATION TITRES WITHIN CARRIER STATE ANIMALS.—Observations on animals in endemic areas showed that the CF titre in naturally infected young calves may become negative within 100 days of the animal showing a patent parasitaemia. The percentage of adult carrier animals as detected by the complement-fixation test was lower than expected from the infection rate of young animals. The duration of infection and the relationship between carrier state and CF titre is being investigated in three groups of experimentally-infected animals —adult *Bos taurus,* adult *B. indicus* and 6-month-old *B. indicus* calves. Results to date, approximately 100 days after infection, have confirmed the field observation: 14 out of 18 calves became negative to the CF test. The adult animals, however, although showing a marked reduction in CF titre, are still positive.

EFFICACY OF THE A. CENTRALE VACCINE.—As some 350 000 doses of anaplasmosis vaccine are dispensed every year, it is important to monitor the efficacy of the vaccine. An experiment involving 54 6-month-old Brahman cross calves is in progress to this end.

ANAPLASMOSIS IN BOS INDICUS CATTLE.—Groups of 8 and 10, 4-year-old *Bos taurus* and *Bos indicus* cattle respectively were each inoculated with approximately 10^{10} *A. marginale,* infected erythrocytes. Disease development in the two groups was compared using prepatent period, degree of parasitaemia, packed cell volume fall, per cent bodyweight change and length and degree of humoral antibody response. No significant differences between the two groups were detected using the above parameters.

These findings support previous work at Oonoonba using groups of 2-year-old animals. Groups of 18 *Bos indicus* calves 6 months of age were inoculated at the same time as the 4-year-old animals with the same inoculum. Disease development in these animals indicated that an age resistance of anaplasmosis was present in *Bos indicus* cattle similar to that described in *Bos taurus* animals.

RHIPICEPHALUS SANGUINEUS AS A VECTOR OF ANAPLASMOSIS IN CATTLE.—Larvae from dog-derived female Rhipicephalus fed readily on the ear of a calf that was reacting to *A. marginale.* The resultant nymphs fed readily on the ear of a serologically negative (CF test), splenectomized calf. The calf reacted to *A. marginale* 26 days after exposure. A second successful transmission of *A. marginale* has been achieved by feeding larval ticks on a calf during a relapse, and subsequently feeding the resultant nymphs on a serologically negative (CF test), splenectomized calf. On this occasion, the recipient calf was housed in insect-proof accommodation (in the isolation building) and reacted to *A. marginale* 34 days after exposure. This experiment confirms the role of the ticks in the first experiment.

SUITABILITY OF CATTLE AS HOSTS FOR R. SANGUINEUS.—Results to date indicate that larvae and nymphs as a primary infestation feed readily on cattle with an engorgement rate usually between 10 and 60%. The effect of previous infestations will be investigated, but the limited data already available suggest that a specific stage immunity may be developed.

No *R. sanguineus* were found on examination of 200 cattle hides at Bohle abattoir. However, the difficulty of detecting engorging larvae and nymphs was discovered during laboratory work, and the time elapsing between cattle leaving their property and slaughter would result in most immature forms being lost before the hides were examined.

Larvae from dog-derived females have been reared through to the adult stage on guinea pigs without the need for collars or bags. Adults however have been reluctant to feed, although of good size and active.

Buffalo fly

Buffalo fly maintained its presence in the non-endemic areas of southern Queensland as far south as the New South Wales border. The mild moist conditions of the 1978 winter favoured the fly in coastal areas and infestations reached the highest level since its encroachment into the southern region 3 years ago. Cattlemen continued to show concern at the apparent effect of fly worry on animal performance and enquiries about control measures were received.

At 'Swan's Lagoon' Research Station, in the second year of the study to measure the effect of buffalo fly control on the performance of steers and bullocks, weight gains between September and May were higher in treated bullocks (16 kg) and steers (10 kg) than in untreated animals. This contrasts with the lack of response to treatment in 1977–78. Fly populations were similar in both years until February, but burdens were heavier in March–May 1979 than in the previous year. Periods of protection afforded by the chemical were similar to those recorded earlier ranging from 18 to 21 days in dry weather to 9 to 14 days in wet weather.

Internal parasites

Heavy infestations of young cattle with *Haemonchus placei* were reported from south-eastern Queensland. *Cooperia* spp. caused loss of condition at Roma. Lungworms (*Dictyocaulus viviparus*) were associated with calf pneumonia at Leyburn.

Interest in treatment appears to be on the increase—partly as an outcome of trial results and partly because of severe outbreaks of clinical disease. Deaths of weaners from helminthiasis were reported from Bundaberg. It is difficult, on available information, to recommend generally applicable control measures, and the renewed activity in field trials should provide practical guidelines for local use.

In a study at Brigalow Research Station comparing the effects of dipping and drenching, alone and in combination, on performance of Hereford and F1 Africander x Hereford steers, responses to drenching over a 6-month period from October 1978 were 16 kg in Herefords and 13 kg in the crossbreds. Sixty per cent of the response occurred in the first 6 weeks, when two drenches had been given.

At Biloela, the effect of drenching at 4-week intervals is being measured on Murray Grey and Brahman x Murray Grey steers grazing a Rhodes-buffel grass pasture. Between July and December, a 16 kg response to drenching was obtained in the Murray Greys, while the crossbreds showed only a 4 kg response. Subsequent performance of the drenched Murray Greys was similar to that of the crossbred steers suggesting that both genotypes could handle the environment similarly once worms were controlled.

In a study to measure the effects of cobalt therapy and drenching on performance of weaners grazing improved legume grass pastures on deep sandy soils north of Bundaberg, drenching increased gains over untreated animals by 16 kg between August and March. The response to anthelmintic in animals receiving cobalt therapy was 22 kg. Faecal worm egg counts increased over the period especially in cobalt-treated animals reaching a mean of 1 000 eggs per gram in February with individual counts as high as 3 560 e.p.g. More than 70% of the larvae which hatched were *Haemonchus* spp., representing pathogenic burdens.

In the Peak Crossing-Wivenhoe trial, regular, 3-week drenching resulted in a marked response in liveweight in both British breed and *Bos indicus* crossbred genotypes up to 2 years of age. After that time, there was little or no benefit from drenching, suggesting that untreated cattle had developed a resistance to worms. Only one crossbred genotype retained all the advantage gained from drenching while Herefords and Brafords lost about one-half and one-third of the advantage, respectively.

Bluetongue

During the year, substantial surveying for bluetongue 20 virus was conducted throughout Queensland. Results of testing in the southern and northern areas of the State revealed no activity of this virus. The testing contributed significantly to the modification of bluetongue movement controls throughout Queensland and, in fact, the formerly gazetted Cape York Peninsula Bluetongue Infected Area was revoked in December 1978. Because of the economic hardship experienced by cattle producers, especially in the Cape York Peninsula area, a Commonwealth-State financial assistance scheme was developed to recompense producers in part for the costs of mustering and testing associated with survey and movement controls. This scheme was made retrospective to cover all of that testing required by the Department in its endeavour to establish the distribution of serological evidence of infection.

Throughout the year, it became obvious that there were viruses other than bluetongue 20 causing confusion in the interpretation of serological results. A sentinel herd scheme was established in six Government cattle herds, located at various centres near the eastern coast of Queensland. The objective of the scheme is to isolate these viruses so that bluetongue testing may be interpreted precisely.

Many cattle sera collected in parts of Australia outside the bluetongue 20 infected area have given positive reactions to group specific agar gel or complement fixation tests for bluetongue. A possible explanation could be that other arboviruses share antigen with bluetongue 20 thus interfering with the group tests. This type of interference has recently been reported in Nigeria.

Sheep were infected in the isolation unit at the Animal Health Station, Oonoonba with D'Aguilar arbovirus. A regime incorporating autoinoculation and transmission to sheep on the seventh day after inoculation was used. Sera were collected weekly until 42 days after inoculation when all sheep were killed and autopsied. Temperatures were taken daily throughout the experiment.

No temperature response or clinical sign was observed in any sheep at any stage. No lesions were observed at necropsy, and this was confirmed with histopathologycal examination of many tissues. C.S.I.R.O. confirmed that all inoculated sheep became infected with D'Aguilar virus, as positive serum neutralization (SN) tests were recorded. At no stage did any sheep record a positive SN test for bluetongue 20. One sheep gave positive gel diffusion tests for bluetongue 20 on days 28, 35 and 42 postinoculation, but all complement fixation tests were negative.

Six sheep 35–42 days pregnant were inoculated with 12·5 ml of bluetongue 20 virus of infected sheep blood intravenously and 12·5 ml subcutaneously. A further four sheep were inoculated 9 days later.

All inoculated sheep recorded a temperature rise lasting 1 to 4 days, and this occurred between 5 and 8 days postinoculation. The highest temperature recorded by one sheep was 41·1 deg. C. Associated with the temperature rise was a 50% reduction in food intake, and reddening of the buccal mucosa. Swelling of the ears and a nasal discharge was seen in one animal. Virus was isolated only during the temperature response stage 3 to 7 days postinoculation.

Agar gel (AG) antibodies were detected by day 14 postinoculation and remained at detectable levels until the end of the experiment on day 152. CF antibodies were detected between days 21 and 28 postinoculation and remained at detectable levels until the end of the experiment. SN tests have not been completed. Seven normal lambs were born. No antibodies were detected in the pre-colostral serum samples as judged by the AG and CF tests. Post-colostral sera contained antibodies. No abnormalities were detected and no virus isolated at autopsies of all 12 ewes and 7 lambs in the experiment. This shows that bluetongue 20 virus produces minimum clinical signs in ewes and no adverse effects on pregnancy or the resulting lamb.

Other diseases

A serious outbreak of the virus disease, infectious bovine rhinotracheitis (IBR) in a feedlot at Dalby was investigated at the close of the year. The feedlot contained some 1 300 yearling steers, mainly Herefords but with some Murray Greys. At the time of writing, 24 had died and approximately 600 had been clinically affected. Clinical signs observed were mucoid to mucopurulent bilateral nasal discharges and coughing. The more severely affected animals exhibited severe respiratory distress. The major pathological findings were a mucopurulent rhinitis, diptheritic tracheitis, a severe fibrinopurulent bronchopneumonia and focal liver necrosis in some animals.

Viral inclusions were readily detected in the lungs and trachea and bovine herpes virus particles were demonstrated in lung and tissue cultures of affected organs by electron microscopy at the Animal Research Institute. The virus has been identified as Bovine Herpesvirus Type 1, the cause of the most prevalent feedlot respiratory disease, infectious bovine rhinotracheitis, in the United States. This virus is widespread throughout Australia but has not previously been associated with severe rhinotracheitis and pneumonia. This is the first confirmed occurrence of this type of IBR in feedlot cattle in Queensland. Factors which operate to cause this disease in feedlot cattle are the introduction of young 1 to 2-year-old animals which have lost their passive immunity, intensive stocking rates, the constant introduction of cattle from diverse backgrounds and stress associated with transport and husbandry procedures.

Following heavy rains early in 1979, widespread outbreaks of ephemeral fever were reported from north Queensland. The present epizootic is affecting mainly cattle under 2 years of age. Numerous outbreaks have occurred in the Mount Isa Division and in the Richmond, Carpentaria, Etheridge, Hinchinbrook, Ayr, Bowen, Thuringowa, Dalrymple and Proserpine shires. Cases of the disease have been diagnosed at Cadarga, Wondai and Berajondo.

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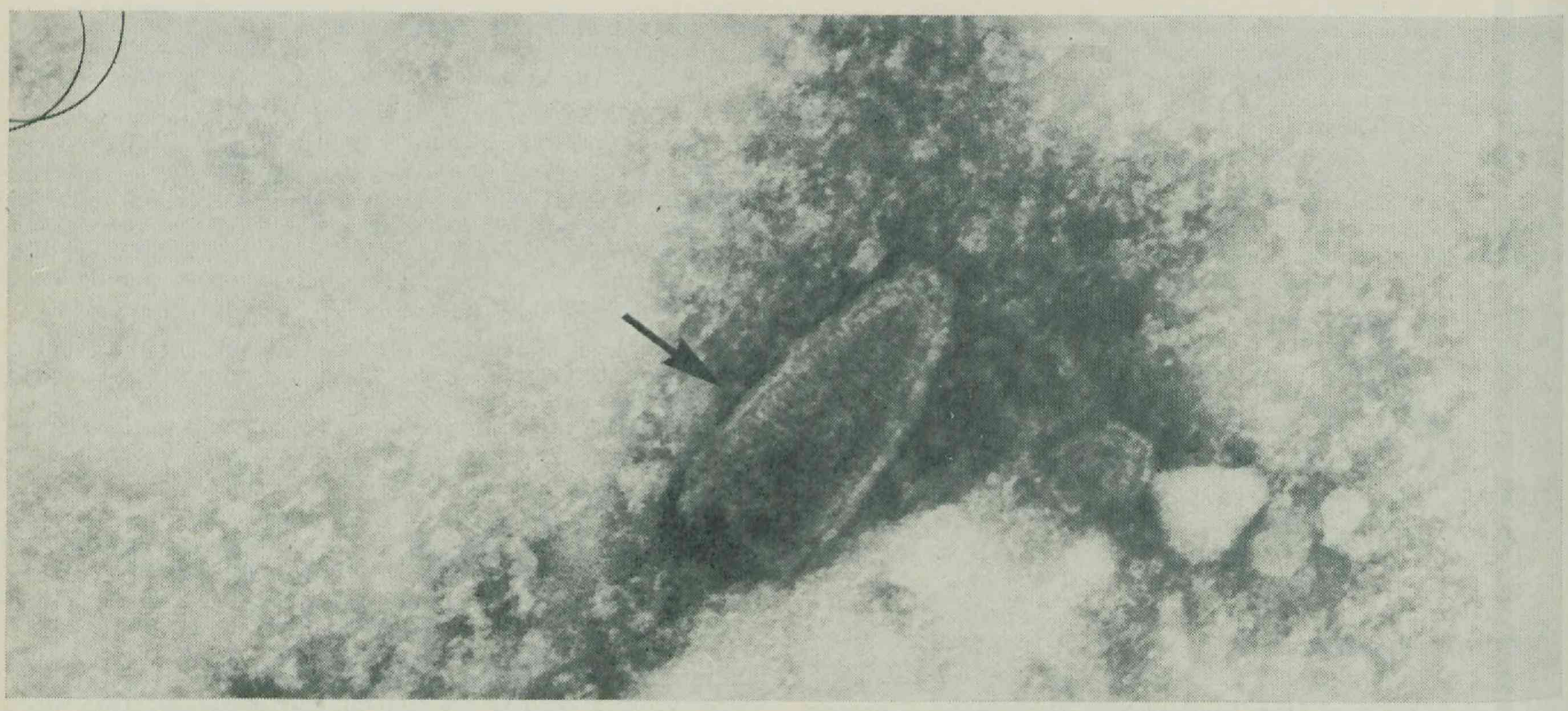


An electron microscope picture of ephemeral fever virus magnified 200 000 times (arrowed). This virus has rarely been photographed.

Sporadic bovine encephalomyelitis was reported in 2 to 4-month-old calves at Grantham with signs of ataxia, opisthotonus, weakness, fixed jaws and nasal discharge. The diagnosis was supported by high positive complement fixation titres ($> 4+$ at 1:64) to *Clamydia* spp.

Ten heifers were reported to have died from tetanus approximately 14 days after spaying, on a property in the Injune area.

High titres to *Leptospira pomona* (5 herds) and *L. hardjo* (35) were associated with bovine abortion investigations within the Cairns, Toowoomba and Brisbane divisions.

Transit tetany was reported from Mitchell, Quilpie and Cunnamulla. In all cases, it was precipitated by prolonged handling and travelling without feed. Bloat was prevalent in the Maranoa and along the Dumaresq River watershed following the good spring rains which produced heavy stands of burr.

Bruising

In their extension activities, Beef Cattle Husbandry Branch officers have continued to emphasize ways of reducing bruising. In particular, they conducted dehorning demonstrations. A pictorial display board proved to be highly successful at local shows in southern Queensland. The 20-minute film on bruising produced by Information and Extension Training Branch in association with the Australian Meat and Livestock Corporation has been in continual demand and well received by the industry.

In May 1978, A. W. Anderson's meatworks, Roma, became the first Queensland company to systematically monitor the bruising of their beef kill. This was done with a possible view to introducing an incentive system for the marketing of unbruised carcasses. The data for the 6 months' survey are now being analysed. A copy of the bruise scoring for each lot killed was returned to the producer.

Research on bruising is continuing, though on a reduced scale. During the year, trials were conducted to assess the effect of breed on bruising. In each trial, the bruising of British breed cattle has been similar to Brahman crossbreds, with overall average bruise scores of 1·3 and 1·1 kg bruised tissue trimmed per carcass, respectively. Once again, Stanbroke Pastoral Company Pty. Ltd. and Thomas Borthwick and Sons (Australasia) Ltd. have co-operated with this research.

Spaying

During the year, Mr J. C. Biggers, District Inspector of Stock, Toogoolawah, visited districts in central and northern Queensland to demonstrate the cattle spaying technique that he developed. Twelve field days were held and these were attended by 268 people. All field days were successful and provided excellent opportunities for private veterinary practitioners, professional spayers, D.P.I. staff, farmers and graziers to practise the new technique. This extension activity was supported by funds provided by the Commonwealth Extension Services Grant. Despite the current need to maximize reproductive levels to rebuild the national herd, spaying should continue to be a useful management tool particularly in the extensive areas of Queensland.

Reproduction

Despite the dry summer in 1978, the calf drop this year was generally reported as being reasonable. Nevertheless many producers accept as 'normal' a calf drop that is much lower than could be achieved through appropriate means of disease control and management, and extension on this subject is given high priority.

At 'Swan's Lagoon', a combination of supplementation and weaning strategies, and their effects on calving rates is being examined in a project supported by the Australian Meat Research Committee (AMRC). The mild winter and early break meant that all groups of cows maintained or gained weight during the dry season—a most unusual feature in this environment. Consequently, although cows whose calves were weaned early came out of the winter slightly heavier (470 v 456 kg) and in slightly better condition the difference is unlikely to affect conception rates for this year.

This difference in weight was more marked in cattle that were pregnant (early weaned 470 v late weaned 425), but much of the difference had disappeared by February. Calves weaned in July were 47 kg heavier at that time than calves that had been weaned in April. By the following January, the difference was reduced to 36 kg.

Weaning is believed to be the most important management practice in preventing breeder losses and ensuring high conception rates. However, the adverse effects of early weaning on the calf is one reason for non-acceptance of this procedure. Other time-of-weaning studies suggest that most of these effects are lost over the ensuing 2 years.

Control over the mating period is another practice that can contribute to improved reproductive performance. Matings from January to June 1978 resulted in an overall conception rate of 64%, compared with 81%, 94% and 92% in previous years. However, conception rates of maiden yearling heifers and dry cows (90%) was little affected by the season.

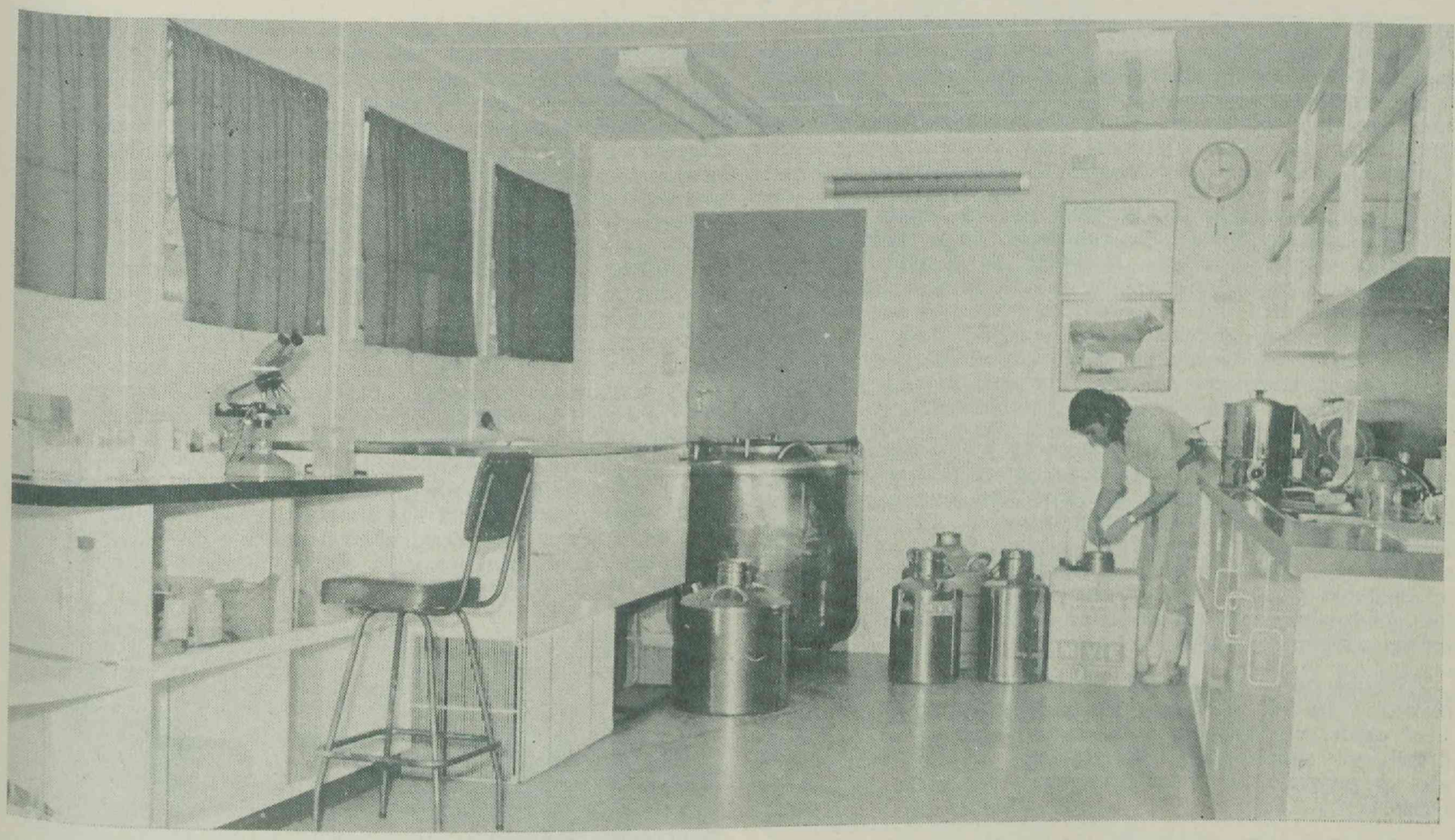
Control over bulls is, however, a real difficulty. The effectiveness of electric fencing for this purpose is also being observed in this trial.

A State-wide extension programme on electric fencing has aroused considerable interest and substantial acceptance of the concept as a practical possibility, even on large western and northern properties.

On Brigalow Research Station and on properties in the Roma area, work continued on the study of dystocia. Weaner heifers from known low and high dystocia herds were mated to the same bull (by A.I.) and run together at two different locations. Some difference in the overall dystocia incidence at the two locations (11% and 20% at Brigalow Research Station and 20% and 33% at Roma) suggest that feeding and environment do have an important effect.

However, the marked difference between the two groups at the same location points to genetic differences that could be used to reduce this serious source of loss. Future work will attempt to separate maternal and foetal factors in dystocia and estimate the extent of improvement that could be achieved through culling of heifers and bulls.

On the Darling Downs, an attempt is being made to interest stud breeders in the use of serving capacity tests and testicular measurements as an indicator of bull fertility.



Packing semen for export from the Wacol A.I. Centre.

Nutrition

Before the drop in beef prices in 1973, urea-molasses was widely used as a winter supplement. The use of this supplement was then largely abandoned because of lack of labour and low cattle prices. In May this year, renewed interest was reported from central Queensland, and it will be interesting to see cattlemen's attitude to supplementation generally, if prices keep up. Extension on the need to feed phosphorus in the very deficient areas of north Queensland has been maintained. Otherwise advice on supplementation has been given only on request.

Trace Elements.—With the diagnosis of cobalt deficiency at several centres on the coast, interest has been renewed in the study of this mineral. At Berajondo, north of Bundaberg, Braford weaners grazing an improved grass-legume pasture on granitic sands responded spectacularly to treatment with cobalt bullets. Cobalt treated animals gained 84 kg compared with 33 kg by untreated controls.

Drenching with an anthlemintic at 3 to 4 week intervals gave an additional increase to 106 kg. Deaths commenced in untreated animals in March. Blood and liver copper levels have declined to very low values in the cobalt-supplemented animals. This decline in copper status when cobalt is administered has been reported from other centres. Monitoring will continue to measure long term effects.

A pilot study with bullocks grazing Hamil grass pasture on sandy scrub soil at Julatten, near Mareeba, north Queensland, showed a substantial response to cobalt therapy between August and December (–31 kg v + 45 kg). Treatment with a combination of copper, cobalt and anthelmintic produced gains of 70 kg.

Sahiwal crossbred weaners at the Isis experimental site where investigations are being carried out into the use of improved pastures for the production of vealers and heavy weaners.

However, at two other centres where cobalt deficiency was suspected, Gympie and Wandoan, cobalt therapy resulted in lowered performance. This emphasizes the danger of indiscriminate extrapolation of data from one site to other areas. A survey is planned with Agricultural Chemistry Branch to obtain additional data on plant cobalt levels in problem areas and to determine the extent of the problem.

Investigations into the problem of low copper status in cattle in Taroom Shire have continued. In a study on one property, copper glycinate injections at 8-week intervals. produced a 9 kg growth response in 118 days, while addition of cobalt negated this apparent response to copper. The final weighings of animals in the previous study held from February 1977 to November 1978 showed marked responses to copper therapy in animals receiving regular injections (237 v 203 kg).

On a second property, treatment with copper-calcium-edatate at 6 or 12-week intervals and with Dewey's needles produced marked responses in blood and liver copper levels but no response in liveweight performance. This was despite the fact that blood and liver copper levels in untreated animals were indicative of gross deficiency. Molybdenum levels in available pasture were in the range regarded as optimal for good copper absorption so molybdenum was not interfering with absorption.

NITROGEN SUPPLEMENTS.—With the interest being displayed in the role of by-pass protein in the nutrition of grazing beef cattle, emphasis in research has charged to comparing urea-based supplements, and by-pass protein. Pen studies are in progress at 'Swan's Lagoon', supported by AMRC funds.

At 'Brian Pastures', Gayndah, the effect of supplementation with the 'standard' molasses-urea supplement or with browsing of *Leucaena leucocephala* on liveweight changes of steers grazing native pasture during the winter-spring period is being studied. During the winter-spring of 1978, the steers grazing native pasture alone maintained liveweight, those supplemented with molasses-urea had a small liveweight gain (7·5 kg), while those supplemented with leucaena had an improved liveweight gain (25·5 kg).

GROWTH STIMULANTS.—In a study at 'Swan's Lagoon' to examine the effects of feeding monensin, a growth stimulant, to steers receiving a basal diet of native pasture hay with and without a nitrogen supplement, total dry matter intake was reduced by 31% when monensin was fed. Feeding of monensin lowered dry matter digestibility of the basal diet when fed alone but not when fed with a nitrogen supplement. This finding is contrary to results from overseas research. It is possible that responses to monensin may be different when feeding periods are longer than the 21 days used here.

INTENSIVE FEEDING.—Monensin has been shown to improve the feed conversion efficiency of cattle fed high grain diets. A feedlot trial was completed at the Rocklea Husbandry Research Farm where cattle were fed a high sorghum grain ration with supplements of monensin either in the feed (30 ppm), or in control release intraruminal capsules supplying 50 to 300 mg monensin per day.

The feed conversion efficiency of cattle supplemented with monensin was not significantly better than that of the non-supplemented cattle. It is concluded that the proportionate production of the control animals was maximal and that no benefit could be obtained from the addition of monensin to the ration.

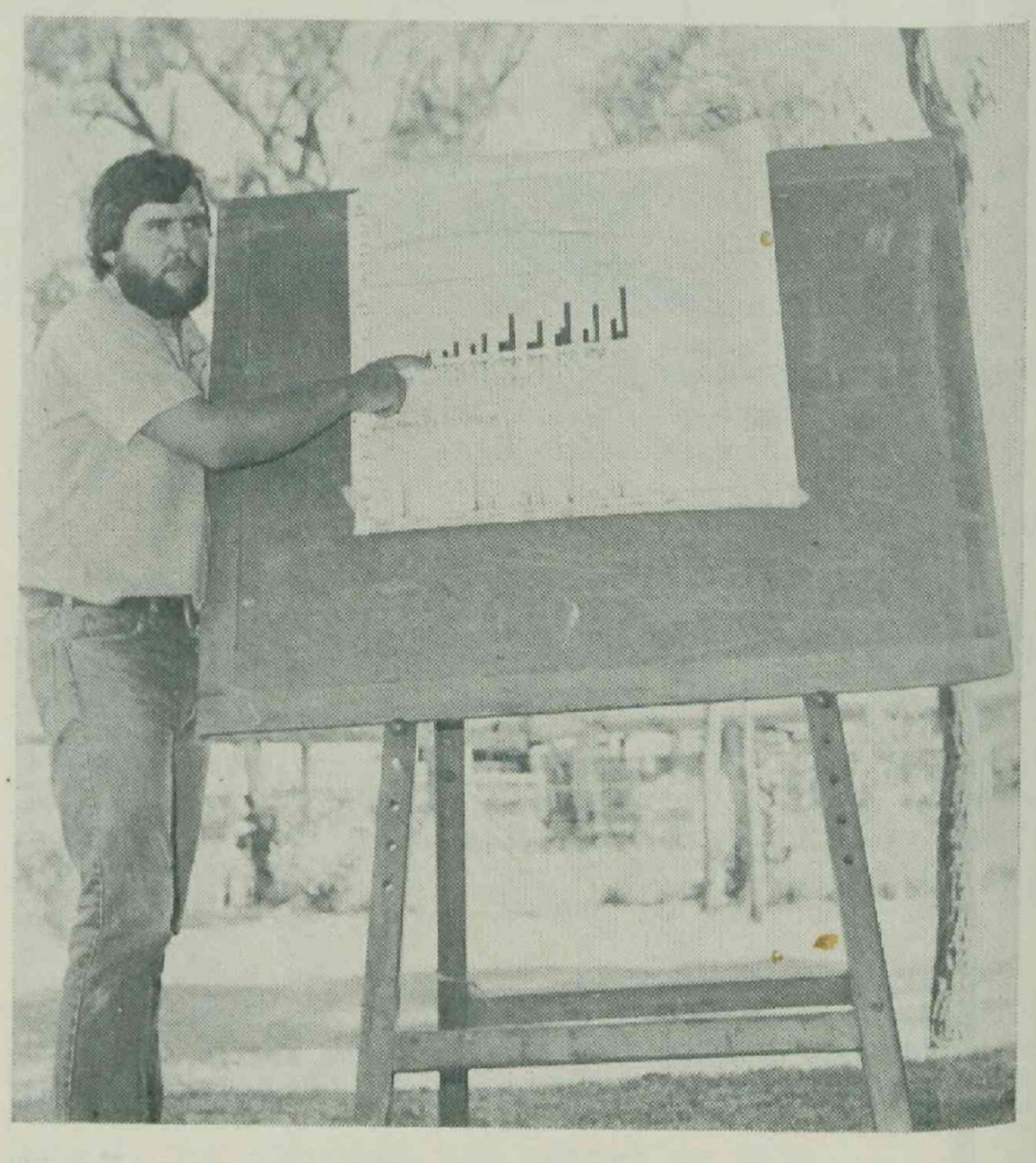
The possible availability of feed grade rice from the Burdekin River Delta prompted a feedlot experiment comparing a high rice grain ration with a high sorghum grain ration both plus minerals. The two grains were fed with and without the rumen modifier monensin. All cattle fed the rice rations had significantly lower growth rates, dry matter intakes and poorer feed conversion efficiencies than cattle fed sorghum rations. The lower intakes of rice were probably the results of lesions in the intestinal tract which developed when the cattle were fed an all-rice ration during the early stages of the experiment.

Cassava, a high yielding root crop, is currently being investigated in Queensland for starch and power alcohol production. Although the energy context of the tubers is equivalent to cereal grain, they are markedly deficient in protein. A preliminary trial was begun on the utilization of high cassava rations with the emphasis on alleviating the protein deficiency. The results show that the organic matter digestibility of an 80% cassava tuber ration is higher than a similar sorghum grain ration and that a pre-formed protein such as fish meal is required to alleviate the protein shortage. Leaves of the cassava plant are also a useful cattle forage.

Analyses for hydrocyanic acid of nine fresh cassava varieties demonstrated that six leaf and five root samples were below the accepted toxicity level of 20 mg HCN per 100 g fresh material.

An experiment was commenced to examine the feasibility of spraying whole grain with sodium hydroxide solution as an alternative to cracking the grain for improving its digestibility by cattle. After 10 weeks, results suggest that sodium hydroxide treatment of whole grain at this level is not as effective as cracking. Feed intakes on all treatments are similar but mean daily liveweight gains so far are 1·16 kg and 0·81 kg for cracked and sodium hydroxide treated grains respectively.

SURVIVAL FEEDING.—An experiment was commenced at Rocklea to determine the suitability of simple molasses based diets for survival-feeding of young calves. Calves are being weaned at 5 and 10 weeks of age and fed *ad libitum* diets of molasses with and without urea, meatmeal and lucerne chaff. Diets containing meatmeal and lucerne chaff have provided for liveweight maintenance or slight gain for approximately 3 months at a cost of about 8c per day. Some deaths have occurred on molasses and molasses-urea diets after about 8 weeks of feeding. Survival should be less of a problem in the older calves. The project has shown that molasses-based diets can be simple and economical to use, while providing at least the maintenance requirements of young calves during long periods of survival feeding.



Mr Don Nichol, Beef Cattle Husbandry Adviser at Bundaberg, explains the results of a trial on cobalt deficiency on improved pasture.

Genetic improvement and breed evaluation

The use of objective measurements for selection of breeding stock continues to be one of the main objectives of Beef Cattle Husbandry Branch's extension and research programme. Allied to this is a breed evaluation programme the aim of which is to give producers the necessary data for decision-making on breeding systems.

With the revitalization of the beef industry, extension staff have reported a renewed interest in performance recording, particularly with the National Beef Recording Scheme (NBRS). Since the installation of the new computer at the NBRS centre, the service provided by the NBRS has improved and expanded. A total of 17 of the 20 or so economically important breed societies is either processing with the NBRS or have agreed in principle to participate within the next 2 years.

Research activities related to genetic improvement continue to give a high priority to the evaluation of breeds likely to be adapted to sub-tropical environments.

At 'Swan's Lagoon' in 1978, the Sahiwal programme was expanded to develop a stabilized half Sahiwal herd in addition to the stabilized three-quarters Sahiwal herd. Stabilized half and three-quarters Brahman herds are also being developed. In 1978, Brahman crossbred cows weaned more and heavier calves than the Sahiwal crossbreds mainly due to their lower losses from conception to weaning. However, Brahman crossbred males were lighter at both 550 and 900 days of age. Brahman crossbreds seem to have less resistance to ticks than the Sahiwal crossbreds.

At Brigalow Research Station, the third crop of F1 Africander x Hereford calves and the first of the Belmont Red x ½ Africander calves were born in late 1978. Their mean birth weights were 32·8 and 29·6 kg respectively, while straightbred Herefords were 33·7 kg. Africander cross calves weaned in May 1978 averaged 167 kg and gained 0·41 kg per day to October, while Herefords calves of 160 kg gained 0·35 kg per day. When finished on oats for 91 days, 2-year-old Africander cross steers gained 0·69 kg per day to finish at 441 kg whereas Hereford steers gained 0·94 kg per day to be only 408 kg. Similar aged steers finished on improved pasture gained 0·20 kg and 0·41 kg per day to finish at 405 and 367 kg respectively. Surprisingly, dressing percentages favoured the steers finished on pasture and not those on oats (51·5 v 48·0%).

The Simmental-Hereford crossbreeding project, begun in 1972 at Brigalow Research Station, included a comparison of the post-weaning growth and carcasses of Hereford and F1 Simmental x Hereford steers grazing improved pastures. The last draft of 46 steers was slaughtered in May 1978. From 2·5 to 3·5 years of age, Herefords gained 0·36 kg per day and Simmental crosses 0·41 kg per day. At slaughter, their respective liveweights were 541 and 614 kg. Herefords had 262 kg carcasses with 9 mm of fat, while the Simmental crosses had 299 kg carcasses with 8 mm of fat.

The evaluation of adapted cattle is also proceeding on co-operators' properties throughout the State.

The Africander is being evaluated in the dry tropics in north-west Queensland. At 'Cubbaroo', north of Cloncurry, the 1978 mating was delayed until May and then continued until early November because of the adverse conditions. Ninety-four per cent of F1 Brahman x Shorthorn cows mated to three-quarters Africander bulls were pregnant and 86% of those mated to three-quarters Brahman bulls.

In 1978, the first heifer progeny were mated to Africander x Sahiwal x Shorthorn bulls. Ninety-five percent of three-eighths Africander cross and 87% of five-eighths Brahman cross heifers were pregnant. At weaning in October–November 1978, Africander cross calves weighed 199 kg and Brahman cross 163 kg. Post weaning gains to November 1978 for the 1977 weaners favoured the Africander crosses (118 v 104 kg after 108 days). Total gains for the cattle weaned in 1976 have been similar, 177 kg by Africander crosses and 176 kg by Brahman crosses (after 196 days).

At 'Rocklands', Camooweal, during the dry season (July to mid December 1977) Africander cross and Sahiwal cross steers grew at similar rates (0·15 kg per day), but during the wet season (December to April 1978) the Africander crosses grew faster (0·61 v 0·55 kg per day). Both genotypes outperformed the Shorthorns, during the dry season when Shorthorn steers just maintained weight (0·04 kg per day) and also the wet season (0·37 kg per day).

The Africander is also being evaluated at 'Lassie Creek', Charters Towers. The first mating was in February 1977 when three-quarters Africander and three-quarters to seven-eighths Brahman bull groups were mated to low grade (one-quarter to three-eighths) Brahman crossbred heifers and mature cows. Overall, for the 2 years, the number of pregnancies per 100 females was similar for the two breeds of sire, averaging 55 per 100 females over the 2 years.

Another trial in the sub-coastal dry tropics, at 'Blue Range', Charters Towers, is evaluating Belmont Red and Brahman crosses, as well as Santa Gertrudis. The first mating commenced in January 1978, when Belmont Red, three-quarters Brahman and Santa Gertrudis bull groups were mated to half to three-quarters and five-eighths to three-quarters Brahman crossbred and Santa Gertrudis heifers.

In June, 65% of half to three-quarters Brahman cross heifers were pregnant, 71% of the five-eighths to three-quarters Brahman crosses and 82% of the Santa Gertrudis. These differences tend to reflect their differences in liveweight in June in that half to three-quarters Brahman crosses were 30 kg and 32 kg lighter than the five-eighths to three-quarters Brahman crosses and Santa Gertrudis heifers, respectively. All heifers mated to the Belmont Red bulls were pregnant, 78% of those mated to the three-quarters Brahman bulls and 91% of those mated to the Santa Gertrudis bulls. The growth of the progeny will be assessed.

Trials in central Queensland are comparing the effect of breed of bull on various traits. At 'Mt. Eugene', Belmont Red, Droughtmaster, Brahman and Hereford bulls are being crossed with cows of various *Bos indicus* x *Bos taurus* combinations. At 'Bride Creek' near Blackall, Santa Gertrudis and Belmont Red bulls are being used.

On the wet coast of central Queensland, Belmont Red, Brahman and Hereford bulls are being mated to half to three-quarters Brahman cross cows at 'Kunapipi Springs', Bloomsbury. In another central Queensland trial, at 'Markwell', via Lotus Creek, Brahman and Braford bulls were mated to Brahman crossbred cows.

At 'Sunnyholt', via Injune in southern Queensland, the project comparing the growth of Hereford steers with Brahman x Hereford (BH), Hereford x (Brahman x Hereford) (H x BH), Chianina x Hereford (CH) and Chianina x (Brahman x Hereford) (C x BH) has been completed.

From weaning to 28 months of age, C x BH and CH steers grew significantly faster than BH steers (0·58 v 0·55 kg per day), and all were significantly faster than H x BH, and Hereford steers (0·50 kg per day). Infusion of Chianina into the Hereford meant an increase of 0·09 kg per day in growth rate and infusion of Brahman an increase of 0·06 kg per day.

Carcass weights followed the same trend as growth, with the exception that H x BH steers were significantly heavier than Hereford steers. The Chianina cross carcasses averaged 296 kg with 5·8 mm of fat, the BH carcasses 286 kg with 11·3 mm fat, H x BH carcasses 272 kg with 9·1 mm fat and the Herefords 250 kg with 8·5 mm fat. While the Chianina out-performed the Brahman and Hereford from the growth point of view, its ability to achieve high reproductive rates and survive has still to be proved under Queensland conditions.

At the Emerald Pastoral College, the progeny of high performance and low performance bulls are being compared. The differences in weight at 1 and 2·5 years of age of the two groups are very close to the predicted differences based on heritabilities of weight for day of age.

Transport and marketing

Transport of cattle and methods of marketing can entail substantial costs and losses. The Division became involved in investigating the causes of bruising some years ago. Research activities have been reduced, but extension is being escalated. The curfew imposed at most saleyards as part of the liveweight selling procedure has caused considerable problems and much controversy.

Beef Cattle Husbandry Branch have started trials that could demonstrate the need to modify the present curfew procedures. It has also commenced a series of trials to measure the extent of losses (carcass weight) entailed in long distance travelling. The small number of deaths that occur in transit are probably far less important, economically, than the other costs entailed in excessive travelling. If this can be demonstrated to the industry, then perhaps a long-term rationalization of the point of slaughter will also reduce transit deaths.

MARKETING.—A study of saleyards distribution in Queensland was completed during the year. A detailed report was distributed widely among pastoral houses, processing companies, local authorities and others. The study highlighted a large number of Queensland saleyards which have extremely low annual volumes. The smallest 46 saleyards surveyed handled only 5·5% of saleyards slaughter cattle between 1972 and 1977. The results also indicated that saleyards usage is related to ruling cattle prices.

As prices fall, saleyards marketing tends to fall and direct-to-meatworks marketings tend to rise. Saleyards which appear viable at times of high marketing and high prices may have their positions reversed if numbers marketed or ruling prices (or both) fall away.

A long-term study investigating operating and pricing efficiency of the alternative methods of marketing livestock in Queensland was initiated during the year. Although the project initially concentrates on methods currently available, it is hoped to examine new marketing alternatives in future work.

WEIGHT LOSS IN TRANSIT.—Losses in the weight of cattle from the farm gate to the saleyards and also to the abattoir cause an economic loss to the livestock and meat industries, and eventually to the consumer. Moreover, the cost of transporting cattle can be up to 10 times more than the cost of transporting boned-out beef in containers.

The increase in liveweight selling has focused particular attention on losses in liveweight, one aspect of which is the effect of statutory fasting periods (curfews) before the commencement of selling. While curfews are applied in an attempt to reduce the variation in gutfill and therefore dressing percentage between sale lots, they also extend the time cattle are without feed and water. At some saleyards, particularly Gracemere, Dalby and Cannon Hill, the distance cattle travel and the timing of train arrivals mean that a substantial number of animals fast for periods of up to 80 hours before weighing.

A series of trials was commenced to examine the rate of liveweight loss over short periods and recovery of weight after travelling. Other relevant information will also be evaluated, particularly the cost of curfews.

At 'Swan's Lagoon' liveweight changes were monitored when Brahman crossbred steers, off native pasture, were fasted for either 12, 24, 48, or 72 hours and during a 48 hour re-alimentation period on either water or water plus native pasture hay. Steers lost weight most rapidly during the first 8 hours of fasting. After 8, 24, 48 and 72 hours steers had lost 4·9, 7·7, 11·5 and 14·4% of their initial mean liveweight of 396 kg. As length of fast increased, steers re-alimented to a greater extent but had lower 'peak' liveweight after 6 to 12 hours re-alimentation. Steers given hay 'regained' 6 to 7 kg more initially than their counterparts on water only, with this difference almost doubling after 48 hours re-alimentation. After a final 12-hour fast, overall liveweight losses varied from 10·2% to 14·6% for steers fasted initially for 12 and 72 hours respectively, and re-alimented on water. Overall losses were 11·2% for steers fasted for 72 hours initially but re-alimented on water plus feed.

Because Queensland cattle travel up to 2 000 km to coastal abattoirs, up to 13 days can elapse between yarding cattle on the property and their slaughter. Even though cattle periodically have access to feed and water during this time, weight losses are inevitable. The effect of fasting for 4 and 8 days on loss of live and carcass weight was studied using Brahman crossbred steers at 'Swan's Lagoon'. In an attempt to duplicate industry conditions, the steers had access to water and feed for 6 hours after each fasting period of 2 days. Fasting reduced final liveweight by 8% and carcass weight by 4 to 5%. Length of fast had no effect. The dressing percentage of fasted steers was 2 percentage units lower than unfasted steers on the basis of farm-gate liveweight (44·7 v 46·8%), but one unit higher on the basis of abattoir liveweight (51·3 v 50·3%).

During the year, three observations were conducted on in-transit weight losses. Bullocks lost 7·9% of their mean initial liveweight of 452 kg when railed 1 260 km from Barcaldine to Cannon Hill saleyards. This loss was reduced to 4·3% after bullocks had eaten and drunk on arrival. However, the loss had increased again to 6·8% by the time the cattle were weighed after sale. In the second observation, pregnant Hereford cows of 444 kg lost 7·7% when transported 880 km from Moura to Brisbane, and this loss had increased to 8·7% by the time the cows were weighed after sale. In the third observation, F_1 Limousin x Hereford animals lost 4·2% of their mean initial liveweight of 420 kg during a 12-hour overnight fast. When railed 880 km to Brisbane their loss increased to 7·5%. All animals were given access to hay and water on arrival. Half the animals were slaughtered 3 days later and their 'shrunk' weight was 90·3% of the initial full weight while it was 92·6% for those slaughtered 10 days later.

Sheep and goat industries

The sheep industry has been buoyant during the past year. The reserve price of wool is approximately 298c per kg clean and the market itself has tended to be somewhat higher than this. The prices for live sheep have continued to show an upward trend over the past 3 to 6 months and this, together with excellent seasonal conditions in many regions of the State, has provided the industry with a situation which augurs well for increased productivity and returns to growers during the current financial year.

Sheep numbers have remained static during the past 12 months; provisional estimates suggest that the State has approximately 13·6m head.

The live sheep export trade from Australia has continued to assist the industry in Queensland. This assistance has been through an indirect supply of animals from Queensland to producers in southern States. There has been no development of a specific live export market of sheep from Queensland. The inability of sheep producers in this State to sell the live sheep is seen as a major constraint. Many sheep in central and north-western Queensland live on the property where they were born until they die of natural causes. During the latter years of their life, they are often unproductive, rearing virtually no lambs and cutting scant amounts of wool. The producer is unable to exercise the obvious management strategy of culling because he has little opportunity to remove these unproductive animals economically from his flock. If a reliable export market could be developed, this would have enormous ramifications.

Officers of the Sheep and Wool Branch are investigating the extent to which unproductive components of commercial flocks are a constraint to the viability of the industry. These data are being collected on a regional basis to demonstrate the benefits of adopting appropriate selection exercises. When this has been done, the next step will be to use the findings in conjunction with improved husbandry practices to show how increased productivity of flocks could be obtained. These practices may include preferential management of weaner sheep, the selection of young, fertile ewes and possible changes in flock structure to run a higher component of wethers. If producers in central and north western Queensland ran more wethers and fewer ewes, they could become less vulnerable to drought, they would cut more wool per head and so defray shearing and general running costs. By running fewer ewes, the producer could select for high reproductive performance and could adopt preferential management strategies such as predator control, the provision of shade and weaner supplementary feeding programmes.

The adoption of these general concepts may provide incentive to producers in the southern more favourable breeding grounds to increase flock reproductive rates and so be able to sell surplus wethers to producers in the northern grazing areas. This would provide producers in the south with another source of income through the sale of young wethers and enable producers in the north to run these wethers for six or seven shearings and sell them as live animals of seven or eight years of age.

Wool harvesting

The Department partially supported with Wool Research Trust Funds (WRTF) has undertaken a bi-directional wool harvesting programme designed to examine ways of biologically defleecing sheep by changes induced in fibre diameter and by the external application of depilatory agents. The biological defleecing programme has investigated ways of causing, first major changes in fibre diameter, second less pronounced changes which require subsequent dissolution, and third fibre loosening. Results suggest that numerous treatments can achieve the effects sought. The major problem stems from the between-animal variation experienced when treating large numbers of animals.

The chemical defleecing programme which externally applies depilatory agents to the sheep has met with considerable success. This can be ascribed to the development of chemical formulations which remove the wool without causing irritation to the skin or excessive damage to the staple, and which leave enough wool on the animal after defleecing to protect it against climatic stress. Development of this programme now depends on aspects of sheep handling and spray technology since these are seen as the major constraints to implementing the technique on a flock basis.

Parasites

The year was one of the worst on record for blowfly strike. Strike was recorded in most districts during late 1978. Body strike was prevalent in the border and south-eastern districts and up to 40% of sheep were affected in the Dalby and Goondiwindi areas. The sheep body louse (*Damalinea ovis*) continued to affect flocks in all sheep raising areas. Sheep owners have been encouraged to avoid travelling lice-infested sheep by instituting control programmes on their properties.

As the control of external parasites is a major cost of production in the sheep and wool industry, research to improve the efficiency of their control and thereby decrease costs has high priority in the Department. The programme receives excellent support from WRTF.

A notable event during the past 12 months has been the development of the air mist insecticide applicator for the control of external parasites of sheep. The Sheep and Wool Branch has been responsible for a concerted effort which has resulted in the development of a system which could have far-reaching consequences in the sheep industry. The system uses air to open the fleece and apply insecticide as a fine mist. Its advantages are the economical use of insecticides (one-third normal), reduced labour costs, and the thorough and even application of insecticide. It has the added advantage of being versatile since it allows sheep with various lengths of wool to be treated for both blowfly and lice infestations.

The Sheep and Wool Branch is fostering the introduction of the air mist technique into the sheep industry. Numerous field days, practical demonstrations and field trials have been or are being conducted in the sheep-raising regions of Queensland. A small booklet describing in detail the technique involved has been published and is available to producers.

A concept of using polymers to act as insecticide reservoirs and so increase the period of protection resulting from the application of insecticide to both sheep and cattle is being developed.

The technique for chemically removing the wool from around the urinary outlet of wethers (chemical ringing) and combating wool blindness in young sheep has developed to the stage where a commercial company expects to make it available to producers during the coming 12 months. The chemical used (phenol) will be marketed in sealed containers together with self-piercing roll-on caps which will contain a chamber designed to administer the correct dose of phenol for each application.

In conjunction with the wool harvesting programme, the Sheep and Wool Branch has also developed a technique for chemically crutching sheep. If collateral developments in the wool harvesting programme are successful, then the need for a chemical crutching procedure will assume high priority. The technique involves the use of externally applied depilatory agents to remove the wool from any part of the sheep and thereby afford protection against blowfly strike.

A study of animals which are biologically resistant to blowfly strike is being undertaken to identify physiological and biochemical reasons for this natural resistance. The programme is designed to use these findings to provide stud and commercial producers with a technique of screening young rams and identifying them as being susceptible or otherwise. Another part of the programme is to develop a vaccine which may one day be used to confer an immunity to young sheep against the challenge of blowfly larvae.

The Wiltshire Horn X Merino breeding programme is aimed at developing a sheep with a fleece comparable with that of the Merino (M) in quantity and quality but less susceptible to blow fly strike by incorporation of some of the fleece shedding characteristics of the Wiltshire Horn (WH). All half-bred WH X M sheep have been found to shed wool from the head, neck, belly, and breech regions each spring and autumn at ages of 18 months and older. Virtually no shedding has been seen from $\frac{3}{4}$ M $\frac{1}{4}$ WH sheep until about 30 months of age when about one-half shed from the belly and breech and one-third from the head and neck. Where shedding occurs, the need for crutching and mulesing is eliminated and pizzle and breech strike is almost non-existent. There is a reduction of up to 2 kg in fleece weight, compared with Merinos, but much of this is the low-valued belly and skirting wool.

Seven fungal strains were extracted and tested against larvae of *Lucilia cuprina* which causes most fly strike. Six, including three *Trichothecium roseum* and three *Fusarium* species, showed appreciable activity.

No field strains of flies were examined for resistance to insecticides. Base line data have been obtained on three synthetic pyrethroids for the susceptible strain of fly and work is continuing with the resistant strains of *L. cuprina.*

Barber's pole worm (*Haemonchus contortus*) was diagnosed as the cause of ill-thrift in the sheep raising areas of central and southern Queensland.

In co-operation with the Karara United Graziers' Association, the Branch is investigating the benefits of high frequency drenching for helminth control in the Granite Belt region. During the year, there has been evidence to suggest the spread of liver fluke infestation in coastal areas close to Brisbane.

Reproduction

The major reproductive wastage problem in the sheep industry of Queensland is poor lamb survival. Each year there is a chronic problem associated with lamb death, and this has crippling effects on the State's lamb-marking percentages. In addition, there are acute episodic losses which are related to poor seasonal conditions and predators. During the past 12 months, a large-scale study of the low lambing performance in many regions of Queensland has been undertaken. This study has shown that there are both chronic and acute components of the problem and has also shown why these compound to assume major proportions in various years.

The low lambing problem is more significant in tropical Queensland and research efforts at 'Toorak' have demonstrated the damaging effects of heat stress on foetal growth and subsequent lamb survival. Further studies are aimed at understanding the physiological basis of heat stress on production and reproduction of sheep in the tropics and to develop methods to alleviate these effects. The findings can be used in the operation of the Ram Breeding Scheme at 'Toorak' to demonstrate the benefit of selecting high producing sheep adapted to the environment. Other studies have shown that the provision of shade for pregnant and lambing ewes increases lamb-marking percentages by 10 to 15%.

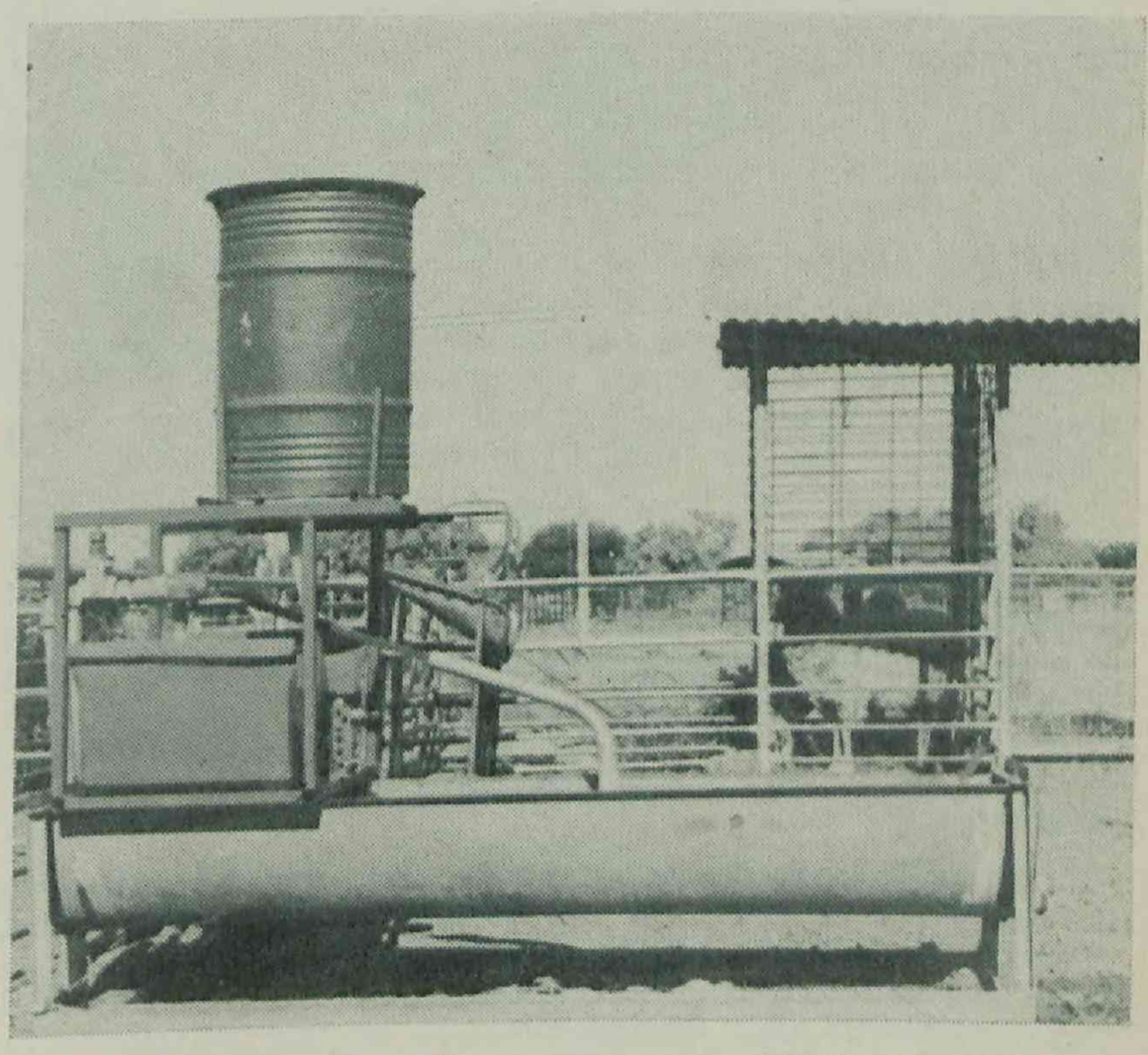
Genetics

The genetics programme is a three-pronged attempt to improve the productivity of sheep from many regions of Queensland. First, the efforts of the Wool Biology Laboratory are designed to assist growers to make prudent judgments in their breeding programmes and so to select animals which are capable of increasing the per head productivity of numerous flocks. This service is an important function of the Branch. The second part of the programme involves research at 'Toorak' in which a Ram Breeding Scheme has been established to provide producers in tropical Queensland with animals that are known to perform well under the harsh environmental conditions in that area. The third component of the Sheep and Wool Branch's genetic programme is the implementation of wether competitions in many parts of Queensland. Extension officers have assisted in these programmes to help producers indentify and select high producing animals on a regional basis.

Nutrition

A large part of the nutrition work which has received financial support from WRTF has concentrated on improving the nutrition of weaner Merino sheep, as young female weaners are an important component of any flock and suffer heavy losses in many parts of the State during adverse seasonal conditions. The research has embraced the development of shallow water systems which provide forage sorghum and a technique of conserving pasture hay containing legumes. The crops are then used as supplements during the ensuing winter. The results indicate that high quality hay or forage sorghum can be produced in north-western Queensland at approximately $10 to $15 per tonne.

Another section of the nutrition programme is to improve the lactation performance of Merino ewes grazing poor quality pasture. This work has shown that the administration of urea to these ewes increases their milk production and the growth rate and survival of their offspring. The findings have prompted the Sheep and Wool Branch to provide graziers with a hand-out describing the technique in some detail and discussing practical ways of administering urea.



This dispenser for adding urea to drinking water was developed at the Toorak Sheep Field Research Station, Julia Creek. Though this method of urea supplementation does not increase liveweight gain or wool growth, it caused a marked improvement in the lactation performance of ewes grazing poor pasture.

Experiments supported by WRTF have shown that significant liveweight and wool growth responses can be obtained by supplementing mulga fed sheep with phosphorus and molasses. Follow-up studies have shown that while mulga leaves contain reasonably high levels of crude protein they also contain tannic acid which could interfere with the digestion of this protein. The results of a pen experiment using mulga leaves subsequently showed that supplementation of sheep with cottonseed meal, molasses and phosphorus doubled liveweight gain and increased wool production by 20% when compared with sheep receiving no cottonseed supplement. Field tests showed that lactating ewes receiving the supplements of cottonseed meal and molasses had higher survival rates and liveweights. Lamb survival rate and liveweight at weaning were also higher in the supplemented groups.

One nutritional experiment compared feeding regimens for fat lamb production. Suffolk cross lambs either grazed or zero-grazed oats with a wide range of supplements of sorghum grain. The lambs converted supplementary grain to hot carcass gain with efficiencies of 0·11 and 0·07 for grazing and yard-fed lambs respectively. The difference probably resulted from the poor performance of the yard-fed lambs in an unusually wet winter. The performance of the grazing lambs was satisfactory, with a mean daily carcass gain of 92 g, and the trial demonstrated that grazing lambs can be profitably supplemented with grain provided crop utilization is efficient.

Wool growth

Studies to clarify the reasons for the presence of high and low-producing sheep in any one flock are being undertaken. This programme is confined to 'Toorak' Research Station though extension to the Charleville Pastoral Laboratory and the Animal Research Institute is planned. Information already collected suggests that, under grazing conditions, high-producing sheep eat more forage with a higher protein content than their low-producing counterparts. A logical progression of this work is its alignment to the genetics programme. If animals express superiority through intake and diet selection, then the impact of this finding as it relates to animals which are bred in one region and reared in another assumes practical importance.

This may alter the emphasis on selection characters used in genetic programmes to improve the wool production of sheep grazing native pastures in different environments.

Labour-saving devices and techniques

Sheep and Wool Branch continues to investigate the potential of electric fences for containing goats and sheep and excluding feral pigs from sheep and goat paddocks. A number of fences has been erected in south-east Queensland to determine the optimum wire spacing. Field days demonstrating electric fences have been held throughout the State.

During the year a publication on yard design and yard modification to permit the handling of sheep with limited labour was produced.

The Sheep and Wool Branch in conjunction with the Goondiwindi United Graziers' Association conducted a Sheep and Wool Expo at Goondiwindi. This Expo was designed to exhibit the range of devices available to the sheep producer which will reduce labour requirements and improve sheep handling.

In conjunction with the Australian Wool Corporation, a survey was undertaken to determine the costs of shearing in Queensland. This survey considered costs additional to the normal contract costs which are generally quoted for sheep shearing. With all costs included, the findings were that shearing costs ranged from $1.58 to $2.20 per head.

The Branch has been co-operating with the Australian Wool Corporation and the sheep and wool sections of the other State Departments in the development of a series of technical notes entitled 'Wool Harvesting Notes'. These serve as resource material for extension officers for the dissemination of information relating to wool harvesting.

Marketing

Several alternative marketing systems are now available to the wool producer of Queensland. Economic Services Branch has investigated these alternatives and produced a document outlining the advantages, disadvantages and economic merits of each system.

In association with the Australian Wool Corporation, the Branch organized and conducted a series of field days on objective clip preparation in western Queensland. These were held in operating sheds at Longreach, Barcaldine, Blackall, Charleville and Cunnamulla districts.

Diseases

Purulent arthritis following mulesing is still seen and mulesing operators need to be made more aware of the hygiene necessary to prevent this condition.

Sera from 23 sheep on a property at Charleville experiencing low lambing percentages were all positive to the CF test for the P.L.G. (*Chlamydia*) group.

Chlamydia are known to cause enzootic abortion in sheep although the presence of this disease in Australia is uncertain. Chlamydia also causes a polyarthritis in lambs the presence of which is recognized in Australia.

Copper deficiency was diagnosed in lambs on two properties in the Stanthorpe area. Post mortem examinations revealed myopathy involving muscles of the limbs and trunk. Biochemical tests indicated the presence of low liver copper levels.

Enterotoxaemia was diagnosed as the cause of deaths in lambs at Dalveen.

The availability of an electron microscope at the animal Research Institute has assisted with the diagnosis of virus diseases generally but its usefulness in the rapid diagnosis of contagious ecthyma (scabby mouth) has been spectacular. Amongst cases of scabby mouth one outbreak was said to be associated with extensive lesions in the shearers.

Following reports of badly tainted lamb carcasses in central Queensland, a co-operative experiment between the Department of Primary Industries, the Lands Department and the C.S.I.R.O. Meat Laboratory was commenced to investigate the taint produced in meat from lambs grazing pastures infested with parthenium weed (*Parthenium hysterophorus*). Tasting tests on meat from sheep that had grazed a parthenium-infested pasture showed that the weed produced a taint that lowered the acceptability of the meat. Transfer of sheep to a parthenium-free pasture 2 weeks before slaughter significantly reduced the taint.

Goats

The Angora goat and mohair industry has continued to grow during the past 12 months. Two mohair sales were held in Brisbane during the past year. An officer of Sheep and Wool Branch has been responsible for establishing classing standards and for supervizing the preparation of sale lots.

Four extension officers in Sheep and Wool Branch are involved in advising Angora producers. This work has assumed a large proportion of the overall programme of two of the officers. The flood of enquiries from Angora producers and the development of a metrology service somewhat similar to that available to the sheep industry is taxing the capacity of the Sheep and Wool Branch to service them and maintain its obligations to the sheep industry. Trials have commenced with feral animals to study up-grading programmes, to evaluate the reproductive performance of these animals and their offspring in the harsh semi-arid environment, and the use of these animals to control woody weed problems in some of the extensive grazing areas of Queensland.

Officers of the Branch have presented papers at numerous field days held on Angora goat husbandry. These field days, organized in conjunction with the breed societies, have been held in Roma, Stanthorpe, Gympie and the Atherton Tableland districts.

In an abattoir survey of feral goats, 110 sera, 40 alimentary tracts and 46 lesions were examined from consignments of feral goats captured in the Aramac and Charleville areas and slaughtered for export at the Toowoomba abattoir to collect data on disease occurrence in these animals. Most lesions were caseous abscesses from which *Corynebacterium ovis* was readily grown (*C. pyogenes* in one case and *Staphylococcus aureus* in another). Parasites recovered included species of *Monezia, Haemonchus, Nematodirus, Oesophagostomum, Trichuris, Trichostrongylus, Cysticercus tenuicollis, Psoroptes, Damalinia, Linognathus, Eimeria.* An interesting find was *Skrjabinema ovis,* a pinworm previously undetected in Australian sheep or goats.

Pseudomonas pseudomallei was recovered from an abscess in the spinal cord of a goat at Townsville. Melioidosis was also diagnozed as the cause of lameness and deaths in young goats at Duaringa. The outbreak occurred about 3 weeks after rain. There were four deaths.

Wallerian degeneration of the spinal cord of unknown cause was diagnozed in a young goat in central Queensland. Five kids ranging in ages up to 6 weeks were affected with an ascending paralysis.

Haemonchosis was the cause of deaths in goats on the Atherton Tableland and in south-east Queensland.

Iodine deficiency goitre was seen on the Darling Downs where pasture heavily contaminated with turnip weed (*Rapistrum rugosum*) was being grazed.

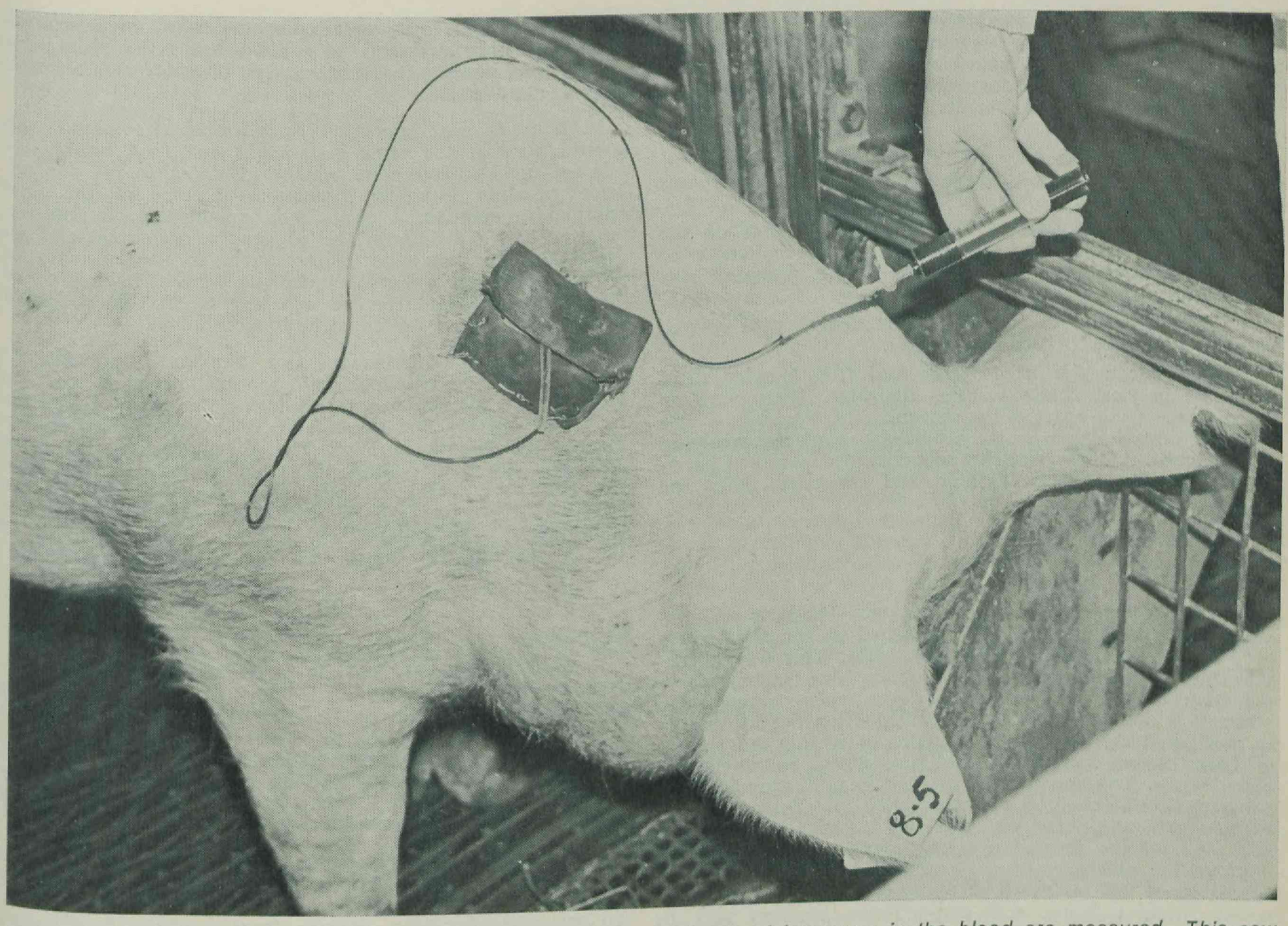
Pig industry

Preliminary estimates place the Queensland pig population at 485 000 head in the year ended March 1979. This represents an increase of 4·8% over that of a year earlier. Pig slaughterings in Queensland in the year to March 1979 showed a slight decline of 0·3% while meat produced was 3·2% higher than the same period ending March 1978. This is reflected in a higher average carcass weight being marketed. National statistics reveal a similar trend.

Bacon and ham production in Queensland in 1978–79 rose 25% above 1977–78 levels.

First advance payments for slaughter pigs rose by 35% to $1.40 per kg hot dressed weight during the 9 months to March 1979. At the same time major processors raised the upper limit of carcass weight to 85 kg.

Grain supplies were plentiful at the latter end of the 1978–79 fiscal year as a result of a bumper winter cereal harvest. The industry, a substantial user of feed grains, continues to press for a simpler system of wheat permit sales following the High Court decision in favour of the Wheat Board monopoly in wheat marketing. High prices set for wheat caused a swing to much cheaper barley grains.



In studies on the effect of heat stress on reproduction in the sow, levels of hormones in the blood are measured. This sow has an indwelling venous catheter for ease of regular blood sampling.

Protein meal supplies were readily obtainable although fish meals were scarce and other protein meals, notably meat-and-bone meal, tended to advance in price. In general, feed values were stable throughout the year.

Producers have tended to market heavier pigs on the basis of weight and grade and this is evident from the rise in average carcass weight of 2 kg. Heavy pigs are more profitable and producers were encouraged to follow this policy wherever possible.

More than 60% of pigs marketed in Queensland are sold on consignment. A considerable number of pigs from south eastern districts was sold for slaughter over the border at the Casino abattoir.

A survey on the causes of pig deaths in transit indicated that the level of loss is 0·3% annually in Queensland and probably rising. The stresses of temperature during travel and distance involved were major factors. Recommendations include travelling pigs shorter distances during cooler periods of the day and in a fasted condition.

The first meeting of the State Council of the Queensland Commercial Pig Producers' Organization was held in Brisbane early in the year. This followed the constitution of District Councils in five areas and the election of producer representatives on them. Pig Section staff assisted in forming branches and have continued their involvement with the organization at local meetings and producer discussion groups. Head office staff maintain a liaison with the State Council.

On some properties, Pig Section staff are encouraging farmers to undertake financial recording usually in the form of a gross margin analysis. This work is time-consuming and progress is likely to be slow until simple schemes which can be easily operated and understood by farmers are developed.

About 25 pig carcass competitions were judged during the year including the National Bacon Carcass Competition. A revised judging system prepared by officers of the Department of Agriculture, Victoria, was used for 1979 competitions.

The Super Porker Campaign conducted by the Pigmeat Promotion Advisory Committee has been launched in Queensland. It appears to have suffered some setbacks in southern States due, in part, to the competitive demand for cured products and a general shortfall in the supply of pigs. It is recognized that there is, in effect, a single market for pigmeat in the eastern States.

The buoyant state of the industry prompted many people to investigate and seek information on the establishment of piggeries. However, the major deterrents appear to be lack of capital, expertise and Local Authority restrictions. A number of small piggeries was re-opened together with the establishment of some new small units. Several piggeries changed hands during the year and this appeared to be the principal means by which newcomers gained entry to the industry.

Disease

Enteritis due to *Escherichia coli* was reported to have affected weaner and grower pigs in the Maryborough, Toowoomba and Brisbane Divisions. Control was rendered difficult due to apparent widespread resistance to antibiotics.

A large number of cases of interstitial pneumonia was diagnosed in the Toowoomba Division. Two-month-old pigs at Highfields exhibited, post weaning, signs of fever, panting, sweating and death. Other cases, which were associated with fibrinous pericarditis and fibrinous polyserositis, occurred at Oakey.

At the Animal Health Station, Oonoonba, micro slide gel diffusion and microtitre complement fixation tests have been developed for the diagnosis of *Mycoplasma hyopneumoniae* infection in pigs. These tests are to be used to survey pig herds in north Queensland for *M. hyopneumoniae* infection. It is envisaged that the gel diffusion test be used for initial screening of all sera, the positive sera then being tested by the complement fixation test. The gel diffusion test is also a convenient method of identifying pig mycoplasma isolates. Recently the first isolate (X1120) using this procedure has been identified.

Streptococcus zooepidemicus was isolated as the cause of a purulent arthritis in a pig at Chinchilla.

Campylobacter sputorum was isolated from cases of terminal ileitis in pigs at Warra. This organism also causes the more acute haemorrhagic bowel syndrome.

Hyperostosis was observed at autopsy of a litter of pigs from Kallangur. This was an unusual finding and the condition is thought to be genetically transmitted. All the piglets died.

Pseudomonas pseudomallei was isolated on three occasions from spleen abscesses found in pigs at slaughter. The animals originated from two properties in the Townsville area.

Swine dysentry was diagnosed as the cause of death in 12 of 100 four-month-old pigs outside Townsville.

Ticks identified as *Amblyoma cyprium* were collected from feral boars at Bamaga on northern end of Cape York Peninsula. It is believed that this is the first time that this tick has been found on domestic animals. Its normal host is said to be the turtle but its life history has not been elucidated.

Mouldy millet toxicity was diagnozed as the cause of 5 deaths in a Kingaroy piggery. *Aspergillus flavus* was cultured.

Parvovirus was detected in a number of herds on the Darling Downs and was suspected as being the cause of mummification, stillbirths and infertility in a group of gilts at Ingham.

Deaths ascribed to mulberry heart disease were investigated at Tallegalla (Brisbane Division).

Three bacon pigs from Dalby died from porcine stress syndrome in yards while awaiting slaughter. There were no antemortem signs apart from reddening of the skin of the ears and ventral abdomen and a suddenly developing weakness of the limbs. Autopsy revealed subpericardial petechial haemorrhages, excess pericardial fluid and congested lungs and kidneys.

Breeding

PERFORMANCE TESTING OF STUD BOARS.—The boar performance testing station at Rocklea evaluated the breeding worth of 372 Large White and Landrace boars. This was a considerable increase over previous years due mainly to a reduction in the liveweight range over which testing takes place. It is now 50 kg to 90kg. Accompanying this increase in throughput, there has been a reduction of 60% in the wastage of boars tested due to leg weakness, illness and malignant hyperthemia. The accuracy of the test in evaluating breeding values was established by the observation that the proportions of boars passing the test were 57% for the sons of tested sires and 45% for the sons of sires not tested in the station. To improve the efficiency of the station further, 75% of total testing space will in future be reserved for sons of previously tested Rocklea boars and non-pedigree breeders will be eligible to use space not utilized by pedigree breeders. An auction sale of tested boars and their close relatives was held in Toowoomba by breeders using the Rocklea Station. The sale was very successful and provided useful extension for objective breeding methods.

ON-FARM PERFORMANCE TESTING.—This project continues in all districts with advisers demonstrating the value of objective selection methods. While some co-operators rely on the adviser to conduct routine testing, an increasing number of producers obtained ultrasonic equipment and operated their own selection programmes along guidelines provided by the local adviser.

While most of the demand is for assistance in testing and selecting replacement sows, an objective is to encourage and give priority to the selection of boars in appropriate herds. This should have a greater genetic impact provided testing procedures are sufficiently rigorous. Although the work is time-consuming, it is seen as well worthwhile and there is a considerable spin-off into management and husbandry areas.

SELECTION FOR ECONOMIC GAIN IN A PIG HERD.—The first phase of this project was completed. As a result of 8 years of selective breeding in a pig herd, the efficiency of growth of lean (lean growth/feed eaten) was increased by 8% on *ad libitum* feeding and 2·3% on restricted feeding. The improvement was valued in excess of $4 per pig slaughtered. A large part of the improvement was due to a reduction in voluntary food intake on *ad libitum* feeding but there was little change in growth rate. A second phase of selection was commenced, and this aims at improving the efficiency of lean growth without any change in appetite. An improvement in growth rate is expected to follow. To avoid costly mistakes from large-animal experimentation, the new selection technique is first being modelled with mice before being applied in the pig herd.

PREDICTING CARCASS COMPOSITION FROM LIVE PIG MEASUREMENTS.— Measurements of echo sounded backfat depths and body weights made on 96 pigs before slaughter were related to weights of fat, lean and bone dissected from their hind legs after slaughter. From these measurements, accurate prediction equations were developed. These will be used to select breeding stock likely to pass high lean and low fat development to their offspring.

MODELLING SELECTION FOR EFFICIENT LEAN GROWTH IN PIGS USING MICE.—A technique for the genetic improvement of the efficiency of protein deposition (grams protein per grams food) was studied. Two mouse lines were selected for high 5 to 9-week weight gain corrected to mean 5-week weight. Appetite variation between mice was eliminated by feeding 83% *ad libitum* intakes in individual daily meals. Realized heritabilities of 5 to 9-week gain were 0·36± 0·05 and 0·19 ± 0·04 for the two lines. After six generations of selection, the lines were compared with an unselected control on restricted and *ad libitum* levels of feeding for growth rate, appetite, food conversion efficiency and chemical body composition.

All traits were increased by selection. Compared with control mice at the same bodyweight and food intake, the selected mice gained more weight of a higher fat content. There was an estimated reduction of 13% in the food required to maintain a given body weight and an improvement of 5% and 33% in the efficiencies of protein and fat deposition. For maximum improvement in the efficiency of protein deposition using the technique studied, high levels of dietary protein should be fed and bodyweight gain measured during youth when protein deposition is high.

CLOSURE OF HERMITAGE AND EXPANSION OF BILOELA PIGGERIES.—In consultation with representatives of the pig industry, the decision was taken during the year to close the Hermitage piggery and expand the Biloela piggery to accommodate the Hermitage herd. The advantages of this move are—(a) with both control and selection herds at the same site (Biloela), continuous monitoring of all aspects of the selection programme will be possible; and (b) more effective utilization of staff and facilities will be possible. Planning of the new facilities for Biloela has reached an advanced stage.

Nutrition

Feed compounders and pig producers made use of least-cost computer diets formulated by the Pig Section. An explanatory leaflet on the interpretation of computer diet print-outs was written for the benefit of advisers and users of the service. Field reports indicate renewed interest from producers in compounding pig diets on-farm and consequently staff were required to assist with formulations and mill-mixing plant layouts and to outline the economics of home mixing.

UTILIZATION OF SYNTHETIC LYSINE.—Experiments have examined the benefit from adding synthetic lysine to diets deficient in lysine when fed in restricted amounts once a day to grower-finisher pigs. Results from synthetic lysine were equal to those from lysine-equivalent amounts of meat-and-bone meal but inferior to that of soybean meal. Such differences as existed between the lysine sources diminished as the pigs grew and disappeared when pigs were above 50 kg liveweight.

METHOD OF MILLING GRAIN.—Performance of pigs fed hammer-milled grain was slightly better than those fed grain processed by roller milling. The difference was greatest with sorghum, less with wheat and without effect with barley. No account was taken of possible differences between milling methods in the weight of grain recovered after processing.

EVALUATION OF PROTEIN CONCENTRATES.—The partial and complete replacement of soybean meal with meat-and-bone meal and sunflower meal combinations in wheat-based diets have been examined. Provided synthetic lysine was used to offset a primary lysine deficiency, all of the soybean meal could be replaced by a supplement of sunflower meal and meat-and-bone meal where each contributed equivalent amounts of crude protein.

An investigation of the nutritive value of navy beans (*Phaseolus vulgaris*) for pigs has commenced. Preliminary studies with rats showed that raw beans are toxic when used in the diet above about 10%; steam cooking destroys the toxin in the bean and produces a protein concentrate of high nutritional quality. Alternative methods of cooking are being evaluated.

Reproduction

Various aspects of the female reproductive cycle have been examined with funds provided by the Australian Pig Industry Research Committee. Pregnancy diagnosis by means of vaginal biopsies proved to be about 90% accurate, suffering from some false positives and negatives.

Work is concentrating on assessing the effects of heat stress on embryo survival, ovulation rate, piglet birth weight and total reproductive failure in sows. An experiment with gilts at Biloela Research Station has compared the effect of environmental temperature during the 16-day period immediately after mating on embryo survival at 16 days after mating. Elevation of the temperature resulted in a markedly reduced live embryo to egg shed ratio compared with those exposed to a normal temperature. Further planned experiments will assess the duration and critical period when heat stress is most damaging.

Heat stress is considered to have its main effects either early in pregnancy or in the last trimester when growth rate of the foetus is most rapid. A trial examined the effect of heat stress on the birthweight of pigs. Twelve sows were

divided into two equal groups. Group 1 (heat stress) was housed in an A frame hut in an otherwise shadeless paddock and thus subjected to the severe Biloela summer sun. Group 2 (cool environment) was housed in the relatively cool breeding shed at Biloela. There were no significant differences between groups for either number of pigs born (total and alive or dead) or average birth weight (range of birthweights: heated 850 g to 2 100 g, cooled 800 g to 2 050 g). This was despite obvious distress by 9.00 a.m. on some very hot days. The small numbers of sows in this trial prevent reaching strong conclusions. The trial will be repeated.

In further studies, gilts have been provided with indwelling venous cannulae to allow daily blood sampling for hormone analysis. Progesterone will be measured by radio-immuno assay to examine the effect of heat stress on this ovarian function.

Management

PIG TATTOO BRANDING.—As at March 1979, registrations under the provisions of the voluntary scheme initiated by Pig Section totalled 8% of Queensland producers who own 26% of the pig population. The results achieved have been largely due to encouragement provided by field staff during the course of farm visits and producer meetings. Limited response was obtained through the mass media. With support from the Queensland Commercial Pig Producers' Organisation tattoo brand registration could become a compulsory scheme, thus bringing it into line with similar schemes legislated in other mainland States.

PERFORMANCE RECORDING.—This has been encouraged for a number of years to assist producers in checking management efficiency and piggery performance. A concept of recording and assessment of breeding herd performance developed in the North Burnett District has met with a good response from producers using the system. New record books printed with assistance from the Commonwealth Extension Services Grant funds were distributed to co-operators in April.

PIG HOUSING AND EQUIPMENT.—High capital cost of establishing new piggeries tended to limit the number constructed. However, field officers were involved in planning building extensions, renovations and modifications with established producers. Due to better returns producers were in a more favourable financial position to carry out this work, which often included the installation of insulating material. Most new piggeries under construction or in the planning stage were designed to incorporate flush buckets for efficient and frequent removal of effluent. Producers in a favourable financial position gave serious consideration to establishing on-farm mixing plants. After investigating the merits of wet feeding others considered installation of automatic liquid feeding equipment.

SITING OF PIGGERIES AND DISPOSAL OF EFFLUENT.—There has been increasing co-operation between Pig Section officers and many Local Authorities on these matters. It is also pleasing to record much closer co-operation and consultation with officers of the Water Quality Council.

Poultry industry

Egg industry

The egg industry continued to operate under a controlled marketing system. Net return to producers for the 9 months ended 31 March 1979 was 71·38c per dozen which was 1·5c above that for the same period in 1977–78.

Increasing egg production during the winter and early spring months of 1978 resulted in a build up of surplus eggs. Hen quotas were reduced by 4% in south and central Queensland in September to correct this situation. This did not have the expected effect and production continued to be slightly above that for the corresponding period in 1977–78. It seems that producers reacted to the quota cut by culling their oldest birds and keeping their actual hen numbers closer to their limit than was thought possible. This had the effect of increasing the egg production per quota bird. The situation changed suddenly in April-May 1979 when production levels were less than expected and egg sales above expectations. At the end of the year, egg supply and demand throughout the State appeared to be finely balanced.

The Cost of Production Committee set up by the Egg Marketing Board Suppliers' Organisation kept the Egg Marketing Board informed on changes in egg production costs. This Committee, which includes officers of Economic Services Branch and the Poultry Section as advisers, reviews egg production costs on a quarterly basis.

The Committee used a model developed by officers of Economic Services Branch and Poultry Section to calculate the cost of production. This model is based on assumptions for flock size, feed intake, productivity, bird wastage rates, labour and capital inputs. These assumptions are reviewed annually to ensure that they are in keeping with current industry trends. The model is currently based on a hypothetical 7 500-bird laying flock. It includes an allowance calculated at the ruling bank rate for return on capital invested. The December 1978 update of the cost of production was 72·32c per dozen.

The cost of production rose by 3·1% in the 12 months to December 1978 but the rise in the 6 months to December 1978 was only 0·6%. Relatively stable feed prices throughout 1978–79 have helped offset cost rises in other inputs such as labour and pullet costs.

Improved prosperity in the egg industry has been reflected in the number of producers who are renovating or re-building their laying facilities. Most of the new units feature high-rise design and automated feeding and egg collection equipment. The first fully-enclosed, mechanically ventilated laying shed has just been completed at Beerburrum. It has been thought that this type of construction would not be warranted in coastal areas, but could be economically justifiable in areas such as the Darling Downs.

The trend away from started pullets has continued with more producers rearing their own replacements. This trend has occurred mainly because of disease problems which have been encountered when started pullets were introduced into multi-age laying flocks. In addition, some producers wishing to increase their investment in the egg industry have changed to rearing their own pullets as a logical extension of their enterprise. Cage rearing systems are increasing in popularity although some problems have been encountered with cages.

Poultry meat industry

Broiler industry expansion in south-east Queensland for 1978–79 has been considerably above the national expansion rate. In fact, figures for the first 8 months of 1978–79 show that Queensland produced 14·7% of Australia's broilers and 15·3% of the total Australian dressed weight of broilers. During this period, Australian production (number of birds) has increased by 8%. Queensland production in the same period has increased by nearly 13% to 18·5 m. If the present rate of production is maintained, Queensland production for 1978–79 will exceed 28 m.

Much of this increase has been due to expansion of production by one processor group which expanded its contract broiler growing arrangements by 40% during the 6 months to January 1979. Further large expansion is planned. Another group is expanding its shedding by approximately 19 000 m^2. This is planned to be fully operational by May 1980. Their abattoir complex is being updated to cater for this expansion.

There are now 94 contract broiler growers in south-east Queensland and eight others in the remainder of the State. In addition, processor-owned farms contribute in a minor way to the overall production.

During the year, there has been a further marked improvement in broiler performance. This has been equivalent to a reduction in the growing period of almost 3 days to achieve average market liveweight of 1·85 kg. Genetic, nutritional and management factors have all contributed to this improvement.

The Chicken Meat Industry Committee continued to act effectively and its stabilizing influence has been appreciated by all sections of the industry.

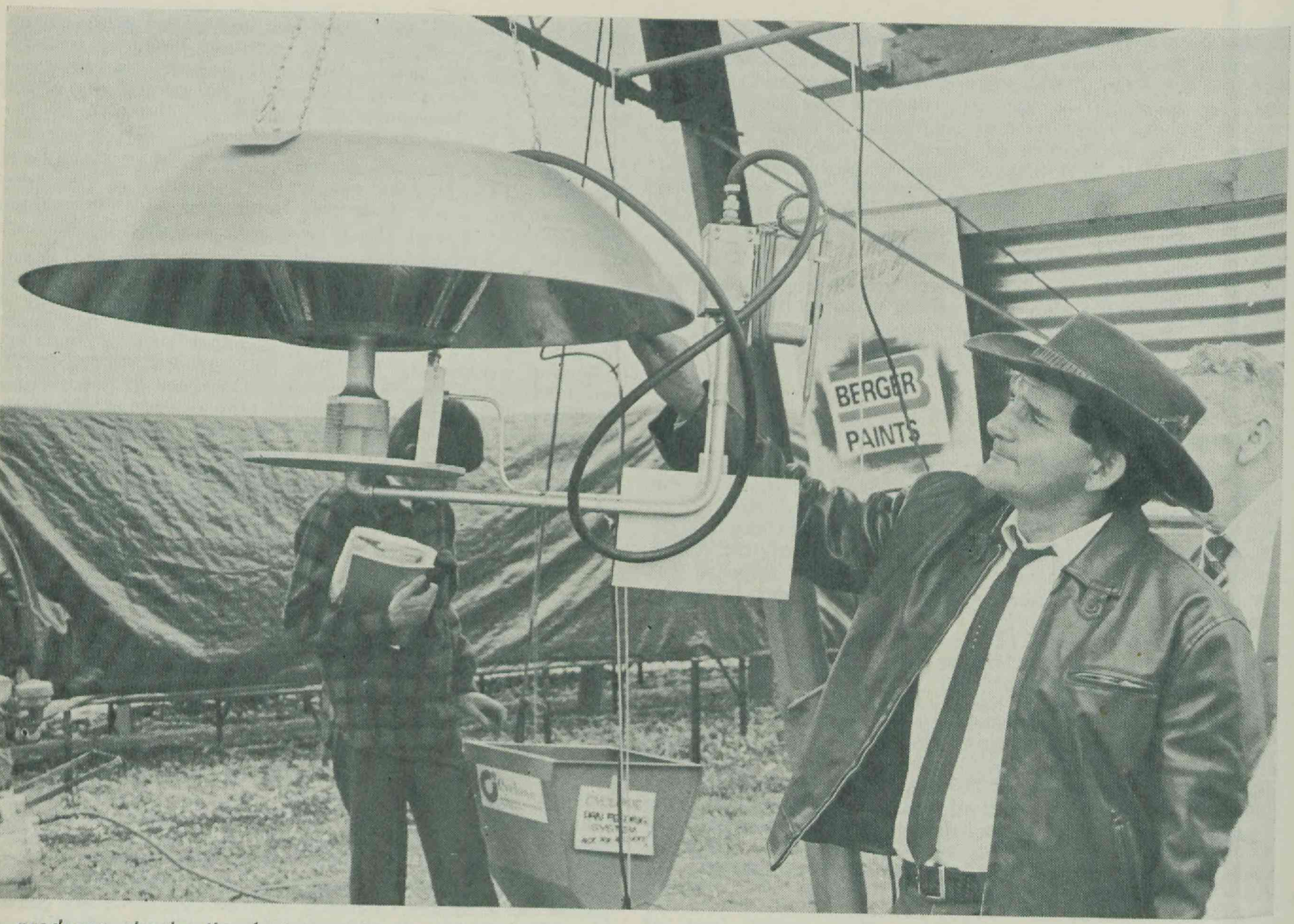
The recovery in the red meat industry resulted in increased demand for poultry meat during 1978–79 and this situation seems likely to continue into 1980. The increased demand is not only for chicken meat, but also spent laying hens which are being sought as an alternative to stewing-type red meats. The duck and turkey market is continuing to be supplied mainly by New South Wales processors who have financial control of the breeding, growing and processing operations.

In addition to the increased demand created by the red meat situation, the take-home foods market has been further exploited by the chicken processors.

Disease

The incidence of poultry diseases in the State is difficult to determine. Most poultry producers tend to accept a certain level of disease, particularly respiratory disease, coccidiosis, and internal parasites. These diseases are reported only when they first occur on a farm, cause excessive deaths, or do not respond to the treatment given by the producer. The disease pattern followed the normal seasonal pattern, for example, respiratory disease incidence high in the first quarter of the year (July–September), fowl pox in the late summer and egg production drops throughout the year.

Departmental staff diagnose many of the problems in the layer industry. Because the broiler industry is serviced by its own veterinarians and servicemen, Departmental staff see less of the disease outbreaks in this section of the industry.



A producer checks the features of a new type of gas brooder in one of the 50 commercial displays at the Rocklea Poultry Research Farm's Jubilee Field Day.

Shortages of Marek's disease and avian encephalomyelitis vaccine in the first quarter of the year caused considerable concern, but no actual disruption to vaccination programmes.

The co-ordinated disease control project has proved to be more extensive than originally planned. It commenced in 1977–78 with a review and rewrite of many of the Section's disease leaflets in Farmnote form. This has been continued in the current year. A satisfactory farm history card has been developed so that reporting of case histories can be standardized. Shire maps showing locations of all poultry enterprises have been prepared for the major poultry producing areas. Photographs of these have been distributed to major poultry firms to emphasise the undesirable concentration of farms which has occurred in some areas, for example, Redlands. Emphasis has been given to the importance of siting and layout of farms and management factors in disease prevention and control programmes.

Two specific diseases were given emphasis. These were infectious bronchitis (I.B.) and infectious laryngotracheitis (I.L.T.). A survey of 11 flocks with infectious bronchitis was carried out in winter 1978 to determine whether vaccination programmes were ineffective. There were fewer outbreaks of infectious bronchitis for this period than for the previous winter. This corresponds with a change from A strain to S strain vaccine. Vaccination reactions with the S strain were more severe.

No common management factors were found in the survey. Most outbreaks occurred after a change to cold, windy weather. Poor vaccination techniques and intercurrent infection with infectious, bursal disease virus appear to have contributed to the outbreaks. I.B. virus and paired sera were sent to N.B.S.L., Melbourne for virus-typing studies.

Outbreaks of infectious laryngotracheitis occurred in the Toowoomba, Warwick, Mundubbera and Brisbane areas in the last year. In some areas, a severe form of the disease occurred. In this, the death rate was approximately 10% and a haemorrhagic tracheitis was evident. The Toowoomba and Warwick outbreaks involved layers and pullets, whereas broilers were affected in the Mundubbera outbreak. Overall losses in layer flocks averaged 5% whereas 7% losses occurred in the broiler flock. Egg production in layer flocks dropped by 5 to 30%. Vaccination of flocks (water method) in the early stages of infection was successful in preventing more serious losses. Laboratory confirmation of diagnosis is required since official disease control measures such as quarantine of properties may be instigated. Recently the use of cell cultures and the electron microscope in the Pathology Branch have facilitated rapid and accurate diagnosis of this disease.

Excessive losses from Marek's disease were confirmed by histopathological examination in a number of pullet flocks originally derived from one poultry firm. These birds and their parents had been vaccinated with herpes virus of turkeys as day-olds. It is possible that maternal immunity interfered with the vaccination of the progeny although other causes such as faulty vaccination technique could have been responsible. A Marek's disease outbreak also occurred in a flock of 12-week-old layer breeders of another poultry farm. These birds had been vaccinated with attenuated Marek's disease virus vaccine at day-old by the New South Wales hatchery that supplied the stock.

Chlamydia psittaci the causative organisms of psittacosis was demonstrated by mouse-inoculation tests in parrots from three aviaries. Characteristic lesions of psittacosis were found at necropsy examination. Details of these cases were provided to the Health Department since humans can contract the disease from parrots and a serious illness may result.

Fowl pox was seen in laying flocks and many backyard flocks in late summer. The higher than normal incidence appears to be associated with dry weather in early summer, followed by a sudden increase in mosquito numbers with the onset of the wet season. Marked fowl pox vaccination reactions were seen in four batches of pullets from a N.S.W. hatchery. Deaths reached 10% in one flock in the first 12 days. Most chickens were vaccinated in the wing muscle instead of the web.

Avian encephalomyelitis was diagnosed in December in a flock of 5 000 3-week-old pullets reared on wire. The pullets were from a New South Wales hatchery, but this was the only one, out of several batches, which showed any symptoms of the disease. The disease affected 5% of the flock.

Eight Newcastle disease viruses were isolated from fowls in the course of disease diagnostic investigations. Because these could be harmful strains of virus not previously found in Australia, pathological and virological characterisation tests were done. Results indicated that the eight viruses were lentogenic (avirulent) strains similiar to those previously isolated from poultry in Australia. In some cases, the Newcastle disease virus was isolated together with another infectious agent. This necessitates purification of the Newcastle disease virus by such tests as haemagglutination-elution and endpoint-dilution.

Haemorrhagic tracheitis occurred in birds from which one of the Newcastle disease viruses was obtained. This lesion also occurs in exotic forms of Newcastle disease. However, in this case diagnostic tests confirmed that the

haemorrhagic tracheitis was due to infectious laryngotracheitis virus. This work is expensive in terms of staff time and specific-pathogen-free eggs and birds, but it is considered to be essential as one means of surveillance for the appearance of exotic strains of Newcastle disease in Australia.

A project to classify avian adenoviruses and study their importance as a cause of disease and production loss in broiler chickens was conducted by Pathology Branch with funds provided by the Australian Chicken Meat Research Committee. To date a total of 23 avian adenoviruses has been isolated from diagnostic accessions of diseased birds and 28 avian adenoviruses have been obtained from other laboratories. The main disease with which these isolates were associated was respiratory disease. Twenty-six of the viruses have been purified and titrated in preparation for serotyping and pathogenicity studies. The Australian isolates will be compared with overseas isolates using FAO typing reagents imported from Northern Ireland. In initial pathogenicity trials, a number of avian adenoviruses caused a mild respiratory disease when inoculated into the respiratory tract of 3-week-old pathogen-free chickens. The effect of non-infectious and infectious agents in conjunction with adenoviruses will be investigated in the next phase of the work. The work has been undertaken because adenoviruses have been incriminated in numerous diseases but critical laboratory trials have not been done to establish under what conditions they may be important causes of economic loss.

Fowl cholera, which is caused by the bacterium *Pasteurella multocida,* has been a major problem in broiler breeder flocks in the Brisbane area in the last year. Both the acute form, characterized by sudden increased mortality rates in the affected flocks, and the chronic form, in which abscesses are found in the wattles and joints, occurred. Tentative field diagnosis of this disease in a number of breeder flocks of two poultry firms were confirmed by laboratory examinations undertaken by the Pathology Branch. At the request of the poultry firms involved, isolates of *P. multocida* from these flocks were sent to a commercial vaccine manufacturer to produce autogenous vaccines for use in controlling cholera in broiler breeder flocks. Cholera was also diagnosed in a flock of 200 quail in Toowoomba.

No pullorum disease was diagnosed and no reactors were seen in any of the breeding flocks tested. Partial pullorum testing was instigated in mid 1978. No problems have been encountered. Stamps were issued to 10 hatcheries in late 1978 for stamping boxes for interstate movement of hatching eggs and day-old chicks. These stamps replace health certificates issued by Government Veterinary Officers, and are an endorsement that the eggs or chicks are derived from pullorum-free flocks.

Tenosynovitis was seen in four successive batches of one breed of pullets reared in flat deck cages (35 birds per cage). Average death rates for the flocks was 12%. Deaths started at 10 weeks of age and peaked at 15 to 18 weeks when the birds were moved to the laying shed.

Salmonella Group B caused the loss of 3% of broilers aged 1 to 3 weeks on one farm. Organisms of the same group were isolated also from 40 to 55 weeks old broiler breeders in the Brisbane area.

Botulism was diagnosed in backyard fowls at Carbrook, in ducks at Gatton and in a pelican at Bundaberg. Losses in turkey poults due to *aspergillosis* were reported from Townsville and Kuranda.

An unusually high incidence of salpingitis was investigated in a 2 000-bird laying flock at Helidon. Approximately 600 birds from 14 weeks of age to the laying stage died or were culled. The problem showed no sign of abating and the producer disposed of the remainder of the flock. It may have been related to an outbreak of omphalitis which occurred in the birds during the first week of life.

Vitamin A deficiency was diagnosed on two broiler farms at Cairns, in started pullets on a farm in the Brisbane area, in mixed ages on another Brisbane farm, in pheasants and in backyard quail. In most cases, deficient liver and/or feed vitamin A levels were confirmed by biochemical analysis. The low feed levels were usually associated with inadequate or lengthy premix storage.

Vitamin K deficiency was diagnosed as the cause of a haemorrhagic syndrome in day-old chickens in a hatchery at Beerburrum. Riboflavin deficiency in a flock of 4-week-old broiler chickens with curly toe paralysis responded rapidly to riboflavin supplementation.

Rickets was prevalent in broilers on three poultry farms during the last year. Clinical signs in 2 to 4-week-old affected birds included depression, poor growth rate, reluctance to walk and some birds had muscular tremors or they took convulsions. A diagnosis of rickets was based on the gross pathological findings of bone abnormalties and enlarged parathyroid glands, the biochemical findings of depressed calcium and elevated alkaline phosphatase in the bird's sera, and the absence of histological lesions of avian encephalomyelitis and encephalomalacia. The cause has not been determined but feed analyses indicate that calcium and phosphorus were not deficient and field reports suggested that vitamin D_3 added to the drinking water prevented the occurrence of rickets.

As a result of these occurrences in the field the Pathology Branch initiated feeding trials. These trials indicated that:— (a) from chemical, pathological and biochemical results the disease produced in the trial chickens was rickets; (b) the 'suspect' feed can reproduce the disease under controlled laboratory conditions and possible economic losses could result from poor growth rates, poor feathering, leg deformities and weak bones; (c) mineral and salt analysis did not reveal a reason for the occurrence of rickets, as levels of calcium, phosphorus, molybdenum, copper, zinc, manganese and iron were similiar to those in the control diet and were within the normal range; (d) aflatoxin interactions with vitamins were not responsible as the feed contained no detectable aflatoxins B_1, B_2, G_1 and G_2; and (e) both field observations and limited laboratory evidence suggested the condition can be prevented or reduced in incidence by the addition of vitamin D_3 to drinking water.

One large broiler company had problems throughout the year with a litter-eating syndrome. The disease was sporadic, but persistent. Sudden mortality (0·5%) occurred in 16 to 20-day-old broilers. Few sick birds were seen. Well-grown birds were found stretched out. Dark brown fluid and litter were found in the crop and the muscles were pale (fish flesh). Flocks responded to a low protein-high fibre ration. The condition seems to be associated with high brooding temperatures and the onset of I.B. vaccination reaction.

Nutrition

CONTROLLED FEEDING OF LAYER STOCK.—This extension programme began in 1976–77 following extensive developmental research at the Rocklea Poultry Research Farm. It is a long-term project aimed at increasing the application of controlled feeding of pullet replacements throughout the State. Some problems were encountered during the year and these included confusion caused by hatcheries recommending different controlled feeding programmes and unevenness in development of pullets on some farms. A survey of egg producers on the Darling Downs is being conducted to evaluate the effectiveness of the controlled feeding extension programme in that area.

The research programme at the Poultry Research Farm, Rocklea, on which the extension programme is based continued during the year. Investigations have illustrated in the past that restricting the feed intake of both the replacement pullets and laying hens are effective means of controlling fat deposition and, as a consequence, improving the efficiency of egg production.

Emphasis has been placed in the last year on establishing nutritional requirements of birds under controlled feeding systems. In particular, the energy and amino acid requirements of Queensland commercial layers and the significance of grower diet quality in influencing age at sexual maturity have been examined. Results suggest that, in the Rocklea environment, optimal calorie intake is approximately 250 kilocalories per day on average over the laying year.

Overall the observations on calorie intake suggest that our birds are extremely unlikely to be in a state of negative energy balance at any time of the year when fed *ad libitum*. Birds both reared *ad lib.* and fed *ad lib.* during lay also showed an apparent inability to control calorie intake to seasonal requirements. An over-consumption of energy during the summer months was particularly evident and this explains the development of obesity of birds managed in this way.

The trials also demonstrated a greater sensitivity by the controlled reared bird to amino acid level in the grower diet than that shown by birds fed *ad lib.* The principal influence was on age at which the birds came into lay. Delays in maturity produced by deficient diets were more than twice as great for controlled fed birds than for *ad lib.* fed birds. This observation has implications in the planning of flock replacement programmes.

Current experiments are comparing the responses of three commercial strains of layers to the 40-hour denial in the 72-hour controlled feeding programme promoted by the Department and programmes advocated by breeding companies, and the responses of lines selected for and against obesity to time of access restriction programmes.

OBSERVATIONS OF LAYER FEED INTAKE.—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 accurate information, formulation to optimize amino acid and mineral intakes becomes essentially guess work.

Data are being collected and evaluated from experiments at Rocklea and intake information is being collected on commercial farms on the Darling Downs and in the Brisbane area. Unfortunately, very few farmers maintain records of layer performance and intake which are satisfactory for identifying weaknesses in efficiency of production. Producers in all areas of the State are being encouraged to record the feed intake of their layers accurately so that intake of specific nutrients can be checked.

Recording feed intake of layers in multi-age flocks had been a problem, but this can be overcome by blocking off sections of the feed trough and weighing feed eaten by 100-bird samples from each age group. Many producers have shown interest in the method and much more data will be available in the coming year.

BROILER BREEDER MANAGEMENT.—An initial experiment with broiler breeders demonstrated that the performance of the Australian bird was markedly inferior to that reported for overseas strains. The evidence suggests that the reason for this inferiority is the relative ineffectiveness of breeding programmes and management to control obesity. High fat level in the carcass was associated with a high death rate, low settable egg production, low fertility and high early embryonic death, and excessive feed consumption.

Sampling of dams from commercial breeder flocks has subsequently shown that obesity is a problem common to all of the Queensland broiler breeder industry. Carcass fat levels of approximately 30% have been demonstrated for all strains while levels of greater than 20% are unnecessary and undesirable. Emphasis in current experimental work to control obesity by management is on development of techniques for controlling calorie intake. Emphasis is being particularly given to the laying period when time of access restriction programmes offer the greatest promise.

CONTROLLED FEEDING OF BROILERS.—Various times of access to feed have been imposed with the hope of reducing maintenance energy requirement and, hence of improving feed efficiency. Denial of access to feed from 7.30 a.m. to 3.30 p.m. from 4 weeks of age improved feed efficiency by 0·03 units in three of four experiments. A further experiment showed that commencing this feed denial programme at 14 days of age improved feed efficiency to a greater extent than later commencement times. Field trials, comparing these techniques on a commercial scale, have begun.

FEED INGREDIENT EVALUATION.—This investigation has been directed to both a better definition of our traditional materials and investigation of the nutritional potential of new feedstuffs.

The main energy sources in diets fed in the intensive animal industries are the cereal grains. The grains also make a significant contribtion to the amino acid composition of these diets. Most commercial manufacturers of feed for livestock have facilities for determining protein, but few have access to facilities for determining available energy and amino acids. A knowledge of the magnitude and variability of these nutrients in the feed grains is essential for efficient practical feed formulation.

An extensive investigation is under way to correct deficiencies in knowledge in these areas. Husbandry Research, Biochemistry and Agriculture Branch staff are involved in the project. The metabolizable energy of a series of feed grade wheats has been determined. Barley, triticale and further wheat samples are being evaluated for available energy and amino acids as the project develops. An important part of the programme is also the development of reliable and practical techniques for predicting the available energy of these grains in the laboratory.

The programme also has agricultural significance. The Department has been conducting an extensive breeding programme to develop feed grade barleys. It is essential that the feeding values of these grains relative to malting barleys be assessed so that the economic viability of a feed grade barley industry can be determined.

Chick bioassays for available lysine in protein concentrates were initiated since assays with pigs and rats by the New South Wales Department of Agriculture showed very large differences in lysine availability between commonly used high protein ingredients. The results so far indicate that the lysine in cottonseed meal is very much less available to the chick than that in soybean meal. Meat-and-bone meals examined have shown values very similar to that for soybean. Further work to develop the assay technique is projected.

New products being evaluated include one of great historical interest and another which is a waste product of modern technology. Both are potentially useful feedstuffs.

The first is *Amaranthus edulis*. This grain supported the Aztec and major civilizations before the Spanish conquest but has been neglected as a feedstuff since. Its unusual feature is its amino acid composition.

In particular, it contains 1% lysine while other grains are only a poor source of this essential amino acid. Levels of other amino acids in the grain also approach the requirements of monogastric animals. While it contains toxic material, this is easily destroyed by heat treatment. In short-term experiments using a ration made up mainly of this grain, excellent growth rates have been recorded in chickens and rats. Longer-term feeding experiments are projected.

Increasing emphasis on effluent water quality is forcing many Australian industries to install and upgrade waste water treatment facilities. Abattoirs are no exception. Several have installed activated sludge plants for effluent water treatment which produce large quantities of microbial biomass. Preliminary work suggests this biomass may have potential as an animal feed. Biochemistry and Husbandry Research Branches are co-operating with C.S.I.R.O. and Hawkesbury Agricultural College staff in the evaluation of this product.

Breeding

SELECTION FOR EFFICIENCY OF PRODUCTION.—The fourth generation of selection in Australorp hens based on liver fat has been completed. Comparing the low-fat line with the high-fat line there has been a reduction of 7·4% units in liver fat and 6·5% units in carcass fat. Growth rate before first egg has been reduced by 0·4 g per day and that after first egg by 1·0 g per day. This has resulted in a difference of 0·15 kg in body weight at 40 weeks. Egg production has been similar for the two lines to 40 weeks of age, while feed consumption from first egg to 40 weeks has been reduced by 0·83 kg, resulting in an improvement in feed efficiency (kg feed per kg egg) over this period from 3·12 for the high-fat line to 2·95 for the low-fat line. Preliminary data from the fifth generation suggest that rate of lay is consistently higher for the low fat line from about 35 weeks of age to 68 weeks of age.

A broiler breeder selection project has commenced to determine whether it is possible to reduce obesity by selection based on 6-week bodyweight and low growth rate after first egg.

FATTY LIVER HAEMORRHAGIC SYNDROME.—Fatty liver haemorrhagic syndrome is a significant cause of deaths in egg production and breeder stock. Preliminary work has suggested the definite lesion of this condition may be a lysis of the liver reticulum. Lysed livers, when heavily infiltrated by fat, fail with massive haemorrhage in stress situations. An investigation is being conducted by Husbandry Research, Biochemistry and Pathology Branches.

Egg quality

Results of the retail egg quality surveys conducted in Brisbane and Rockhampton were used to formulate recommendations aimed at further improvement of quality of eggs reaching consumers. These recommendations which were discussed at the Poultry Information Exchange in October were—(a) Reduce the 'use-by' date from 3 weeks to 2 weeks, (b) adopt oiling of eggs to preserve quality, (c) escalate the campaign to encourage retailers to improve the conditions for storage and display of eggs.

Three experiments were conducted at the Rocklea Poultry Research Farm during February-April to investigate the effect of oiling on quality. Oiling was compared with refrigerated storage as a quality preservation measure. Eggs were examined at 3, 10 and 17 days after oiling. Consistent benefits in quality were obtained with oiling even when eggs were held under ideal storage conditions (cool room). Differences of 4·9, 5·4 and 6·4 Haugh Units were recorded in favour of oiling when eggs were checked after 3, 10 and 17 days storage respectively.

Differences in favour of oiling were greater when eggs were held at room temperature. In this case, oiled eggs checked after 3, 10 and 17 days' storage were 11·2, 17·5 and 17·9 Haugh Units better than unoiled eggs.

Differences in favour of oiling after 3 days' storage were large enough even in cool room storage conditions to be financially significant for producers. Under the quality incentive scheme operated by the Egg Marketing Board, a penalty of 3c per dozen applies to consignments of eggs which do not meet the required minimum quality standard of 67 Haugh Units. These experiments have amply demonstrated the value of oiling as a measure to reduce quality deterioration in eggs held under conditions similiar to those which apply in retail stores.

Equipment

TEMPERATURE IN FEED STORAGE BINS.—It is known that temperature is an important factor in vitamin potency loss and deterioration of stored feed. Farmers store mixed poultry feed in a variety of bulk feed bins. These bins differ in size, shape, colour and location with respect to exposure to sunlight. It is generally accepted that vitamin potency loss is negligible when temperature is less than 15 deg C. However, the rate of potency loss is doubled for each 15 deg C rise in temperature.

Tests were conducted in the Toowoomba area to determine the effect of colour (red, silver, unpainted, white gloss, white flat) shape (square, circular, sphere) and location (shade, no shade) on internal temperature of feed storage bins. Recommendations arising from the investigations are that feed bins should be painted with flat white paint, shaded, and round rather than square.

FANS IN BROILER SHEDS.—An important function of circulation fans is to increase air movement around the birds. This increases the efficiency of removal of ammonia, respired air and body heat. This results in a more comfortable environment for the birds and increases their ability to tolerate high temperature and humidity.

A trial was conducted early in 1978 in conjunction with the Queensland Agricultural College but results were not available for inclusion in the 1977–78 report. The findings can be summarized as follows—Birds from pens equipped with circulation fans were significantly heavier at 61 days of age than those from pens with no fans (2·034 kg against 1·96 kg). Fans had little effect on air temperature, black bulb temperature, and relative humidity, but the level of ammonia was reduced. This work supports the widely-held view in the broiler industry that circulation fans improve broiler performance during the warmer months.

Animal behaviour

Studies on behaviour of broiler chickens under commercial conditions are being conducted by the poultry behaviour specialist in the Poultry Section with funds from the Australian Chicken Meat Research Committee.

Preliminary work on this project showed that drinking space provided ranged from 41 cm to 181 cm per 100 chickens. The number of chickens which drink during the first 2 hours after arrival on the farm may vary between batches on the same farm by a factor of 2 or more. Data are also being obtained on height, arrangement and different design of drinkers. The project has been planned to continue for an initial period of 3 years.

Farm records

The computer programme for analysis of pullet rearing records was completed and an active campaign will now begin to encourage producer participation in the recording scheme. The scheme is being promoted to producers on the basis that it will provide a simple, quick and highly efficient management aid. It is designed to provide a quick turnaround of results.

Horses

At 31 March 1978, Queensland had a recorded domesticated horse population of 0·2m. The horse continues to play a very important role in the pastoral industries of this country and this will continue, particularly in the cattle industry.

Over the last 10 years, the popularity of horses for pleasure has increased. In the racing industry the Thoroughbred has always had a strong following. In more recent times, trotting has gained in popularity and a growing industry is developing around the Standardbred.

Undoubtedly the greatest increase in interest has been in pony clubs and for sporting, such as cutting and 3-day events. The introduction into Australia of breeds such as the Appaloosa and Quarterhorse and the increase in popularity of the Arabian breed have generated increased interest in stud breeding.

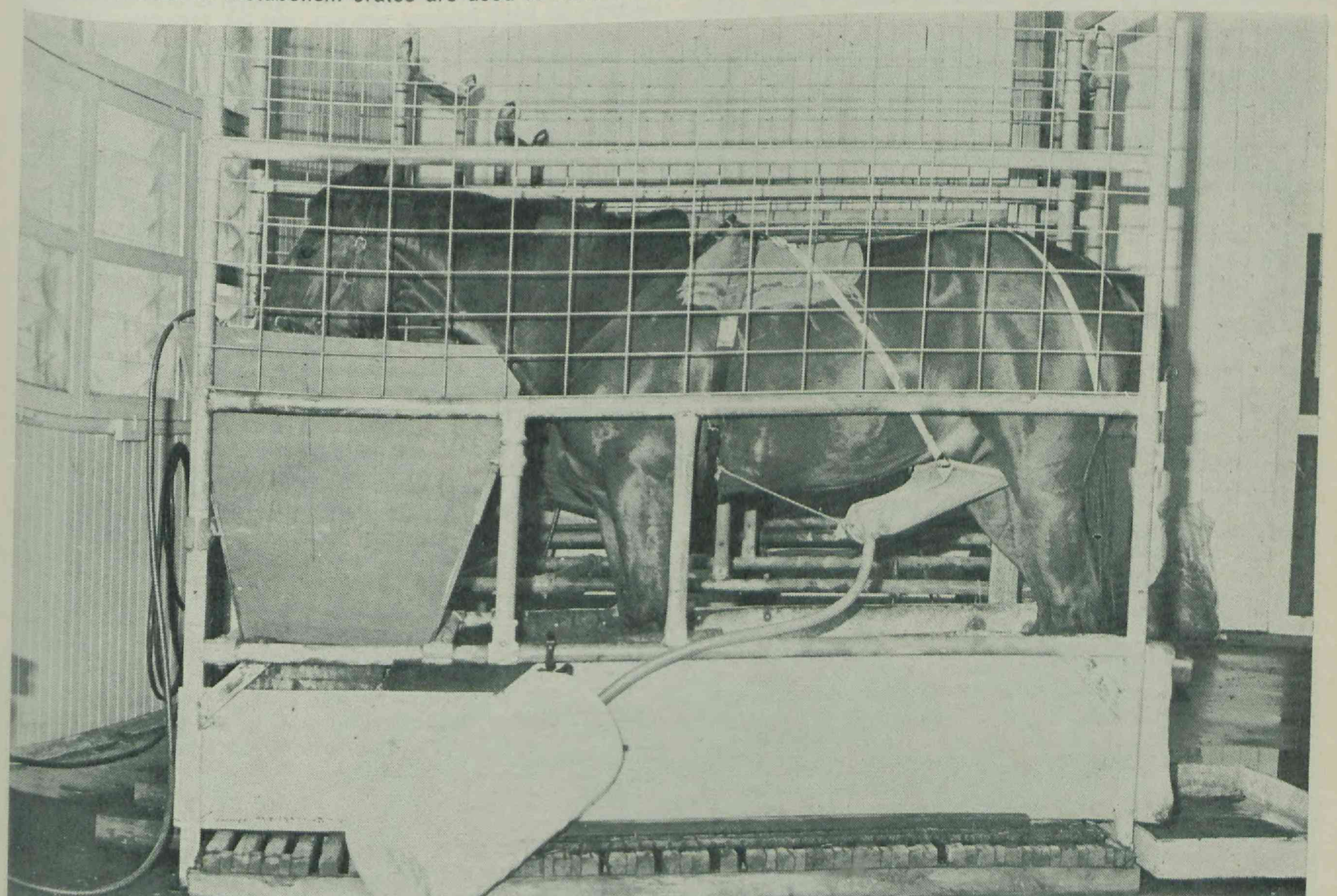
The general growing interest in horses has created a greater demand for advice on horse husbandry and this area now occupies a significant portion of the advisory time of several Branches but particularly that of Beef Cattle Husbandry Branch. The need is arising for more specialization in this field.

Following the diagnosis of abortion due to equine herpes virus in New South Wales in the previous year, an unusually high number of aborted foetuses (31 in the first quarter) was examined at the laboratory for the causative agent. Equine herpes virus was not incriminated in any of these cases. There was a variety of diagnoses including infection with *Klebsiella pneumoniae, Streptococcus zooepidemicus* and *Escherichia coli*. Infection with *Actinobacillus equuli* emerged as an important cause.

Considerable testing of samples submitted from the field to the laboratory indicates that Queensland remains free of contagious equine metritis. The controls placed on the importation of horses from overseas, the controls on movement of horses interstate and intrastate and the treatment of infected horses diagnosed in southern States have prevented the introduction of this disease to Queensland.

A Standardbred yearling died at Oakey following signs of fever and laboured respiration. Autopsy revealed an aneurism with abscessation in the anterior mesenteric artery, haemorrhages in the lungs with swollen bronchial lymph nodes and severe vegetative endocarditis. *A. equuli* was recovered from the heart valve and lung lesions.

To determine the cause of osteodystrophia (big head) in horses, balance studies are done with pasture plants high in oxalate. Horses in metabolism crates are used to measure feed intake and faeces and urine output.



Equine infectious anaemia (E.I.A.) continues to be a problem in some areas of the State and diagnoses of E.I.A. at Charleville (two horses), Quilpie (one), Roma (one), Longreach (two) and Charters Towers (one) were confirmed by laboratory examination.

One mortality due to melioidosis was reported from Townsville. A serum sample from a 4-year-old mare at Goondiwindi with periodic opthalmia characterized by unilateral corneal ulceration and opthalmia had a titre of 1/3000 to the agglutination lysis test for *Leptospira pomona.*

Two interesting diseases of horses were observed during the year and it is intended to continue further observations on them. They were combined immunodeficiency in the Arab breed and equine wobbler syndrome in some strains of other breeds.

In the days of draught horses on south Queensland and northern New South Wales banana farms, an interesting disease, 'Tallebudgera Horse Disease' thought to be due to Crofton weed (*Eupatorium adenophorum*) toxicity occurred. With motorization this problem was not seen but with the resurgence of the horse as a companion and recreation animal it has again come to attention. The first clinical sign is coughing followed by rapid heaving respiration, decreased exercise tolerance and loss of body condition as the disease progresses. In long-standing cases, the lungs have shown fibriosis, alveolar lining cell proliferation, neutrophil infiltration and abscessation. In some cases, vasicular thrombosis and inflammation occur in the lungs. Similar signs and lesions occurred in one horse fed *E. adenophorum* for 8 months and early lesions in another fed the flowering stage of the plant for about 6 weeks. Lesions also developed in two rabbits experimentally fed the plant. However, no reaction occurred in sheep and rats.

Causes of osteodystrophia fibriosa (O.D.F.) are still being recorded in the buffel grass areas of the State and metabolic studies and supplementation trials continue in order to define the cause of the condition and satisfactory methods of supplementation for therapy or prevention. These trials generate a considerable number of analyses of feed, tissues and excreta for calcium, phosphorus, magnesium, protein and oxalate. The hypothesis that feeding horses a diet adequate in calcium but containing added oxalate would produce O.D.F. was validated in a feeding experiment.

However, it took an average of 12 months to produce O.D.F. experimentally whereas there is a more rapid onset of the disease in the field (2 to 8 months). Also, there was less pronounced swelling of the maxillae and mandibles in the experimentally-induced disease. The difference between the experimental results and those encountered in the field in horses grazing certain grasses could be due to the form in which the oxalate is present, other unidentified compounds in grasses interfering with calcium absorption, an increased secretion of calcium into the alimentary tract or some other cause.

The grasses buffel, kikuyu, pangola, Kazangula setaria and green panic were fed to horses in digestibility trials. Whereas it was once considered that only grasses high in oxalate (2·5 to 6·0%) would be potentially dangerous when grazed as single species by horses as far as producing O.D.F. is concerned, all the above mentioned grasses produced a negative calcium balance (losing from 2·7 to 16·7 g per day) at oxalate levels as low as 0·9%.

Indications from the balance studies are that a calcium supplement on its own (limestone) may correct a negative calcium balance but not a concurrent negative phosphorus balance. Studies on the possible use of either limestone or rock phosphate as a supplement to horses in the field are continuing.

Meat inspection services

Commonwealth Department of Primary Industry and State inspectors stationed at export meatworks co-operated in the inspection of all meat processed, whether for export or for domestic consumption. At export meatworks, where no State staff are stationed, Commonwealth inspectors undertook the inspection of meat for domestic consumption in addition to that destined for export.

During the year separate amenities for Commonwealth and State inspectors at most export meatworks were completed. To date, only at two meatworks have State amenities not yet been provided, but completion is expected within the next few months.

The new Lockyer Valley meatworks at Grantham commenced an export kill during the last quarter of 1978. The appointment of a State disease control officer to the Grantham works was delayed since the Queensland Meat Industry Organisation and Marketing Authority would not issue a licence because State amenities had not been provided to the standard specified in Meat Industry Regulations 1973. The matter has now been rectified.

Tancred Bros. new export meatworks at Mt. Isa began operations on the 2 October 1978. As it was known before the opening day that Tancreds intended killing both for export and for domestic consumption, a State inspector was directed to take up a position on the slaughter floor. This action by the State inspector resulted in the Commonwealth inspectors walking off the slaughter floor. Such action by the Commonwealth was an abrogation of the 1964 agreement between Commonwealth and State Departments which provided that, where stock are killed for export and domestic consumption, inspectors of both Departments should be rostered for duty on the slaughter floor and that their duties should be rotated.

Because the dispute between the Commonwealth and the State was likely to disrupt operations at the Mt. Isa meatworks, the matter was referred to arbitration. The result of the hearing was a recommendation that a committee of enquiry be set up into all aspects of meat inspection in Australia. Pending the result of the enquiry it was determined that inspectors of both Departments should continue to work side by side under the terms of the 1964 agreement. Since the decision and recommendation of the Arbitration Court, a Committee of Enquiry has been established by the Commonwealth Government to investigate all aspects of meat inspection in Australia. Submissions have been made by all interested parties to the Committee of Enquiry.

Full-time inspection was provided during the year at new abattoirs established at Tolga and Innisfail in north Queensland.

Abattoirs killing solely for domestic consumption were staffed by State inspectors, who also undertook inspections as far as was practicable at country slaughter houses. In areas where no Slaughtering and Meat Inspection Branch staff were available, the latter services were undertaken by Veterinary Services Branch officers.

Inspection of meat in premises registered as butchers' shops was regularly undertaken for the purpose of supervising franchise provisions of the Meat Industry Act in relation to Public and District Abattoir and Regional Meat Areas.

Inspection of poultry carcasses is not carried out routinely. Nevertheless inspection of poultry was undertaken when practicable and regular weight-gain tests to detect the degree of water absorption during the processing of poultry were carried out.

Slaughtering facilities

A new small-stock chiller was constructed at the Ipswich Abattoir during the year. This has resulted in the kill at the abattoir being increased so much that the inspection staff are being overtaxed.

In spite of the provision of increased chilling accommodation, hot beef is still leaving the abattoir. This programme is contrary to good hygiene practice and the previous excuse of inadequate chilling capacity no longer applies. Undoubtedly the increasing kill at the Ipswich Public Abattoir is because the slaughtering charges are considerably less than those at the Metropolitan Public Abattoir at Cannon Hill.

New extensions and improvements were made at Tancred Bros., Bromelton works during the year. New chillers came into operation. The beef viscera table was lengthened by about 2·5 m to facilitate fronting out and kosher inspections. Modifications were made to the by-products section. A new roller cleaning facility came into operation involving five steps instead of the previous four-caustic dip for removal of fat and grease, water rinse, acid dip for removal of rust and scale, water rinse, and finally oil and dewatering fluid dip.

Extensive boning room renovations were undertaken at the works of North Queensland Bacon, Mareeba, and this abattoir became the first in Queensland to commence double shift operations in early May.

During the year, continuing advice and assistance was given by officers to licensees of country slaughter houses to ensure compliance with legislative requirements. From the structural standpoint, the position now is reasonably satisfactory. More supervision of slaughter house procedures and inspection of carcasses and meat are required at these slaughter houses but location and distance between premises makes the provision of more staff to undertake these duties an uneconomic proposition at the present time.

Pressure continues to be applied by the Queensland Meat Industry Organisation and Marketing Authority to persuade licensees who intend feeding swill containing animal matter to pigs to bring their boiling down pots and piggeries to full compliance with the requirements of the Meat Industry Regulations 1973. Practically all problem situations have now been resolved.

Poultry

Poultry abattoirs continue with the installation of mechanized equipment to reduce the need for labour and improve efficiency and hygiene. Four major abattoirs installed new mechanical equipment to aid processing.

Regular inspection of poultry slaughter houses was carried out during the year. Regular weight-gain tests were undertaken at the large poultry slaughtering establishments using spin chilling equipment. One result over 8% was recorded but a repeat test was satisfactory.

Since the Meat Industry Regulations came into operation in 1973, several Class 2 poultry slaughter houses which previously did not operate a chain system of dressing have now installed such a system. This has meant that, in these cases, the maximum of 30 000 birds per month for a Class 2 slaughter house is now an unrealistic figure. These slaughter houses are capable of handling considerably more than this. Agreement has now been reached with the Queensland Meat Industry Organisation and Marketing Authority for the regulations to be amended so that Class 2 poultry slaughter houses operating an approved chain system of dressing will be able to kill up to 80 000 birds per month.

Butchers' shops and smallgoods establishments

The insistence on high standards of construction and appliances in new premises has been maintained during the year. Detailed plans are submitted for approval before construction commences. Excellent co-operation has been forthcoming and some very high standard premises have been constructed, mainly associated with supermarkets. New smallgoods processing premises were provided at Wacol to replace unsatisfactory premises at Gailes.

Reasonable standards in older premises are being maintained. Good co-operation is obtained from most butchers but regular inspection of all premises is necessary to ensure high hygiene standards in all shops.

More specialized and frequent inspections are now being given to Class 2 butchers' shops (smallgoods factories) because of their high volume of throughput. A high hygiene standard of these premises is essential from a public health standpoint.

A proposal to erect a meat market consisting of 16 butchers' shop units was made during the year. Similar meat markets are already in operation in Victoria and New South Wales. If introduced, it would be a new concept in Queensland. The plans as submitted do not meet the requirements of the Meat Industry Regulations 1973. The proposal is still under consideration.

Meat quality

Tenderstretch usage remained unchanged during the year for reasons outlined in previous annual reports. The voluntary system of identification with green dyes is working satisfactorily outside of Brisbane.

The purple branding of lot fed beef continues without problems. This is a low volume trade but the system has been proved practical in the commercial situation.

With the co-operation of Slaughtering and Meat Inspection Branch and C.S.I.R.O. staff, electrical stimulation has been adopted successfully by one local slaughter house in Queensland. Equipment for automatic electrical stimulation is being built into the chain at an abattoir in south-east Queensland. Routine use is expected to begin very soon. Advisory information for slaughter house application of electrical stimulation is being prepared in collaboration with C.S.I.R.O.

Staff have collaborated with officials of the Queensland Division of the Meat and Allied Trades Federation of Australia in organizing and manning an information booth at the Meat Hall at the R.N.A. Show. This proved a very popular and worthwhile activity. This was in addition to providing judges, stewards and supervisors for the D.P.I.-Woolworths bone out carcass competition. At the 1978 competition, staff took the opportunity of testing a number of formulae for predicting yield of saleable meat of carcasses from simple carcass measurements. Results are to be compared with actual yields obtained in the bone out. Formulae applied included Dr Johnson's new formulae for predicting yield from non carcass parts (feet weight and tongue weight). Data have not yet been analysed completely. The yield and carcass parameter data which have gradually been accumulated from this competition are in continuing demand by scientists and organizations for study. Not least among the practical applications of this material will be the information it has to offer to the Australian Carcass Classification System.

Slaughtering and Meat Inspection Branch staff have continued to collaborate with industry and the trade on the superporker. Officers have given talks illustrated with slides and films to various organizations and consumer groups on this and other aspects of meat quality. This included each intake of apprentice butchers to the Food School, Coorparoo.

Mr John Sullivan, Sullivan's Meats, Coorparoo (left), Mr Bill Meynink, Chairman of the Queensland Meat Industry Organisation and Marketing Authority, and Mr Barry Daley, State Manager of Woolworths' Meat Division, sample tenderstretch and no-stretch meat from British breed and Zebu-cross carcasses. They met at a seminar on meat quality at the C.S.I.R.O. Meat Research Laboratory, Cannon Hill. One of the Department's projects is to overcome the prejudice against Zebu-cross cattle by meat processors and butchers.

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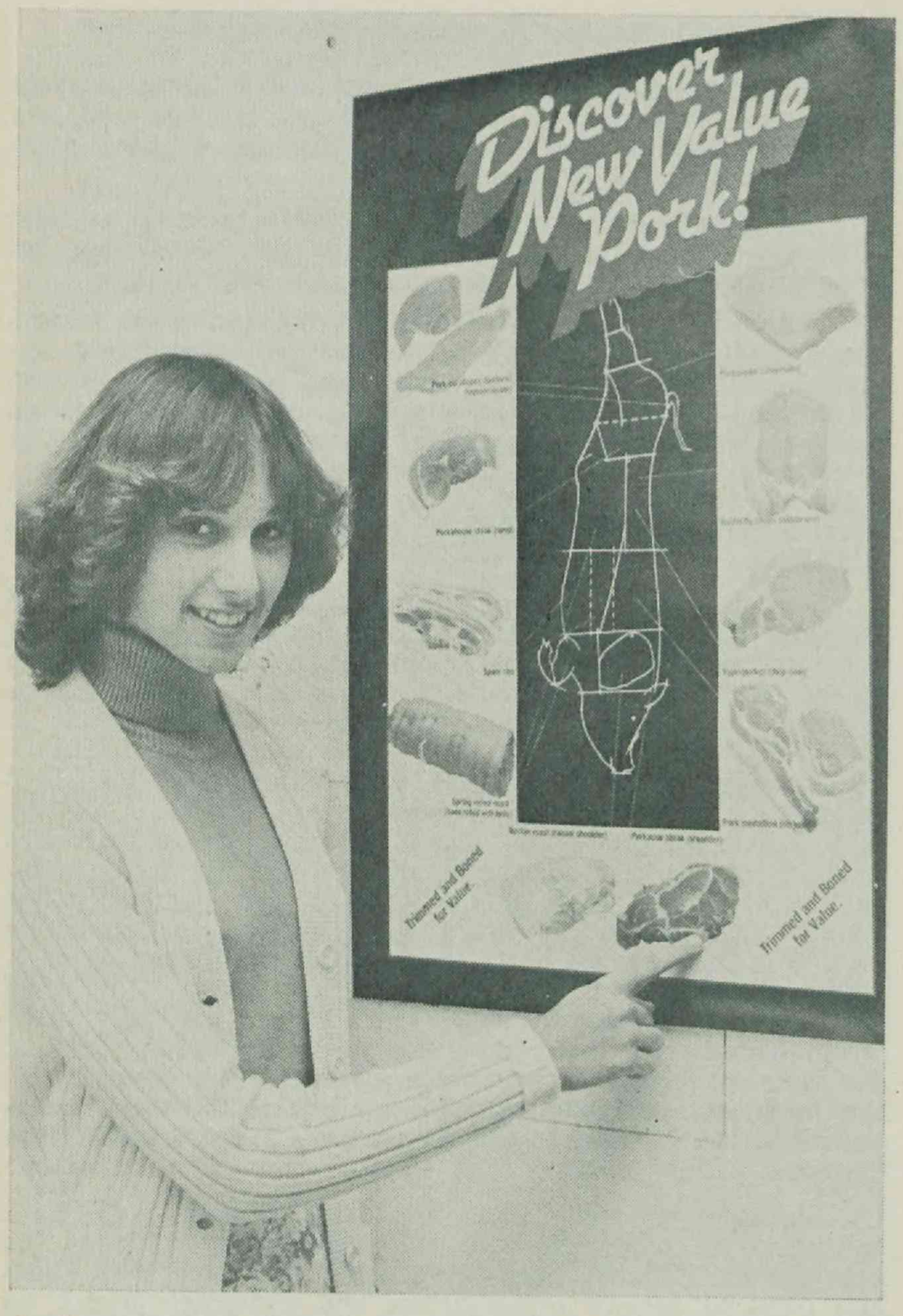


Staff of the Department work in close liaison with the Pig Promotion Council. Following an extensive Queensland advertising campaign by the Council, superpork is now being retailed through major chain-store outlets in south-eastern Queensland and by individual butchers in Brisbane.

Officers have worked in close liaison with members of the Pig Promotion Council who, in early May, launched an extensive Queensland advertising campaign using television, radio, women's magazines and daily newspapers. The council has appointed a full-time promotion officer in Queensland. Superpork is now being retailed through major chain outlets in south-east Queensland and by individual butchers in Brisbane.

Production of vacuum-packaged meat continues at a high level. Material aimed at trade and consumer education is being produced. Some concern is still felt that there is no way known of identifying to retailers and consumers which packages have reached a reasonable standard of ageing. This need is being borne in mind. When the technology becomes available, a proposal will be prepared for a system of voluntary identification for retailer and consumer protection.

Carcass classification

The trial of automated carcass classification equipment at the Metropolitan Public Abattoir Board showed that there are substantial problems with all aspects of that particular system. This is in keeping with experience in other trials throughout Australia. As a result, all trials except those at Donald (Victoria) and Robbs Jetty (Western Australia) were terminated.

During the year, responsibility for carcass classification passed to the Queensland Meat Industry Organization and Marketing Authority. Staff have continued to work collaboratively on carcass classification with that organization. Mr Ramsay continues to represent the State on the National Carcass Classification Supervisory Committee (N.C.C.S.C.). During the year Mr I. Jarratt of Q.M.I.O. and M.A. was co-opted as a member of this Committee also.

Staff have collaborated with the Q.M.I.O. and M.A. in a manual beef carcass classification trial at Bundaberg. Departmental responsibilities have been the training and monitoring of operators. Monitoring results, which have been recorded regularly, have shown an acceptable level of accuracy. Figures will be used by Biometry Branch in developing a statistically-designed sampling plan for monitoring carcass classification. An undertaking has been given to the N.C.C.S.C. that Queensland will be responsible for the development of monitoring recommendations for the Australian carcass classification system generally.

In the manual trial conducted at Kilcoy, management made it possible for details of the grades attributed to carcasses by the works grader to be recorded along with the carcass description in classification terms. Statistical study of these data revealed that the grades cannot be simply defined in terms of the carcass classification parameters. If this result is confirmed in other trials, it will mean that grades such as the export grades and grades used by processors in weight and grade trading will not be simply transposable into classification terminology. This is not the case with the Queensland blue ribbon system. In 1975, this was changed towards being largely a classification system. Should it be necessary to do so, no difficulty is anticipated in transposing the grading system into classification terminology.

Federal funds were made available for trials for manual carcass classification. Towards the end of the year, a plan was drawn up for a more extensive trial to be undertaken at Kilcoy. The objectives will be to allow graziers and butchers to become familiar with the system and to study the problems, costs and benefits associated with implementation, extension, feedback and trading in classification terms.

Since monitoring accuracy is to be an integral part of any Australian carcass classification system, and since weight is the main criterion of the value of carcasses, investigation of problems of verification of weights will be undertaken in this trial. This will be done in collaboration with Biometry Branch and Weights and Measures staff. A programme for weight verification in meatworks is being developed and costed.

Officers of Beef Cattle Husbandry Branch are involved at both the State and Local Working Party levels in planning the extension activities relevant to producers. An initial general awareness programme will be followed by demonstration field days at two abattoirs. Farm visits will be made to answer the queries of producers selling by weight and class and assess their reactions to classification. At the same time, officers in other areas are continuing to run carcass field day competitions, in which producers assess live animals in carcass terms. They have also addressed several producer meetings on carcass classification.

The system of cutting and measuring fat now used is the West Australian variant of the technique developed in Queensland. This has been adopted in Queensland and by the N.C.C.S.C. as the standard for the National Systems. Slaughtering and Meat Inspection Branch staff published material during the year which further validated the manual 'cut and measure' technique's accuracy.

Staff studied practical aspects of fat distribution during the year in relation to various aspects of importance to carcass classification. These included the incidence of damage to the fat measurement site related to both upward and downward pulling hide pullers, the correlation of alternative sites and that of the anal fold with the classification site. The relationship of the anal fold measurement with the classification point measurement, on preliminary figures, appears high enough to have practical significance. It may be useful in assessing fat levels in the living animal. Definitive studies on this are being undertaken by staff in collaboration with Dr R. Johnson, of the University of Queensland.

Some introscope measurements of pig carcasses have begun in meatworks at Murgon and Kingaroy. Results are being fed back to producers. Figures are not going forward into the meat trade as yet and trading is not taking place on this basis. Discussions have been held with major pig processors on carcass classification. A deal of interest has been expressed by one major company. This is being handled by the Queensland Meat Industry Organization and Marketing Authority. Introscopes are available for loan to works wishing to adopt voluntary pig carcass classification.

Pig carcass classification should be given a high priority because it is simple; its commercial meaning is immediately clear to the trade; and its use will pave the way for understanding of beef carcass classification. At present, a survey of butchers in the Brisbane area is being made by a shop inspector to determine their needs and the relationship of needs to carcass classification. The survey is in the form of a questionnaire.

At Ipswich Show this year, a new meat hall opened. The meat hall was provided by the Meat and Allied Trades Federation (Ipswich Branch). Local butchers provided a carcass break-up exhibition on similar lines to that provided at the R.N.A. Show. This display has filled a gap which was left when the Ipswich carcass competition ceased.

Grading

During the year, the decision was taken to change the definition of heifer beef. Lactational or reproductive history or status is now ignored. The reason for this is that neither of these parameters is directly related to any aspect of meat quality. Also, it is impossible to make accurate decisions on these from carcass characteristics. In addition, this brings the grading system closer to carcass classification concepts.

Slaughtering and Meat Inspection Branch staff are collaborating with Pig and Poultry Branch staff and Kewpie Pty. Ltd. in a series of trials comparing losses and dressing percentage between pigs of common origin near Kingaroy being killed locally and at a Brisbane works.

The modified Blue Ribbon grading scheme continues to meet most of the trade requirements in the Brisbane area. It is now used also in Toowoomba.

Poisonings and Mycotoxicoses

Poisonous plants

LOSSES IN STOCK.—Algal toxicity of cattle, although previously suspected, was confirmed for the first time in Queensland, the species being *Anacystis cyanea.*

Two cases of pyrrolizidine poisoning of cattle were attributed to *Heliotropium amplexicaule* indicating the encroachment of this weed in south-east Queensland. Lantana mortalities in cattle were reported from Kenilworth and Charters Towers. Dwarf Darling pea (*Swainsona luteola*) was incriminated as the cause of sickness in yearling cattle at Roma.

Deaths occurred in calves on a Kenilworth farm following the ingestion of bracken fern (*Pteridium esculentum*).

Ten cows died on a Gin Gin property from prussic acid poisoning following access to wild sorghum. Oxalate and nitrate poisoning associated with the ingestion of Kazangula setaria were recorded at East Barron and Evelyn Central.

Polioencephalamalacia was diagnosed in a flock of sheep at Chinchilla. Twenty of 400 sheep had died following nervous signs such as circling and lateral recumbency with paddling movements. This disease has been associated with thiaminase activity as a result of toxicity with bracken, Nardoo or coccidiostats. The ferns *Cheilanthes seiberi* and *C. distans* are more than suspect as a source of this enzyme.

Noogoora burr seeds present in grain fed to pigs on a piggery north of Townsville produced severe illness manifested by vomiting, anorexia, abortions and one death.

The toxicity of wild sunflower (*Verbesina encelioides*) to sheep and cattle has been known for many years. However, during the last year, pigs grazing an area where this plant was growing in profusion suffered from hydrothorax, hydrocardium and centrilobular necrosis.

RESEARCH.—Muscle degeneration in cattle from Texas, U.S.A., was first reported in 1952. This degeneration was of unknown aetiology but thought to be associated with Vitamin E deficiency or cottonseed meal poisoning. However, in 1965, reports from the U.S.A. described widespread skeletal myodegeneration in cattle grazing pastures containing the plants *Cassia occidentalis* or *Cassia obtusifolia.* The syndrome was characterized by dark brown or red urine, muscular inco-ordination, recumbency and death together with skeletal myodegeneration. In that country, the syndrome was reproduced in calves by dosing them with *C. occidentalis.* At the Animal Research Institute, an investigation into the toxicity of *C. occidentalis* seeds was undertaken to confirm the toxicity of this species in Australia and to characterize more fully the pathology of the condition. Eight calves were dosed by stomach tube with hammermilled seeds. Total dosage administered ranged from 0·5% to 1·3% of bodyweight. Five calves died and three were killed in advanced stage of intoxication 6 to 9 days after the last dose. Severe fluid diarrhoea of 2 to 3 days' duration developed after dosing. Other signs included anorexia, reluctance to move, a stumbling swaying gait when moving, recumbency, tachycardia and dyspnoea in the terminal stages. Brown or red-brown urine was present in most calves from the fourth day. Terminally, there was a neutrophilia and greatly elevated serum GOT and CPK levels.

Autopsy revealed pale skeletal muscles of the upper pelvic limb and a characteristic red stippling giving a banded appearance to some affected muscles. Marked pulmonary oedema was present in four calves and the myocardium had a streaky mottled brown appearance in several cases. Light and electron microscopic examination revealed severe myodegeneration of all grossly abnormal skeletal muscles, varying degrees of myocardiopathy and focal hepatic necrosis in three calves.

Toxicity of the seed appeared to decline with maturity of the plant. It is probable that this condition has occurred naturally in Queensland in the past.

Lymph nodes either diffusely or focally green in colour have been detected in cattle at slaughter in northern Australia on eight occasions over the past 8 years. These lesions were caused by infection with green algae of the order Chlorococcales but specific identification of the four strains isolated was not possible in the light of present knowledge. The infection was restricted to retropharyngeal and mandibular lymph nodes in all but one instance when a mediastinal node was also involved. It evoked a largely proliferative inflammatory response.

Non-progressive or slowly progressive infections were established in the peritoneal cavity of rats by inoculation of cultures of the organism. The presence of numerous strongly PAS and GMS positive granules, well developed chloroplasts and the green colour of the organisms, both individually and of the colonies, serve to differentiate it from the morphologicaily similar *Prototheca* species which are probably achloric algae. The organism has potential public health significance in that 18 human cases of protothecosis have been reported in the world literature, most of which were unresponsive to chemotherapy. It is also unique in that it is capable of growth in distilled water and sunlight or deep within animal tissues where there is no light.

When ground *Crotalaria goreensis* seed was fed to day-old layer strain, cockerel chickens at different rates in a commercial ration of chick starter mash, it was found that all three treatment levels of 1%, 3% and 5% depressed growth although only the latter two treatments were significant ($P<0{\cdot}01$) at weeks 1 to 4 inclusive. Three of 20 chickens in the 5% group died. Lesions consistently found in surviving chickens receiving the seed included ulceration of the proximal large intestine and a dark grey discoloration of the glandular portion of the proventriculus. Moist faeces were a common feature of chickens in the 3% and 5% groups. *C. goreensis* should be excluded from all poultry rations and in particular those of chickens.

Research deriving from the isolation of the toxins of several poisonous plants has continued. The sunflower daisy (*Wedelia asperrima*) has yielded four toxins and two other inactive compounds of similar structure. From the plant, a compound having a protective action against tumours induced by aflatoxin has been isolated. Co-operative research is continuing with the Research School of Chemistry at the Australian National University. Similar toxins are apparent in wild sunflower (*Verbesina enceloides*).

Determination of the structure of the toxin previously isolated from the larvae of a saw-fly (*Lophyrotoema interupta*) is continuing in co-operation with the University of Bologna. The effects of the toxin on liver and heart is being examined by X-ray microscopy. There is strong evidence that the larvae may contain a substance that inhibits the action of the toxin.

Mineral poisonings and drug overdosing

During the year arsenic poisoning of cattle was confirmed on six occasions. Individual property losses were light except on a farm in the Chillagoe area where 17 deaths occurred. Six outbreaks of lead poisoning in calves were investigated and confirmed. There were 16 deaths involving young calves.

Treatment of 2 000 7-week-old pullets for coccidiosis with Toltro (sulphaquinoxaline and diaveridine and Vitamin K) resulted in 25% deaths and a further 25% badly affected. Investigations revealed that the drug was being used at eight times normal dose rate. Ataxia and flaccid paralysis of the neck in 3 to 4 weeks old broiler chickens at Beerwah was traced to excessive levels of 3-Nitro in the feed. This was being added at 320 p.p.m. (normal level of 50 p.p.m.). The chickens recovered once the level of the growth promotant in the feed was corrected.

Three steers were given a 10 g dose of monensin orally. Steers weighed 190 kg, 150 kg and 770 kg making dosages of 52 mg per kg, 66 mg per kg and 58 mg per kg. Two steers died in 2 and 4 days respectively. The third animal became depressed and scoured but recovered. It survived following further drenching with doses of 75 gm per kg and 120 mg per kg. Thus there appears to be an individual susceptibility to this material. However, these doses are much higher than the 25 to 30 mg per kg of total feed normally given.

Mycotoxins

A survey of the aflatoxin status of the 1978 maize crop in the South Burnett was undertaken by the Biochemistry Branch. A rapid screening test to distinguish samples likely to contain fungal metabolites was established. A total of 805 samples representing each truckload delivered to the marketing authorities was examined. Of these samples 140 positive to the rapid screening test were selected for analysis. Of these, 15 contained aflatoxin the average level being 45 micrograms total aflatoxins per kilogram. In addition, 70 of the 665 samples screened as negative were analysed and two contained aflatoxins averaging 7 micrograms per kg. The overall incidence of mycotoxin in this susceptible crop was most satisfactory as any bulked sample drawn would conform to statutory limits.

Liaison with the Peanut Marketing Board has been maintained involving a consultative role for the Biochemistry Branch in this aspect of consumer protection. To maintain authority in aflatoxin assays, the Branch participated in both Australian and international analytical trials. In addition, the necessary assay and certification was done in connection with 51 samples of export peanuts.

Environmental studies

Chemical residues in animal products

A collaborative programme to monitor 7 500 slaughter cattle a year for residues of 10 pesticides having the potential for biological persistence has become fully operational. The samples are analysed for DDT, DDD, DDE, lindane, BHC, HCB, dieldrin, endrin, methoxychlor and selected organophosphorus acaricides. This programme, supported by the industry through the Australian Meat Research Committee, aims at assisting the industry to meet the quality control standards implicit in statutory limits for residues that are set to conform with good agricultural practice. By trace-back and problem solving in cases of near violation, it offers the consumer the assurance that residue limits will be increasingly met in all cases. The trace-back would not have been possible without the introduction of the Cattle Identification Regulations 1976. The trace-back aspects of the programme are supported by quarantine powers in terms of the *Stock Act* 1915–1978.

The present achievement, after analysis of 4 960 samples, of 99·6% of compliance for environmentally pervasive chlorinated hydrocarbons and 97·2% for chemicals used directly on animals for pest control can be considered a satisfactory standard of quality control in any industry.

Trace-back investigations have revealed the following sources of contamination: dieldrin (white ant control, old cane land or fallow cane land used for fattening, buffalo fly control, banana farms), DDT (associated with cotton areas, buffalo fly control), organophosphate acaricides (overstrength dips, dipping too close to slaughter and short-interval dippings).

The data collected suggest that one dipping with the organophosphate acaricides at the correct concentration should not result in residues above the maximum residue limit (MRL) if the cattle are not slaughtered for 10 days after dipping. This is the current Departmental recommendation.

Staff of Veterinary Services Branch have undertaken a concerted extension programme to advise the industry of the problems of chemical residues.

The Monitoring programme is expensive in terms of manpower and laboratory equipment and represents a major initiative in further consumer protection.

Other studies on chemical residues in animal products have involved the determination of heavy metals in tissues of cattle from selected areas of Queensland; organochlorine levels in cattle from cotton growing areas; the examination of meat extracts for heavy metals; the residues in cattle deriving from mixtures of acaricides and the determination of residues of a synthetic pyrethroid in milk fat. Methods to recover the mercury from organomercurial fungicidal dips were also examined.

Manure disposal

Intensive finishing of beef cattle is becoming economically feasible again but one problem it creates is the disposal of the large quantities of waste materials produced in the form of liquid run-off and manure. Historically the method of disposal is by spreading this material on land to improve its fertility.

A joint Pathology and Husbandry Research team has just completed a 3-year study on the pollution aspects of the disposal of manure on pasture. The results of this study show that a potential pollution problem does exist and emphasizes the fact that the siting of feedlots should be considered with this aspect in mind.

Evidence was found of the persistence of salmonellas on pastures on which manure was spread, but data from unfertilised paddocks and studies of the varieties of salmonellas isolated suggest that there may be several other factors involved in the contamination of pastures. It was found that care should be taken in interpreting data on pollution based on short-term or inadequate sampling.

Animal pathogens as soil inhabitants

The 2-year survey of soil from a sheep paddock at the Animal Health Station, Oonoonba, for the presence of *Pseudomonas pseudomallei* has been completed. Nine soil and three muddy water isolates were obtained. Eight of the nine soil strains were isolated from the clay layers of the soil at depths of 25 to 40 cm. The ninth strain was isolated from the surface layer (brown, sandy loam). No isolates were cultured from the sand layers at depths greater than 45 cm. These 12 isolates were cultured from soil and water that was lifted from under either of two trees, a fig tree and a mango tree.

Soils from which *Ps. pseudomallei* were isolated were held in their original plastic containers and stored in a box at ambient temperatures. Of the soil samples that were retested for the presence of the organism at 6-monthly intervals, two survived for 6 months while one strain persisted for 31 months. This was a clay soil and very moist at the commencement of the trial.

These observations have important implications for the control of melioidosis in that persistence of the micro-organism in the depths of soil indicates that recontamination of surface layer is possible.

A manure spreader in operation in a research project on pollution of pasture. Run-off water is checked for bacteria.

Laboratory services

Specimens examined

A major part of the Division's resources is devoted to the examination of specimens by the laboratories to support the regulatory, product control, extension and research officers servicing the livestock industries and the consumer public.

The total batches of specimens examined by the Pathology Branch excluding those received in connection with the brucellosis and tuberculosis campaign were 8 225 at Yeeerongpilly laboratory and 2 096 at the Oonoonba laboratory. Some 62% of this total were cattle specimens. However, only 35% of the specimens from cattle were submitted for investigation of sickness, abnormality or death. The remainder involved routine or regulatory disease testing. This demonstrates the increasing regulatory work load and highlights the reduction in disease investigation in cattle. It is anticipated that the recent improvement in buoyancy in the beef cattle industry will stimulate an increase in disease investigation work on cattle. There has been a marked increase in the amount of diagnostic work with horses as a result of the continued interest in this animal for recreational and work purposes.

In addition to the serological tests for bluetongue for movement and export purposes (60 000 tests) and brucellosis for the eradication programme outlined elsewhere in the report, 119 171 serological tests were undertaken against a large number of organisms at the two laboratories for the 12 months ended 31 March 1979.

Most of these tests were on cattle sera and 58 797 of the total tests were to meet export requirements. This is an increase of 25 207 compared with the same period of the previous year. When the bluetongue tests were undertaken to meet the requirements of importing countries are added, the high level of resources needed to meet these requirements is apparent. This continuing difficult situation is exacerbated by the vagaries of some biological tests, and the need to adhere to strict deadlines often with minimum time for the tests to be done between submissions of the samples and the loading of animals.

The dip analytical services of the Biochemistry Branch have maintained sample numbers (2 510) despite the depressed state of the cattle industry during much of the year. The arrival of additional mixed dips and the need to measure lime concentrations in samples containing one proprietory acaricide necessitated 3 903 analyses on the 2 510 samples from 1 970 vats. The number of vats examined is less than half the total number of vats in Queensland.

The analytical service works in association with the chemical industry and methods of analysis appropriate to three prospective acaricides are being developed.

Diagnostic services undertaken in Toxicology and Clinical Biochemistry are integrated into the function of the Animal Research Institute. The number of samples is reflected in the diagnostic services of the Animal Research Institute. The clinical service involved 2 169 analyses over a range of 20 different analyses. In addition they undertook 7 195 analyses in connection with field trials. The Toxicology Diagnostic service involved 818 analyses over a range of 28 different analyses. This group was also responsible for chemical investigations of such diverse problems as identifying taint in meat, estimating dieldrin in wool samples, leachates from plastic bags, and polychlorinated biphenyls in fish.

Other laboratory services involved assistance to the pig and poultry industries. Sixty poultry feeds and 38 pig feeds indicated that mineral imbalance is still a major problem in 'on-farm mixed rations'. In addition, the servicing of Departmental trials involved the analysis of more than 500 samples for a variety of components.

Zoos, laboratory animal colonies and the public seek laboratory assistance for the diagnosis of diseases of non-domestic animals such as kangaroos, crocodiles and rabbits. Deaths in native animals or birds such as pelicans nowadays excite public interest if the numbers are higher than normal. These specimens present a special challenge to pathologists and scientific staff as there is little known about the circumstances of the animal's death.

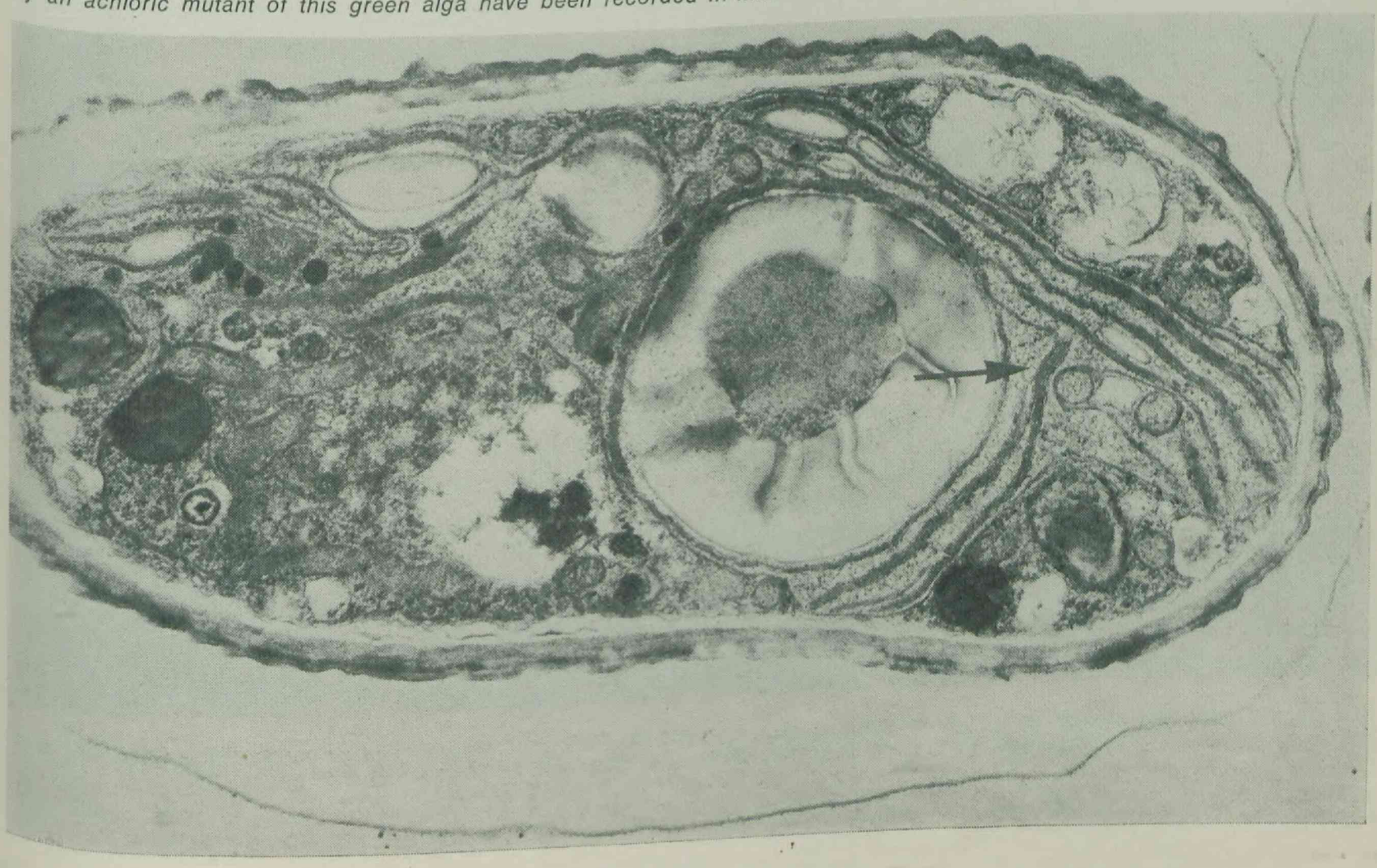
It is important to monitor diseases in zoo and fauna animals for the purposes of controlling disease outbreaks and to ensure that these animals are not a major source of disease to commercial livestock.

Specialized knowledge of this type can be built up only over a number of years as the number of specimens received is small and circumstances change from year to year. Also, the time allotted to this specialized work is restricted by the need for staff to devote most of their time to the servicing of specimens from the major domestic animals.

The importance of intestinal coccidiosis in kangaroos in captivity again came to attention at a Brisbane animal park.

A new tick identification was made in the far north of Cape York, *Amblyomma cyprium* from a pig. This is thought to be a tick of turtles but its life cycle is not well known. The establishment of red deer farms in the Brisbane and Mary Valleys and the anticipated escalation of this new industry has necessitated the formation of a Departmental team of laboratory and field staff to develop expertise in disease control and husbandry problems of these animals under farming conditions. Research into diseases, velvet and venison production, and other production aspects of deer is projected in future years.

Green algae. This organism (magnified 20 000 times) was grown in distilled water and sunlight. It is capable of photosynthesis and contains chlorophyll within the finely laminated strands of material (arrowed). It was originally isolated from a lymph node within the thorax of a cow. Eight such cases have been diagnosed in northern Australia and this is the first time a plant has been shown to be capable of photosynthesis and of invading animal tissues. Cases of infection by an achloric mutant of this green alga have been recorded in man.



Members of the team prepared extension material for industry members, Departmental staff and officers of the National Parks and Wildlife Service. This latter Service is responsible for the control of the capture of feral deer and the licensing of deer farms.

Method development

Method development is an integral part of analytical chemistry. Special effort has been devoted to research into the Carbon-rod Furnace Atomic Absorption Spectrophotometer. This has improved the sensitivity of methods for trace metals copper, cobalt, lead and chromium to allow estimation of concentrations of 10^{-10} g in biological tissues.

The introduction of assay methods for Vitamin D was investigated in response to problems in the poultry industry. The provision of new radio-isotope facilities in the Biochemistry Branch and the provision of automated counting equipment has necessitated the application of considerable resources to method development in this new area of Branch activity. Work has continued on the rapid thermal release of hydrocarbons from biological tissues. A microwave oven has been tested and its heating patterns investigated with fish, fat and muscle samples.

The second phase of a collaborative study to identify any nutritional factors responsible for low reproduction and production in sheep grazing Mitchell grass pastures and pastures in mixed mulga communities began in October 1978. To date, two sampling runs have been completed and analysis of samples has commenced. This analytical load accounts for a significant proportion of available resources ($\approx$ 30%) of the Biochemistry Branch. Preliminary appraisal of the first phase (that is, Mitchell grass pastures) of this programme has demonstrated that, apart from any other considerations, it is feasible to obtain valid data concerning nutritional throughputs from surgically prepared sheep (that is, oesophageal, rumen, abomasal and ileal fistulas) under extensive grazing systems.

The electronmicroscope is proving to be an excellent adjunct to Pathology Branch's diagnostic facilities. As an example of this the number of virus identifications made during the quarter ending December 1978 was—avian adenovirus (14), avian coronavirus (13), avian herpes virus (8), avian paramixovirus (5), avian poxvirus (1), avian reovirus (5), porcine poxvirus (2), ovine poxvirus ORF (9), bovine herpes virus (1).

Approximately 200 actinomycete strains have been isolated from animal and soil sources. The differentiation of these into genera by means of paper chromatography (for presence or absence of M-DAP and L-DAP (diaminopimelia acid)) and thin layer chromatography (presence of various sugars) is at present under way. Final speciation will be by a minimum number of selective biochemical, cultural and morphological tests.

Control strains (*Nocardia asteroides, N. brasiliensis, N. caviae, Streptomyces albus, S. griseus, S. somaliensis*) have been subjected to the proposed battery of morphological and biochemical tests. The detection of diaminopimelic acid by paper chromatography has proved a quick and reliable test.

Five animal actinomycete strains have been screened so far. Three *Nocardia* and two *Streptomyces* strains have been identified. Speciation of the *Nocardia* strains is at present in progress.

Miscellaneous

The Department of Primary Industries services to the cattle industry include two very important areas: the supply of vaccines against infections carried by the cattle tick; and the supply of semen for artificial insemination of cattle. Both vaccine and semen should be above suspicion with regard to disease agents as both are given to a large number of cattle.

Laboratory tests for contamination of the blood or semen have formed an increasing part of the work done in the microbiology section of the Pathology Branch at the Yeerongpilly laboratory. Often these tests are time-consuming and expensive as are those for virus diseases. These increased requirements for quality products have been a heavy burden on resources and funds. Highly skilled staff find the work uninteresting as positive results are rare and tests are repetitious. Approximately 330 semen samples were examined for *Campylobacter foetus* and *Trichomonas foetus* and 250 serum samples for infectious bovine rhinotracheitis, mucosal disease and ephemeral fever during the year.

The use of the computer for storing and retrieving the results of diagnostic work, for epidemiological studies and for the analysis of the data of planned surveys continues to develop.

The Angora goat and mohair industry continued to grow in 1978-79. Through up-grading programmes using feral does and stud Angora bucks, producers are developing purebred flocks like this one.

Division of Plant Industry

THE range of climatic conditions within Queensland means that the number of crop and pasture species grown commercially is considerable. The need to maintain and improve productivity on the farm and the maintenance and improvement of the quality of produce at the market place require a continual upgrading of farming and handling technology.

Satisfying the research and extension demands to meet these needs for the benefit of the entire community is the responsibility of the Division of Plant Industry.

The activity of the Division is centred around two major production Branches—Agriculture and Horticulture, 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 protection and beekeeping.

Three 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.

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 reponsible 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.

Plant improvement is an important area of endeavour in the Division. Yield and quality improvement is achieved and control of pests and diseases by this method is cheap and non-hazardous. The year was marked by the release of a number of improved field crop and vegetable varieties. The wheat variety 'Cook' released in 1977 has been rapidly accepted by the industry and recently 'Banks' was released after outstanding performances in regional trials.

New pesticides are constantly being tested and 1978–79 saw the widespread commercial use for the first time of the fungicide 'Ridomil'. It gave outstanding control of blue mould of tobacco. Minimum pesticide use is a major aim in all plant protection studies and progress to this end was achieved with pest management in cotton. An outstanding achievement this year was the release of the Plant Diseases Handbook which contains colour illustrations of all important plant diseases and current information on control.

New crops continue to be investigated. An example is the 'energy' crop, cassava, for which trials have been set up to establish areas where commercial production is feasible.

The need for constant vigilance for introduced pests was highlighted towards the end of the year by the discovery by Botany Branch of a serious weed, Navua sedge, in north Queensland. Divisional officers continued the detection and baiting campaign in north Queensland for the Giant African Snail. No live specimens have been found since December 1977.

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

Overseas study tours were made by P. G. Allsopp (New Zealand); R. B. Brinsmead (U.S.A., Mexico, Colombia, Brazil), and L. Pedley (U.K.).

Other officers went overseas either as consultants or on scientific exchanges. These included G. M. Behncken (China); B. I. Brown (Fiji); D. W. Currey (Indonesia); J. Dale (China); D. Hawton (Burma); N. W. Heather (Russia); J. M. Hopkinson (Argentine); K. R. Jorgensen (Western Samoa); B. L. Oxenham (China); G. S. Purss (India); R. Schoorl (Papua New Guinea); and A. W. Whiley (Fiji).

Mr T. J. Beckmann represented Australia at the 22nd meeting of the Collaborative International Pesticides Analytical Council and the 8th informal meeting of the F.A.O. Working Party on Pesticides Specifications at Versailles. Mr R. J. F. Henderson spent most of the year as the Australian Botanical Officer at Kew, England.

Agriculture Branch

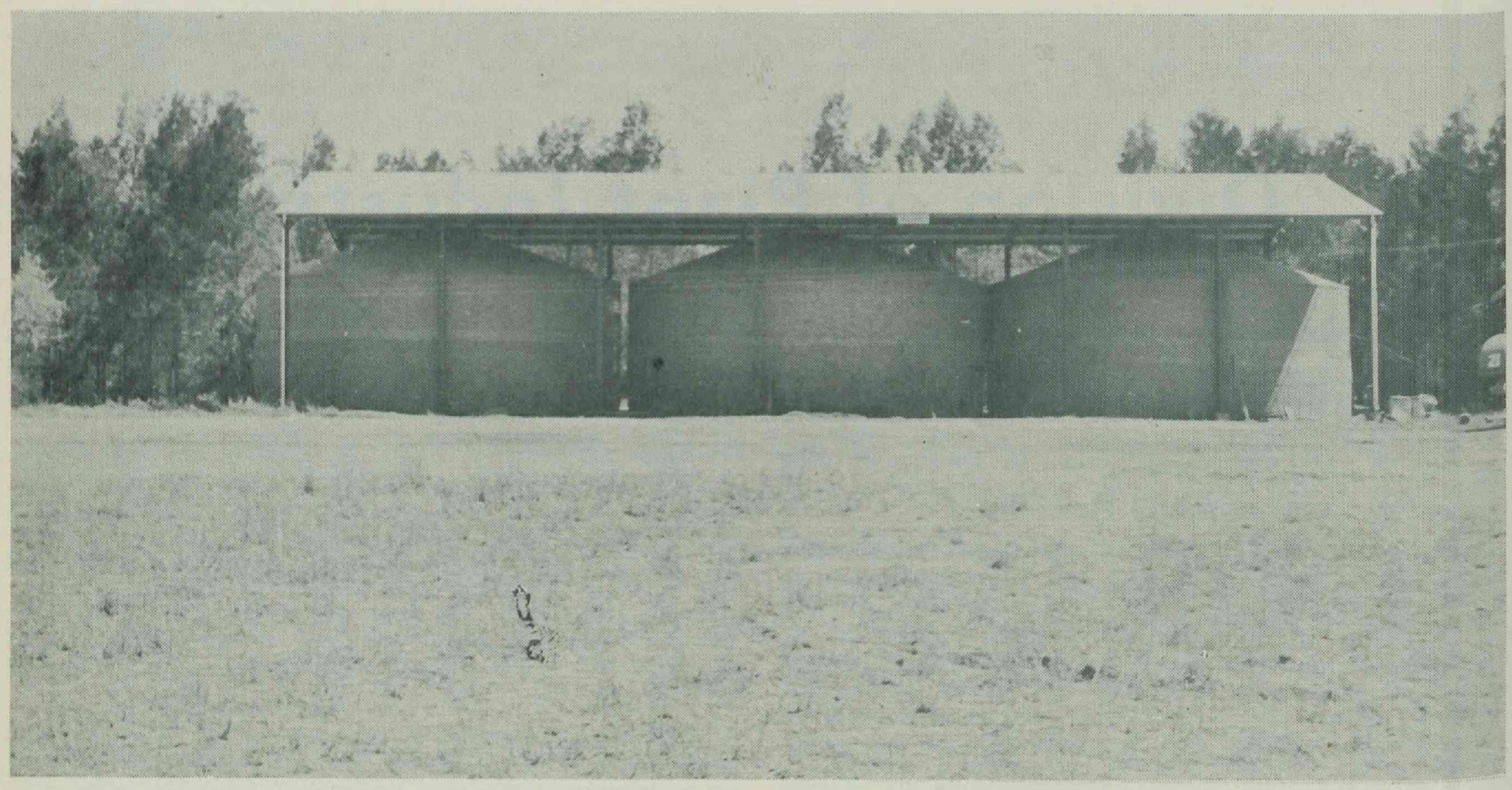
IN broad terms, Agriculture Branch seeks to improve the productivity and stability of field crop, forage crop and pasture production in the State through a combined research and extension programme.

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



An example of on-farm storage at Miles for the bumper 1978 harvest.

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

Oxley, the first wheat variety released by the Queensland Wheat Research Institute, continues to be of major importance to the wheat industry in Queensland. The strain of stem rust virulent on Oxley was widespread in the wet 1978 season but severe losses did not occur.

The variety Cook released in 1977 is rapidly becoming popular with growers and millers. In variety trials in the 1978 season, its yield exceeded those of Timgalen and Gatcher by 32 and 28% respectively. The milling quality of Cook was superior to that of all other cultivars in the trials.

A new variety, Banks, has been released this year and 60 tonnes of seed were distributed to growers. Banks, which was tested as QT 4081, is a quick maturing spring wheat and has valuable adult plant resistances to stem rust and leaf rust combined with high yield potential and excellent hard grain quality.

In the regional variety testing programme, an introduction from Mexico was tested as QT 7605. This line was high yielding in all regions and gave the best overall yield of 3 727 kg per ha. In addition to high yield, this line had good grain quality and disease resistance which is unusual in introduced material.

A project is in hand to determine to what extent the development patterns of available wheat varieties can be better adapted to the environmental conditions pertaining to the northern wheat belt of Australia. No differences in yield potential were found within the existing range of developmental patterns in present wheat varieties under irrigation or low water stress conditions.

This was due to all varieties being able to produce by anthesis the critical dry weight for maximizing yield potential. Short season varieties, however, only just produced this dry weight when planted after the end of June and they could be disadvantaged if transitory water stress occurred before anthesis.

Barley

Several selections, mainly from the cross Bussell x Zephyr, have given yields 20 to 25% higher than that of the commercial variety Clipper in strain trials. These selections, which have similar malting quality to Clipper, are being advanced to the regional variety testing programme in 1979. If they maintain their advantage in these trials, they will be considered for release for commercial production in the 1981 season.

Queensland participates in the Interstate Barley Variety Testing Programme with Western Australia, South Australia and Victoria. Each State enters five selections from their respective breeding programmes. Results indicate the necessity for breeding programmes in each State. The Queensland selections gave excellent yields at Queensland sites but did poorly in other States where they are susceptible to diseases that do not occur in Queensland. Likewise, three varieties under consideration for release in southern States, performed poorly at Queensland trial sites where their grain quality was much inferior to that of the commercial variety Clipper.

Sorghum

The late flowering Greenleaf Sudan grass variety referred to in last year's report was released during the year as QL 18. Departmental tests indicate it to be superior to the normal earlier flowering types. Seed of QL 18 has been supplied to five seed companies and several hybrids based on this line could be available to farmers next season. It is believed that this is the first Sudan grass variety of this type to be released in the world and that it will make a significant contribution to the forage sorghum industry. From the population breeding programme, a random mating population of R lines was released to commercial and public plant breeders during the year as QPIR.

In the sugarcane mosaic virus resistance breeding programme, a further two or three lines may be available for release in the next year. These lines contain a single Krish gene, 'K', for resistance and are versions of KS4 and Redlan both of which are used as female parents. Breeding for midge resistance is being continued and several hundred lines are being screened for resistance combined with acceptable agronomic characteristics.

In the regional variety testing programme, the highest mean yields in trials in central Queensland in the 1978 season were produced by Tropic (7 700 kg per ha), Monsoon (7 208 kg per ha) and C 43 (6 572 kg per ha). In the Darling Downs and South Burnett regions, harvesting of the 1979

season trials has been completed. Highest mean yields in the Darling Downs region were produced by PAC 710 (5 501 kg per ha), Nuggett (5 422 kg per ha) and A 51/QL 10 (5 303 kg per ha). In the South Burnett region, Big Red (6 393 kg per ha), Yates 266 (6 004 kg per ha) and E 57 (5 899 kg per ha) gave the highest mean yields.

In co-operation with Plant Pathology Branch seven sorghum hybrids were tested for lodging resistance in three trials using a 'rainout' facility. The hybrids were grown under irrigation until flowering, after which further water was withheld by using the rainout shelter. Plant percentage lodged at harvest (9 weeks after flowering), were E 57 (0), F 64a (3–20%), Q 5161 (0–39%), Goldrush (38–60%), Dorado (33–75%), Goldfinger (68–79%) and Texas 610 SR (68–80%).

Maize

Two new hybrids, QK 690 and QK 694, were released for limited commercial production this season after yielding close to 40% better than the standard QK 217 in the preceding 3 years.

Sweet corn production in south Queensland has been severely affected by the lack of a commercial hybrid with adequate resistance to sugarcane mosaic virus. A cross of Hawaiian and Iowan inbreds with resistance to the virus has been developed at Kairi Research Station, and released through Horticulture Branch for limited commercial production as QK 467 S. Seed production of this hybrid has proved difficult and attempts are being made to improve the compatibility of the parents.

In the regional variety testing programme, no early maturing hybrid has given better yields than the popular XL 81 variety on the Darling Downs or in the Lockyer Valley. In the South Burnett region, however, the variety Sergeant yielded 7 518 kg per ha compared with 6 215 kg per ha from XL 81. Among the late maturing hybrids, GH 5004, from the New South Wales Department of Agriculture, gave the highest yield at Kingaroy and, in north Queensland, approached the top yield of Kairi hybrid KTW 473.

In a maize-pasture rotation experiment conducted on the Atherton Tableland, it has been found beneficial to grow maize in rotation with pasture. When the pasture phase lasted for 2 years the benefit, in the form of increased maize yield over the yield of continuous maize, disappeared after 6 years. With longer pasture phases, the maize yield benefit persisted in proportion to the length of the pasture phase. The sixth crop of maize after a 6-year pasture phase was still yielding 30% more than continuous maize.

A mung bean experiment in the Dalby district.

Soybean

In the regional variety programme, two lines bred by the University of Queensland showed to advantage. P 24 was the best variety in south-east Queensland, while P 25 was one of the three best varieties in all regions except the Darling Downs. The mean yields from these varieties over 11 sites were: P 24, 2 543 kg per ha and P 25, 2 482 kg per ha. These compared favourably with the two best yielding of the recommended varieties—Wills 2 422 kg per ha and Flegler 2 405 kg per ha. The University used these trial data when releasing P 25 as the variety Fitzroy.

The population breeding programme is proceeding and crossing will be completed during the winter and spring of 1979 and the population fully constituted during the summer of 1979–80. The 17 parents in this programme derived from widely different origins including U.S.A., Brazil, Australia, Taiwan, Japan and Africa. Disease resistances are present in some of the parents whose maturities cover the whole range required for Queensland.

In north Queensland, two varieties, which are only slightly affected by photoperiod, Chung Hsien No. 2 and Improved Pelican, show promise for winter production.

Soybeans and maize have been shown to be suitable crops for growing in rotation with rice in the Burdekin area. Soybeans have produced yields up to 2·5 tonnes per ha and permit control of red rice which is a serious weed of rice crops.

Sunflower

The development of oilseed sunflower production in Australia was restricted by a lack of knowledge on regional adaptation of the crop and on agronomic principles to guide husbandry decisions. In recognition of this, initial research was directed at understanding crop adaptation and the yield, oil content and oil quality responses to such management variables as plant population and geometry, antecedent moisture and time of planting.

To enable such knowledge to be extrapolated as widely and as quickly as possible, this research was directed concurrently at development of an interpretative model with the capacity to simulate oil yield and quality for diverse environments. The concept has been one of using relatively short-term experimentation to develop the model and applying the model to long-term weather records to analyse crop expectancy for various production regions in relation to management strategies within the farmer's control.

The model has already been used to examine long term oil yield and quality expectancy for Biloela in relation to planting time and antecedent soil moisture levels.

The rate of plant development was found to vary genetically between varieties in response to day-length—a phenomenon not previously recognized in sunflowers and one with important implications to varietal selection and management strategies for particular districts.

Dry weather during the early part of the summer interrupted planting of trials in the variety testing programme. In those trials which were planted early, the quicker maturing varieties yielded significantly higher than the slower maturing ones which suffered moisture stress. Late-planted trials produced much higher yields than the early-planted trials and the slower maturing varieties were able to develop their yield potential in the absence of moisture stress. The outstanding varieties included Suncross 51, Suncross 53, Sungold and Pacific 301.

Peanuts

The selection programme to reselect higher-yielding lines within the existing commercial varieties is progressing well and several hundred lines have been selected. These will undergo testing in the next two seasons for selection of the best lines in respect of yield and quality.

In the main breeding programme, introduction of germplasm from overseas has continued and crossing has been commenced. Local varieties have been crossed with leading overseas varieties and with lines carrying resistance to rust.

In experiments on the wet tropical coast, White and Red Spanish both gave higher yields than Virginia Bunch.

In peanut nutrition studies on soils with very low potassium and calcium contents, highly significant increases in yield of nut in shell were obtained as application rates of potassium increased. There was no yield response to increasing rates of application of calcium. In terms of kernel quality, the percentage of edible kernel decreased as the application rate of calcium was increased, the percentage of edible kernel also increased.

Tobacco

In the plant breeding programme, evaluation of the line ZZ 100 has been continued in commercial plantings. Maturation tests on cured leaf are due for completion by October 1979. Results to date indicate the line ZZ 100 may be released for commercial use in 1980. This line has been developed as an alternative to NC 95, a bacterial wilt resistant variety which is not well accepted by growers due to some undesirable plant characteristics including leaf shedding. Bacterial wilt is a disease of increasing concern.

In addition to developing disease resistant varieties, plant breeding is also directed towards increasing yield potential. Attempts to incorporate nematode resistance into commercial varieties from *Nicotiana rapanda* have not been successful and as a result this work is being discontinued.

The tobacco agronomy programme is concerned with plant performance in terms of yield and quality as the result of crop development and crop management practices. Studies showed that leaf number and leaf area increased with later plantings (August and October) while leaf weight per unit area decreased. Yields from early season crops (May plantings) were increased by growing introduced varieties. The number of harvestable leaves was increased by modifying crop management practices and by applying the growth regulant gibberellic acid. These studies are being undertaken to enable growers to utilize more efficiently their labour and capital investments by spreading planting times and growing season over longer periods.

Cotton

Development of cotton varieties resistant to insects as a means of reducing cost of production and minimizing adverse environmental effects of excessive pesticide use is still the major objective of the cotton plant breeding project. Approaches being investigated include testing of lines incorporating high levels of gossypol; lines including the characters for nectariless, glabrous, frego-bract and super-okra leaf; and early maturing lines. These are being tested under unsprayed conditions, normal commercially sprayed conditions, and 'manager' conditions, where use of chemicals for insect control is kept to a minimum with recognition of the role of beneficial insects and other bio-control agents.

In previous work high gossypol lines outyielded low gossypol lines under unsprayed conditions. In 1977–78 trials at Biloela and Gatton the yield advantage for high gossypol lines was again apparent.

It was possible to identify about 20 lines with high yield potential, high gossypol percentage, and adequate fibre strength. Bio-assays on high gossypol lines again indicated an association between high gossypol level and detrimental effect on *Heliothis* larvae.

In the Australian cotton variety trials conducted at four sites in Queensland and four in New South Wales in 1977–78, Deltapine 61 produced the highest mean yield over all sites for the second successive year. Fibre quality of this cultivar in 1976–77 trials was at least equal to that of Deltapine 16 and Deltapine SL 13. It is probable that Deltapine 61 will be recommended for commercial production after the results of the 1978–79 trials are finalized.

At four sites (Biloela, Emerald, St. George and Brookstead), trials involving six varieties planted at three times all showed progressively lower yields at the later planting dates. For example, at the Emerald site, the mean seed cotton yields were 3 989, 3 585 and 2 426 kg per ha for the planting times October, November and December, respectively.

Rice

The search for better adapted varieties than the current commercial varieties Bluebonnet 50 and Starbonnet has been intensified in recent years. At present, 75 rice lines from the Philippines and 38 from Colombia are in the replicated trial stage of testing. Observations in the seed increase plots have shown that some of these have excellent agronomic characteristics with low plant height, high yield and lodging resistance.

The final trial in the Starbonnet-Bluebonnet 50 comparison under a range of nitrogen fertilizer levels again showed a trend for Bluebonnet 50 to have a higher potential yield than Starbonnet. As far as the industry is concerned, however, Starbonnet should prove better overall due to the propensity to lodging of Bluebonnet 50 under conditions of high nitrogen and adverse weather at harvesting.

Safflower

Experimental work in conjunction with Plant Pathology Branch has shown that *Alternaria carthami* is able to survive on safflower stubble from one season to the next. Clean seed planted in May into an infested area harvested in the previous November resulted in 45% of the emerging seedlings being infected. Clean seed planted into an adjacent unaffected area at the same time had less than 1 per cent incidence.

Lines from India and U.S.A., with reputed tolerance to *Alternaria carthami*, were grown for seed increase.

Potatoes

The co-operative programme with Plant Pathology Branch to evaluate the possibility of producing good quality seed potatoes in Queensland is nearing completion. The experimental scheme involves 10 stages of multiplication, four in the glasshouse and six field multiplications. Two field stages are carried out each year; in winter in coastal areas and in summer in the highlands of south-east Queensland. Stage 9 has now been reached. Tubers produced in each stage of the experimental scheme have been tested for disease freedom and yielding ability in comparison with imported certified seed from Victoria and New South Wales. These results are promising in that the Queensland seed potatoes have yielded comparably with Victorian certified seed and usually significantly better than certified seed from New South Wales.

Onions

The onion variety evaluation programme conducted over the last 4 years has resulted in the following planting time recommendations. For early plantings up to mid March, use local strains of early Lockyer Brown and White. For late March and April plantings, use commercial strains of Early Lockyer Brown and White, and Lockrose White. For late plantings (May to July), use Gladalan Brown and White and W 100 as these varieties show a greater resistance to downy mildew. These recommendations do not include many other varieties currently grown in south-east Queensland.

Onion irrigation and time-of-harvest trials have shown that it may be possible to reduce the frequency of irrigation after bulbing without adversely affecting yield.

Grain legume crops

CHICKPEAS. In 1977, the first year of the assessment programme, a remarkable performance was achieved from the majority of the trials grown in the State. That season was exceptionally dry in all districts and the crop showed its adaptation to low soil moisture conditions.

During the 1978 season, planting rains fell in April and a number of trials was planted. The season was very different from that of the previous year with prolonged cool, showery weather in all districts continuing until late November. Vegetative growth was excessive and the plants failed to set pods during the cold, wet or overcast weather. A weak pathogen, *Botrytis cinerea*, took advantage of showery weather and frost damage, and caused considerable damage to the plants.

In this season, damage from the herbicide simazine was considerable. The damage was attributed to the excessively heavy rain which leached the herbicide into the root zone.

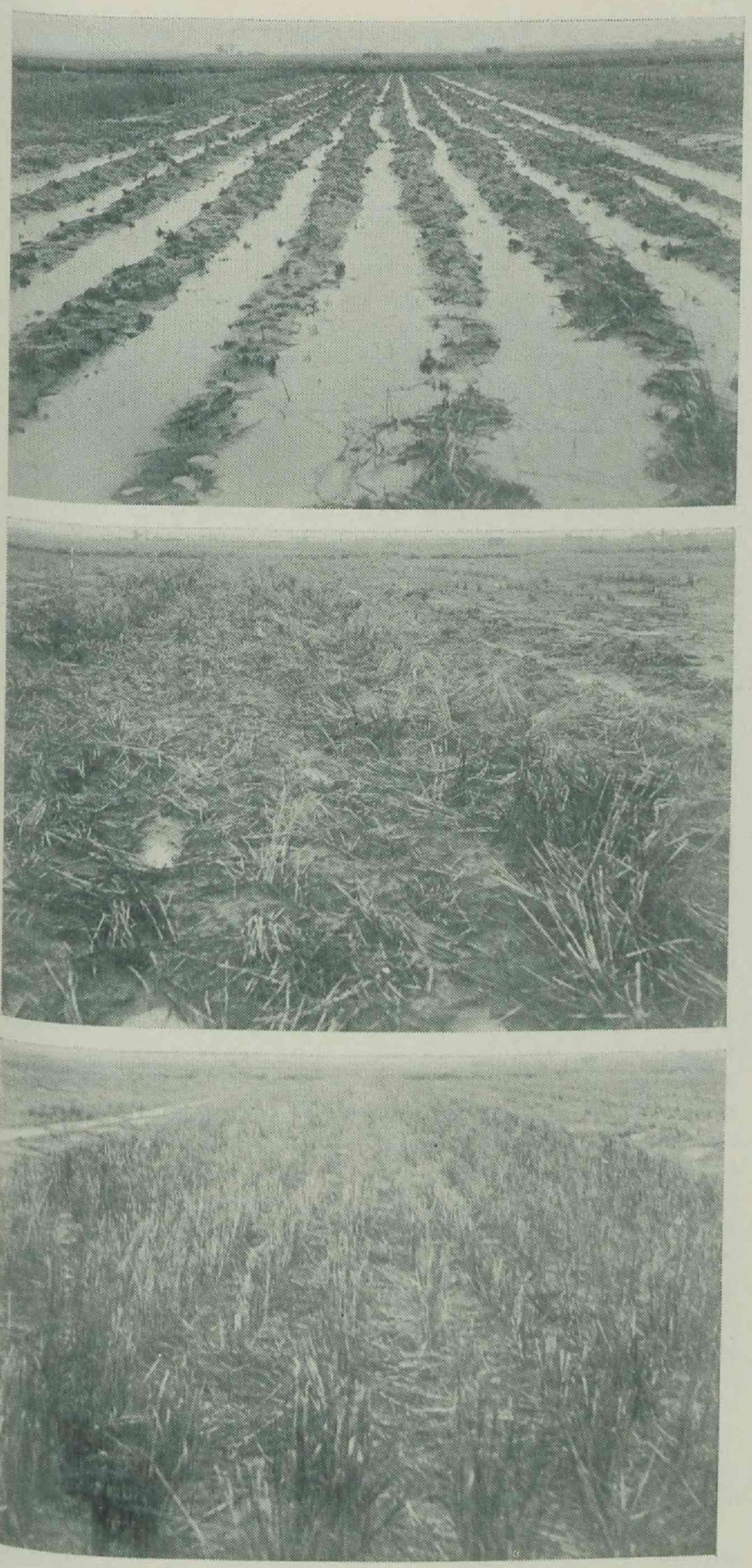
The recently-released variety Tyson produced the highest yield at Emerald but did not do so well at other centres. At Biloela and Dalby, CPI 56566 gave the best yields.

GUAR. A programme is being conducted to determine whether suitable areas exist in central Queensland for profitable production of guar. (Guar seed contains approximately 33% gum which is used in industry and foodstuffs and 33% protein which can be used in stock feed).

Sixty-one lines were screened in trials at Biloela and Emerald. Early indications from the screening trials suggest that nodulation is poor and future work will aim at resolving this problem.

LUPIN. From a series of trials conducted over seven seasons, it has been determined that, in southern Queensland, Ultra (*Lupinus albus*) is slightly superior to Hamburg (*L. albus*) and Unicrop (*L. angustifolius*) on well drained, lighter soils. On heavy clay soils, Unicrop is much superior to Ultra and Hamburg because it is better able to withstand the poor internal drainage characteristicts of these soils. In central and northern Queensland, Ultra and Hamburg are quite superior to Unicrop although the difference is less pronounced on the poorly drained heavy clay soils at Emerald.

NAVY BEAN. Three variety trials were grown in the 1978 season. Good yields were obtained in the trials at Kingaroy and Inglewood but were lower in the trial at Hermitage Research Station. Planting of the Hermitage trial was delayed by weather conditions and the plants were frosted in late April before they were fully mature. The best average yields were given by Selection 46 and Actolac but three new lines R 78, R 115 and R 80 showed promise where they were included. R 115 is field resistant to rust and common blight.



Stubble and zero tillage increase water infiltration and reduce run-off. This series compares the effects of three treatments in a long-term experiment at Hermitage Research Station. The series, taken after a heavy storm, shows from the top: stubble burnt and cultivated, stubble retained and cultivated, and stubble retained and zero tillage.

Cassava

A programme to study the regional adaptation of cassava in the subtropical and tropical areas of Queensland has been initiated. Emphasis is being placed on field agronomy and climatic response involving time of planting, time of harvest, planting density and water stress-yield inter-relationships.

Raingrown trials have been commenced at Coolum and South Johnstone, while a raingrown trial and an irrigated trial are being established at Southedge. On completion of this series of trials it should be possible to interpret the potential of this crop for all areas where future commercial crop development is feasible.

Irrigation

Four years of bulk cropping trials on Koberinga and Dalrymple soil associations at the Fort Site in the Lower Burdekin area were completed with the termination of the lease in early 1979.

In this programme, the principal objective was to assess the performance of a range of agricultural crops which were considered likely to be useful for irrigated agriculture on these soil types if major new water reservoirs were constructed to serve an expansion of irrigation in the Lower Burdekin. A similar assessment programme on the Oakey-Barratta soils was carried out at Millaroo Research Station in earlier years.

The cropping work carried out at the Fort Site has emphasized two aspects of irrigated row crop management which have a major bearing on consistent good crop performance and on which research is required. These are the problems of consistent good crop emergence and establishment, particularly on the Barratta and Koberinga soils; and the problem of water management including crop water requirements, irrigation frequency and drainage of wet season rainfall.

Weeds

In north Queensland, effective control of *Hyptis suaveolens* in peanut crops was obtained by using a single application of 2,4-DB at 0·5 kg per ha 3 weeks after planting. Further applications at 6, 9 and 12 weeks did not significantly reduce the crop yield and produced no improvement in weed control over the single application.

Further work has been carried out on weed control in seed crops of various tropical pasture species.

Non-rhizomatous, grassy, off-type sorghum plants exhibiting seed shattering and seed dormancy were recorded in Queensland in 1977. In a survey of *Sorghum* spp. in the 1977–78 season, shattering of the seed head was reported in *S. bicolor, S. halepense, S. almum, S. nitidum and S. verticilliflorum*. Of these, *S. nitidum* was the only species not exhibiting seed dormancy. There appeared to be a closer association of seed dormancy with the presence of rhizomes than with seed shattering. The survey supports the original assessment that *S. verticilliflorum* is the major threat in terms of a diploid off-type sorghum contaminant in areas of hybrid sorghum seed production.

In the South Burnett, crop rotation and the use of residual herbicides are practised widely. Atrazine is used extensively on sorghum and maize for residual control of annual grasses and broadleafed weeds. Trial work has shown that, even at double the recommended rates, atrazine applied to sorghum 13 months before planting the subsequent crop of peanuts gave no reduction in peanut emergence, yield or quality. It appears safe to plant peanuts in soil to which atrazine has been applied the previous summer.

On pumpkins in 1977, no visible effects followed applications of chlorthal-dimethyl, nitrofen, benfluralin, bensulide and alachlor, but dinoseb applied at emergence caused severe foliage injury. In 1978, trifluralin and pendimethalin caused severe damage in some conditions but yield was not affected by alachlor.

Following reports of damage to onion plants from field applications of chlorthal-dimethyl under certain conditions, this herbicide was retested in an attempt to simulate possible causes of phytotoxicity. No differences in onion population and yield resulted.

A range of herbicide treatments was evaluated for the control of *Raphanus raphanistrum* in Clipper barley. Currently recommended treatments based on 2,4-D and MCPA and their mixtures with picloram or dicamba gave excellent control, with a trend for 'late' applications (up to 500 mm diameter rosette) to give better control due to further germinations than the 'early' applications (up to 80 mm diameter rosettes).

Cultural techniques

Results of wide and twin-row cropping experiments in grain sorghum indicated that there was no yield advantage to be gained by use of widely spaced (2 m), single or twin (0·36 m apart) rows, compared with 0·36 or 1·07 m single rows, except perhaps at low yield levels (less than 600 kg per ha). At higher yield levels, however, (greater than 1 600 kg per ha), considerable yield reductions, of the order of 15 to 25% occurred in a number of trials with the use of wide, single or twin, row spacings compared with the narrower spacings. It was concluded that yield improvement claimed from the use of wide, twin-row spacings under commercial conditions were the result of improvement in other cultural factors associated with the wide row spacing, for example, better weed control and use of precision planters.

A long-term soil surface management programme has been initiated in central Queensland designed to measure the effects of stubble retention and tillage method on water entry and soil moisture storage, soil nutrient status, crop establishment and crop productivity in grain sorghum. In central Queensland, planting time for summer grains is the major hazard period for soil erosion under a conventional bare fallow system of seedbed preparation.

During 1977–78, the tenth winter cereal crop was sown on the long-term trial on Hermitage Research Station designed to compare the effects of various methods of fallow management on the productivity of winter cereals on a non-sloping black earth soil of the Darling Downs. The first six crops for this trial were wheat cv. Timgalen. During these six seasons there was a build up in the stubble systems of yellow spot disease (*Pyrenophora triticirepentis*). To overcome this, barley cv. Clipper was used for the next three crops. The tenth crop was again wheat cv. Timgalen, and the incidence of yellow spot disease was very low.

Following an extremely dry growing season in the 1977 winter, available soil moisture at harvest was very low. During the subsequent fallow period increases in available soil moisture were significantly greater with zero tillage than with mechanical cultivation. The mean percentage rainfall accumulation with zero tillage was 37·4% compared with 25·4% for mechanical cultivation.

This trial and a similar trial at Allora have demonstrated that stubble retention with zero tillage is fraught with certain problems including difficult planting into stubble, and problems relating to technical and economic aspects of weed control. In spite of these difficulties, there appears to be a place for zero or reduced tillage with or without stubble retention on the black earth soils of the Darling Downs.

Summer crop nutrition

A research programme has been commenced to determine guidelines for the commercial use of nitrogen and phosphorus fertilizer in the cropping areas of central Queensland on summer crops particularly sunflower and grain sorghum. These guidelines are required to be pertinent to the range of soil types, cultural conditions and weather variability, particularly rainfall, within the region.

A nitrogen x phosphorus field trial at Biloela indicated that early growth responses to phosphorus are similar in sorghum and sunflower, but that there is a substantial difference in response between the two sunflower genotypes, for example, Hysun 30 gives a lower response to P than Sunfola and grows much better than Sunfola in the absence of applied P.

In the Burnett Region, a soil fertility-plant nutrition programme has been in progress for 7 years. A combination of pot screening in the glasshouse and field screening is being used to assess the nutrient status of selected regional soils and to determine the nutrient requirements of individual crops growing in these soils.

The pot screening of the grey sandy loam duplex soil derived from granite which occurs to the west of Kingaroy and also a similar soil occurring in an area extending from Kilkivan to Nanango has been completed. Results from the pot trials have been consistent with major deficiencies of P, N, Ca, S and Mo being shown and marginal deficiencies of Cu, B and K. Field testing so far has shown large responses to applied phosphorus and in current trials growth responses to potassium at the first site and molybdenum at the second.

Field work on the initial series of trials in the soybean plant nutrition programme to assess the requirements of phosphorus, calcium, sulphur and potassium on red forest and red scrub soils of the South Burnett has been completed. The data indicate that the critical soil test P level (acid extraction) is 25 p.p.m. No responses to either calcium or sulphur were recorded in the trials. Good responses to applied K were recorded in nine trials out of 19 where soil test K levels ranged between 40 and 60 p.p.m.

On the Darling Downs, soil phosphorus studies on a Mywybilla black earth soil which characteristically has a low bicarbonate extraction phosphorus test, showed that application in 1976 of phosphorus at rates ranging up to 210 kg per ha resulted in the establishment of various soil P test values at the experimental site ranging from 10 to 58 p.p.m. In the 1977–78 Semstar soybean indicator crop, however, the only significant responses were in percent phosphorus in plant dry matter and recovery of phosphorus in kg per ha, both of which increased progressively with increased initial phosphorus application. The maize indicator crop (cv. P48) gave significant plant dry matter responses to application rates of 150 kg P per ha and over. While the grain yield results were not significant, there was a trend for increasing yields up to 120 kg P per ha.

Winter crop nutrition

Residual responses to fertilizer phosphorus have been studied in wheat crops in the Wallumbilla district over three seasons. Residual responses in the first year following P at rates of 8, 28 and 50 kg per ha respectively applied to the previous wheat crop were equivalent to about 2, 4 and 8 kg per ha of fresh applied P. In the second year, practically no residual responses were evident.

A survey on the extent of copper deficiency of wheat in the Western Downs region continued. A further 16 sites were tested, one of which had a history of copper deficiency. Visual symptoms of copper deficiency and a response to applied copper were observed only at this one site. Results were similar to those of the previous year. It is concluded that copper deficient soils occur only in small, isolated pockets which may be identified by characteristic symptoms in wheat crops. Application of two foliar sprays of copper sulphate is an effective remedy, and alternative crops or wheat varieties tolerant to low levels of copper can also be used to overcome the problem.

Pasture research

Seed production studies

In north Queensland, seed production studies have concentrated on the effects of post-harvest handling on seed quality. A start has also been made to study the effect of seed history on field establishment and to relate this to laboratory performance. Otherwise identical pairs of seed samples from three Gatton panic (*Panicum maximum*) and two signal grass (*Brachiaria decumbens*) harvests, dried either fast or slow, showed the fast dried samples to be consistently poorer in seedling emergence, average success of establishment, and reliability of establishment in the field.

Field establishment from five plantings at Kairi Research Station between December 1977 and March 1978 using 40 lines of seed of six cultivars (*Panicum maximum* cvv. Gatton, Makueni and Petrie, *Setaria anceps* cv. Narok, *Paspalum plicatulum* cv. Rodds Bay and *Brachiaria decumbens*) showed that emergence counts related well to laboratory germination. Subsequent changes in populations were not attributable to seed quality. Most forms of seed dormancy were lost rapidly in the field and, provided dormancy did not complicate the laboratory test, the germination test appeared to be an adequate indication of planting value.

In *Brachiaria decumbens* the efficiency of recovery of seed actually taken into the header is high, only 5% of seed being lost over the riddles and walkers. However, the amount taken in is less than one quarter of the total present in the crop.

In south Queensland, work has concentrated on obtaining a better understanding of the factors complicating seed production of Callide Rhodes grass (*Chloris gayana*). Experimental yields of reasonable quantity and quality can now be obtained in favourable seasons with adequate nitrogen application and careful harvesting. As a result Callide has been re-established as a valued commercial cultivar with an effective seed certification scheme. Cv. Samford is also beginning to come forward as certified seed. Seed yields and particularly quality, however, still tend to be erratic and unpredictable. In part, faulty post-harvest handling is suspected for the poor quality.

High rainfall tropical pastures

From South Johnstone, the assessment of a series of pasture production systems has continued at King Ranch while a larger unit has also been established at Utchee Creek to put these in near-commercial aspect. In the old grazing trial at Utchee Creek, units with one-quarter of the area under N-fertilized grass are now carrying 3·7 beasts per ha while the full common guinea (*Panicum maximum*) common centro (*Centrosema pubescens*) units are only carrying 3·09 beasts per ha. Where Belalto centro is present, liveweight gain has been significantly higher, and Makueni guinea has performed better over the last 12 months than common guinea.

Also at King Ranch, south of Tully, a stocking rate of 3·7 beasts per ha was maintained throughout the year on systems utilizing *Brachiaria decumbens* and N-fertilized buffer areas. The corresponding grass-legume system was stocked at only 2·47 beasts per ha and, while surplus pasture was available throughout the year, liveweight performance was poorer than expected.

In an attempt to improve the legume content of centro-based pastures in the early years after planting, a series of trials has been conducted varying the proportion of guinea grass and centro seed planted and the planting rates. Seed ratios of 95% legume to 5% grass increased the centro yield and content but only at the lowest seeding rate (2·5 kg total seed per ha) and was accompanied by a decrease in guinea grass yield and an increase in broadleaf weed yields. Even then the centro yield over the first 18 months after planting did not exceed 10% of the total dry matter on offer.

Strip grazing using an electric fence.

Calopogonium coeruleum CPI 28107 has for some years shown promise of persistence and productivity at Utchee Creek, and has now been brought under grazing in a 0·8-ha area which is continuously stocked at 2·5 beasts per ha. The animals have averaged 0·5 kg LWG per animal per day for 2 years, which is slightly less than can be expected from guinea grass-centro pastures at higher stocking rates. The *Calopogonium* in this time has increased to 40% of the pasture on offer, indicating a possibly inferior palatability.

At Mackay, work is continuing in the search for legumes better adapted to the low-lying wet solodic soils, and in methods of restoring Siratro to run-out pastures.

Vigna luteola, Aeschynomene americana, Centrosema pubescens and *Teramnus gillettii* lines have shown promise in wet situations, with the *Aeschynomene* and *Centrosema* accessions persisting well under continuous grazing in 1977–78. *Stylosanthes guianensis* CPI 40255 has also established and persisted well under difficult conditions at 'Tedlands' Koumala with Verano also performing well.

Where adequate hard seed populations exist in the soil, Siratro (*Macroptilium atropurpureum*) can be fairly readily restored to run-out pastures with fairly simple soil disturbance and some deferment of stocking. At 'Tedlands' ripped plots had three times as many mature Siratro plants 13 months later than the controls, and twice the Siratro DM yield. Of four implements used in the November 1977 study, rotary hoeing had by 6 weeks later increased Siratro seedlings from 2·5 to 11·7 per square metre and yield from 1 162 to 2 905 kg per ha; tines, disc harrows and deep rippers improved Siratro stand and yield less dramatically. Oversowing 2 kg Siratro seed gave a slight increase in seedling numbers each time but did not affect Siratro yield.

In the residual paddocks of the old 'Tedlands' grazing trial still under observation, Siratro stands have increased dramatically where the stocking rate was reduced from 3·3 to 1·1 beasts per ha.

Dry tropics pastures

The 1977–78 summer was a particularly dry one in the north Queensland dry tropics zone and severely tested much of the new material on trial, besides limiting drastically the results from field nutrition studies.

At 'Meadowbank', on the red basalt soils south of Mt. Garnet, further changes have been made in the stylosanthes grazing study. Large areas of native pasture are now associated with the variously supplemented stylosanthes paddocks. All yields were low in the dry 1978 season and all stylosanthes was consumed by September. While ample stylo was available, the cattle gained substantially more weight than on native pasture alone, and supplementation with sodium sulphate plus sodium chloride further increased liveweight gain. Elemental sulphur applied as a fertilizer to the stylosanthes paddocks had little effect in this dry year.

A study of *Macrotyloma axillare* is also being undertaken. This plant is not well grazed during the growing season but becomes more acceptable to stock as feed quality deteriorates.

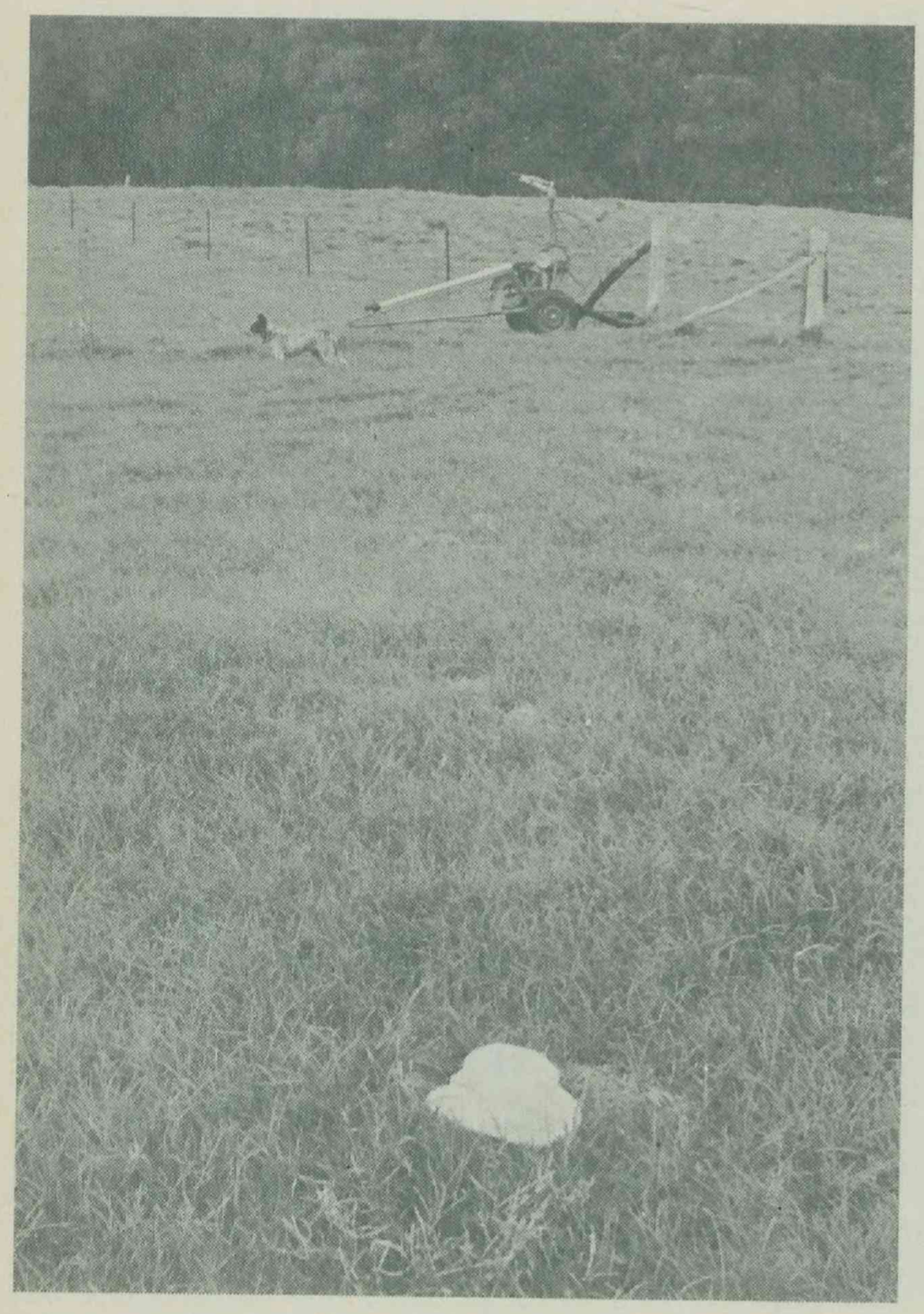
Some 20 lines have been under evaluation at 'Boomerang'. They failed to provide any lines outstandingly superior to cv. Archer although some were superior in specific features.

In another planting of the 20 available lines of *M. axillare* at 'Meadowbank' in January 1975 and subjected to normal stock access, nine lines survived to 1978 in both replicates. Archer was not one of them.

Approximately half a 40-ha paddock of native grasses (*Themeda* and *Heteropogon*) was sown to cv. Archer at 'Meadowbank' in January 1977. Archer established well and has carried animals in similiar condition to those on adjacent native pasture with access to stylo supplemented with S and NaCl lick, indicating that this legume needs a wider evaluation on the Mt. Garnet basalt country.

With the prospect of useful legumes being available, more emphasis is now being placed in the search for associated grasses. A series of studies is in progress in co-operation with C.S.I.R.O., Davies Laboratory. Since December 1974, a range of Urochloa lines has been under test at 'Southedge', 'Boomerang' and Georgetown with several showing some promise. Of a further 86 grasses from 22 genera grown at 'Boomerang', 'Southedge', 'Merluna' and 'Kalinga' *Andropogon gayanus, Bothriochloa insculpta, Brachiaria decumbens, B. dictyoneura, Chloris gayana, Hyparrhenia rufa* and *Paspalum plicatulum* are among the most promising.

Of a further range, planted in January 1977 at 'Meadowbank' and 'Woodleigh', *Brachiaria nigropedata* and *Dichanthium annulatum* were among those attracting attention. Further new sowings in January 1978 at 'Meadowbank', 'Southedge' and 'Brooklyn' were severely affected by the dry season, but Callide Rhodes, *Urochloa mosambicensis* CPI 46876 and *Bothriochloa insculpta* cv. Hatch all showed some promise.



Irrigated pangola grass.

Pasture studies in central Queensland

As a prelude to major work in the sub coastal forest country, a survey of the state of disturbance of the original vegetation is being carried out, in the process of mapping most of the central Queensland region. The major regrowth problem so far identified in the wetter shires, has been *Melaleuca viridiflora,* with others of lesser importance including *Tristania suaveolens, Planchonia careya, Acacia* spp., *Eucalyptus intermedia, E. papuana* and *E. alba.* The main herbaceous weeds are *Urena lobata, Sida rhombifolia* and *S. cordifolia.* The grasses *Themeda quadrivalvis, Sporobolus diander* and *Eriachne triseta* are causing problems in specific areas.

On the Central Highlands, where the native grasslands have been under study for some years, peak standing biomasses of 3 500 and 2 890 kg per ha were measured over two successive summers with mean community growth rates of 17·9 and 14·9 kg per ha per day and a peak of 43 kg per ha per day. Basal cover varies in these pastures from 2·6 to 9·0%, but botanical composition is apparently the best indicator of condition. Good condition is indicated by *Bothriochloa erianthoides, Dichanthium* spp., *Digitaria divaricatissima* and *D. brownii.*

This work has been interrupted by the appearance of *Parthenium hysterophorus* in weed proportions on the Central Highlands, and the biological, edaphic and management factors associated with infestation of grazing lands are being assessed from a survey of 53 sites on 11 properties. Grass basal area at the sites ranges from zero to 21% and parthenium cover from 0 to 100% with up to 8 x 10^5 plants per ha. It appears that, the less grass, the more parthenium invasion there is.

A wide range of new legumes was planted at three sites in each of three localities in the region in January 1978. Matching clay, duplex and red earth soils were selected at each locality. Despite difficult early conconditions, reasonable establishment has been achieved at most sites, especially of the *Stylosanthes* spp. Of the 60 *Stylosanthes* accessions planted, the *S. scabra* material and especially CPI 55875, 55858 and 55817 were outstanding. CPI 40255 was the best *S. guianensis* line. Forty accessions from other genera were also planted but these suffered more from the harsh conditions and grasshoppers than the stylos. Siratro, *Atylosia scarabaeoides* and *Lotononis bainesii* were the most promising.

Pasture studies at Brian Pastures

At 'Brian Pastures', breeding system studies commenced in June 1977 with 85 cows on 310 ha of native pasture with access to 34 ha of leucaena (*Leucaena leucocephala*) in five paddocks x 3-weekly rotations from June to November. A further 85 cows graze 310 ha of native pasture with fine stem stylo (*Stylosanthes guianensis* var. *intermedia*) sown in contour strips in accessible portions of the paddocks. The remaining 590 ha of native pasture are grazed with urea blocks or urea-molasses lickers from June to November. From June 1977 to August 1978 breeders in the leucaena-supplemented paddocks had gained 24 kg LW while those in the fine stem stylo and control paddocks had each lost a mean of 16 kg. So far there have been no visual ill effects from grazing leucaena. More detailed monitoring is yet to commence.

The weaners from these cows are then grown out under two systems, an extensive one which takes 2 years to produce an unfinished store animal, or an intensive system to finish them to slaughter weight at 21 to 24 months of age.

The 52 extensive system weaners spend 2 years on 194 ha of native pasture with access to 32 ha of leucaena. For the first year, grazing area allowances per head of native pasture and leucaena are only half those available in the second year. Mean animal weight gain was 101 kg per head in 1977–78 with gains of up to 28 kg per head over the 1978 winter. Standing native pasture on offer was highest in November 1977 (4 800 kg per ha) and lowest in May 1978 (3 200 kg per ha).

The 60 intensive system weaners have access to a 110 ha unit made up of 25 ha of green panic (*Panicum maximum* var. *trichoglume*) fertilized in October each year with 125 kg per ha of urea and grazed from June to November; 60 ha of native pasture grazed from December to mid April with 6 ha leucaena also available from early March to mid April. In late autumn they go onto 25 ha of crop residues (*Lablab purpureus* or grain sorghum) grown in ley rotation with the green panic. From the beginning of June they go into pens to be fed lablab chaff and milled grain sorghum until the target sale weight of 450 kg LW is reached. In 1977–78, due to the dry summer and autumn, changes of phase lagged somewhat and the final sale weight was only 383 kg with a mean carcass weight of 234 kg.

Lucerne studies

With the arrival of the two lucerne aphid pests, a range of introduced lucernes from the U.S.A. has been brought under test. A rain-grown and an irrigated trial are planted to 28 cultivars (five of Australian origin as controls) at Biloela Research Station. Another irrigated trial is at Gatton and rain-grown ones are at Toowoomba (Q.W.R.I.) and Mitchell. The effects of the aphids and the diseases root rot (*Phytophthora megasperma*) and anthracnose (*Colletotrichum trifolii*) on yield and persistence will be determined. At Gatton, an early attack of *Phytophthora* root rot has revealed C_3 Composite ex Deniliquin, DeKalb 167, Falkiner PS 545 and CUF 101 as the most resistant lines with Hunter River one of the worst affected.

In one earlier-planted trial at Gatton, the American cultivar CUF 101 has been the outstanding line. It yielded 1·6 times as much as Hunter River over the first 11 months. At Toowoomba, the field testing of lines of Hunter River and Siro Peruvian selected for resistance to anthracnose (*Colletotrichum trifolii*) in the laboratory by Plant Pathology Branch shows that the F_2 lines are slightly more resistant than the F_1 lines of both cultivars, and that the unselected commercial material in each case was reacting more severely to the disease.

Annual medic studies

Annual winter medics are not normally regarded as useful pasture plants in central Queensland but strain trials were planted in autumn 1973 at Biloela and Brigalow Research Stations. Most of the lines planted have persisted. Jemalong barrel has been one of the best at both sites and the wet 1978 winter allowed it to grow very well indeed. By October 1978 it was yielding 6 300 kg per ha ODM at Biloela.

On a shallow upland basaltic soil on the eastern Darling Downs, a strong nitrogen x sulphur interaction was obtained from an old medic stand in natural pasture. Pasture yield declined with increasing N alone and highest yield was with 20 and 40 kg per ha S at the 240 kg per ha rate of N. At Q.W.R.I. medics grown with Makarikari panic (*Panicum coloratum* cv. Pollock) produced increases in grass yield and nitrogen content equivalent to 50 kg per ha applied nitrogen.

The major medic programme has continued from Warwick with further regional trials at Roma and Brian Pastures. The year 1978 was outstanding for medics at all three sites with rain-grown yields in excess of 8 000 kg per ha being recorded at several sites. Jemalong barrel medic continues to be among the best cultivars at all centres.

Temperate species

There is considerable scope for hardy temperate species in southern Queensland pastures. This is because of a substantial winter-spring rainfall in southern parts of the State in some years and the complete winter dormancy of most tropical and subtropical species. White clover and annual medics are widely naturalized in appropriate areas and prospects of improving the performance of both groups exist. There is also a prospect of adding further to the array of valuable legumes.

Serradella (*Ornithopus compressus*) is one such legume performing well on the deep acid sands near Cecil Plains and at Leyburn. *Astragalus hamosus* (milkvetch) is another possibility but cv. Ioman is susceptible to the blue green lucerne aphid and is being plagued by nodulation problems on the deep black clays to which it is best adapted.

Within the temperate grasses, ryegrasses, grown essentially as an irrigated winter forage crop, are now being widely used as an alternative to oats. Cultivar appears to be relatively unimportant in the final yield, water and applied nitrogen being the over-riding factors in performance of stands.

In south-east Queensland, studies on Siratro establishment suggest that covering the seed is important, while seed source and method of scarification are less important. In other studies, weather after planting, be this spring, summer or autumn, was more important than time of planting or seedbed preparation in determining the final stand. However, if seasonal conditions are adverse, establishment is more reliable with more intensive seedbed preparation.

Species evaluation in semi-arid areas

Anthephora pubescens and two introductions of buffel grass (*Cenchrus ciliaris*) Q 10087 from Rhodesia and Q 10077 from Ethiopia, continue to perform well at Charleville although Biloela buffel has been comparable with them under preliminary grazing.

Eragrostis curvula/chloromelas lines are the other promising material here. They respond earlier than other exotic species. *E. curvula* CPI 30379 continues to be impressive at Morven and Eulo but has declined in vigour at Cheepie.

Management studies in semi-arid pastures

Recordings in the range of sites established in 1972 for long term monitoring continue to reflect the changing seasonal conditions. After a dry summer they carried almost entirely perennial grasses, mainly *Astrebla* spp.; after a wet winter the species composition was more diverse, with a bias towards annuals.

Studies have commenced on the characterization of reaction of a range of native and exotic grasses to defoliation at various intervals. In pots up to 15 weeks from planting *Cenchrus ciliaris* accumulated 10 times as much dry matter as two important native grasses, *Monachather paradoxa* and *Thyridolepis mitchelliana*. *C. ciliaris* and *Astrebla lappacea* also had the smallest proportion of inflorescences and greatest proportion of roots, whereas the wire grass *Aristida jerichoensis* behaved in the reverse fashion. In another study, clipping stimulated tillering in *C. ciliaris* only.

At 'Burenda', Augathella, the heavy use of Mitchell grass pastures is showing more damaging effects on the pasture after $3\frac{1}{2}$ years than on the wool production and liveweight of the sheep grazing the different treatments. Changes in seasonal conditions, coupled with break-up of tussocks and seedling populations, are making it difficult to interpret just what is happening to the pastures at this stage.

A similar study has also commenced on mulga country at 'Arabella', Charleville, and already there is a trend to heavier sheep weights in the more conservative utilization (20%) treatment.

Agricultural extension

Farmers, primary producer organizations and other government instrumentalities at local, State and Federal levels require technical information and managerial advice on crop and pasture production, soil and farm management. Agribusiness firms and their representatives, backyard gardeners, and hobby and weekend farmers 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.

Branch extension

The improved economic state of the beef industry has not significantly affected extension operations during the year. Beef producers tend to be meeting other commitments before re-commencing property development. Significant progress in pasture research in the last 5 years will benefit property development programmes.

Beef properties which diversified into grain cropping during the beef depression have extended their cropping programmes. Grain sorghum and sunflowers remain the preferred crops but significant areas have been sown to wheat and other winter cereals in the southern inland beef areas.

Effective control of timber regrowth is a side-benefit of cultivation in these diversification programmes. An increase in pasture development enquiries occurred towards the end of the year and was accompanied by the first enquiries on chemical control of woody weeds received for many years.

Recommendations on the appropriate crop varieties to plant in each district have been continued. This on-going service covers wheat, oats, barley, grain sorghum, maize and soybeans and provides grain growers with information on the varieties or hybrids producing the best yields.

The extension programme to control insect pests of stored grain was directed specifically at on-farm storage. The record winter cereal harvest created mammoth storage problems for all wheatgrowers and insect pests were significant wherever grain was stored on-farm. While significant losses were reported from some farms, most wheat and barley growers successfully minimized their losses despite having to store grain on-farm for up to 4 months.

Agricultural extension officers combined with departmental engineers to mount a successful campaign on header cleaning which emphasized the benefits of operating clean headers: improved machinery maintenance, improved operating efficiency, control of the spread of weeds and removal of one site of infestation by stored grain insects.

The highlight of this campaign was the demonstrations to thousands of Queensland grain growers at Farmfest in September.

Inservice training activities during the year were held in all regions. A major workshop on plant disorders was held for officers in southern Queensland. This workshop covered nutritional disorders, diseases and insect pests in crop production.

Training activities in other regions included a winter cereal and sunflower workshop in the Moreton region, a soils workshop in the Burnett region and in Far North Queensland a workshop on integrated property development in Cape York Peninsula.

The role of extension officers has become more complex, more technically based and more management oriented. The demand for advice on farm machinery has increased significantly as machinery and labour costs rise. Extension officers have combined with departmental engineers and agricultural economists to undertake a major extension programme on farm machinery management and use.

All Agriculture Branch extension officers have reported a significant increase in the number of farmer contacts, for example, farm visits, office enquiries and telephone calls. While this is both rewarding and stimulating, delays in servicing enquiries have occurred. In a few instances, these delays have caused financial loss to individual farmers. Extension activities are now outlined in more detail on a regional basis.

North Queensland

The peanut industry continued its rapid expansion in north Queensland and an additional 30 growers entered the industry. Some 6 000 ha were grown in 1978–79 compared with 1 500 ha 5 years ago. The crop is now grown at Mt. Garnet, Innot Hot Springs, Mareeba, Walkamin and Dimbulah and Lakeland Downs as well as the traditional areas on the Atherton and Evelyn Tablelands.

Extension activities directed at the peanut industry included a well-attended, 1-day school for new growers just before the season started, and programmes on disease and weed control. The increased number of enquiries on curing peanuts indicates the increased awareness of the importance of correct drying.

The expansion in the rice industry at Mareeba continued and 1 000 ha were grown in 1978–79 compared with 575 ha in 1977–78. The area also expanded in the Burdekin to 2 650 ha: some 1 700 ha of winter crop and 950 ha of summer crop.

Supervised seed production schemes in collaboration with the Rice Board exist at Mareeba and in the Burdekin.

The tobacco industry received a major boost with the release of a systemic fungicide to control the disease blue mould in both seedbeds and the field and the fungicide has gained wide acceptance.

Another significant extension project was directed at improving the application strategies of chemicals for sucker control.

In the dairying areas of Malanda and Millaa Millaa, extension activities have been directed towards boosting winter and spring production from irrigated fertilized ryegrass and clover, and towards problems of sown pasture reclamation and fertilizer usage.

The legumes, Seca and Verano stylo are the basis of the pastoral extension effort in the dry tropics of north Queensland. Grazing demonstrations were sown on two sites at Georgetown and another is planned for the Laura district. A similar demonstration near Mareeba has been producing animal performance information for some 2½ years and has been used for a number of extension activities with Peninsula and Gulf beef producers.

The management of sown pastures for beef production was a major activity on the wet coastal areas and the grazing systems demonstration at Utchee Creek has been extensively used. The sown pasture management practices and feed systems demonstrated are gaining acceptance among beef producers along the coast from Ingham to the Daintree River.

Farther south in the high rainfall areas around Proserpine, two major projects have been commenced. One concerns tea-tree (*Melaleuca* spp.) regrowth and is studying various control strategies. The other project is investigating methods of increasing productivity of pastures dominated by *Sporobolus* spp. and *Eriachne* spp. which have invaded previously highly productive Townsville stylo pastures.

Capricornia

One of the highlights of the year has been the high level of production from the Emerald Irrigation Area. The irrigators have rapidly developed skill and expertise in irrigated crop husbandry. Extension programmes have been directed at assisting farmers improve fertilizer and irrigation strategies, plant populations, insect and weed control in particular and the success of these have been reflected in both increased crop areas and yields.

The emphasis in Parthenium weed extension activities changed and most activities during the year stressed the effectiveness of pasture management and stocking rate manipulation in controlling and reducing property infestations.

A film on these aspects of Parthenium weed control was made during the year and will be widely used in extension activities in 1979–80.

Graingrowing continues to expand in the region. Extension officers are encouraging graingrowers to plan this development so that soil erosion is minimized.

To this end, a significant project with Soil Conservation Branch officers assists farmers develop stable cropping systems in the Dawson-Callide. A very successful field day attended by some 140 farmers demonstrated recent innovations in trash farming machinery. Machinery demonstrated included blade ploughs, chisel ploughs, trash planters, slashers, stubble busters and precision planters.

Burnett and South Burnett

Extension activities directed at farmers in the main cropping areas have emphasized insect, disease and weed control. The range of agricultural chemicals available is increasing and application techniques are becoming more important. Pest management strategies frequently have to be modified for each farm and each crop. Moves have been made to integrate the pesticide information available to farmers from both commercial and Government sources.

The diversification of the cash cropping enterprises in all districts has been consolidated. For example, peanuts and sunflowers were grown on a significant scale at Monto and irrigated peanuts assumed significant proportions both in Monto and Gayndah.

The programme to develop a lupin industry has been retarded by shortage of seed of Ultra, the preferred variety.

In coastal areas, cane growers have expressed interest in property diversification. Lupin growing was expanding but leaf spot ruined most crops, and resistant varieties are essential. Soybeans are also a promising crop.

The use of high analysis fertilizer mixtures was promoted for tobacco production at Bundaberg and Miriam Vale. These fertilizers offer considerable savings and some 40% of the tobacco growers adopted them.

Extension activities in the beef industry increased towards the end of the year. Oxley fine stem stylo is a particularly promising legume for the lighter textured soils of the sub coastal Burnett and extension activities emphasized the need for graziers to produce their own seed supplies as commercial seed production ceased during the beef depression.

Moreton and Near North Coast

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 and Soil Conservation Branches.

High density, fertilized, irrigated ryegrass is the basis of winter and spring production and these pastures have done much to minimize production losses during this critical period. Kikuyu grass is also being promoted for summer feed.

In the Gatton district, a joint project with Soil Conservation Branch has assisted many farmers in building on-farm water storages. This has enabled these farmers to either diversify into crops or increase dairy production.

A group of Lockyer Valley onion farmers was accompanied to the Murrumbidgee irrigation area to assess a newly-developed onion harvester which promises to be very useful.

The Moreton region is now a significant oilseed and coarse grain producer. Soybeans, sunflowers and grain sorghum are now significant crops and much extension effort has been directed at improving crop husbandry practices. Both production and area have increased significantly with sunflowers in the Boonah district, for example, increasing from 80 ha to 800 ha in 1978–79.

An extension project in the Beerwah–Glasshouse tobacco area significantly reduced barn rot in bulk curing barns and the incidence of the disease was very low in the 1978 crop. Each tobacco grower with bulk curing facilities has received a comprehensive set of guidelines to minimize barn rot incidence.

Lotononis and Safari white clover show particular promise as pastures in tree crop situations. Extension work at Nambour in these situations will be extended to other tree crop situations along the coast.

Darling Downs and Near South West

The number of enquiries increased significantly in these regions. The excellent winter season in which weeds threatened to become a major production restraint was a factor in this increase.

However, part-time and hobby farmers, particularly those along the eastern fringe of the Darling Downs, also placed increased demands upon the extension staff. Servicing these farmers can be very time-consuming as their production and farm management problems are quite different from those of the full-time commercial farmer.

Extension staff on the Darling Downs also devote considerable portion of their time to servicing the technical requirements of agri-business firms. A number of mutually beneficial extension activities were held in conjunction with these firms.

The Johnson grass control programme was continued. Roadside slashing to encourage competition from paspalum and Rhodes grass in particular is gaining favour as farmers recognize the effectiveness of this control strategy.

This programme has been most effective in the grain growing areas but has met with very little acceptance in the dairying areas where Johnson grass is a useful forage for dairy cows. Generally, the dairy farms are at the top of the watersheds and provide a ready source of re-infestation to the grain farmers farther down the watershed. Particular attention will be given to these dairying areas in future activities.

The project to minimize spray drift was expanded to the Dalby and Chinchilla areas as well as in the Brookstead irrigation area. The programme emphasizes the dangers of drift during application of all agricultural chemicals. This project has contributed significantly to the agricultural diversity of the Darling Downs and in particular, that of the Brookstead irrigation area.

No grain was reported to be contaminated by insecticides in 1978–79, and only one area of 40 ha of cotton was reported to be affected by phenoxy type herbicides.

A project documenting the occurrence of the perennial weeds Russian knapweed and perennial ground cherry was commenced on the Darling Downs. This project will also study management strategies to enable profitable crops to be grown despite infestations of these weeds.

At Inglewood, a 3-year extension project to boost grain legume crop yields has been completed. The district's 1979 navy bean crop, is estimated to yield 1 800 kg per ha compared with 1 100 kg per ha in 1976–77.

In the traprock and granite country around Stanthorpe and Warwick, some 50 demonstration plots have been sown on 40 properties to demonstrate the benefits of incorporating annual winter growing legumes in native pastures. Grazier co-operation and interest is high and these plants offer exciting prospects to boost animal production.

Some 50% of the oats planted in the granite and traprock has been undersown with woolly pod vetch in 1979 and 1 500 ha was similarly treated in 1978.

At Goondiwindi, St. George, Miles and Roma, extension officers assisted many wheat growers plan temporary on-farm storage for the 1978 wheat crop. Many of these storage facilities were ingenious and the design features of the more effective storages have been documented.

The use of phosphate fertilizers in wheat production is gaining momentum. Graingrowers are being encouraged to use test strips of fertilizer through their crops in a project in the Taroom, Miles and Tara districts so that they can monitor grain yield response.

Irrigation development along the Macintyre River is occurring following the availability of water from Glen Lyon Dam. An irrigation seminar was held in Goondiwindi in September at which irrigated crop agronomy, irrigation strategies and economic considerations were discussed. There have been difficulties in establishing irrigated cropping in the area but profitable irrigated crops of cotton, soybeans, grain sorghum and wheat have been produced.

The St. George irrigation area in contrast is well established with soil and crop husbandry practices well understood. Extension activities in this area have emphasized insect control particularly in cotton.

Horticulture Branch

THE work of the Horticulture Branch is directed towards promoting and developing horticultural productivity in Queensland while recognizing the need for conservative utilization of the land resources of the State. Its activities cover fruit and vegetable crops as well as ornamentals and nursery production.

It aims at improving the efficiency of commercial horticulture from the point of production right through to the consumer. Suitability of the enterprise is important, as is also the investigation of new crops, new products and new methods.

Investigations of problems and opportunities in the production of horticultural crops is a major function. This work is centred at five horticultural research stations at Applethorpe (Granite Belt), Ormiston (Redlands), Nambour (Maroochy), Cairns (Kamerunga) and Bowen (Delta) and is supplemented by field trials in the main producing districts. Post-harvest and processing research is carried out at the Sandy Trout Food Preservation Research Laboratory, Hamilton.

Extension services are provided by the Branch in all fruit and vegetable growing districts. Assistance is also given in providing an extension service to those involved in handling the produce right through the marketing chain.

Liaison with industry is maintained through six horticultural advisory committees, covering six major crops or groups of crops, and composed of grower and Departmental members.

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.

A further function of the Branch is the supervision of the gardens at Government House, the Queensland Museum, Queen's Park and the State Migration Office.

Research

The major aim of the research programme of this 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 systematic, less labour-intensive and more reliable for the producer.

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, as well as assessment of crops that represent new potential commercial crops for the State.

Improved vegetable varieties

The programme to develop improved vegetable varieties for use in the Queensland industry is continuing. Large numbers of promising varieties were again obtained this year from throughout the world, tested for adaptability, disease resistance, yield and quality characteristics. The most promising varieties were distributed to major producing areas in the State for local evaluation. In this year's programme, especially promising varieties have been identified in tomatoes, French beans, cabbage, cauliflower, capsicum, cucumber, and rock-melon. These are being extensively tested on growers' properties.

In addition to the varietal importation programme, there are major breeding programmes in tomatoes, French beans, capsicums, and sweet corn, and smaller breeding programmes in zucchini, cucumber and broccoli. A mildew tolerant, semi-elongated white cucumber, Redlands Long White, has recently been released to the industry. This variety, which is similar in flavour to Crystal Apple, is in keen demand by both growers and consumers. The sweet corn hybrid QK 467S, has also been released to industry. This hybrid has high resistance to sugarcane mosaic virus and leaf blight, and is especially suited to fresh market production during the hot summer months when these diseases severely affect present commercial varieties.

Flora-Dade, introduced and promoted by the Department, has now become the major tomato variety for the Bowen and Bundaberg districts. The improved carrying ability of Flora-Dade with its firm, attractive fruit, has resulted in a considerable improvement in tomato quality on Sydney markets and has resulted in a considerable expansion in supply of tomatoes to Melbourne. The Bowen bred line 58-4B-3BB has continued to perform well in trial plantings, and grower evaluation trials are in progress this season. If the variety is well received, it will be recommended for release as a commercial variety.

Fusarium foot rot remains an important problem in certain locations in the Bowen district and because sources of resistance to this disease are presently not available, a screening programme for disease resistance is in progress in co-operation with the Plant Pathology Branch. Screening for nematode resistance has also been incorporated in this programme. The introduction and testing of processing tomato varieties has identified promising types with resistance to both Races 1 and 2 of *Fusarium oxysporum* and this provides a base for the establishment of a processing tomato industry in the Dry Tropics.

A number of introduced and locally-bred tomato varieties is at present being evaluated for trellised production on growers' properties in south-east Queensland. Improved resistances to Verticillium and bacterial wilt diseases are especially being sought to overcome important industry problems. The most promising varieties under test are Pole Boy, an introduced line, the bacterial wilt resistant lines produced by Plant Pathology Branch staff, and Verticillium wilt resistant lines bred at Redlands. In addition, the evaluations include F_1 hybrids produced from crosses between a number of tomato varieties and these show potential for high yield coupled with multiple-disease resistance. F_1 hybrids have become an important part of the American tomato industry, but their future in the Australian industry requires further evaluation.

Breeding work in capsicums is especially directed towards the incorporation of bacterial spot resistance into a variety having similar characteristics to Northern Bell, including its resistance to PVY virus. A new source of resistance to bacterial spot and PVY virus has been identified in a line imported from U.S.A. and a new approach in the breeding work to supplement existing programmes commenced with this material.

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Nitrogen, sulphur and calcium deficiencies have been involved in problems of beetroot production in the Lockyer Valley. The use of poor quality irrigation water is part of the problem.

Cabbage varietal assessment work has identified the variety Green Coronet, an import from Japan, as having high potential for production in Queensland cabbage-producing areas. The variety has high resistance to internal browning, a major problem which occurs in the present most important commercial variety Hybrid 33 under certain environmental and management conditions. Green Coronet is currently undergoing extensive trials on growers' properties throughout the State. The Japanese variety YR Summer 50 was the most promising of 42 new imported cabbage varieties for summer production in south-east Queensland and will be extensively tested on growers' properties next summer as a replacement for the present variety Olympic, which is meeting considerable buyer resistance because of quality problems.

The cold tolerance French bean breeding programme has produced eight fresh market lines with potential for winter production, and these are being evaluated by growers in the Gympie district. Forty French bean breeding lines imported from the U.S.A. this year include lines with resistance to the important soil borne diseases caused by *Sclerotinia sclerotiorum, Rhizoctonia solani, Fusarium solani* and *Pythium* spp. Some of the lines also possess resistance to mechanical damage of the seed. The processing varietal introduction programme has identified four varieties with potential for the Queensland French bean processing industry and grower evaluation trials are continuing.

Vegetable agronomy

The use of plug-mix planting and the transplanting of container-grown seedlings is continuing to replace the use of bare-rooted seedlings in Queensland tomato crops. Research trials in co-operation with Plant Pathology Branch at Bowen have shown a reduced incidence of Fusarium foot rot in tomato crops where the plug-mix or container-grown seedling system is used and better crop uniformity is also in evidence. This improved crop uniformity results in a more concentrated harvest pattern which reduces the number and the cost of harvesting operations.

Nutrition and soil fertility studies have established that calcium deficiency is an important factor in the production problems which have occurred with beetroot in the Lockyer Valley in recent years. The incidence of calcium deficiency in plants growing in soils with high available calcium levels is unusual, but appears to be caused by a combination of high pH, high magnesium and sodium levels, and poor soil structure. These are related to the use of poor quality irrigation water. Field trials are in progress to identify methods of overcoming the complex problems involved. Previously nitrogen and sulphur deficiencies have also been identified as casual agents in beetroot reddening.

Bean seed research

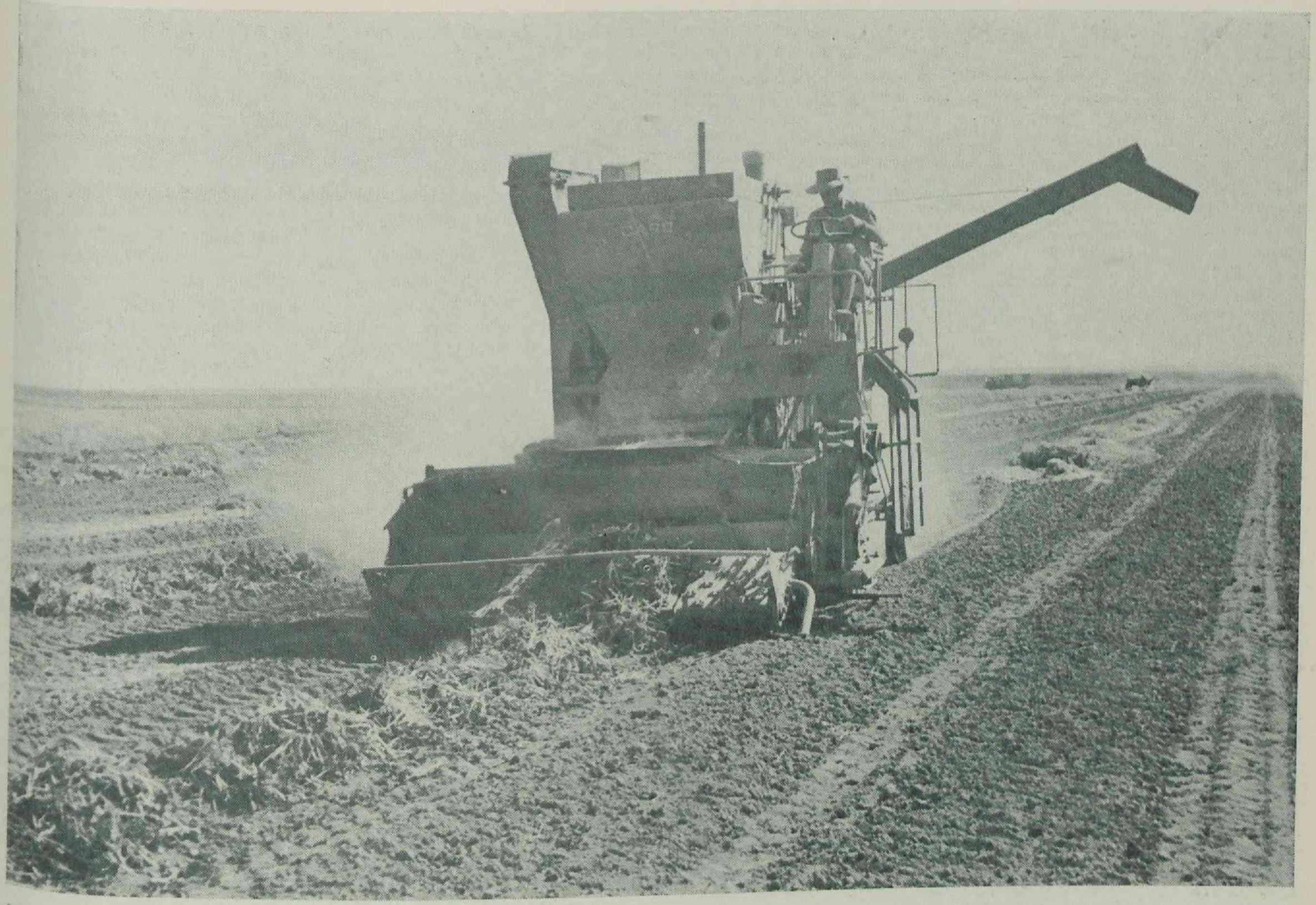
The research programme aimed at improving the yield and quality of French bean seed produced in Queensland has shown developments in a number of areas. Nutritional studies, using seed, leaf and soil analytical data and pot trials, have suggested that potassium deficiency may be an important cause of low yield and quality in considerable quantities of bean seed produced in the Burdekin. A bean field trial investigating the seed yield and quality response to applied soil potassium is currently in progress on a low potassium site in the Burdekin.

Environmental factors have been shown to exert the major control on seed size in French beans causing size variations of two to three times. Bean seed crops flowering during the winter produce the largest seed, while those flowering during the summer produce the smallest. Both temperature and day length appear to be involved in this relationship. The opportunities for manipulating bean seed size by altering planting times is being further evaluated in the dry tropics this season. The finding explains the reason for the relatively large size of Burdekin-produced bean seed. Excess water and nitrogen are also capable of affecting seed size but their total effect is considerably less than that due to environment. Plant density appears to have only a small effect on seed size.

Mechanical damage during harvesting operations remains the major cause of seed quality problems in French beans and research and extension programmes aim at minimizing the damage involved. French bean breeding aims at producing seed capable of withstanding increased physical impact. Engineering Services Section is investigating alternative harvesting systems which result in improved harvesting efficiency and minimal seed damage.

Sub-tropical tree fruits

Research projects continue to evaluate the potential of kiwi fruit, avocados, litchis and mangoes for drier, cooler areas inland from the southern Queensland coast, and of guavas, custard apples and litchis for the poorly drained soils of the wetter coastal districts. In the South Burnett, a shortage and a salinity of the irrigation water are restricting fruit production, but it is anticipated that the use of trickle irrigation systems together with salt-tolerant rootstocks can overcome these problems.



Mechanical damage during threshing can result in serious loss of French bean seed quality. Departmental engineers are investigating alternative systems which result in less damage.

Kiwi fruit is a new crop for Queensland growers. The Kingaroy and Mt Tamborine districts are showing considerable potential for growing this crop.

The future for kiwi fruit production looks particularly promising in the South Burnett and Mt. Tamborine areas. It has been found that the vines will not crop adequately in the coastal lowland areas such as Nambour due to lack of winter chilling.

Three Queensland processors are now processing guava products in commercial quantities following research activities and promotion in this crop. Varieties suitable for processing have been identified in the studies. The search continues for suitable fresh-market varieties, which are seen as an integral part of the crop promotion programme. A 25% urea spray used as a defoliant in August on 15-month-old trees induced early cropping, increased fruit yields from 11 to 35 kg per tree, and reduced the length of the harvest period from 15 to 4 weeks. Fruit yields this year appear to be in the order of 70 kg per tree which is high by world standards. Fruit quality for processing is high.

Techniques for clonal propagation of custard apple varieties and rootstocks by cuttings have now been developed and the material is being field tested. This method offers the potential for the production of large numbers of trees identical to well established ones showing outstanding field performance. The application of relatively high dressings of nitrogen, before or during flowering, increased fruit set and subsequent fruit size. Pruning studies with custard apples have shown that bud-pinching together with leaf removal techniques can be used to control the direction of leader growth and development.

The breeding and regular distribution to the industry of improved lines of papaw have resulted in a marked improvement in fruit yield and quality of papaws produced in southern Queensland. To date, sufficient seed has been distributed to growers to plant 330 ha of crop. Breeding and selection have resulted in a smaller fruit, with improved shape, colour, flavour and resistance to ripe fruit rot. The breeding and selection programme is also aimed at improved varieties for the central Queensland papaw industry.

The five introduced mango varieties, officially released by the Department in 1975 after trials had shown they had considerable potential for extending the mango production season in Queensland, are now widely planted in the industry. The cropping performance of these varieties in these widespread locations will now be studied over the next few years. A large number of new varieties is in process of introduction and early testing.

Maturity bronzing continues to be a major problem associated with the production of bananas in north Queensland and the only practicable control measure developed to date is to cut bunches before the completion of finger filling. This practice results in a considerable reduction in fruit yield. In research studies, the incidence of maturity bronzing has been strongly associated with high humidity and rainfall during bunch development. The application of a wide range of growth regulators, anti-transpirants and nutrient elements to the bunches has failed to reduce the incidence of the disorder. Histological and histochemical techniques are now being used to gain an understanding of the development of the disorder. Density trials have resulted in a recommendation of 2 200 to 2 600 plants per hectare in double row plantings for banana production in north Queensland. This system has given maximum yield while maintaining fruit quality, and provides good access for management operations such as bunch covering, spraying and harvesting.

Imperial mandarins can now be successfully thinned using ethephon sprays following a series of research trials at Gayndah. A 250 p.p.m. ethephon spray applied during the November fruit-drop period can achieve a 30% reduction in fruit numbers and result in increased fruit size and crop value. The yield of fruit in the following year is also increased.

Leaf and soil analysis is now widely used to fertilize citrus crops in Queensland and this has resulted in outstanding improvements in fruit yield and quality. Research continues to refine the leaf analysis interpretative information for mandarin varieties. Studies with the Imperial variety have shown that it requires higher than normal leaf potassium levels for good fruit size. Similar studies with Ellendale mandarins are continuing.

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. The introduction of low chilling peaches from the U.S.A. has created considerable interest.

The varieties have a range of chilling requirements which means they can be grown outside the Granite Belt in warmer parts of the State. These different varieties would produce at different times, all considerably earlier than the Granite Belt, and thus extend the peach marketing season in the State. Three low-chilling peach varieties and one nectarine variety are currently being established in 13 different areas of the State for evaluation trials. Two of these varieties, Flordasun and Flordaqueen, were established earlier at Mareeba and this year they produced quality, yellow-fleshed peaches in the November to December period.

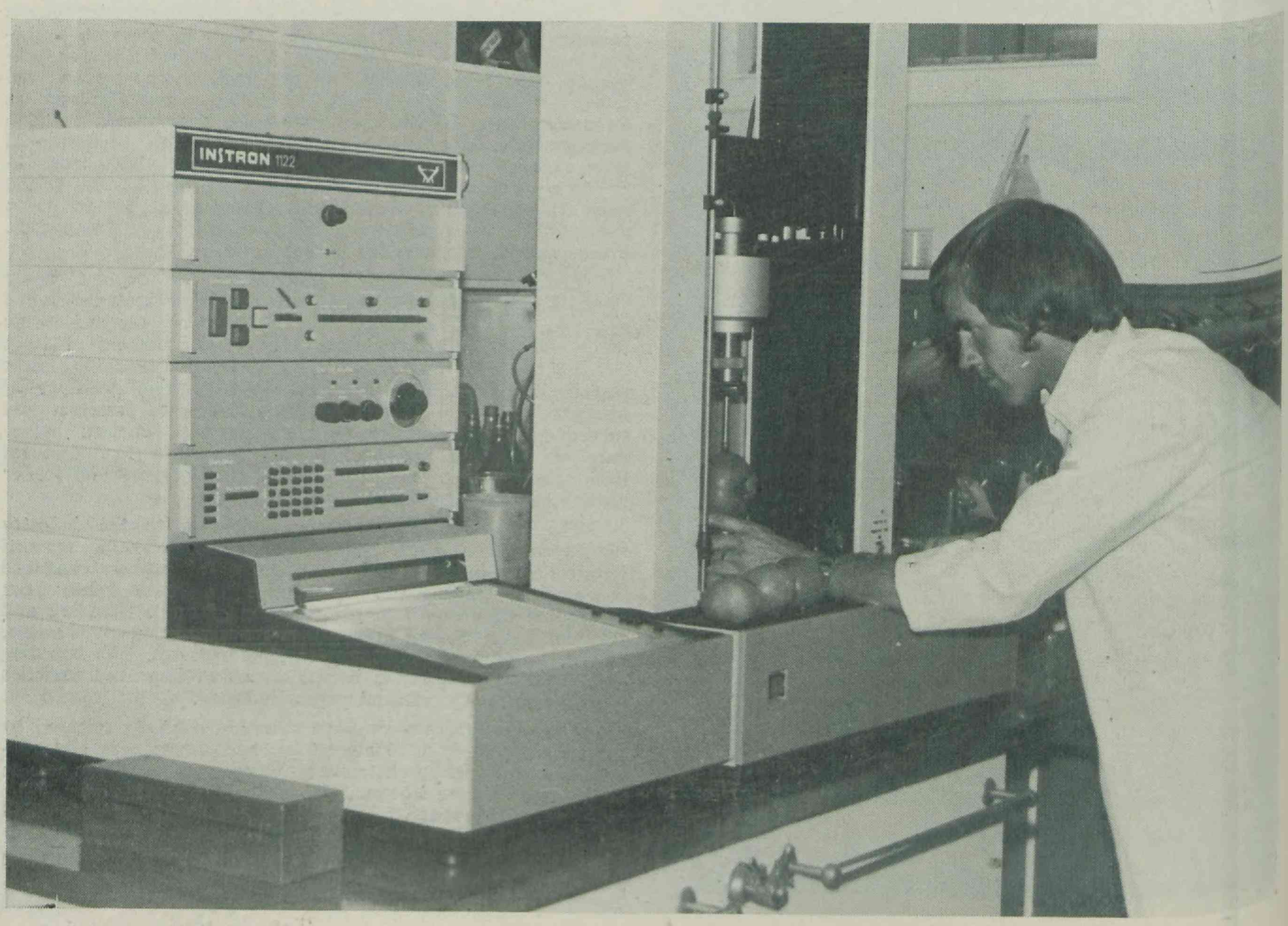
Apple close-planting experiments now in their sixth year of cropping have resulted in the recommendation of MM106 as a rootstock for close-planted Delicious and Granny Smith apples in the Granite Belt. Other rootstocks tested resulted in excessive tree vigour for the close-planting arrangements used and growth retardant sprays plus pruning failed to achieve a desirable tree size. Fruit yields with the close-planted arrangement are many times those for normal wide-spaced trees. New plantings of apples being made in the Granite Belt are mostly close-planted according to these recommendations.

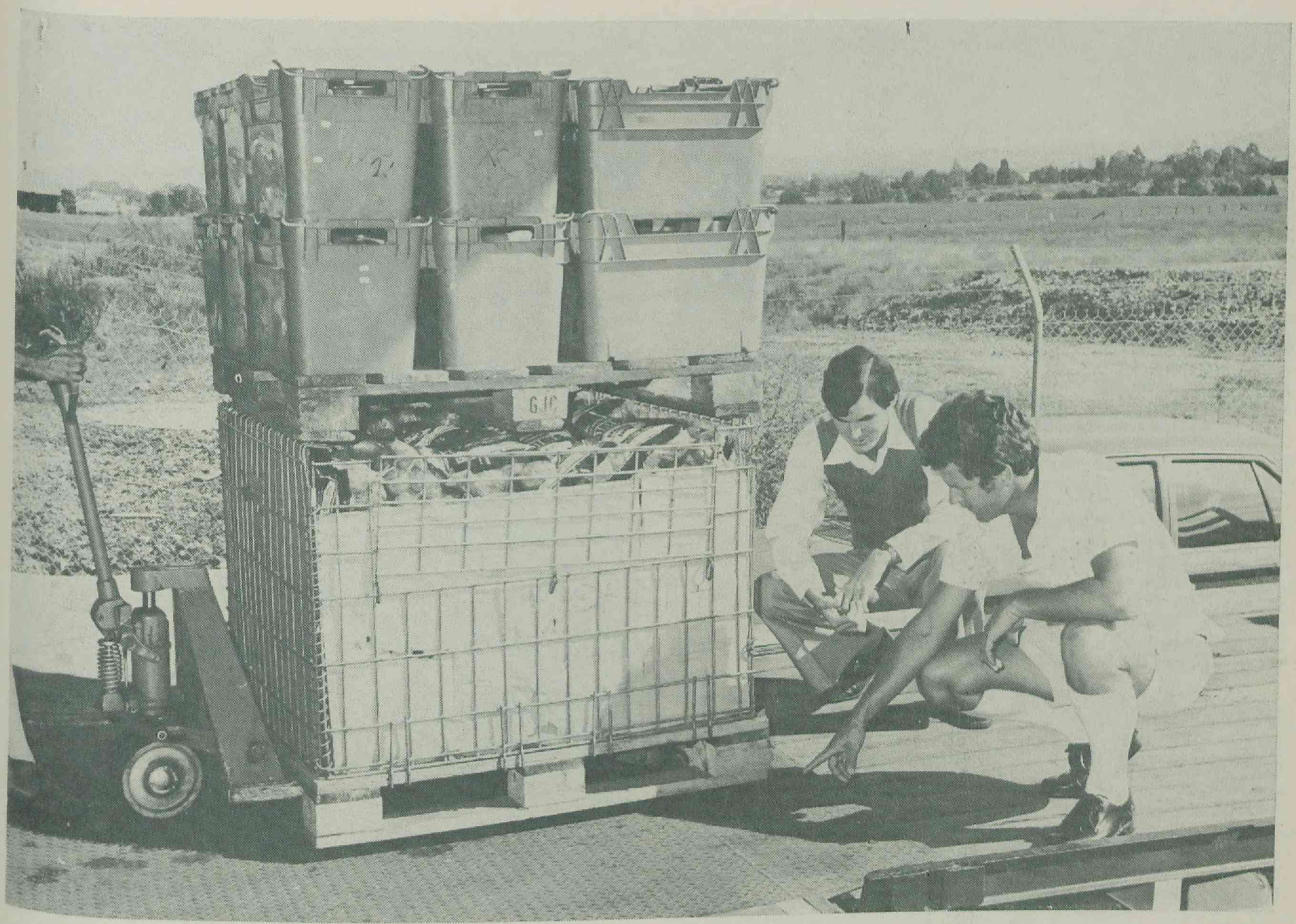
Research to assist the developing wine industry in the Granite Belt has continued with varietal assessment trials to study field performance and subsequent laboratory production of wines from field samples. This year's production of wines from the Granite Belt will be in excess of 450 000 *l* which is the highest production recorded from the area. The search for suitable dry white table wine grape varieties for the area continues, to overcome the problems of rain damage and breakdown often being experienced with traditional varieties. Because consumer preferences have been increasingly changing to dry white table wines at the expense of red table wines, this varietal introduction and assessment programme is an important factor in the continued development of the Granite Belt as a wine-producing area.

Post-harvest treatment

Studies on the effects of stage of fruit maturity at harvest and subsequent storage and ripening treatments on fruit carrying and eating quality have continued. New maturity standards for mango (13% total solids) and avocado (21% dry matter) have now been included in the marketing regulations as a result of this programme. A minimum of 9% soluble solids has been recommended as a standard for Wilson plums to overcome the problem of the crop being harvested when too immature and then coloured by gassing. A study with pineapples has shown that eating quality does not improve after picking, and that the commonly used criterion of picking at green to tinge of colour is too early for best eating quality, and that the earliest satisfactory picking stage is quarter colour.

An Instron unit being used to evaluate the firmness of tomato fruit. The improvement of fruit quality in tomatoes is a major aim of the research programme.





Pallet handling of produce, including 36-litre returnable crates and a bulk bin. The dock leveller allows fast, efficient loading of the truck.

Research work has shown that Granite Belt apples are generally too mature when harvested for optimum controlled atmosphere storage life. The programme aims at producing an objective standard for determining the optimum picking stage for controlled storage of apples. Controlled atmosphere storage also looks promising for extending the storage life of bananas as compared with conventional cool storage methods.

The grape varieties Waltham Cross and Purple Cornichon can now be satisfactorily stored at 0°C for 12 weeks provided two grape-guard pads are present in each container. The pads release sulphur dioxide when exposed to moist air. Quality deteriorates rapidly after removal from the cool storage conditions.

Pineapples showed chilling injury at all storage temperatures below 20°C. The chilling injury symptoms are similar to those of blackheart of pineapples, a troublesome field disorder. The chilling injury symptoms take some time to develop after removal from storage. Fruit could be satisfactorily stored at 10°C for 15 days, provided it was consumed within 6 days after removal from storage.

The use of refrigeration to remove field heat from fruit and vegetables before forwarding to markets continues to increase rapidly. Forced air cooling, where cool air is forced through vents in the carton, allows for rapid removal of field heat and is now widely used for tomatoes, and its use with broccoli, lettuce and sweet corn is expanding.

Handling and distribution

Considerable savings in packaging and handling costs could be made if the number and type of fruit and vegetable packages in use in Australia could be rationalized. A range of five packages with sizes ranging from 9 *l* to 54 *l*, having dimensions such that they are compatible with one another when palletized for cooling, storage and transport, is being further developed. The use of palletized units for handling fruit and vegetables is continuing to increase and the industry is being encouraged to adopt improved methods of handling and storing the units, for example, dock levellers for easy loading on trucks, and pallet racking for more efficient storage. Apart from actual cost savings with the use of unit loads, the system almost eliminates the problem of manual dropping of cartons, which has been found to be the main cause of fruit bruising during marketing.

Pallet racking is the most efficient means yet devised for storing produce. Thirty-six-litre returnable crates are being used in this store.

Varieties of statice imported from overseas are being evaluated for winter flower production in the Redlands district.

The number of 36 *l* plastic returnable crates in use in Australia has continued to rise with presently about 0·5m in use. In South Australia where a crate exchange is in operation, the cost of crate hire for a marketing operation is 23c compared with 60 to 80c for a fibreboard carton. A half-crate of 18 *l* is presently being developed.

A study of the use of electronic colour sorting systems in tomato packing sheds is presently in progress to further reduce the cost of packing operations. The operation is designed to sort the fruit into three sizes and three colour grades.

In studies on the road transport of bananas from north Queensland, fruit damage was most severe in cartons located over the front and rear axles. Polythene liners inside the cartons resulted in a marked reduction in abrasion injury to the bananas during transport.

Ornamentals

A programme of introduction of new flower crops for the Queensland industry is in progress. *Gypsophila paniculata*, cv. *perfecta* has been introduced from California and small quantities released for grower trials. Industry reaction to this variety has been very favourable. Nine varieties of statice have been introduced from the U.S.A. and Israel and evaluation trials are in progress.

Extension

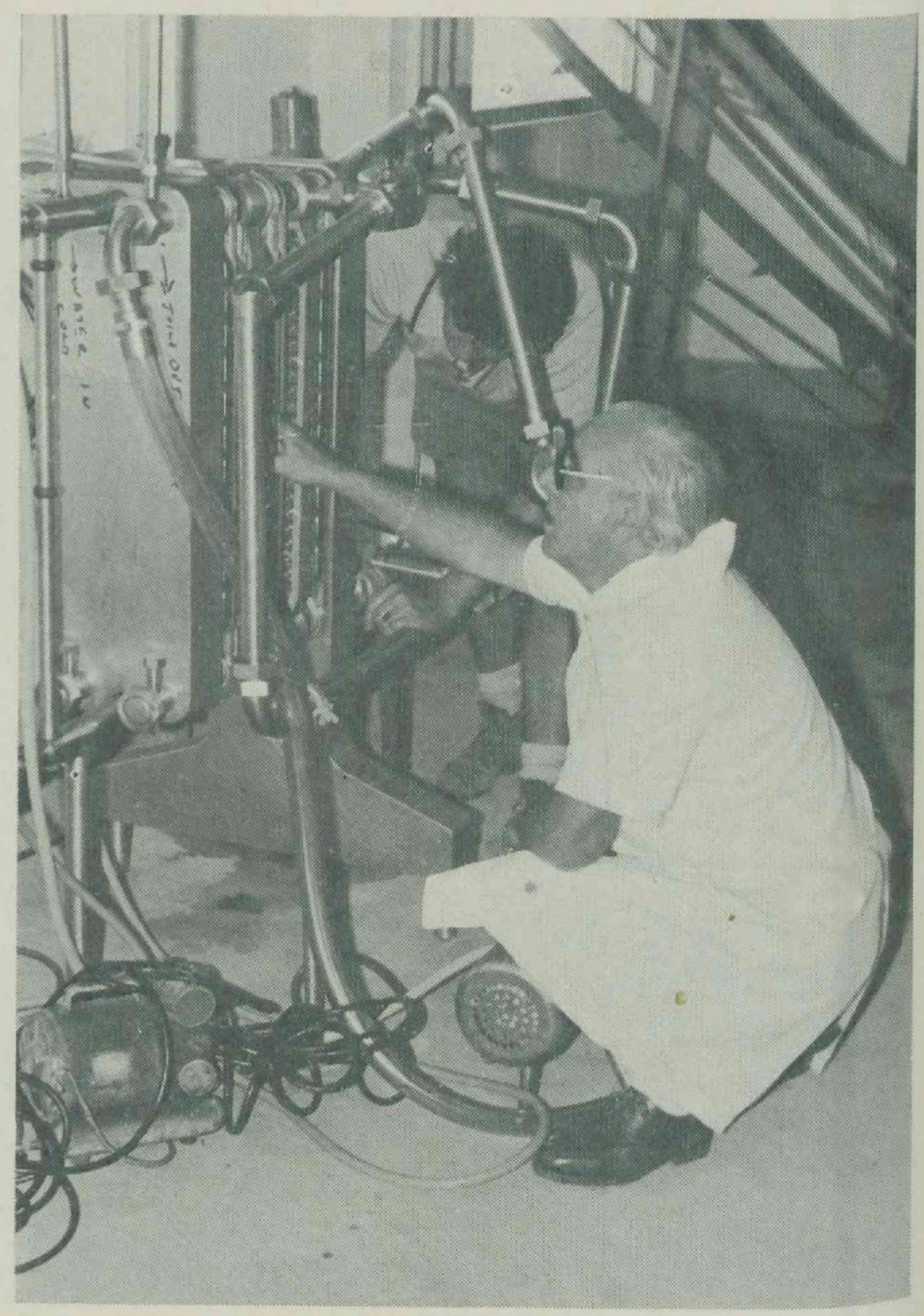
The continual high demand for the services of horticultural extension officers has persisted in all parts of the State, and in some regions has increased appreciably. Time-consuming requests for advice come from many new growers, some of whom have moved from other States, while others are inexperienced persons seeking an investment or a different life style. Increasing numbers of home gardeners also apply to the extension officers for advice. These heavy demands make severe inroads into the time which extension officers are able to devote to planned extension aimed at serving the established horticultural producers.

The following comments relate to the more important extension projects which have been in progress in the various districts this year.

In the Granite Belt, planned extension activities were reinforced by servicing the strong demand from individual growers for farming information. Demonstrations of forced air cooling of produce attracted considerable attention, and, as more growers adopt this practice, it is expected that their example will stimulate wider acceptance. Recent promotion of soil fumigation before planting tree crops has already had some success, and it is hoped that this will soon become an established practice in the district.

Promotion of the new 18 *l* carton which was introduced for stone fruit, vegetables and grapes has been highly successful, and this is now used almost universally. In addition to the usual Deciduous Fruit Spray Schedule which is produced annually, crop protection advice was increased through a series of regular releases in the local newspaper. In particular, the black spot warning service appeared to be very successful.

Granite Belt extension officers, working in collaboration with the Sandy Trout Food Preservation Research Laboratory staff, demonstrated that, in 1978, the period 15 to 22 February was the most suitable time for harvesting Delicious apples intended for controlled atmosphere storage. This trial will be repeated in 1979. The 6-year-old trees in the Close Planting Apple Demonstration produced their first reasonable crop this year, and close planted trees greatly outyielded those at the wider spacings.



Advice to industry on processing technology. This machine is a heat exchanger used in pasteurizing passionfruit juice.

After a lapse of 3 years, the Granite Belt Horticultural Research Station Field Day was reintroduced, and attracted over 170 growers. The activities were organized by extension officers, and included field trial and machinery demonstrations, and addresses on close planting, packaging, pre-cooling and fruit tree propagation.

As usual, the local press and radio were again used extensively to disseminate extension information; two issues of the Granite Belt Horticultural Digest were produced, and articles were also published in other journals.

Home gardeners and part-time growers

In the South Moreton Region, demand for service from innumerable home gardeners and part-time and potential horticultural growers has increased as subdivision of larger properties continues. In addition, the estimated 1 700 full-time commerical growers of mainly vegetable crops required substantial support as production problems continue to increase. While every effort is made to satisfy individual requests for assistance, increasing emphasis is being placed on group or industry extension activities. Numerous field days, grower seminars, group discussions and farm walks were held, all of which were well attended by interested growers. Subjects covered the more important aspects of the wide range of fruit and vegetable crops produced in the region.

Of particular interest is the Processing Vegetable Technical Discussion Group which was formed in the Lockyer district to provide a regular forum for growers, processors and technical organizations to discuss technical aspects of the vegetable processing industry. It serves as a medium for exchange of extension information, and also as a co-ordinating body for processing vegetable research, development and extension. Extension officers have also been co-operating actively with the recently re-formed Toowoomba Lettuce Growers' Association.

Other planned extension activities in the South Moreton Region have been designed to serve the banana, vegetable and strawberry industries, and to publish technical information for use by a wide range of horticultural growers. Such information appeared in two editions of the 'South Moreton Horticultural Digest' which has a circulation of 1 600, and the Committee of Direction of Fruit Markekting publication, 'Fruit and Vegetable News'. Many of the advisory leaflets on crop culture and gross margins were updated during the year.

In the North Moreton Region it has been necessary to rationalize the approach to extension because of the number of new extension staff, and the large and ever increasing volume of enquiries from new and inexperienced growers. Priority has been given to upgrading the technology and management techniques available to the major horticultural industries by evaluating, adapting and publicizing existing information and promoting research to fill gaps in the present knowledge. Attention has also been directed towards raising the capabilities of the less efficient growers, from whom most requests for assistance come. The intention is to increase the extent to which these growers will be serviced through appropriate group activities and self help and educational programmes.

Promotion of pre-cooling

In the Gympie District promotion of pre-cooling of produce has been very successful, with 14 cool rooms established and more being planned. Pre-cooled produce is moved to southern markets in refrigerated transport. Throughout the region, many displays and demonstrations of vegetative plant propagation, particularly of avocados, were arranged, using material prepared for Horticulture Expo IV which was held at the Queensland Agricultural College.

Close contact maintained with local grower associations throughout the region has led to many extension programmes and activities designed to meet common needs. Examples of these were the programmes of lecture and discussion sessions conducted through strawberry growers' associations at Nambour and Narangba during the strawberry season. These were devoted to subjects which were topical at each stage of the crop. Most extension in macadamias has been conducted through the Australian Macadamia Society using publications, field days and discussion groups. Particular attention is currently being given to encouraging the adoption of crop logging methods in fertilizer use.

In the Kingaroy district, surveys have shown that the major limitation on horticultural production is salinity of irrigation water. Trials to assess the suitability of a range of crops and varieties have been established in co-operation with interested growers.

Attention is being given to training staff in technical aspects of crop production. Of particular note in this connection was the production of an irrigation manual which was distributed to all Horticulture Branch extension officers.

In the Burnett Region there has been increased interest in growing horticultural crops by cane farmers wishing to diversify production to augment reduced farm incomes. This trend has resulted in a considerable increase in demand for extension services.

Promotion of pre-cooling and refrigerated transport of produce has been highly successful, but existing facilities are insufficient to handle the current rapid increase in horticultural production, particularly at peak harvest periods. Further extension work is planned to promote palletization, rapid cooling and chemical post-harvest treatment. Continuing extension work has been necessary to reduce the incidence and spread of watermelon mosaic virus in zucchini. Developmental and extension work is being carried out in the Gin Gin–Childers area to assist landowners to adapt to tree cropping. This sugar-cane land was declared an area of erosion hazard, and the assignments were transferred to other areas. Much of the area is suitable for horticultural crops which do not require inter-row cultivation, but nutritional problems and the eroded state of the land have created difficulties.

Citrus exports

The buoyant nature of the citrus market discouraged expansion in the adoption of vibra-packing, although it is generally used with the smaller sized mandarins. However, it is hoped that the current higher incomes will encourage investment in much needed bulk handling equipment. The use of gibberellic acid to delay rind senescence in export Ellendale mandarins has now been accepted as standard practice. The 1978 export crop attracted good prices, and the fruit had good internal quality with few breakdown problems, although some showed excessive green colour in the rind.

A series of lecture and discussion meetings has been conducted in co-operation with various grower organizations in the Bundaberg district. This approach to extension is proving beneficial in rationalizing the efforts of extension officers. The crop summary leaflets produced in Bundaberg are in good demand and, as they are of particular value to the many new growers, save much time for the extension officers.

The usual two issues of the 'Queensland Citrus Bulletin' were produced at Gayndah for distribution to all Queensland citrus growers.

In central Queensland the requests for service from hobby farmers and home gardeners tended to distract advisory officers from more active extension programmes. However, close liaison has been maintained with the various local producers' associations, and informative articles on various aspects of horticultural production have been published regularly in the local press.

In the dry tropics, the volume of enquiries has again increased as the numbers of both commercial and non-commercial growers continue to expand. Assistance has been given to growers at Alligator Creek, Oak Valley and Bluewater in developing their new avocado, mango, papaw and vegetable ventures. Mackay and Proserpine growers in particular are requesting more service as their horticultural industries expand. Here again, close liaison is maintained with local growers' associations.

Increasing efforts have been made in the wet tropics to cushion the impact of the heavy demand from commercial and non-commercial growers by producing appropriate leaflets. While there is still scope for widening the range of these publications, their rate of production is necessarily limited by other pressures for advisory services.

Promotion of the establishment of banana nurseries has been successful, as about one-third of the growers have adopted this technique to produce planting material. Problems with lifting the stools have been largely overcome by the use of improved cutter bars, and by siting the nurseries on light soil. Unfortunately, there has been little success so far from an educational programme aimed at improving banana irrigation practices.

Superior pineapple variety

The Queensland Cayenne pineapple variety released a few years ago has been found to be so superior to average farm run material that growers are now planting it as fast as it can be multiplied. Many have benefited from the extension programme on butt sectioning and the use of multiprop to achieve rapid multiplication of planting material. Extension involvement with the new avocado industry on the Atherton Tableland has been highly effective through close liaison with the Atherton Tableland Avocado Growers' Association and the publication of appropriate extension material. As a consequence of this close collaboration, growers have adopted the latest cultural and crop handling techniques.

Extension officers have promoted papaw plant selection through field days and extension leaflets, and by provision of nucleus stocks of seed. Definite improvements in pest and disease control in litchis and in selection of the most suitable varieties for the Coast or Tableland have resulted from planned extension activities. Northern staff also conducted a workshop on horticultural crops for aborigines from many parts of north Queensland, in association with the Department of Aboriginal and Islanders' Advancement.

Extension conducted from the Sandy Trout Food Preservation Research Laboratory has been aimed at disseminating information on the latest methods of handling fresh produce, and food processing. Considerable effort has been devoted to promotion of on-farm pre-cooling of fruit and vegetables and the efficient use of refrigerated transport. There has been a very good response from the Bowen, Lockyer Valley and Gympie districts, and interest has been shown by many retail firms in the cool storage of fruit and vegetables. The laboratory is co-operating with the Committee of Direction of Fruit Marketing in developing the 'humidifresh' high humidity cooling system which will be of particular value to country consumers of produce from the Brisbane Markets.

Regular contact has been maintained with commercial food processors, and research results and new products developed by the laboratory have been made available to them. Assistance has also been provided in developing markets for guava products, preparation of dried fruits, and improving the quality of wine produced in the Granite Belt.

Servicing activities

Marketing Extension Service

This service is now in its fourth year of operation and it continues to be very favourably received by growers throughout the State. Oversighting of fruit and vegetable consignments on the Brisbane Market has continued on a regular basis to identify any quality or presentation defects which are occurring and notify the growers concerned through the local extension officer.

During the past year, 193 notifications were issued providing details of consignments in which improvements could have been effected. This compares with 297 in the previous year.

There has been a very obvious improvement in the marketing of broccoli and, despite increases in supplies from 21 500 containers last year to almost 40 000 packages during the past 12 months, the average price has risen from 85c to 88c a kilogram. The use of pre-cooling, improved varieties, and better packaging have all contributed towards higher returns to the grower.

There was a general improvement in the quality of cabbages compared with that of last season when many consignments showed moderate to heavy caterpillar damage. The use of newer insecticides has contributed to the improvement in pest control.

Anthracnose appeared to be the main problem in avocados, although fruit in some consignments was excessively blemished by insect damage. In order to maintain their reputations, growers must ensure that avocados are not harvested before they reach an oil content high enough to guarantee satisfactory ripening and good flavour.

The quality of papaws, particularly from the North Coast, has improved markedly, and the incidence of ripe fruit rots has decreased substantially. Mixed maturity of tomatoes continued to be a problem; and market losses in rockmelons from ground rots has not improved when compared with the wastage during the previous year.

Citrus Budwood and Seed Distribution Scheme

During 1978, Queensland citrus nurserymen and some orchardists were supplied with 141 020 citrus buds and 91·85 kg of seed for rootstocks. This represented an increase of 17% for buds and 8% for seed over the previous year. There were increases in orders for buds of Washington Navel and Joppa orange, Imperial mandarin and Villa Franca, Lisbon and Meyer lemon. Availability of rough lemon seed was in excess of requirements, but Troyer seed fell far short of demand because of a light and generally poor crop in the Gayndah district.

Problems were encountered in locating adequate supplies of scaly butt virus-free Joppa budwood and brown spot-free Emperor mandarin. It is expected that the demand for scaly butt virus-free budwood will rise as nurserymen use more Troyer rootstocks.

Establishment of Special Mother Budwood blocks commenced late in 1978 with the planting of 400 trees comprising Washington Navel and Valencia oranges. Young trees are being raised for planting two more blocks in spring, 1979. These trees have been produced from virus-free true-to-type propagating material and will be grown under specified conditions of isolation for the supply of budwood under a new improved scheme.

Strawberry Runner Scheme

The operation of this Scheme is under the control of a committee comprising representatives of the Committee of Direction of Fruit Marketing, commercial strawberry growers and the Plant Pathology and Horticulture Branches of this Department. Field inspections of contract runner growers' properties, and the investigation of problems associated with the distribution of Special runners continue to involve an appreciable time commitment by Departmental officers, particularly the extension staff.

The main objective of the Scheme is to provide virus-free planting material to the strawberry industry, but it also guarantees high quality true-to-type runners as free as possible from pests and other diseases. In its 16 years of operation, the demand for runners has increased steadily and, in 1979, 1 085 000 Redlands Crimson and 397 000 Earlisweet runners were supplied to 345 growers.

Unfortunately, production of marketable runners did not meet the demand, and many orders could not be completely filled. The shortage developed late in the production stage because root development on many runners was reduced by the very unfavourable weather conditions which occurred. A problem with crimp nematode was also encountered on one contract area.

Bean Seed Scheme

Production of French bean seed under this Scheme was confined, until recently, to the Burdekin and Bowen areas. However, production has commenced in the Biloela area of central Queensland and interest is increasing. In 1979, 142 ha were planted in the Biloela area, which was double the 1978 planting; and it is expected that 250 ha could be planted in 1980.

This year, a total of 412 ha of beans in all seed categories was registered in the Burdekin area and 25 ha in Bowen, with production of Approved seed increasing at the expense of Crop Certificate. In 1978, some early-planted areas of processing bean varieties in the Burdekin were damaged by rain in August close to harvesting but, after cleaning, the yield and seed germination were still high.

There has been a generally low demand for Queensland-produced French bean seed, and processors have tended to draw their supplies from reserves or from overseas. The variable size and quality of Queensland produced bean seed is believed to be responsible for the attitude of processors. Accordingly, several research projects have been initiated with the objective of obtaining solutions to these problems and at the same time increasing seed yield. Based on the results of this work to date, extension efforts have been directed towards encouraging growers and seed merchants to improve handling techniques to reduce seed damage during harvesting, cleaning, storage and transport.

A quarantine inspector in north Queensland inspects the area around banana plants for the possible presence of the Giant African Snail.

Regulatory

Plant quarantine

The Plant Quarantine Service aims at preventing the entry into Australia of any pests or diseases of plants or any weeds that might constitute a hazard to primary production. The Branch operates this service in Queensland as an agent of the Commonwealth.

The activities involve the surveillance of all passengers and cargo entering the State from overseas by air and sea and the supervision of all plant introductions. Officers service all points of entry, the main ones being Brisbane, Gladstone, Rockhampton (Port Alma), Townsville and Cairns.

Cape York–Torres Strait is an area 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. There is increasing movement of small boats and aircraft in the sparsely populated area. Arrangements are being made to locate a plant quarantine officer in this area to increase the surveillance of this traffic and to continue the pest trapping programme. This programme aims at monitoring the movement of fruit flies in the area so that, if any exotic species are found, eradication programmes can be initiated.

While every effort is made to prevent entry of pests, diseases and weeds, from time to time one of these may pass through the primary quarantine barrier and become established. The Giant African Snail was detected at Gordonvale in April 1977 and, although the baiting and detection programme is continuing, no live snails have been caught since December of that year. It now appears that the saturation baiting programme with associated publicity and assistance from the public has led to the successful eradication of this dangerous threat.

Developments in containerization have now reached the stage where 85% of the cargo entering the Port of Brisbane is containerized. Logs and timber are the major exceptions. Although containerization does make quarantine surveillance more difficult, satisfactory procedures have been developed.

The following table lists the volume of traffic in some of the main categories—

	1977/78	1978/79
Total No. of passengers by sea and air	160 305	174 467
No. of overseas cargo vessels (Brisbane)	509	632
Containers from overseas ..	19 800	26 600
Timber in cubic metres	58 542	57 447
Consignments of plants imported	382	378
Consignments of plants released ..	275	287

The value of a Plant Quarantine Service continues to be evidenced by the interception several times throughout the year of serious pests such as the Giant African Snail, Sirex timber wasp and several types of wood borers in imported timber.

Treatment of fruit for interstate movement

Supervision of fumigation of fruit and vegetables destined for areas free of fruit fly in the southern States has again been carried out by extension staff this year in collaboration with officers of Standards Branch. Gayndah district staff attended to citrus fumigations at the Gayndah Co-operative Packers' room, and the Golden Mile orchard at Mundubbera during part of the harvest season.

At Bundaberg, staff supervised the fumigation of 24 952 cartons of capsicums destined for Victoria and issued 35 certificates between June and November.

Treatment of plants for interstate movement

The number of persons entering the nursery industry has continued to increase, and there are now in excess of 1 200 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 to the extent that there are now six with Group A and 93 with Group B registrations.

Although the volume of the interstate plant trade has expanded, the number of inspections carried out in connection with the supervision of plant treatment, and the permits issued, have remained at about the same level as last year. This is because registered export nurseries are permitted to carry out treatment of plants without supervision and issue their own certificates.

Banana Industry Protection Board

The total number of banana growers in Queensland has remained fairly constant and the figure now stands at 1 078. The total area under crop has increased from 3 100 ha to 3 300 ha. Bunchy top disease has continued to be a problem in the Southern Banana Quarantine Area, and infected plants have been found in 83 plantations during the year. Panama disease was located on 148 properties.

A total of 1 796 bunchy top infected plants was found in the Southern Banana Quarantine Area, which is equivalent to one diseased plant in 0·75 ha. However, this infection rate is based on diseased plants found in both commercial and residential holdings, and is therefore somewhat higher than it would be for commercial plantations alone.

Further progress has been made in the campaign to eradicate bunchy top in the Brisbane Metropolitan area. The number of infected plants found has decreased, but it is evident that it will be some years before the project is completed. Locating diseased plants in residential holdings is much more difficult and time consuming than inspecting commercial areas.

During the year, 16 leaf spot notices were issued under the legislation aimed at eradication of neglected plantations, compared with 14 last year. The drive to eradicate neglected areas has had some success, but unfortunately it is still sometimes necessary to exert pressure on growers to obtain their co-operation.

Once again, the levy payable by growers on Queensland-produced bananas had to be increased by approximately 15% to offset continually rising costs of field inspectional operations.

Agricultural Chemistry Branch

BESIDES providing analytical, diagnostic and advisory services to primary producers, and other Branches within this and other government departments, the Agricultural Chemistry Branch, through its main centre at Indooroopilly and regional laboratories, is engaged in a wide range of investigations in the field of agricultural and animal science.

As part of a rationalization programme, the small Branch laboratory at South Johnstone was closed. Chemical services for work in the wet tropics will be provided by the new Branch laboratory at Mareeba.

Research

Pesticide chemistry

Because of development of resistance to other insecticides, treatment of grain with newer pyrethroids may be required to control pests of stored products. In co-operation with Entomology Branch, a study is being made of residues of these pesticides in treated grain to ensure these fall within acceptable limits. Wheat and sorghum treated with permethrin, phenothrin, decamethrin and fenvalerate at the silo level have been stored for nine months in pilot usage trials. Analyses of the grain at regular intervals have shown that the concentrations of the four pesticides do not vary appreciably during the storage time. Further work has shown that much of the residue is in the bran fraction with little in the flour when the treated grain is milled. Little of the residue is lost during the baking process when bread is prepared from the flour. This information on residues will be presented to the Codex Alimentarius Commission.

In the laboratory, rates of breakdown of the four pyrethroids on grain for various extreme conditions of storage (time, temperature and moisture) are also being studied so that the residue level remaining may be predicted under field situations.

Entomologists have observed that, for some insecticides, aged residues are less effective against insects than fresh residues even though chemical analysis has shown the same concentrations to be present. This effect is being studied for decamethrin on wheat, but excessive variability between samples has as yet prevented any definite conclusions being drawn.

Work on the pyrethroids was supported by funds from the Wheat Industry Research Council for the purchase of a high performance liquid chromatograph.

Fifty-three samples of grain (sorghum and barley) from commercial silos and sheds were analysed for carbaryl and fenitrothion residues. For most stores, analyses showed that pesticide was evenly distributed indicating that effective pest control without residue problems could be expected.

Samples of pawpaws, mangoes and capsicums were fumigated with ethylene dibromide (EDB) for fruit fly disinfestation. Residues of EDB were then measured in the stored fruit after various storage times to find the rates of loss of the fumigant.

Chemical analyses to determine herbicide residues in soil are costly and time consuming. A simple bioassay method has been developed as a rapid test for many herbicides. Beans are the most useful indicator plant and symptoms produced by soil residues have now been identified for 12 herbicides. By growing bean seedlings in suspect and control soil any obvious damage symptoms will indicate the presence of herbicide residues and may allow the type of herbicide to be identified.

Diphenyl is used as a fungicide on citrus fruit for export. After reports of high residues and problems with skin burn, two cases of mandarins which had received normal commercial treatment were analysed for diphenyl, layer by layer. The layer of fruit next to the diphenyl-treated pads had the highest residue levels but even these were below the 70 p.p.m. MRL. Even after storage for 4 weeks there was no sign of any problems with skin burn.

Benomyl dips are used as a post-harvest control of fungus disease in citrus. Queries had been raised about the stability of dip concentrations but laboratory studies have shown that the concentrations remain constant at working temperatures of ambient and 52 deg. C. Also, inadequate preparation of the dip gives a concentration in suspension lower than expected.

Bees are important primary pollinators of crops, as well as producing honey and beeswax. Forty-one compounds have been synthesised and/or laboratory tested for their ability to repel bees from pesticide treated crops. Two compounds, one of which may be useful for this purpose and the other more useful for robbing hives, warrant further testing.

Plant chemistry

The rate of nitrogen fixation can be found by measuring the activity of the nitrogenase enzyme complex in leguminous plants. This activity can be estimated from the reduction of acetylene to ethylene in controlled experiments using incubations in glass jars. After standard incubation times in an acetylene atmosphere, samples of the air are analysed by gas chromatography for ethylene content. A number of samples of nodulated roots has been assayed by this technique in joint work with the Plant Pathology Branch.

A study of selenium levels in Queensland grains, prepared poultry feeds and feed ingredients has been completed. No potentially toxic amounts of the elements have been found but quite low values in grain samples have occurred. These low selenium grains are associated with soils derived from tertiary volcanic parent material in several areas of the State.

Analysis of cotton squares for terpenoid aldehydes has continued in support of the programme aimed at developing lines resistant to *Heliothis* species. A more specific analytical technique is being used to test promising lines for active compounds other than gossypol.

Cereal chemistry

The primary role of the Cereal Chemistry Section stationed at the Queensland Wheat Research Institute is to evaluate the quality of new material arising from the Department's wheat and barley breeding programmes. Two levels of testing are involved. Firstly, to determine which lines are worth keeping in the programmes, several hundred lines are screened using relatively few quality tests. Later evaluation establishes whether new crossbreds are of suitable quality for production in Queensland. This involves a large number of tests on samples from 15 to 20 locations for at least 2 years. The wheat variety Banks, released this year, combines good grain appearance with excellent milling and baking quality.

In addition the section tests the most promising lines from breeding programmes conducted in New South Wales. This work enables the identification of varieties which may have suitable quality for Queensland and also allows recommendation of New South Wales varieties to be made in Queensland without delay.

Unfortunately, associated with the increased yields of the newer varieties is a decrease in protein content. This results in less of the crop in any year being eligible for Prime Hard classification.

A rapid technique for estimating the malting potential of barley cultivars using near infrared reflectance spectroscopy has been developed. This new method offers the potential to select lines for malting quality at the rate of 45 per hour compared with four per day using the standard procedures.

Soil fertility

Through soil chemical analyses and glasshouse nutrient screening experiments the nutrient status of major soils is being assessed in several regions of the State. As part of this ongoing programme the changes in soil fertility after development are being determined.

Other studies are designed to produce information which will permit more reliable predictions of fertilizer response and so lead to more economic and efficient use of fertilizer. Much of the work is done in co-operation with officers of Agriculture Branch. The Commonwealth Extension Services Grant provided part of the finance for this programme.

NUTRIENT SCREENING OF SOILS. Programmes in several regions are aimed at better definition of nutrient status through the detailed sampling of soil mapping units for chemical and physical analyses and for glasshouse pot experiments. This is followed by confirmation in several field experiments.

Laboratory analyses have been completed for major soils recently mapped in the Burdekin region and are continuing for basaltic clays in central Queensland. In the South Burnett region, eight field experiments have now been conducted in the Gordonbrook soils to test the results of pot experiments.

PHOSPHORUS IN TROPICAL SOILS. Since the amount of phosphorus required for optimum plant growth on a particular soil depends on the phosphorus sorption ability of that soil, a study of the phosphorus sorption parameters of a number of north Queensland soils has been conducted. An easily measured index of a soil's ability to absorb phosphorus has been developed and used to define which factors are important in determining phosphorus sorption in soils. This index is also being tested in combination with empirical extraction methods of analysis as a predictor of the fertilizer requirements of Greenleaf desmodium pastures.

GRASS-LEGUME PASTURES. In previous years this experimental programme, designed to investigate the phosphorus, potassium and sulphur nutrition of grass-legume pastures in south-east Queensland, had concentrated on white clover, desmodium and Siratro-based pastures. In 1978–79 the emphasis was on glycine-based pastures.

Phosphorus fertilizer recommendations, based on either soil or plant tissue analyses, have been formulated for white clover, desmodium and Siratro-based pastures. A critical soil sulphate figure has been determined for Siratro-based pastures.

PEANUTS. At an experimental site near Kingaroy, potassium and calcium fertilizers have been applied to create a range of soil levels in these nutrients. Peanuts cv. Virginia Bunch growth at the site showed marked yield improvement with potassium and quality improvement with calcium. However, yield and quality were only poorly correlated with measured soil values. Efforts to obtain a soil test diagnosis of potassium and calcium deficiencies in peanuts will continue. Possible nutrient deficiencies are being studied in the Dimbulah and Mt. Garnet areas of north Queensland where peanut production is expanding.

SOYBEANS. Fertilizer experiments in the South Burnett have shown that present laboratory tests are not good predictors of the phosphorus requirement of soybeans on these soils. A test based on the phosphate sorption capacity of the soils is now being investigated. This test is also being studied on Darling Downs black earths where it has been found that soybeans can obtain sufficient P from soils on which maize requires phosphate fertilizer.

WHEAT. Branch officers at Q.W.R.I. have assisted in 30 nitrogen x phosphorus fertilizer trials in the Central Highlands and 48 similar trials in the Western Downs region over the past 5 years. Yield and quality assessments from these trials, together with associated soil analyses, have provided the basis for predicting N and P fertilizer requirements for wheat in these regions.

SORGHUM. Two long-term experiments in the South Burnett and one at Emerald were established to relate sorghum yield to measured soil P values.

These experiments compare low annual maintenance rates of superphosphate with the residual effects of once-up heavy applications (up to 3 tonnes super per hectare).

Such information is being used to develop strategies for economical long term usage of superphosphate.

Experiments in the South Burnett have shown that nitrogen applied to sorghum at planting was more readily utilized than either pre or post planting applications.

RICE. In rice studies in the lower Burdekin, two soils each containing 5 p.p.m. P_A (acid extractable phosphorus) responded to added phosphorus while one of 14 p.p.m. P_A did not. The absence of response at 14 p.p.m. P_A (when 30 to 40 p.p.m. P_A is needed by most other crops) shows that rice is an efficient exploiter of low phosphate soils.

GENERAL. Various glasshouse and field nutrient trials were conducted to (1) evaluate nutrient deficiencies in particular soil types, (2) evaluate nutrient deficiencies in pasture soils with different management histories, (3) compare nutrient requirements of different pasture legumes, (4) compare the efficiency of utilization of isotope-labelled phosphorus by sunflower, safflower, rape, linseed and soybeans.

Salinity

Salinity is a hazard of irrigation areas and the Branch studies of possible salt movement continue for Emerald and Burdekin areas. Further sampling has been done for localized saline seep areas at Emerald and at one site the insertion of a slotted PVC drain has resulted in some improvement. Elsewhere in the irrigation area, regular sampling has shown downward movement of salt after a few years of irrigation.

In the Callide Valley sampling and analysis of underground waters have continued. Following high winter rainfall in 1978 water levels have risen and salinity decreased in many bores.

There has been increased awareness of outbreaks of dryland salinity and selected affected areas are being studied in detail to determine causes and suggest amelioration methods. The earth resistance meter is being evaluated as a rapid field technique to define the extent and severity of salt affected areas.

On the Darling Downs, some dryland salt outbreaks have been sampled in detail. Tubes were installed to measure changes in water table depth and quality to allow the most suitable amelioration methods to be developed.

A coastal salt-affected area near Brisbane was studied and a detailed plan devised for drainage and reclamation of the land for horticultural use.

Soil and land use surveys

Soil surveys for irrigation planning and development have continued in the Burdekin and Emerald areas. The irrigation suitability of alluvial soils of the Byee area on Barambah Creek in the South Burnett was studied and a soils map and report prepared. A soil survey of the Kalbar area in the Fassifern Valley has also been completed.

A 1:100 000 soil survey has commenced on 190 000 ha of the agricultural lands of the Kingaroy, Wondai, Murgon and Nanango Shires.

A mining lease area of the Collinsville Coal Company was surveyed to define soils suitable for rehabilitation topdressing and to determine suitable areas for acid water ponding. Operating funds were provided by the Company.

Soil physics

SOIL-PLANT WATER RELATIONSHIPS. The possibility of soil factors limiting yields of Pangola grass was studied at Millaroo Research Station in the Burdekin Valley. Tractor ripping of soils increased available water storage and measured water use was greater in ripped plots but this was not associated with increased yields. It appears that soil factors other than available water are responsible for the low yields.

In the Emerald Irrigation area results from small plot studies on plant available water are being tested on commercial crops. Associated studies of possible leaching of nitrogen fertilizer have shown some significant losses of nitrate through tail drains. However, through drainage in shallow Basaltic soil profiles appears to be small.

Prediction of plant available water from laboratory measurements was used in a study of the irrigation potential of soils of the Byee area, South Burnett. Predicted values were in good agreement with actual field measurements at two experimental sites.

SOIL MANAGEMENT. A request from the Collinsville Coal Co. to develop suitable methods of ponding acid mine water to prevent soil and water pollution led to a series of laboratory experiments. Several treatments were applied, including the addition of limestone. This precipitates heavy metals from the water, thus removing pollutants from the system and, at the same time, restricting water movement through the soil. The most effective method of soil treatment was to add slaked lime to the soil, incorporate it into the surface, and compact the soil at the optimum water content. A guide to the selection of suitable soils for ponding was provided.

SOIL PHYSICAL PROPERTIES. One officer from the Soil Physics group spent 12 months at the Waite Agricultural Research Institute, Adelaide, using specialized equipment for the study of soil microstructure and surface adsorption. Twelve cracking clay soils from the Darling Downs, central Queensland and the Burdekin Valley were examined. Measurements of soil microstructure were related to physical properties relevant to field behaviour, such as swelling, shrinkage, stability to wetting and "self-mulching" characteristics. Self-mulching which may be described as the capacity of soil aggregates to form under the influence of field wetting and drying, was related to swelling capacity.

A simple set of measurements, based on the adsorption of water vapour by soils at low relative humidities, can be used to predict with acceptable accuracy cation exchange capacity, clay mineral activity and swelling capacity. The use of these measurements could lead to considerable time saving in routine soil analysis.

Method development

A high performance liquid chromatograph was installed during the year. Methods using this technique have been developed for the analysis of pyrethroids in wheat and sorghum, carbaryl in wheat and azinphos ethyl in apples.

An inductively coupled plasma spectrometer (ICP) was recently purchased. Preliminary testing of this instrument has demonstrated that it is a powerful tool for determining trace amounts of metals in plants and soils. A method for the measurement of chromium in bovine faeces has been established to service an investigation of food intake in grazing animals.

An in-depth study was made of the application of optimization strategies, in particular Simplex strategies, to the problem of establishing optimium instrument operating conditions. Use of these techniques has enabled significant improvements to be made both in instrument sensitivity and economy of operation.

Other methods examined during the year include a study of the effect of milling on trace element content of plant samples, and determination of cadmium, fluoride and galactomanans in plant material.

Regulatory and general chemistry

Regulatory

Analytical controls required by the Agricultural Standards Act are provided by the Branch. In addition, chemical testing of fumigation chambers for certification and testing for the presence of protective fungicides in stone fruits are a Branch responsibility. In the wider sphere the Branch takes part in national and international programmes for setting standards for pesticide analytical methods and specifications.

The analyses provided for administrative purposes for the Agricultural Standards and Agricultural Chemicals Distribution Control Acts were:

Pesticides	213
Veterinary medicines	39
Fertilizers and limes	119
Stock feeds	712
Pesticide residues	112
Miscellaneous	62

The year has been noteworthy for the extension of regulatory analytical services relating to fruit export and import.

General chemistry and services

Most samples handled are plant and soil samples from departmental research projects but there is also a large number of waters, soils and miscellaneous samples examined for primary producers. Besides chemical analyses other services provided relate to diagnosis of mineral deficiencies in plants and advice on soil physical and soil classification problems. In addition, comments are made on the suitability of waters for irrigation based upon figures supplied by the Queensland Water Resource Commission.

Other samples handled included sawdust for pentachlor phenol residues, seeds and bees for insecticide residues, various pesticides for identification, and eroded soil and silt for atrazine residues.

Samples analysed at the Indooroopilly laboratory were—

Plants

Elemental analysis	15 704
Oil seeds—oil content	3 087
—fatty acids	134
Tobacco —alkaloids	650
Waters	2 132
Soils	13 782
Pesticides	41
Pesticide residues	17
Miscellaneous	98

The number of soil samples received is 49% more than the number handled in 1977–78. The laboratory resources are strained to the utmost and there is a carry over of almost 4 000 soil samples.

Of interest are the results of work done on the disposal of fowl manure on soil and pasture. Analysis has shown that there is no significant build-up of nitrate ions in the soil profile after 2 years' monitoring. A report is being prepared on this work.

The upsurge in interest in home gardening has led to requests from nurserymen for assistance in finding substitutes for potting mixtures.

Thirty-five samples of local peats were tested as possible substitutes for expensive, imported sphagnum moss peats in potting mixtures. None of the local samples had the water-holding capacity of sphagnum moss peat.

Entomology Branch

THE objectives and functions of Entomology Branch are—

To develop practical and economic methods of controlling insect and allied pests of plant crops (excepting sugarcane and forest products) and crop products grown in Queensland and to make these control measures available to the primary producing community through the extension services.

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 and three each in central and north Queensland.

Pest activity

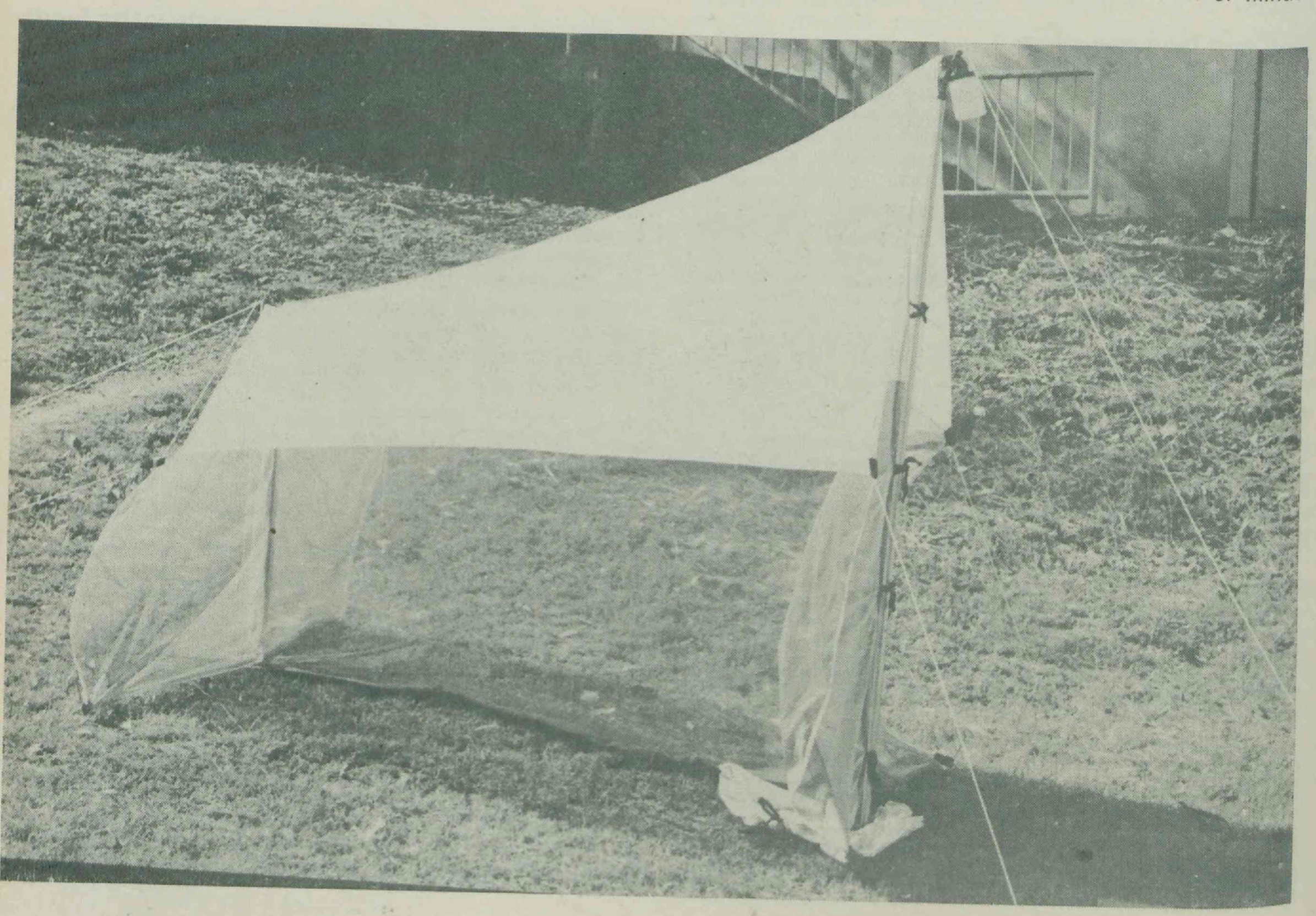
Locusts

In contrast to previous years, locusts were not a significant problem in 1978–79.

Populations of the spur-throated locust (*Austracris guttulosa*) consisted of scattered, isolated individuals confined for the most part to grassland areas in central and western regions of the State. Invasion of cultivated crops by this insect occurred on only one occasion when small to moderate numbers of adult locusts inflicted slight damage on unsprayed soybean plants in the St. George Irrigation Area. In fact, the spur-throated locust has not been of major concern in Queensland for the past 2 years.

Above-average activity by the two species most prevalent during the year, the Australian plague locust (*Chortoicetes terminifera*) and the migratory locust (*Locusta migratoria*) either occurred over a comparatively brief period or was confined to a relatively localized area. Damage to crops and pastures resulting from the activity of these two insects was negligible.

Not a tent but a Malaise trap used by entomologists for collecting small flying insects. The insects fly into the trap, strike the back wall and then make their way to the highest point of the roof where they are caught in the collecting jar. Using one of these traps, D.P.I. entomologists have added considerably to the Department's reference collection of minute parasitic wasps.



For most of the year, the Australian plague locust existed as scattered, isolated individuals in southern border districts and the far south-western region. Hatching of eggs in border areas in late summer was followed by the development of several hopper bands, which in turn produced adult swarms of medium density during autumn. Swarms of this type were located in the Goondiwindi, Inglewood, St. George, Mungindi and Cunnamulla districts.

Most of these populations occurred in natural grassland and were of little concern. Two of the swarms in the Goondiwindi district were discovered adjacent to grain sorghum crops and a further one was found adjacent to an oat crop. However, none of the crops suffered economic damage. Low-density populations of adult Australian plague locusts were found in the Millmerran and Yelarbon districts during late autumn but did not cause any significant damage. By the end of the year, populations of the Australian plague locust in all areas had declined naturally.

Activity of the migratory locust (*Locusta migratoria*) was largely confined to central areas of the State in the Barcaldine, Blackall, Yalleroi, Longreach and Isisford districts. Infestations in these areas developing over several generations persisted through summer and into late autumn, reaching a peak of population increase during March. Despite the population build-up, no migration away from the region occurred and little economic damage was inflicted on local crops and pastures.

Two small concentrations of mature migratory locusts were observed in areas of the Banana Shire east of the Dawson River, but these did not produce significant infestations.

Heliothis

Budworms (*Heliothis armigera* and *Heliothis punctigera*), which are among the most serious agricultural pests in Queensland, were active in most parts of the State during summer and autumn. Early-season infestations caused damage in linseed and lucerne crops in the South Burnett district, in lucerne and soybeans in the Lockyer Valley and in sunflower crops on the Darling Downs.

In central Queensland, grain sorghum and cotton were the crops most affected. Abundant egg-laying on tobacco heads occurred in the Mareeba and Dimbulah districts during late summer. Parasitic insect species which normally effect about a 25% reduction in *Heliothis* numbers in the tobacco-growing districts were comparatively inactive this season, allowing a considerable build-up of budworm infestations.

Despite the widespread activity of *Heliothis* populations and the development of damaging infestations throughout the State's agricultural areas, control of these pests was excellent in most instances.

Brown planthopper on rice

Outbreaks of the brown planthopper (*Nilaparvata lugens*), which is a serious pest of rice in Asia, severely damaged rice crops in the Mareeba and Ayr districts during late summer. This insect has been established in north Queensland for some years, but previous infestations have not attained the degree of severity experienced this year.

Infestations at Mareeba began in late January and quickly developed to damaging levels throughout the district. Control action was taken, but the insect's spatial distribution and the growth habit of the rice plant make it difficult to achieve control with insecticides. The planthopper occurs mainly near the base of the plant, just above water level, and the crop forms a dense canopy which acts as a barrier to penetration by low-volume sprays applied by aircraft. In addition, the high temperatures and humidity at the time were ideal for rapid development of planthopper populations, while the frequent, heavy showers contributed to difficulties with insecticide applications.

A new insect in Australia

An insect new to Australia, the three-lined potato beetle (*Lema trilineata*), was discovered in Queensland last October, when larvae of the beetle were found eating the leaves of a potato crop at Gatton. As well as feeding on the potato crop, the insect was breeding on thornapple (*Datura* sp.) and Apple-of-Peru (*Nicandra physaloides*) plants which were growing among the potatoes.

The adult is a yellowish beetle about 1 cm long, with three black stripes on the wing covers. The greyish-yellow larva is nearly always covered with a wet mass of its own excrement.

The three-lined potato beetle has been recorded from Canada, mainland U.S.A., Hawaii and South Africa. It is not known how the insect came to be established in Queensland. In the United States, the insect occasionally feeds on potatoes in the central and eastern regions and in Texas and California. Since its discovery at Gatton, a survey has found the insect also in the Redlands, Ipswich, Toowoomba, Brookstead and Greenmount districts.

Although the three-lined potato beetle was in fact discovered on potatoes, it may not be as serious an invader as was first thought. Observations indicate that the insect prefers wild solanaceous plants to potatoes. Infested *Datura* plants have been found in untouched potato crops. The insect has been found also on *Physalis* spp., including the cape gooseberry (*Physalis peruviana*). *Lema trilineata* has been shown to exhibit different host preferences in different areas and this has led to the naming of sub-species. Field observations suggest that the species in south-east Queensland is very similar to *L. trilineata daturaphila* from the western United States. This sub-species apparently is restricted to the Solanaceae, showing a marked feeding preference for plants of the genera *Datura, Physalis, Atropa, Nicandra* and *Salpichroa* and rarely attacks commercial species of the Solanaceae such as potatoes.

Research

Northern Territory fruit fly

In August 1975 a species of fruit fly which has external characters similar to those of the Oriental fruit fly (*Dacus dorsalis*) was discovered in the Northern Territory. Until then the recorded distribution of Oriental fruit fly had extended to the Indonesian Archipelago, but the species had not been found in Australia. Oriental fruit fly is a serious pest in Asia, Hawaii and other Pacific Islands, attacking a wide range of commercial fruit crops. If it spread to the major production areas, the effect on Australia's fruit industries would be devastating.

However, results from preliminary ecological studies that contrasted markedly with all known information on Oriental fruit fly suggested that the Northern Territory insect may not be the Oriental fruit fly. To investigate this possibility and because traditional classification methods could not distinguish between the two forms, genetic studies were undertaken at Indooroopilly with financial support from the Commonwealth Department of Health (Plant Quarantine) to determine the degree of genetic similarity between Northern Territory specimens and specimens of Oriental fruit fly from the Philippines and Hawaii.

Gel electrophoresis of enzyme material and studies on chromosome morphology have provided strong evidence that the Northern Territory insect is a different species from the Oriental fruit fly.

Genetic differences, together with the results from supporting ecological and biochemical studies carried out independently by other institutions, indicate that the Northern Territory form is not the serious pest species of Asia, the Oriental fruit fly. Moreover, there is evidence based on measurements of genetic heterozygosity, that the Northern Territory species has inhabited its present environment for a considerable period and is not a recent introduction.

Disinfestation treatments for fresh fruit

Disinfestation treatment against fruit flies, principally Queensland fruit fly (*Dacus tryoni*), are needed to enable compliance with quarantine requirements for the movement of fruit commodities in interstate trade within Australia The research on this aspect received financial support from industry sources through the Fresh Fruit Disinfestation Fund.

As disinfestation treatments at present depend almost entirely on gaseous fumigation with one product, ethylene dibromide (EDB), it was considered prudent to investigate other methods including the use of other fumigants such as methyl bromide and phosphine and physical methods such as heat and cold. Unfortunately, these alternative methods are less efficacious than EDB fumigation or produce undesirable side effects. For example, preliminary tests on phosphine fumigation against eggs of Queensland fruit fly in avocados have shown that very high doses of phosphine over a prolonged period are required to obtain appreciable mortality. As damage to some varieties of avocado in the U.S.A. has been caused by a dosage of only one-twelfth of the maximum dosages needed in Queensland, it would seem that phosphine does not have much potential for use against Queensland fruit fly in this commodity. However, there is evidence from experiments that fumigation of avocados with methyl bromide followed by cool storage for eleven days at 7 deg. C is effective against eggs of the Queensland fruit fly without having any apparent harmful effect on the fruit.

Biological control

In recent years, the introduced mite predator, *Typhlodromus occidentalis* has given excellent control of the two spotted mite (*Tetranychus urticae*) in deciduous fruit orchards in the Granite Belt and continues to maintain this level of control. In a monitoring survey carried out during summer, 7 500 leaves were examined and only five were infested with two spotted mite.

However, this predator does not control European red mite (*Panonychus ulmi*) and an unforeseen effect of controlling two spotted mite was an upsurge of European red mite populations which had been released from competition with the two spotted mite. To counteract these population upsurges, another predator resistant to organophosphorus sprays, the phytoseiid mite *Typholdromus pyri* was introduced and released in the Granite Belt in the summer of 1977. Since then, its activity and population dynamics have been monitored regularly.

This predator is much more difficult to establish than the related species, *T. occidentalis* and in its first season failed to suppress a large population of European red mite. However, it has persisted and has become firmly established on several trees in the study block. On these trees, the active stages of the predator have increased in number to the point where they have markedly reduced infestations of the European red mite. The European red mite population averaged 20·9 ± 6·3 females per 50-leaf sample in the predator release block compared with 100·7 ± 11·1 females per 50-leaf sample in a control block which did not have predators. In the release block the population of the European red mite predator *T. pyri* increased to 49·0 ± 6·7 active stages per 50-leaf sample. These results are very encouraging and control of the two major/mite pests of deciduous fruit orchards by means of the introduced predators appears to be a distinct possibility.

Other biological control studies have involved the release of parasites of the lucerne aphids, spotted alfalfa aphid (*Therioaphis trifolii* f. *maculata*) and the blue green aphid (*Acyrthosiphon kondoi*). Four exotic parasite species have been released and one of them, *Trioxys complanatus* is widely established from Rockhampton and Biloela to the N.S.W. border. Establishment of *Praon exaletum* has been reported from Kingaroy and Beaudesert while *Aphidius ervi* was readily established in the field a Toowoomba and in the Murphys Creek district during late autumn of 1978. Although abundant host aphids were available during winter, parasitism rates for *A. ervi* were very low and the parasite cannot now be found in the field.

In other biocontrol research, work has begun on a laboratory-rearing programme for the introduced Braconid wasp, *Apanteles ruficrus* which may have potential as a parasitic control agent for the armyworms, *Pseudaletia* and *Mythymna*. A consignment of live specimens was obtained from New Zealand and these insects will form the breeding nucleus for colonies which ultimately will be released in field-study areas in south-east Queensland.

Economic injury level for budworm on sorghum

The budworm, *Heliothis armigera* can be an important pest of grain sorghum in some seasons. Although *H. armigera* can attack the sorghum plant at any stage of growth, the main damage occurs when the larvae feed on the head. However, it has been recognized that there is some difficulty in determining the level of infestation that causes actual, economic loss and at what pest population density it is profitable to undertake control measures. Most estimates of what constitutes an economically damaging infestation of budworms on sorghum are subjective. A series of trials was carried out at Toowoomba on the sorghum variety Texas RS610 to determine more precisely the amount of damage caused by *H. armigera* larvae on grain sorghum. The aim was to define an economic injury level for *Heliothis* infestation based on yield loss, the monetary return for sorghum and cost of insecticide treatment.

Assuming control costs of $15 per ha and a price for grain sorghum of $70 per tonne it was calculated that an economic injury level occurred at 90 000 larvae per ha. This economic injury level would need to be modified if there were significant changes in control costs or the price of sorghum. The economic injury level quoted here for *Heliothis armigera* on sorghum is not intended to be the final definitive answer, but a starting point for attempts to dispel some of the uncertainty plaguing farmers faced with the decision of whether or not to apply control measures. Research will be carried out to find a simple field sampling technique to assist growers in making this decision.

Cotton pests management

The bollworms *Heliothis armigera* and *Heliothis punctigera* are the most important pests of cotton and the need to obtain satisfactory control of these pests dominates any control programme. For many years, the use of routine insecticide schedules involving more than a dozen spray applications was accepted as the normal method of achieving control and maximizing yields.

Now, a cotton pest management trial at Emerald has shown that acceptable yields can be attained with fewer insecticide applications through the timely and discriminating use of insecticides together with conservation of the pests' natural enemies. A yield of approximately 4·5 bales of cotton per hectare is expected from the pest management trial which has received eight sprays compared with an expected yield of approximately 5·5 bales per ha from the commercial blocks which received 12 sprays.

Heliothis eggs are detected more easily than larvae, so an insecticide that would kill the majority of eggs before they could hatch would be a useful addition to the growers' armoury of control methods. In this respect, methomyl used at low dosage rates has some potential. In a trial at Emerald, methomyl applied five times during the cotton-growing season at the low rate of 112 grams active constituent per ha killed about 80% of *Heliothis* eggs and also killed early-stage larvae up to third instar.

The effect was tested first in laboratory experiments, but field counts of larvae and damaged bolls following treatment provided practical confirmation of the chemical's ovicidal activity. At this low application rate, beneficial insects were not harmed provided they escaped direct contact with the spray, which indicates the potential value of this treatment in a pest management system.

Several commercial growers successfully tried the low rate on their entire crops with a resultant cost saving ranging from $3.50 to $13.50 per ha depending on the type of chemical for which the methomyl treatment was substituted.

Services

Insect identification service

One of the responsibilities of Entomology Branch is the operation of an insect identification service to provide determinations for Departmental officers, primary producers, householders, quarantine authorities and workers of other institutions. During the past year, more than 1 400 insect determinations were provided through the examination of numerous insect specimens.

A continuing specialist service provided by the Branch involves the identification of Dacine fruit flies, selected groups of parasitic wasps and predatory coccinellid beetles, for various institutions throughout Australia and the South Pacific Region. This complements similar services provided for other insects by various organizations in Australia.

Cotton pest activity monitoring service

Entomology Branch has continued to provide cotton growers with details of seasonal activity of the major cotton pests so that they can plan appropriate control strategies. Pest activity is assessed by means of light traps located in cotton growing areas. Moth catches are examined daily and the growers advised by radio broadcasts of the need for control action and the appropriate insecticide to use.

Primary interest centres on the incidence and activity of the two bollworm species (*Heliothis armigera* and *Heliothis punctigera*). In central Queensland, *H. armigera* comprised the bulk of early season populations until the end of September, at which time *H. punctigera* became the dominant species. Huge numbers of the latter species were collected in light traps in late October and numbers remained high until February. A further upsurge of *H. punctigera* numbers occurred again in March simultaneously with a late-season build up of *H. armigera* populations.

Growers who availed themselves of the service found the advice invaluable in assisting them to plan control programmes.

Apicultural services

Services available 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. The importance of this regulatory function has increased considerably with the discovery of European foul brood in some areas of southern States. Because of the seriousness of this disease, which has not been diagnosed in Queensland at present, restrictions on the movement of bees, hives, honey products and apiculture equipment into Queensland assume far greater importance and inspections to detect disease have been intensified.

Plant Pathology Branch

THE objectives and functions of Plant Pathology 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 also 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

MAIZE. In a joint trial with Agriculture Branch on the Atherton Tableland, 30 maize hybrids were rated for resistance to leaf blight (*Drechslera maydis* and *D. zeicola*). The most resistant were GH 5004, GH 5006, GH 5007, QK 413, L99, QK 690 and XL 99.

Two different sources and types of resistance to mosaic (sugarcane mosaic virus-Jg) have been discovered and are being incorporated in commercial maize lines.

NAVY BEAN. Rust (*Uromyces appendiculatus*) is a problem in many navy bean plantings. In a field trial in the South Burnett, the efficacy of mancozeb in controlling rust was increased by adding the wetting agent Agral 60* but was not improved by adding Triton B1956*, Nufilm 17* or spraying oil.

PEANUT. Stem, peg and pod rot (*Sclerotium rolfsii*) remains the most serious disease problem in the South Burnett. No effective control was obtained in six field trials with quintozene or carboxin soil treatments.

The level of benzimidazole resistance in populations of the leaf spot fungus *Cercosporidium personatum* (1·2%) was higher than at the same stage in the previous season but less than the previous maximum level (6%). In a field spray trial, the level of resistance increased in benomyl-sprayed plots but remained static in mancozeb-sprayed plots. However, the use of benomyl-mancozeb mixture did not slow the rate of increase in resistance as much as might have been expected.

A project, supported by a Rural Credits Development Fund Grant, has commenced on the factors affecting invasion of pods by *Aspergillus flavus* and aflatoxin production. To confirm previous observations that much *A. flavus* invasion occurs before harvest, isolations of fungi were made from 2 130 kernels from 156 pod samples of different ages and condition. Fungi were obtained from 22·5% of which 5·1% were *A. flavus;* the latter was more frequently isolated from damaged and insect injured pods.

Field trials at Tolga and Walkamin for control of nematodes (*Meloidogyne hapla* and *Pratylenchus brachyurus*) showed marked increases in yield after soil treatment with fenamiphos, aldicarb, or ethoprophos when root-knot nematode was predominant but not when *P. brachyurus* was predominant. Spray treatments with oxamyl 10 weeks after planting (but not 6 weeks) reduced pod nematode infestation.

POTATO. In three field trials for the control of root-knot nematode (*Meloidogyne javanica*) on the Atherton Tableland, soil treatment with EDB or fenamiphos reduced tuber galling and increased yield significantly especially in December-planted crops. Pre-planting sprays with fenamiphos were more effective than post-emergence sprays.

SAFFLOWER. Blight (*Alternaria carthami*) remains an important factor limiting the growth of the safflower industry in Queensland. Further testing of fungicide seed treatments is being undertaken.

SORGHUM. Work is proceeding to develop methods for effective screening for head smut (*Sphacelotheca reiliana*) resistance. Head smut susceptible lines Q5161 and Goldrush from the SCMV resistance breeding programme were detected and removed before the release of virus resistant cultivars.

SUNFLOWER. Rust (*Puccinia helianthi*) continues to be an important disease and a study of mechanisms of rust-resistance is in progress. To date all rust collections throughout Queensland have been in the race 1 group.

On the Central Highlands, the Noogoora burr rust (*Puccinia xanthii*) has been found on adult sunflower plants and the development of this rust on sunflower is being closely monitored.

Leaf spot (*Alternaria helianthi*) continues to cause concern and estimates of 17 to 20% yield loss were obtained in field trials at Gatton and Hermitage.

Stem and head rot (*Sclerotinia sclerotiorum*) is an important disease particularly when wet weather follows flowering. Benomyl, omadine, thiophanate-methyl, iprodione and dithianon have been shown to inhibit germination of sclerotes in contaminated seed but effects on seed germination and plant growth have still to be assessed.

TOBACCO. The introduction of the systemic fungicide Ridomil* in the 1978–79 season resulted in complete control of blue mould without the need for benzol fumigation. Work is progressing on the study of the most suitable application methods to avoid phytotoxic side-effects. Ridomil* also gave good control of black shank (*Phytophthora nicotianae* var. *nicotianae*.

Resistance to bacterial wilt (*Pseudomonas solanacearum*) was found in only one line (Speight G-140) which was also superior to NC-95.

WHEAT. The so-called long fallow disorder remains a problem especially in the cv. Gatcher. The effects of crop sequence, fertilizer, soil fumigation and nematicides on the disorder have been investigated for two seasons. The second wheat crop after sorghum-long fallow was badly stunted. Substantial yield increases were obtained by soil treatment with dazomet, chloropicrin, fenamiphos and aldicarb, but the cause of the disorder has not been determined.

Studies on the inheritance of resistance of wheat to crown rot (*Gibberella zeae*) were continued with F_3 lines derived from single F_2 plants from the cross Gala x Puseas being assessed for reaction to crown rot. The number of genes controlling resistance has not yet been determined.

The resistance of current and potential cultivars to crown rot was compared at two sites. None of the new cultivars was as resistant as Gala.

A survey to determine the distribution of common root rot (*Cochliobolus sativus*) in Queensland wheat growing areas indicated that the disease was most severe around Dalby and the Western Downs and the incidence was lowest in the Central Highlands, Dawson-Callide and Maranoa.

During 1978, wheat cv. Timgalen was grown on seven sites where wheat had been grown previously. Plants were sampled at four growth stages and the severity of common root rot and yield measured. On a site where 87% of sub-crown internodes were diseased at early tillering, the harvest index was reduced from 37% to 25%.

Studies on rust (*Puccinia graminis tritici*) continued with several experiments designed to examine quantitatively the various phases of the infection process in slow rusting cultivars. Results to date suggest that the slow rusting mechanism operates in the post-penetration phase.

Yellow spot (*Pyrenophora tritici-repentis*) is increasing in incidence. In a trial at Kingsthorpe, yields in the most severely diseased plots were 26% less than in plots protected with fungicide sprays. Resistance of cultivars to yellow spot has been examined in field trials.

Pastures

LUCERNE. In a joint project with Agriculture and Entomology Branches, four trials have been set out to ascertain the persistence, productivity and disease and aphid resistance of lucerne cultivars introduced from the U.S.A. All cultivars are rated for root rot (*Phytophthora megasperma* var. *sojae*) and crown rot (*Colletotrichum trifolii*). Most introduced cultivars proved to have little resistance to *C. trifolii*. The progeny from a joint breeding programme with the C.S.I.R.O. Division of Tropical Crops and Pastures are also being screened for resistance to both diseases.

Stylosanthes

Anthracnose (*Colletotrichum gloeosporioides*) continues as the most important disease of stylosanthes particularly in seed crops. In co-operation with C.S.I.R.O., a collection of isolates of *C. gloeosporioides* was screened on 10 differential stylosanthes lines. All fell into the type A or type B categories and were ranked close to the type standards.

Anthracnose is readily transmitted with seed of *Stylosanthes* spp. In co-operative work with C.S.I.R.O. exposure of podded seed to short periods of high temperature controlled seed transmission.

* Trade name.

Fruits

APPLE. The efficacy of spraying soon after leaf fall with urea or paraquat to prevent release of ascospores of scab (*Venturia inaequalis*) the following season was confirmed in further field trials.

Powdery mildew (*Podosphaera leucotricha*) was controlled more effectively by bupirimate and metiram + nitrothal-isopropyl than by surphur.

Pancil T* (an experimental acrylic dressing) and colgraft + copper oxychloride provided very good protection against pruning wound infections, particularly those caused by basidiomycetes such as *Trametes versicolor*.

AVOCADO. Control of root rot (*Phytophthora cinnamomi*) in avocado plantations has been achieved by drenching soil under the trees with Ridomil* and spraying the foilage with Aliette*.

Work in this Branch recently demonstrated the cause of sunblotch disease to be a viroid. A rapid biochemical assay for sunblotch is now being sought to avoid the long graft-indexing procedures now used to screen new avocado material for freedom from this disease.

BANANA. The establishment of nursery areas free of nematode root rot (*Radopholus similis*) and the use of fenamiphos in plantations have reduced the importance of this problem but work is progressing on developing more effective treatment schedules.

MANGO. Bacterial black spot of mangoes has only recently been recognized in Queensland and now appears to be widely distributed. Extensive leaf and fruit damage of cv. Kensington was found at Gin Gin, Mundubbera and Bowen. The causal agent of this serious disease has been identified as *Pseudomonas mangiferaeindicae*.

PASSIONFRUIT. Leaf spot (*Septoria passiflorae*) is normally controlled adequately by spraying with a dithiocarbamate. Reports of poor control in the Palmwoods District led to the finding of a leaf and fruit spot caused by *Alternaria alternata*. The problem appears to be most severe on neglected or poorly grown vines.

A project has commenced to study the properties and ecology of passionfruit woodiness virus strains, particularly those causing severe fruit woodiness.

PINEAPPLE. Root and heart rot (*Phytophthora cinnamomi*) was not a serious problem in the 1978–79 season. In field trials at Beerwah, Ridomil* and Aliette* gave very good control of *P. cinnamomi* and greatly improved root growth.

STRAWBERRY. Crimp, caused by the bud nematode *Aphelenchoides besseyi*, was a problem in some runner production areas. In field trials, soil treatment with aldicarb and preplant dipping of runners in oxamyl increased the subsequent yield of nematode infested and nematode-free runners. Post plant treatment with UC21865, fenamiphos and oxamyl increased early yield of nematode-infested runners.

Vegetables

BEANS. Field blight (*Sclerotinia sclerotiorum*) is a serious disease of beans particularly in wet seasons. Studies showed that a small number of sclerotes cause direct infection when near the base of the stem but the usual method of infection is by spores produced in apothecia. Overhead watering appeared to favour the production of apothecia. Wastage of sclerotes due to breakdown was high.

BEETROOT. Poor control of leaf spot in the Lockyer Valley in 1977 was found to be due to the development of benzimidazole resistant strains of *Cercospora beticola*. In a field trial, the proportion of the population of *C. beticola* with resistance was approximately 70%. Strategic spraying involving two applications of fentin, chlorothalonil or mancozeb increased yield by 19%, 16% and 13% respectively.

CAPSICUM. In a trial at Bowen, triadimefon gave very good control of powdery mildew (*Leveillula taurica*). Benomyl, pyrazophos, dimethirimol and sulphur gave a lower level of control.

CRUCIFERS. Downy mildew (*Peronospora parasitica*) is often a problem particularly in seedbeds. In field trials seedbed drenches with Fongarid* and Ridomil* gave complete control for 6 weeks. Aliette* drench and weekly sprays with mancozeb were unsatisfactory.

Cabbage yellows (*Fusarium oxysporum* f.sp. *conglutinans*) is a problem in the Redland Bay District. Fifteen cabbage lines were compared with resistant and susceptible standard lines for resistance to the disease. Five lines possessed the A resistance type (quantitative) while the remainder were susceptible.

CUCURBITS. Post-harvest wastage of rockmelons caused by fungi (mainly *Fusarium* spp.) continues to cause serious losses to retailers and consumers. In a series of trials, rotting was most markedly reduced by dipping fruit in a mixture of benomyl and dicloran at 55 deg. C for 2 minutes or 58 deg. C for 1 minute. Dipping at ambient temperature gave a lower level of control.

Downy mildew (*Pseudoperonospora cubensis*) was a serious problem on rockmelon in the Bowen District. In a field trial mancozeb and chlorothalonil gave better control than Ridomil* when applied as weekly sprays.

Seventeen watermelon cultivars were tested for resistance to wilt (*Fusarium oxysporum* f.sp. *niveum*, Calhoun Grey strain) and only Red Seeded Citron was resistant.

Watermelon mosaic (WMV-1 and WMV-2) remains a major problem. Hybrids of *Cucurbita ecuadorensis* with *C. maxima* and *C. moschata* showed good resistance.

TOMATO. Root and foot rot (*Fusarium solani*) continues to increase in importance in the Bowen District and efforts are being made to find sources of resistance for a breeding programme. The cultivars Indian River and Q3 proved to be resistant in glasshouse tests.

Bacterial wilt (*Pseudomonas solanacearum*) restricts the production of tomatoes in the summer months in the coastal districts. In a breeding programme to develop an acceptable resistant cultivar, 80 sub-lines from 33 lines of the F_7 generation of Floradel x VC9-1 were screened in the field for resistance to wilt and for fruit quality. No plants were lost due to wilt and fruit quality is approaching suitable commercial standard. Farmers in the Nambour–Caboolture areas are now producing tomatoes in summer on land where commercial cultivars consistently wilt.

Verticillium wilt is a problem in the winter months in coastal areas and in the summer on the Granite Belt. Nine breeding lines and three newly-introduced cultivars were compared for resistance to Verticillium wilt with the resistant cv. Tropic and four susceptible cultivars. Three of the breeding lines and one of the introduced cultivars were as resistant as Tropic. Two breeding lines were classed as susceptible and the remainder showed intermediate levels of resistance.

New diseases

Fusarium oxysporum was recorded as the cause of a wilt disease of parthenium weed in the Emerald district.

Rhizoctonia leaf sheath and ear rot of maize caused by *Rhizoctonia solani* was widely distributed in a trial area on the Atherton Tableland.

Rust (*Uromyces appendiculatus*) was recorded on Siratro in July 1978 and was soon found in a number of widely scattered areas of the State.

Monilinia fructicola was found causing blossom blight on flowering quince (*Chaenomeles japonica*) at Stanthorpe.

New virus diseases include cucumber mosaic virus on sunflower and alfalfa mosaic virus on soybean and mung bean.

Extension services

The major extension activity this year was the preparation and publication of a two-part Plant Disease Handbook which contains extensive disease information including colour illustrations of important diseases as well as current control recommendations.

Diagnostic services

More than 3 500 enquiries requiring disease diagnosis were handled through Indooroopilly and the seven country field stations. The majority were caused by fungi.

The specialist bacteriologist handled 162 accessions, many of which required detailed laboratory checking. The nematologists processed 1 200 plant and soil samples. In the virology section, more than 400 specimens were examined with the electron microscope and 420 were indexed in the glasshouse.

Legume bacteriology

During the year, 72 rhizobial cultures were supplied to agrostologists and farmers for 12 different legumes for which no commercial cultures are available.

The testing of rhizobial strains for a broad spectrum replacement of strain CB756 is continuing. One hundred and fifty strains were further screened on *Macroptilium axillare*, *Cyamopsis tetragonoloba*, *Glycine wightii* and *Cajanus cajan*. At this stage, there are indications that the number of working cultures could be drastically reduced because of some consistently ineffective reactions on all four hosts.

Quarantine

Introductions of *Cajanus cajan*, *Glycine max*, *Glycine* spp., *Pisum sativum*, *Vigna mungo*, *V. radiata*, *V. umbellata* and *V. unguiculata* from several countries were indexed from seed-borne virus infection as part of a continuing investigation. The detection of symptomless virus infections, particularly in *Vigna* spp., has highlighted the risk and inadequacy of relying solely on visual inspections.

* Trade name.

Botany Branch

THE principal objectives of Botany Branch are to acquire, store and disseminate information on the plants and plant communities of Queensland. A service is provided to other Branches of the Department of Primary Industries, other State and Commonwealth organizations and the general public by identifying plants and advising on their properties.

Maintenance of efficient service depends on adequate staff and facilities and relevant research also needs to be continued.

The activities of the Branch have been grouped into three interacting units. A Taxonomy Group deals with questions concerning individual species or other taxonomic groups that occur in Queensland; an Ecology Group studies plant communities in the State; and a Supporting Services Group provides assistance to other groups and maintains the Queensland Herbarium.

Research

Taxonomy

Major objectives of the Taxonomy Group are the correct naming and description of all native and naturalized vascular plants in Queensland. The correct identification of plants, supported when necessary by competent taxonomic research, is the basis of much applied botanical research, including work in the field of range management, agrostology, ecology, phytochemistry, phytogeography and geobotany.

Plants of wild oat (*Avena* spp.), the most important weed of winter cereals in Queensland, were grown under glasshouse conditions in 1975, 1976 and 1977 as part of a joint project with Dr B. Wilson, Queensland Wheat Research Institute.

The aim of the project is to find an association between wild oats types and important agricultural characteristics such as dormancy and susceptibility to herbicides. Data collection from these plantings has been completed. From a preliminary investigation of various methods of data analysis, the most appropriate one is now being used to analyse results for all 3 years. Preliminary findings suggest little association between wild oat types and dormancy characteristics.

A preliminary check-list of Australian grasses was completed and published during the year. The checklist contains information on distribution and habit of native and naturalized species. A companion paper, a check-list of Queensland grasses, including data on distribution within the State, habit and habitat, was completed during the year. The data were organized with assistance from officers of the Division of Land Utilisation. The list will appear during the year. Keys to all genera and species of grasses were constructed and are ready for publication. An analysis of the grass flora of Australia based on the published check-list is almost completed and will be published. These papers on grasses will be of considerable value to field workers as well as to plant taxonomists.

A new species of *Bothriochloa* and two new species of *Dichanthium* from Queensland are in the process of being described.

The first part of a revision of *Acacia* in Queensland was issued early in the financial year and the concluding part has been sent to the Government Printer. Early publication is expected. The revision includes keys, descriptions of and notes on 236 species and is the most comprehensive account of this large and economically important genus ever to have been published in Queensland. A revision of another legume genus *Atylosia* was completed during the year. Seeds of several species were collected in north Queensland. These may be of value in the breeding programme of pigeon pea (*Cajanus cajan*) being carried out by ICRASAT, Hyderabad, India. Work also continued on *Tephrosia*, a large genus widespread in tropical Australia.

A rainforest tree from north Queensland was found to be a new species and genus of Combretaceae. It will be described as *Dansiea elliptica*. A revision of Sapindaceae a large family particularly well represented in Queensland rainforests was finished. Publication will be in parts spread over a number of years. *Comesperma* (Polygalaceae) was also revised during the year.

Five new species of *Asplenium* and one of *Elaphoglossum*, both fern genera, will be published as an appendix to the *Handbook to the Ferns and Fern-allies of Queensland*.

Some preliminary work was done on a number of other groups. Much of this will take several years to complete. Preliminary investigations for Australia-wide revisions of *Breynia* (Euphorbiaceae) and *Nymphaea* (Nymphaceae) and of *Melaleuca* (Myrtaceae) in northern Australia were started. A paper on the taxonomy of *Kunzea*, another genus of Myrtaceae, in Queensland is being prepared. Several undescribed species of *Leucopogon* (Epacridaceae) widespread in heaths of Cape York Peninsula were studied. During the year there was little progress in the revision of Convolvulaceae or of *Cordyline* (Agavaceae) and taxonomic and cytological studies in *Dianella* and *Stypandra* (Liliaceae) were curtailed due to pressures of other work.

The compilation of the *Handbook to the Flora of South-eastern Queensland* progressed satisfactorily. The manuscript of the first volume with the exception of parts of Mimosaceae and Caesalpiniaceae is almost ready for the printer. The account of the sedges for the third volume was completed. The *Handbook to the Ferns and Fern-allies of Queensland* is being set up by the Government Printer. Accounts of only a few families, glossaries and indexes have still to be submitted.

Ecology

The Ecology Group continues to co-operate with other branches of the Department and with other State Government organizations.

Three 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. The botanical sections of the report on Part 2 have been written up and are now in the editor's hands. The report on Part 3 (a strip of country between the Maranoa–Balonne area surveyed by C.S.I.R.O. and Part I, the report on which has been published) is also well advanced. Preliminary summaries of plant communities have been prepared ready for vegetation descriptions, and a list of species has been completed. Field work in Part 5 (Longreach–Winton–Muttaburra area) continued. All 39 land systems have now been sampled, vegetation data have been put on computer cards, and photo-pattern boundaries have been transferred to 1:250 000 base maps. Three hundred and fifty sites were sampled in Part 6, the last WARLUS area (Boulia–Birdsville). A start was made on the preparation of a species list and in transferring data to computer cards. Another field trip will be required.

The mapping and description of mangrove communities along the Queensland coast continued. This is Queensland Fisheries Services' project 'Biological Resources Survey (Estuarine Inventory)' but the botanical work is being done by the Ecology Group. The botanical text to accompany 1:250 000 maps of Round Hill Head and Tannum Sands published last financial year has still not been published. Maps of mangroves of Moreton were also printed last year but again the explanatory text is awaiting publication. Proofs of maps covering Round Hill Head to Urangan were checked and the work is being written up.

Aerial photographs of Trinity Inlet were marked-up but another trip to the area will be necessary to complete the field work. An officer spent a week in the Princess Charlotte Bay area, mainly the Marrett River estuary. A report and map will be produced. Mangrove communities between Thursday Island and Cairns were examined in another 2-week field trip. Fifteen species of mangroves were recorded in the various estuaries visited. *Xylocarpus moluccensis*, formerly believed to be uncommon in Australia, was found to be fairly common in the Escape River. Marking-up of aerial photographs of mangroves in the Temple Bay and Newcastle Bay areas was started.

The survey of vegetation of coastal dunes for the Beach Protection Authority continued. Maps and a report explaining the mapping units were prepared for the Authority for use in its Beach Erosion Investigation Report. Because the data collected are often more detailed than the Authority can use, the maps and associated reports will be published separately by Botany Branch.

A survey of the Livingstone Shire (Capricorn Coast) was completed during the year. The five maps which were prepared by the Beach Protection Authority are now ready for printing. Two botanists are engaged in a survey of the Sunshine Coast from Bribie Island to north of Noosa. Field work is almost finished and the survey is expected to be completed this year.

Ecological studies on hairy spinifex (*Spinifex hirsutus*) were written up and will be published. The studies include work on germination and measurements of seed yield and vegetative growth.

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Special projects

Three projects are funded largely through Commonwealth Government Grants. They are the Herbarium Data Storage Project (HERBRECS) supported by the Australian Biological Resources Study (ABRS), the Moreton Region Vegetation Mapping partly funded by grants received under the National Estate Programme and the Vegetation Mapping of Southern Queensland. Major problems with the last two projects have been caused because of the uncertainty of continuing funding.

1. HERBRECS is the establishment of a computerized data bank based on information on labels of specimens in the herbarium collections. During the year, 52 500 records were entered, bringing the total to 282 000. It is expected that data from labels of all specimens incorporated in the herbarium will be transferred to the master file by June 1980. The transfer of the master file and associated programmes to the new Univac 1100 computer at the State Government Computer Centre was completed and most problems arising from the transfer were corrected.

2. Moreton Region vegetation mapping—Cartographic work on the 1 : 100 000 Murwillumbah map sheet is complete and the map is ready for printing. Work on the explanatory booklet is in the final stage. This map and explanatory text will be a significant contribution to the understanding of rainforests of the McPherson Range. The explanatory booklet for the Caloundra sheet has been printed and cartographic work is well advanced. A paper dealing with conservation areas covered by the four coastal areas now mapped should be ready for publication by the end of 1979.

The remainder of the Moreton Region is to be mapped at a scale of 1 : 250 000 using the Ipswich, Warwick and Gympie National Mapping Topographic Sheets as base maps. Field work for the Ipswich and Warwick sheets is expected to begin this financial year.

3. Vegetation mapping of southern Queensland—The south-western sheet bounded by the borders of the Northern Territory, South Australia and New South Wales and by latitude 29 deg. S. and longitude 144 deg. E., has been printed. Thirty-one plant associations are distinguished on the map and work has begun on the accompanying explanatory text. A list of species known to occur in the area will be included. There are 769 species (in 298 genera, 85 families). Field work was begun on the south-central sheet which lies east of the south-western sheet, bounded by 149 deg. E. longitude. Preliminary vegetation maps at 1 : 250 000 of about half of the area were prepared. Delays in receiving base maps and in printing, as well as the uncertainty of funds, have hampered this project.

Service and extension

Plant identification and related advisory services maintained by the Taxonomy Group and the preparation and examination of environmental impact studies by the Ecology Group are major functions of the Branch.

About 20 420 specimens were identified by the Taxonomy Group during the year. This represents a 46% increase in the number identified by the group last year. This large increase was due to many more enquiries from the public generally, Departmental officers, particularly from Agriculture Branch, tertiary institutions, and CSIRO. A large number of grass specimens (*Aristida*) collected in Queensland in 1931 by C. E. Hubbard was identified for the Kew herbarium.

Identification of *Cannabis sativa* for the Police Department continued at a high level. A total of 941 certificates of identification and four certificates of destruction of *Cannabis* was issued by two officers. This is about 13% increase on 1977–78. The officers also attended 35 court cases, a decline on last year. Seventeen statements on plant identification were issued in response to enquiries from the Commonwealth Bureau of Customs.

Identification of roots blocking sewerage pipes was undertaken on 27 occasions. Enquirers are advised that removal of roots from pipes is only a short-term solution. Despite this, requests for identification are increasing. Rumen samples from post-mortem of stock were also examined for recognizable plant fragments.

The Ecology Group continued to act as an advisory body, examining Environmental Impact Statements. A revised statement of impact on the proposed bridge access to North Stradbroke Island was prepared for the Main Roads Department. Comments were prepared on new procedures for Impact Assessment of development projects in Queensland for the Co-ordinator-General's Department and on the following major projects—

Proposed oil shale development, Rundle.

Proposed Farnborough resort development.

Proposed aluminium smelter, Boyne Island—Draft Environmental Study Report.

Phase I of Brisbane Airport Development.

Other projects considered were canal developments, transmission lines and substations and a proposed open-cut coal mine.

The development of Brisbane Airport led to requests from the Commonwealth Department of Housing and Construction and the Department of Transport for advice on ecological problems related to the construction of the airport. The Department of Transport is seeking advice on the re-afforestation of areas on both sides of the new runways to reduce bird populations. The Department of Housing and Construction, which is the construction authority for the airport, requires advice on the growing of mangroves to stabilize banks of a proposed tidal channel north-west of the airport and on monitoring the effects of the construction on existing mangroves. Advice has been given and it is planned to carry out experimental plantings of mangrove seedlings on a specially prepared section of tidal creek in the airport area.

The leader of the Ecology Group again represented the Department on the 6-monthly inspections of sand-mining work.

The second number of the Branch's publication *Austrobaileya* was issued during the year and the third part is being printed. Publication of the *Weeds of Queensland* has been delayed though proofs of the major contents of the book have now been corrected. Further articles in the series on wildflowers of south-eastern Queensland were published in the *Queensland Agricultural Journal*. Articles on *Canthium*, *Grevillea*, *Leucopogon* and *Acacia* were published, another seven were submitted for publication, and five more were drafted. There has been a continuing steady demand for the first articles of the series which were published separately as *Wildflowers of South-eastern Queensland* vol. 1. The second article in the series on the aquatic plants of Queensland was published in the *Queensland Agricultural Journal*. A third article has been submitted to the editor and a fourth has been written.

A preliminary check-list of the plants of north Queensland, north of about 20 deg. S. latitude was completed. Initially only a few copies of the list will be available as there are likely to be considerable changes when the contents are updated by an officer who is to be stationed in Mareeba in the coming year.

Recently Navua sedge (*Cyperus aromaticus*) was found growing on footpaths in Cairns by officers of the Branch. The plant is a native of Africa and is a serious weed in Fiji, where it grows on a wide range of soils receiving 1 700 to 3 800 mm annual rainfall. Though most troublesome in pastures, it has also been recorded as a weed of cultivated areas. It is a perennial and could be a serious weed in wet coastal areas of the State. Appropriate authorities are now assessing the extent of the problem and the control measures to be taken.

Queensland Herbarium

Because of the large increase in demand for identification of specimens and a shortage of staff, the Taxonomy Group has required additional assistance from the Supporting Services Group. This, together with service demands in other areas, has reduced the time available for routine work. Mounting of specimens was carried out only when other demands had been met and consequently fewer specimens were mounted this year. Labelling and incorporation of specimens into the main collection have also remained at a depressed level. Incorporation of the Blake, Smith and Everist collection has been sporadic and little progress was made in reducing the backlog of their important collections. The herbarium collection is becoming badly overcrowded.

During the year, 7 400 new accessions were added to the herbarium. Loans to and from other institutions declined. A total of 3 665 specimens (35 loans) was despatched and 1 358 (30 loans) were returned to the herbarium. Specimens for exchange to other herbaria continue to be a problem. Approximately 2 700 specimens were sent but 4 100 were received.

A major achievement was the upgrading of the special collections. The spirit collection which had for many years undergone continued deterioration was completely reorganized and restored and is now easily accessible through a specimen register and a card index. The carpological collection was rearranged and individual specimens sealed in plastic bags. Sorting of the photographic collection was also completed.

The number of visiting botanists using the facilities of the herbarium and library remained at about last year's figure. Use of the library remained at a high level, though the number of books and periodicals bound was somewhat lower than the previous year due to increased costs.

Miscellaneous

The Director participated in a subcommittee of the Committee of the Heads of Australian Herbaria which was formed to set guidelines for the production of a series of taxonomic revisions aimed at the production of a new 'Flora of Australia'.

Three officers attended a symposium on 'Fire and the Australian Environment' held in Canberra. A paper 'The role of fire in the establishment and management of agricultural systems' was presented. Three officers also attended a workshop on Vegetation Classification in the Australian Region held in Canberra at about the same time. A paper 'The comparison of two small-scale (large area) mapping techniques' was presented (with Mr J. Pickard, N.S.W. National Herbarium).

Two officers attended a seminar on the 'Conservation of Genetic Resources of Forage Legumes' held at Townsville. The opportunity was taken both at the formal sessions and in private discussions to stress the importance of basic taxonomic studies and of the correct identification of plants introduced as potential forage plants. An International Legume Conference at the Royal Botanic Gardens, Kew, England, which was attended by one officer was largely concerned with problems in the taxonomy of legumes. Useful contributions were made to discussions and first-hand contact was made with workers engaged in research in groups such as *Cassia, Acacia, Glycine, Cajanus* and *Stylosanthes* of importance to the development of agriculture in Queensland.

One officer participated in a poplar box symposium held at Cobar. Considerable basic information on poplar box communities was provided to other participants at the seminar by the Ecology Group.

Two officers of the Ecology Group attended a National Mangrove Workshop and presented a paper entitled 'Mangrove Communities of Queensland'.

As well as the field trips in connection with mangrove-mapping projects, there were collecting expeditions by two officers to central Queensland and by another officer to McIlwraith Range, Cape York Peninsula. The latter was financed by the Australia Orchid Foundation. Valuable plant material was collected on both trips.

The 88 855 tonnes of pineapples processed in 1978 were insufficient to satisfy completely the Australian demand for canned pineapple products. Pineapple production was more than 7 000 t higher than in the previous year.

Division of Dairying

THE main activities of the Division of Dairying in the year were designed to assist the dairying industry to maintain and improve quality of milk and dairy products, to provide technical advice to producers in general herd improvement and feeding practices to maintain a supply of good quality milk, and to undertake associated research.

These activities are related to the following objectives which summarize the main operations of the three Branches in the Division—

(1) To provide services to producers in those farming practices related to dairy cattle feeding, breeding and management based on producers' perceived needs and officers' assessments.

(2) To provide advisory services to processors in the manufacture, packaging, storage, distribution and quality control of dairy products.

(3) To undertake research into problems which emerge from activities associated with dairy farming and dairy product processing.

(4) To implement the terms of the *Dairy Produce Act* 1920–1974 and the *Margarine Act* 1958–1978, and to assist in the implementation of the *Milk Supply Act* 1977–1978.

The Queensland Milk Board began operations on 1 June 1978, replacing the Brisbane Milk Board. This has been the first full year of operation by the new Board. Close co-operation has been maintained with this Board, and some officers, particularly from Field Services Branch, have been heavily committed to aspects of Board work.

One of the functions of the new Board, through the Milk Entitlements Committee, is to effect a more equitable distribution of returns from the sale of market milk by the control of transfers of milk entitlements among processors. At the end of May 1979 (that is, 12 months' operation), some 30 500 litres of milk had been reallocated, 4 000 *l* from growth sales and 26 500 *l* from the entitlements of farmers who ceased dairying.

The Rural Adjustment Scheme for both dairy farmers and processing plants continues to operate and close liaison has been maintained with the Lands Administration Commission which administers this scheme.

Officers have been associated with two training courses for overseas students sponsored by the Australian Assistance Development Bureau.

The Australian Dairy Corporation imposed production controls on butter and this action resulted in a fairly heavy financial loss for some factories. Any butter manufactured in excess of quota received payment at a rate of about $400 per tonne below that for the rest of the butter produced. Certain types of cheese, cheddar and gouda, were subject to equalized payments and as a result there has been some interest in the manufacture of other cheese varieties, notably eye-type. Investigational work in this field has been extended to commercial operations, on a trial basis, at two factories.

Although it was expected that some milk producers were waiting for the establishment of the Queensland Milk Board to allow them to receive payment for ceasing dairying, the total decline in numbers was 9%, from 3 897 to 3 547. Of this, 118 were cream suppliers and there are now only 643 farmers in this group. Difficulties in providing for economic collection of cream are a cause for concern.

Dairy product quality

The extensive testing programme continued, and the Dairy Research Branch performed 120 000 tests on 52 000 samples of dairy products. These included products made in Queensland or imported from interstate and overseas. A comprehensive market milk testing programme is conducted on behalf of the Queensland Milk Board.

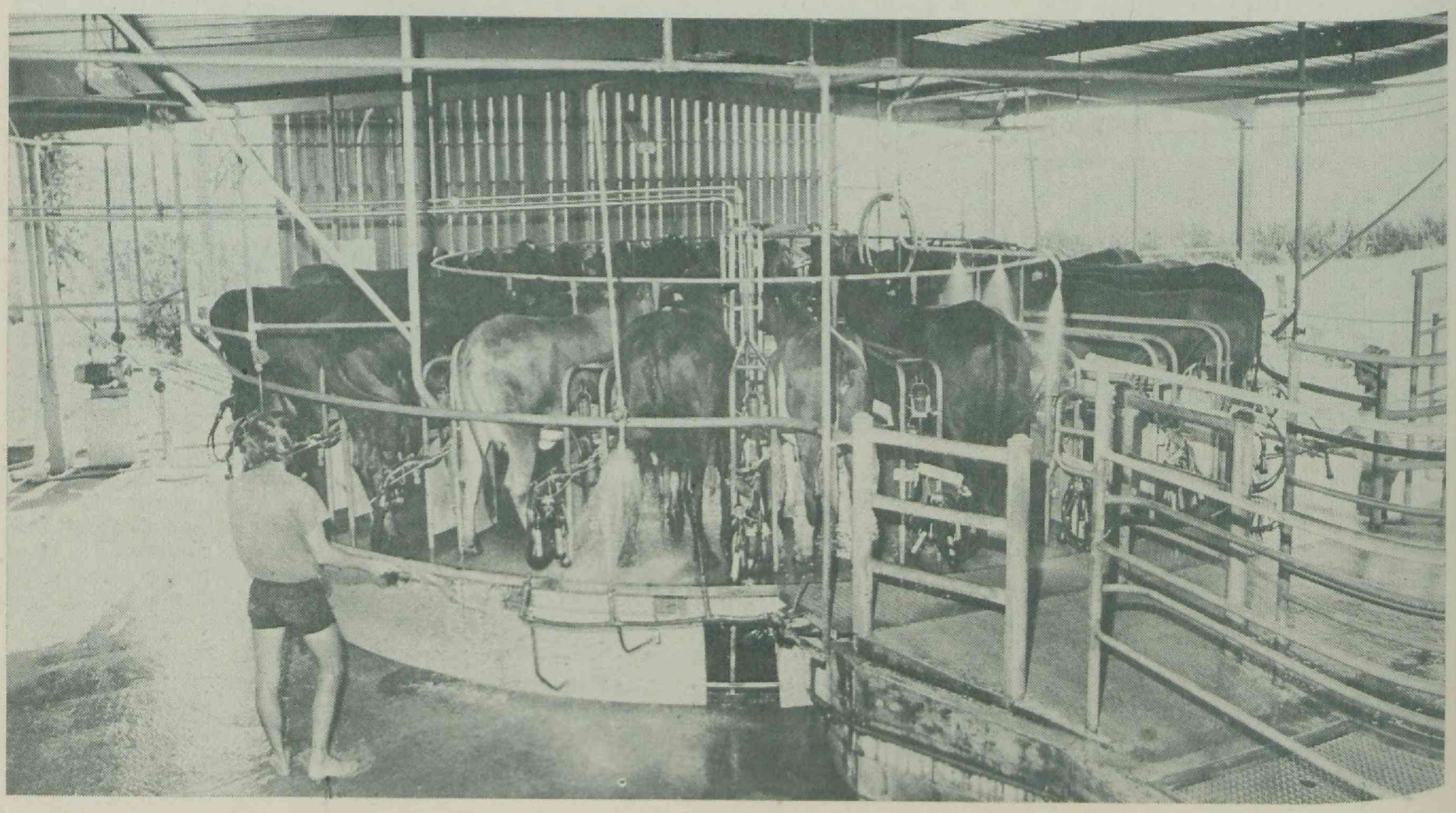
Raw milk quality has improved with regard to both microbiological and chemical results. Some 76% of factory tanker milks passed the standard for Total Bacterial Count compared with 37% in the previous year. Chemical composition also improved markedly, particularly with respect to S.N.F.

The incidence of pesticide residues in butter, cheese and milk remained at a satisfactory level, although the number of samples with dieldrin levels above the Maximum Residue Limit increased slightly.

The number of samples analysed for iodine doubled this year with 3 589 samples being examined. The testing programme is now being undertaken at regional laboratories at Toowoomba, Murgon and Malanda to give a more intensive monitoring. As a consequence of this testing, together with testing conducted by factories and a Field Services extension programme, there has been a marked decrease in iodine levels. Only 1% of raw milks tested by the Dairy Research Branch had levels exceeding 500 μg per *l*.

Dairy products have also been checked for levels of heavy metals (copper, chromium, nickel, lead, zinc, iron, mercury, cadmium). Apart from mercury, contamination from these metals was not high. The level of mercury in casein was found to be slightly above the maximum level permitted for food and this was traced to the acid used in manufacture.

Australian Friesian Sahiwal cows being milked on the platform of a rotary dairy at the Ayr Research Station.



The incidence of penicillin in milk has decreased but there has been some increase in the detection of other inhibitory substances.

The Mastitis Cell Count testing programme continued each month with herd milks from 2 700 to 2 800 producers. There has been a substantial improvement in cell counts. This is almost certainly due to improved cattle prices which which have allowed the culling of old cows and those with chronic mastitis. The monthly State mean ranged from 320 000 to 572 000, with the last 6 months all below 400 000. Modifications to the equipment used for this work have greatly improved data handling and further modifications are in progress to improve data storage and allow ready access.

Dairy product research

The Dairying Research Committee has continued to support research programmes and $21 000 were provided for some of the research work conducted.

Studies have been made of two methods to accelerate the development of mature flavour in cheddar cheese to reduce storage costs. The addition to milk of a high inoculum of a non-acid producing, non-proteolytic mutant of *Streptococcus lactis* gave a substantial reduction in ripening time. Commercial trials with an enzyme extract from the yeast *Kluyveromyces lactis* have shown variations in the commercial extract. Laboratory trials are proceeding to develop a more suitable extract.

A sampling procedure for milk and milk powder plants is being evaluated for application to all such plants throughout Australia. The effects of storage times and temperatures on the final raw milk quality have been studied, particulary with respect to the clumping of bacteria.

Production of eye-type cheese has progressed from pilot plant scale to commercial trials. Two types of cheese have been developed, one with large, regular eyes and the other with smaller, irregular eyes. As a result of this work, information is available on the details of manufacture, and equipment has been modified to allow further commercial trials in the near future. Considerable financial benefits can follow the manufacture of these types of cheeses and two Associations are interested in commercial operations.

Herd improvement

ARTIFICIAL BREEDING. The artificial insemination centres at Wacol and Ormiston processed 287 400 doses of semen which satisfied the minimum quality standards for distribution. The total movement of semen from sires at both centres increased by 25%, despite a large increase in charges for semen and other services. The excellent team of Friesian bulls at Wacol is considered to be an important factor in this increase.

On average, 95 dairy and 24 beef sires were maintained. Semen was exported to several overseas countries with 30 000 doses of Sahiwal semen to New Zealand and 5 000 doses of Braford semen to Russia.

There was some decline in the demand for training in herdsman courses, but 136 people were trained as inseminators and 100 attended refresher training courses on the Atherton Tableland.

There was a good attendance at a field day on bull proving and a successful seminar was run at Wacol in conjunction with the Friesian Cattle Club.

Sales of semen from Rockhampton and Mackay depots decreased by 19% but there was an 8% increase in sales on the Atherton Tableland.

HERD RECORDING. Butterfat production from an A.I.S. cow 'Wilmington Plum' was 540 kg in 300 days, which was 4 kg more than the previous record for a mature cow. She was sired by the A.I. proven bull 'Sunny View Princess Mario'.

Increased charges for herd recording were introduced during the year, together with a restructuring of fees. A system of farmer own sampling has been provided to reduce costs for those producers who are willing to do this work themselves. Herd recording numbers have been maintained.

A trial has commenced in conjunction with 70 recorded herds to determine the somatic cell counts on individual cows every 2 months. This work will identify animals with varying levels of cell count and will help to distinguish between infected and non-infected cows. If there is a favourable reaction to this work, it could be made an integral part of the herd recording scheme for those desiring this service.

A.F.S. BREEDING PROGRAMME. The work in developing this breed continues and more farmers are becoming familiar with these animals as more A.F.S. (Australian Friesian Sahiwal) cows are loaned to co-operating farmers on the Atherton Tableland and in Mackay and south-east Queensland districts. Approximately 90 cows and heifers are now located on 24 properties.

The F2 and F3 generation A.F.S. cows at Kairi Research Station produced 25% less milk than Friesian cows fed similarly. The highest producing A.F.S. cow yielded 5 053 *l* of milk and 203 kg butterfat in 296 days. A.F.S. breed averages were 2 387 *l* of milk and 93 kg butterfat in 267 days.

HERD HEALTH PROJECT. The pilot project, based on manually collected records, has been operating successfully in six co-operators' herds. Cow fertility has been identified as a major source of production loss on these farms. Culling of chronic cases detected during the project has benefited the co-operators. The next step, the integration of herd health data in the herd recording computer programme to provide a computerized management information service, has been initiated.

Nutrition

Research at the Ayr Research Station has demonstrated that annual sowings of irrigated ryegrass and clovers in the autumn have tremendous potential for increasing milk production in the winter-spring when there is a pasture feed shortage. As a result of this work, more than 70% of farmers in the Mackay area claim that the winter-spring is no longer a feed problem period now that they have planted ryegrass-clover pastures.

The milk production of Friesian cows grazing ryegrass-clover pastures is 3 *l* per day greater than that from those grazing pure nitrogen fertilized tropical grass pastures. Production from pure ryegrass pastures is 2 *l* per day greater than that from tropical grass pastures.

Minimum cultivation of land (slash, burn, disc) gave satisfactory land preparation for clover-ryegrass pastures.

An evaluation of supplementary protein requirements of calves between weaning at 2 and 6 months of age at Ayr Research Station has shown that a supplement of 5 parts maize, 1 part cottonseed meal will give acceptable daily weight gains to calves grazing irrigated, nitrogen-fertilized, tropical grass pastures. However, there was no response to extra protein once the animals had reached 110 kg in weight.

The importance of feeding supplementary sodium in a lactating cow's diet when grazing a tropical pasture was demonstrated in a trial at Kairi Research Station. An immediate increase of 12% in milk yield occurred when cows were fed 40 g of coarse salt per cow per day.

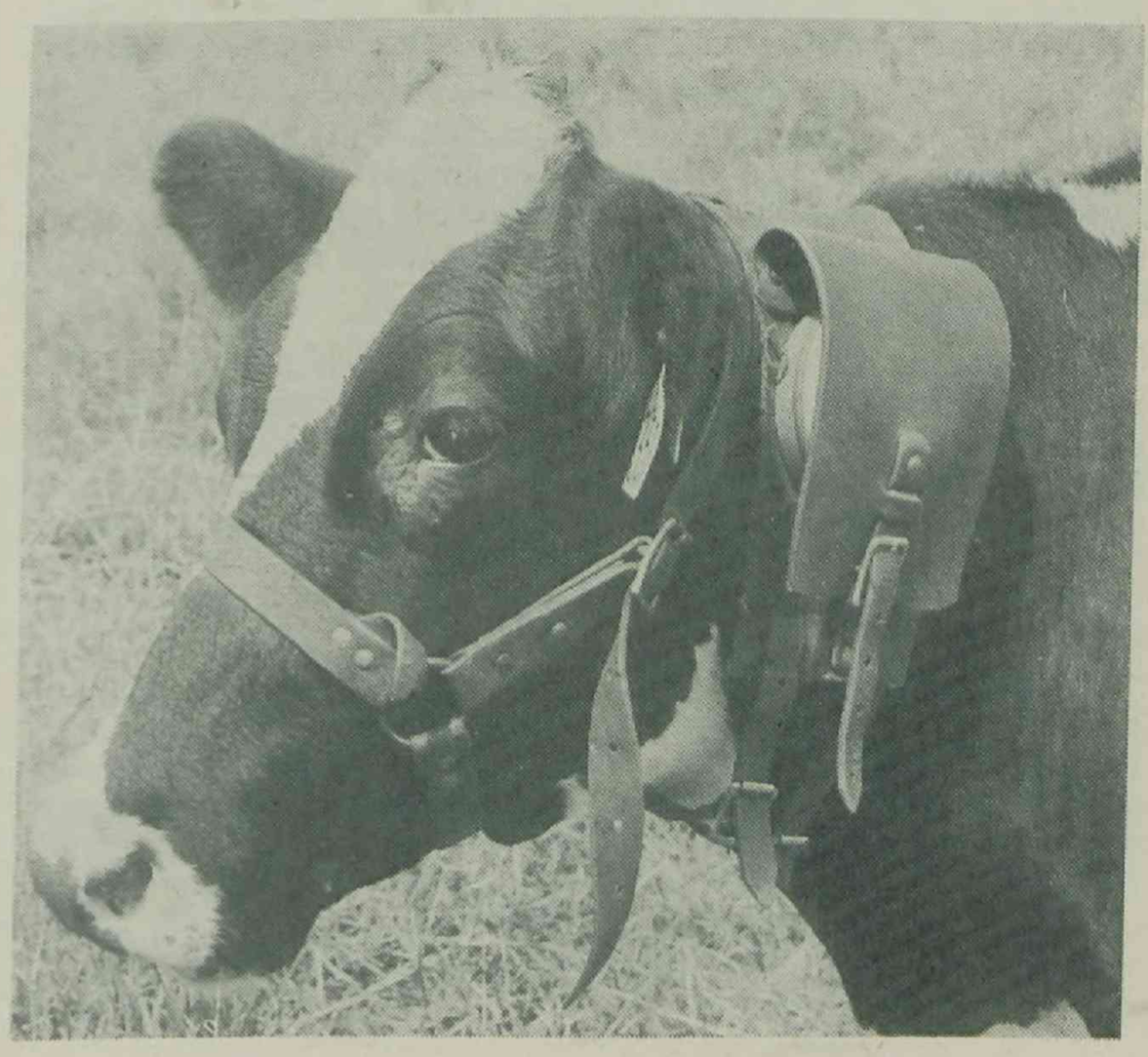
Dairy farmers using tropical pastures, especially those with a high legume content, should have salt available for their milking cows all year round.

Molasses is now recognized by many dryland farmers as a more economical energy supplement than grain.

General

The Downs Co-operative Dairy Association has fitted milk meters to all farm milk tankers in its fleet. This is the first farm milk tanker fleet in Australia to be fully metered. A new cheese factory at Malanda is the first fully mechanized cheese factory in Queensland.

A cow fitted with a device to record the amount of time spent in feeding. This device is used on research stations to assess the length of grazing time.



Dairy Field Services Branch

THE number and types of supply of registered dairies supervised by officers are set out in the following comparative table.

Type of Supply	1977–78	1978–79
Cream	761	643
Market milk	3	17
Manufacture milk	128	35
Market + manufacture milk	2 996	2 835
Cream + market M + manufacture M	1	2
Milk — raw	8	15
TOTAL	3 897	3 547
Goat dairies	18	18

This represents a decrease of 9%, which is similar to the reduction in the previous year.

Average returns to dairy farmers in the 1978–79 year have increased substantially above those of the previous year because of increased production and an increase in price. The price paid for both market and manufacture milk increased substantially during the year.

Production

In spite of the decrease in the number of suppliers, milk production has increased but this was accentuated by the favourable pastoral conditions compared with the previous year which was drought-affected. This has resulted in a marked increase in the amount of 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 515·6m *l* for 1977–78—an increase of 10%.

Product	1977–78	1978–79	% Change in Production 1978–79—1977–78
Market milk including cream (m *l*)	251·5*	240·3	
Flavoured milk (m *l*)	..	11·7	+2·9
Modified milks (m *l*)	..	6·9	
Butter (tonnes)	4 968	5 730	+15·3
Cheese (tonnes)	9 872	12 277	+24·4
Casein (tonnes)	938	956	+1·9
Powders (tonnes)	10 720	11 265	+5·1

* Includes flavoured milks in 1977–78.

The demand has been increasing for products containing lowered fat content and increased solids and also for flavoured modified milks. Sales of pasteurized milk have increased slightly.

Branch activities

The programmes and activities of Branch staff are directed towards the implementation of five objectives. The highlights of these activities are reported in their appropriate sections.

Objective No. 1. 'To provide advisory services in the field of dairy cattle management to Queensland dairy farmers.'

Major highlights with regard to this objective were—

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. A total of 233 staff meetings for this purpose was attended throughout the State.

DAIRY CATTLE NUTRITION. One of the highlights of the year has been the continued expansion in the use of ryegrass for winter feed on irrigated farms throughout the State. This has altered the production patterns in most areas and has made a large difference to farmers' attitudes to winter production. There has also been interest in the use of fertilizer on kikuyu pastures for summer and autumn feed.

On dryland farms, there is a growing awareness of the economics of feeding molasses as an energy supplement rather than grain. The Land Administration Commission, through the Dairy Farm Reconstruction Scheme, continues to play an important part in financing the installation of storage facilities for molasses and grain.

The use of strategic fertilizer application accompanied by irrigation has been heavily promoted in some regions with very good results.

Mastitis—Cell count programme. The mastitis cell count programmes began in 1972 using the Wisconsin Mastitis Test (W.M.T.) to evaluate mastitis levels in all herd milks in Queensland. A Fossomatic Automatic Cell Counter was purchased in 1976–77 and this allows all milks to be tested using this instrument.

As from July 1977 the advice notes to farmers detailed cell counts and not W.M.T. results. A summary of test results for the last 12 months is detailed below.

The results indicate that there has been a substantial improvement in cell counts during the period under review. Much of the improvement must be attributed to the improved beef prices which has allowed dairy farmers to cull old cows and cows with chronic mastitis.

MONTHLY ELECTRONIC CELL COUNT RESULTS
May 1978–April 1979

Month	No. of Tests	Mean* Cell Count (x 1 000)
May 1978	2 742	559
June	2 825	572
July	2 726	559
August	2 745	571
September	2 768	486
October	2 713	436
November	2 792	390
December	2 672	392
January 1979	2 649	394
February	2 652	335
March	2 717	320
April	2 728	330

* All suppliers in the State.

Routine calibration of the Fossomatic includes a monthly split sample check against the Coulter Counter, regular checks against the Direct Microscopic Cell Count and quarterly Australia-wide Cell Count Standardization Trials. This latter check has provided valuable information, but has also shown variations in results from the several States and in the instruments used.

An electronic interface was designed and built to allow results from the Fossomatic to be transferred directly to a Hewlett Packard 9825A programmable calculator. This has greatly improved data handling operations in this laboratory. Further modifications are planned to improve data storage and recall of information.

Teat dip and dry cow therapy treatments. Sampling is now completed on all of the 18 farms selected for these trials. Final reports have been submitted on 13, one was abandoned when the farmer ceased dairying and results are being analysed on four. The aim of this work is to compare the efficiency of various recommended treatments and combination of treatments under commercial conditions.

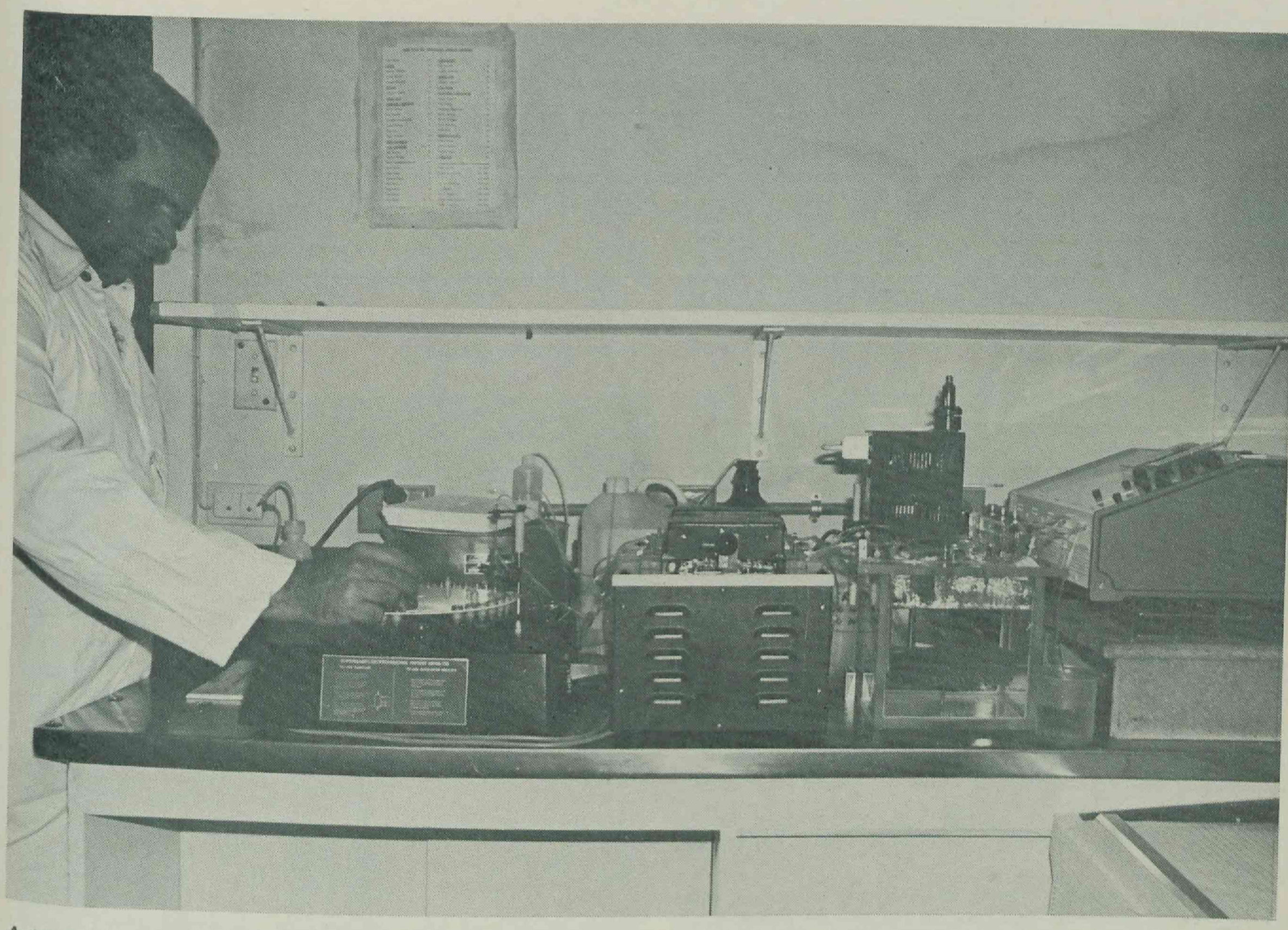
Individual cow cell counts. Increasing interest has been shown by farmers in cell counts of individual cows, particularly where cow samples are available through herd recording. This information could be useful in selecting cows for culling or for dry cow therapy, and may be useful for monitoring recovery after treatment for clinical mastitis. World-wide, little information is available about levels of cell counts to be expected in udder samples from infected and non-infected cows and the variations that occur.

A series of trials involving four commercial herds is continuing. Cows are aseptically sampled monthly from each quarter and samples examined for cell counts, Bovine Serum Albumen (B.S.A.), N-acetyl-B-d-glucosamidase levels (NAG-ase) and conductivity as measures of mastitis, together with bacteriological tests for mastitis pathogens. The results will be used in assessing the value of individual cell counts and in determination of thresholds to distinguish between infected and non-infected cows.

Some preliminary results from these investigations have shown that a lactation arithmetic mean cell count of 400 000 cells per ml would be a suitable threshold to distinguish between infected and non-infected cows. Fewer than 5% of cows with cell count results under this threshold showed infected quarters at the drying off bacteriological examination.

A pilot individual-cow cell count trial project associated with the herd recording system was introduced late in the year. A total of 70 farms throughout the State was selected and tested on a bi-monthly basis. It is proposed that this trial be run for 2 years.

The main purpose of the trial is to gauge farmer reaction and likely acceptance of an individual-cow cell count service combined with herd production recording.



Automated analysis for NAGase in milk—a new method for mastitis diagnosis.

Herd improvement—Herd recording. The major change during the year was the increase in herd recording fees. The new scale of charges and conditions has been generally well received by farmers with little adverse reaction. Herd recording numbers were maintained at approximately the same level as in the previous year. Some interest has been shown in the farmers-own-sampling scheme with interest in some regions greater than in others.

Artificial breeding. Herdsman Courses, which train producers to carry out their own artificial insemination, have continued. Courses have been conducted in a number of regions with the training team from Dairy Cattle Husbandry Branch receiving support from district officers. Ten one-day refresher courses have also been held in north Queensland. There is continuing strong interest among farmers who wish to do their own A.I.

Calf rearing. A strong upsurge in interest in calf rearing has occurred in all districts. This has been brought about largely by the increase in value of calves, plus the need for more replacements in the herd. 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.

Breeding management. Considerable interest has been expressed in evolving a breeding management extension programme. Plans are well advanced to introduce an expanded breeding performance option through the production Herd Recording Scheme. Officers from the north Queensland region attended a special extension workshop at Magnetic Island to develop the programme, which will be relevant to all regions.

Farm accounting schemes—Currently 43 dairy farmers are using the Dairy Farm Management Scheme. These are from central Queensland, Wide Bay, East Moreton and the 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 anticipated.

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.

Australian Development Assistance Bureau—Branch staff have been associated with A.D.A.B., a Commonwealth agency of the Department of Foreign Affairs, and have been responsible for the organization and running of an International Training Course in dairy husbandry. This course was held over a period of 3 months and provided useful in-service training for 16 field staff in this subject. Mr K. B. FitzGerald was appointed as Director of Studies for an International Training Course in Veterinary Services Administration during the year.

Regional newsletters-communication.—Regional information news sheets continue to be published in north Queensland, Mackay, Wide Bay, East and West Moreton, Darling Downs and South Burnett. Field officers contribute to these publications which are a valuable avenue of communication with producers.

A major communication activity for this year was the printing of the 'Happy Jack' Calendar for 1979. This was financed by commercial firms and prepared by officers of East and West Moreton. It was distributed to all dairy farmers in the State.

Special investigations—Energy determinations. A trial using the Modified Acid Detergent Fibre (M.A.D.F.) method of determining metabolizable energy began during the year. This is a relatively simple test to perform and initial results are encouraging.

The M.A.D.F. can also be used to estimate Digestible Dry Matter and Voluntary Intake.

This project is being carried out in co-operation with D.R.L. staff in Toowoomba.

Butterfat test trial—use of Bentonite clay. A trial using Bentonite clay to increase butterfat percentages was conducted during the year. Results were inconclusive but a significant response was noted in one herd. A joint report has recommended that further trial work be carried out.

Oat sickness trial.—In conjunction with Agriculture Branch and A.R.I. staff, a trial has begun to try to determine the cause of sickness which is sometimes evident in cows on grazing oats.

Ryegrass and clover trials. A trial in the central Queensland region comparing Mt. Barker sub-clover-ryegrass, Hannaford medic-ryegrass, and straight ryegrass was completed. These preliminary investigations indicated that the legume-ryegrass mix produced slightly higher yields than straight ryegrass. This aspect needs further investigation.

Summary of activities—The following tables summarize activities in the several subject areas described above.

FARM VISITS

—	Darling Downs	West Moreton	East Moreton	Wide Bay	Burnett	Central Qld.	North Qld.	Total
Routine	1 203	508	525	553	501	229	164	3 683
Quality improvement	732	369	505	631	416	129	60	2 842
D.P.S.S.	1	0	0	0	7	1	0	9
Husbandry	1 761	970	750	1 055	933	768	414	6 651
TOTAL ..	3 697	1 847	1 780	2 239	1 857	1 127	638	13 185

EXTENSION ACTIVITIES

Description	No.	Attendance
Farm walk-field day-tour	35	2 534
Method demonstration	38	266
Film-lecture evenings	33	816
Project clubs-Junior farmer	17	681
Farmer schools	14	972
D.E.A.C.-Q.D.O.-Disc. Group ..	10	1 282

These levels of association with industry are generally comparable with those of the previous year, although farm visits have decreased slightly. This may be attributed to the cessation of the Dairy Pasture Subsidy Scheme. Discussion groups and field days-farm walks have attracted a lot of attention. Farmer school numbers have increased due to A.I. training schools.

Objective No. 2. 'To provide advisory services in the fields of dairy product processing to Queensland manufacturers.'

Processing centres. There are 44 dairy product 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. During the year, 1 428 visits and 107 investigational surveys were completed by specialist dairy product officers. Visits include inspections of milk depots and dairy produce stores.

AMALGAMATIONS AND CLOSURES. Milk suppliers to Nestles, Kraft—Kenilworth, and Wide Bay have formed a new Wide Bay Co-operative Association. The reasons given for the formation of the new body were to maximize economies in farm bulk milk collection and to strengthen the bargaining of the local producers in industry negotiations.

The milk processing plant of Altadonna Bros., Ingham, ceased operation. Local farmers supplying this factory have closed down and the Atherton Tableland Co-operative Dairy Association is supplying packaged milk to Ingham from its Townsville factory.

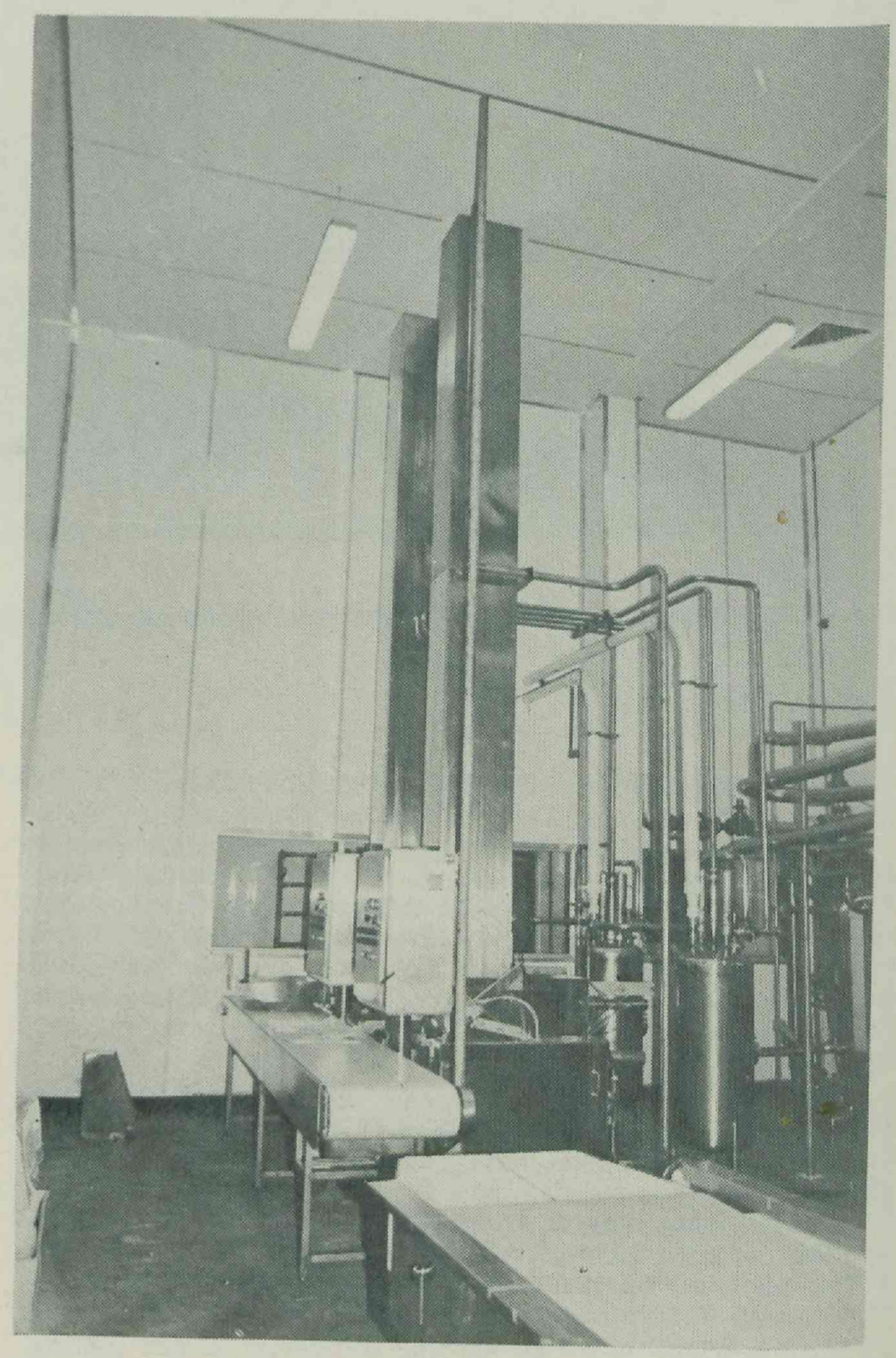
MILK PACKAGING. New packaging equipment is being installed in factories throughout Queensland as the trend away from packaging milk in bottles continues.

Sachet machines were installed at Townsville and packaging in bottles ceased. A new sachet machine was installed at Malanda. No milk is bottled at this factory.

Murgon, Maryborough and Bundaberg factories have installed new carton machines for milk products.

Dairy processing buildings and equipment—Buildings. During this year, a total expenditure of $2 274 562 for construction of new buildings or alterations was approved. Major building operations throughout the State have been—

- A new milk processing factory completed and operating at Murgon
- A new milk depot at Maroochydore for Suncoast Milk
- Alterations by Kraft Foods at Kenilworth and Quinalow
- Building renovations by Nestle to house new equipment
- Minor renovations at Maryborough, and planning commenced for major alterations to comply with Code of Practice requirements
- A new cheese factory is being constructed at Malanda
- The Port Curtis Co-operative Dairy Association has begun building a new milk factory at Mackay



Two Wincanton Towers installed in the new Malanda cheese factory. These machines form the cheese curd into a continuous block and eliminate the need for hoops and gang presses.

- Work has begun on the Gladstone factory of P.C.D. to reconstruct the building to comply with Code of Practice requirements
- New cheese cold rooms have been installed at Warwick
- Rebuilding of Townsville milk factory commenced

EQUIPMENT. During the year a total expenditure of $3 114 618 was approved for new factory equipment.

The Downs Co-operative Dairy Association equipped its farm pickup tanker fleet with Diessel milk meters. This will be the first farm tanker fleet in Australia to be fully metered.

Equipment to be installed at the Malanda cheese factory will make this factory the first fully mechanized cheese factory in Queensland.

Nestle's factory installed a new evaporator to increase capacity. This also entailed major modification to the spray drier to cope with increased throughput.

Queensland Farmers' Co-operative Association has installed a pilot-scale ultra-filtration plant at Booval. Initially, it is to be used to conduct trials on the manufacture of feta cheese.

Moura Dairy Supplies installed a H.T.S.T. pasteurizer and a homogenizer.

Factory operative training. In association with the Queensland Division of the Australian Institute for Dairy Factory Managers and Secretaries, three programmes were completed. Two of these were held in Brisbane for factory operatives who were sitting for certificates in Milk and Cream Testing and Milk Grading. A 1-week school on liquid milk and milk processing was held at Kirra for 15 factory operatives. These activities provide meaningful assistance to industry in the training of factory operatives.

District officers continued to provide training for bulk milk tanker drivers as part of a State-wide programme to improve milk quality.

'Dairy Products' bulletin. This bulletin 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 industry practices.

Investigations—Pesticide residues in dairy products. The level of pesticide residues in Queensland dairy produce remained at a satisfactory level during 1978. Commonwealth laboratories tested 271 samples of butter and cheese and Dairy Research Branch tested 115 pasteurized milks. The percentage of samples found to contain pesticide residues above the maximum residue limit (M.R.L.) during the period 1970–1978 are listed below—

Year	Chlorinated Hydrocarbons						Organo-phosphates		
	DDT	Dieldrin	Aldrin	Lindane	BHC	HCB	Ethion	Dursban	Nexagan
1970 ..	5·7	0·4	0·1	0·2	0·8	5·1	10·8	3·0	Nil
1971 ..	3·2	3·7	Nil	0·1	1·8	6·3	9·8	0·2	Nil
1972 ..	0·6	2·4	Nil	Nil	1·6	3·2	11·4	Nil	Nil
1973 ..	1·5	0·9	Nil	Nil	Nil	1·2	7·6	1·3	Nil
1974 ..	0·9	2·2	Nil	0·1	Nil	1·5	9·6	2·1	Nil
1975 ..	1·2	0·8	Nil	Nil	0·4	0·1	0·2	0·5	Nil
1976 ..	0·6	2·8	Nil	Nil	Nil	Nil	Nil	0·9	Nil
1977 ..	Nil	1·5	Nil	0·2	Nil	Nil	Nil	Nil	Nil
1978 ..	Nil	2·6	Nil	Nil	Nil	Nil	Nil	Nil	Nil
M.R.L.*	1·25	0·15	0·125	0·2	0·3	0·3	0·5	Zero	1·0

* M.R.L. amended during 1974.

During 1978, carbophenothion was found above M.R.L. in one sample of butter (0·1 p.p.m.), while methoxychlor (buffalo fly treatment) was found in three samples of pasteurized milk (2·0, 3·0 and 4·0 p.p.m.).

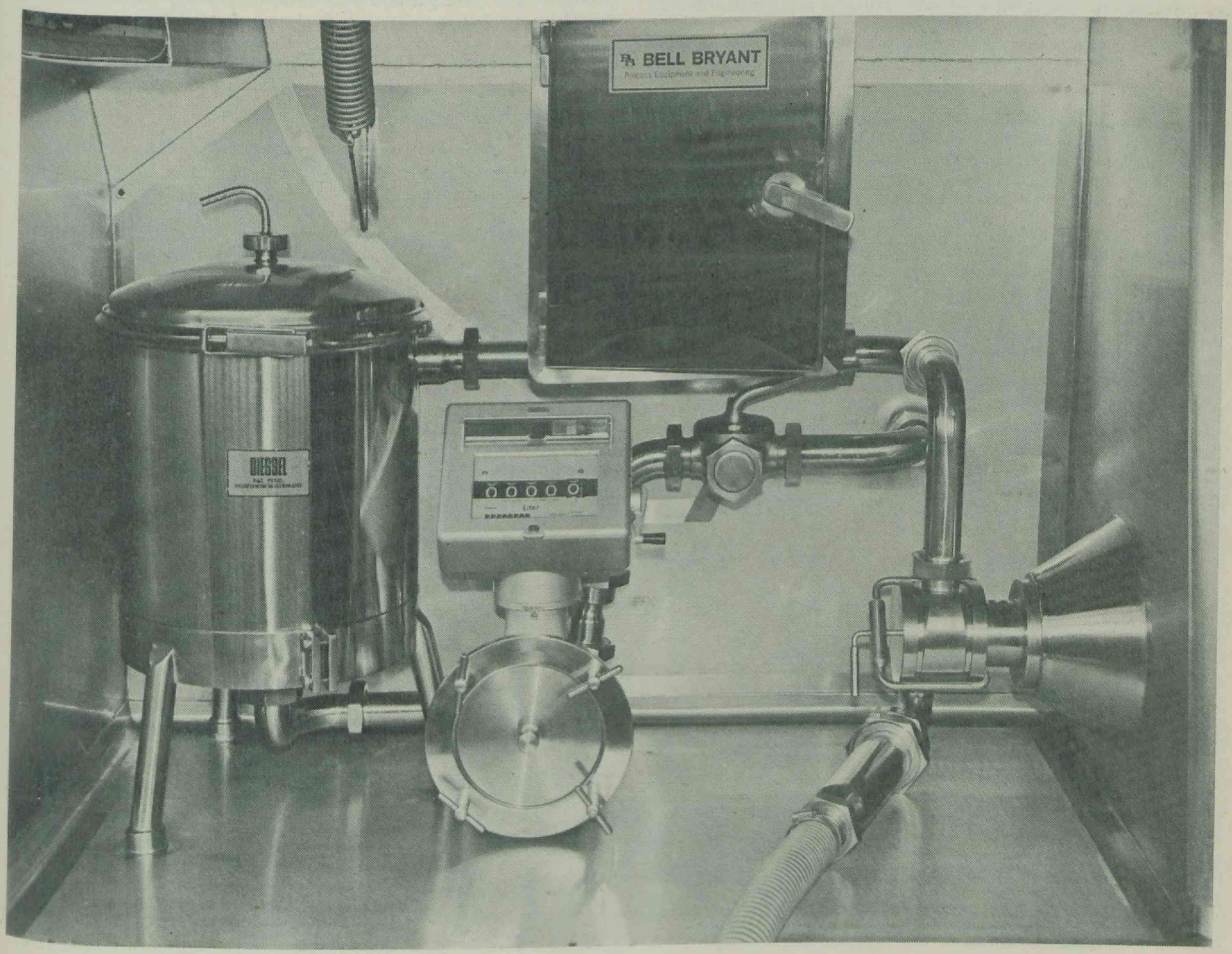
Blue Vein cheese. Investigations have continued into the problem of slime growth on Blue Vein cheese. Previous work had shown that both Cryovac S bags and barrier bags control slime growth as does freezing and to a lesser extent, storage in a CO_2 atmosphere. However, vacuum-packed cheese exhibited a fruity flavour at 6 weeks' storage which was further pronounced after 12 weeks' storage.

Further trials were conducted to obtain parameters for cheese storage. The maximum storage life for good quality cheese was found to be 9 weeks. It was also found that freezing of wedges and subsequent frozen storage will control slime growth. Snap freezing with liquid nitrogen eliminates the chalky body found with slow freezing of product.

The colour of the mould *Penicillin roqueforti* becomes bleached under the effects of vacuum but, once oxygen is available to the mould, colour quickly returns to normal.

As a result of these trials, the Downs Co-operative Association has changed the packaging system for wedges from a foil wrap to a foil wrap plus vacuum pack.

One of the milk meters installed in each of the farm milk collection tankers operated by the Darling Downs Co-operative Dairy Association. The meters eliminate the use of dipsticks to measure milk in the farm vat.



Investigations were also carried out into a white mould contaminant on Downs Blue Vein cheese, identified as *Scopulariopsis*. Improvements to hygiene and processing routines were recommended and adopted and the problem has apparently been resolved.

Use of enzymes to accelerate cheese ripening. These investigations were carried out at a commercial cheese factory to determine the effectiveness of commercial enzyme preparation claimed to accelerate ripening of cheddar cheese.

Results showed that, though accelerated cheese ripening was possible, the cost of enzyme for factory operation would be prohibitive. Even though storage time is reduced when using the enzyme, it cost 14c per kg cheese, compared with 0·7c per kg per month for conventional ripening.

Commercial medium-eye type cheese trials. Following a period of developmental work by the Dairy Research Laboratory, small scale trials have commenced on a factory basis. It has been found necessary to modify existing factory equipment so further trials may continue.

Development of an organoleptic grading system for cheese other than cheddar. This project is supported by the Dairying Research Committee and has involved the assessment of non-cheddar cheese varieties under four separate grade point systems, with accent on cheese attributes as well as defects.

The grading system most suited to each variety will be determined and varietal characteristics recorded for reference by graders.

To date, 305 samples comprising 63 varieties and sub-varieties of cheese have been examined and assessments recorded.

Objective No. 3. 'To administer the provisions of the relevant legislation—Dairy Produce Act, the Margarine Act, and the Filled Milk Act'.

Dairy Produce Act. The new Act, passed by Parliament, has not yet been proclaimed. Regulations are being drafted and should be finalized in late 1979.

Dairy buildings. Most farmers so disposed have now converted to bulk milk and hence only 25 new buildings were erected and 66 renovations completed. Of the new buildings, 20 were herringbones, both high-line and low-line. A total of 45 bulk milk vats was installed under guidance of district staff in accordance with Regulation 220, many of these being installed in north Queensland as second vats.

Milking machines. In association with the reduced building programme, there were 44 new milking machines installed and 59 second-hand units placed into operation. In supervising this, officers completed performance testing on 779 milking machines. This was a substantial increase on the previous year's figure.

Certificate in Competency. A total of 48 examinations was held in connection with Certificate examinations conducted under this Act. These examinations are taken by operatives in the industry who do not possess the qualifications necessary to perform the skilled duties in factories.

Dairy produce grading. Two officers are engaged full-time performing grading duties in Brisbane. They also provide assistance to regional officers who carry out grading of local butter and cheese at factories within their respective regions. This has assisted factories to improve the quality of their products, as problems encountered through grading can be discussed with factory operatives.

Butter has continued to decline throughout the year. This is attributed to problems associated with the storage and handling of small quantities of cream. The following table shows the overall quality of butter manufactured in Queensland. The bulk butter was graded at the Butter Marketing Board and represents 55% of the State's production. The remainder butter was patted at factories for local consumption and was graded by regional officers.

Grade	Quantity (kg)		Total	% of Total
	Bulk	Pats		
Choice	1 289 000	728 568	2 017 568	38·0
First	1 259 200	1 385 401	2 644 601	49·9
Second	477 550	14 895	492 445	9·3
Below second ..	142 975	5 295	148 270	2·8
TOTAL	3 168 725	2 134 159	5 302 884	100

Overall, 92·2% of the State's butter production was graded.

All butter supplied from Victoria is graded by State Grading Officers. A total of 9 006 tonnes of butter were received from that State which is only slightly less than that received the previous year (9 061 tonnes).

Though less butter was graded as second than previously, the table butters (93 and 92 points) were of lower quality than previously.

Generally, the quality of cheddar cheese continued to improve during the year, 30·8% choice this year compared with 19·9% in the previous year. A total of 8 253 tonnes of cheese was graded, 67% of total cheese production in the State, as follows:—

Grade	Quantity (kg)	Percent
Choice	2 543 788	30·8
First	5 472 568	66·3
Second	236 697	2·9
TOTAL	8 253 053	100

In addition to grading cheese in bulk stores, a programme of grading cheese at individual factories has been further developed.

Raw milk quality. The total count test is now applied to raw milk at all stages of handling. A system of 6-monthly checks on factory laboratory operative testing procedures has been instituted to ensure factory tests on farm supplies are accurate.

Residue contamination of milk.—As detailed in another section of this report monitoring of pesticide levels in dairy products has continued.

The incidence of iodine contamination in milk was again reviewed during the year and further work on rapid testing methods was carried out. Milk from suppliers to all factories except for two are tested at regular intervals. This has identified those with high levels and allowed follow-up visits by officers. As a result of testing by factories and Divisional officers and advice from officers, both by advisory circulars and visits, there has been a general diminution in the levels of iodine, particularly in market milk.

Milk licensing. The major activity involved applications for 1979 licences from existing vendors and applications from new owners.

Some problems were encountered with the introduction of new forms under the Milk Supply Act. After initial problems the work involved has progressed satisfactorily.

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.

All factories were inspected by State officers during 1978–79 and the second combined State–Commonwealth inspections are to be carried out in 1979–80.

One of the benefits of the Code of Practice is in having factories planning ahead for future alterations.

Objective No. 4. 'To advise the Director-General on matters relevant to the dairy industry in Queensland.'

A considerable amount of time was spent by officers in collecting 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 required data.

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.

Dairy Cattle Husbandry Branch

DAIRY CATTLE HUSBANDRY BRANCH is responsible for developing and operating programmes in artificial breeding, dairy herd management, dairy breed improvement, dairy herd health and reproduction, and dairy herd production methods.

A.I. centres are located at Wacol and Redlands (Ormiston) and a herd improvement laboratory is also at Wacol. Research stations at Ayr and Kairi provide facilities for experimental work.

Artificial breeding services

This has been the most successful year ever experienced by the A.I. Centre. A large part of the increased volume of trading can be attributed to factors which have been beyond the control of the Centre (for example, sales of Sahiwal semen to New Zealand) and every effort must now be put into consolidating these gains by effectively promoting our product. Increases by major categories are as follows—

	Doses	Increases %
Total movement from D.P.I. sires ..	150 380	25
Total semen despatched	174 430	27
Semen sales	128 905	24
Exported overseas	39 770	26
Exported interstate	29 662	23
Friesian (D.P.I. bulls)	50 315	34
Beef (D.P.I. bulls)	53 934	28
Distribution of consignment semen through Wacol	13 512	65

UNLICENSED SEMEN. Seventy-nine consignments, comprising 10 538 doses from 99 bulls, were despatched during the year.

D.P.I. SEMEN DEPOTS. One hundred and fifty-one orders (5 966 doses) were despatched from depots at Mackay and Rockhampton.

PROMOTION. The rapid growth in export sales of both cattle and semen has warranted the preparation of an export brochure featuring the breeds of cattle available for export from Queensland.

SHOW EXHIBITS. An exhibit was staged at the 1978 Royal National Show and a display was also organised for the Australian Cattle Field Days held at Oakey.

A small display was erected at the University of Queensland Agriculture Faculty building featuring equipment used in the collection and processing of semen.

LICENSED SEMEN PRODUCTION. A total of 332 834 doses was processed at Wacol and Ormiston. Of these, 287 386 met the minimum quality standards for distribution.

Thirteen privately-owned bulls were housed at Wacol with six still located at Wacol on 30 April 1979. Two privately-owned bulls were housed at Ormiston.

UNLICENSED SEMEN PRODUCTION. The variable demand for processing unlicensed semen continued. A total of 17 660 doses was processed (8 550 in 1977–78, 16 800 in 1976–77): 13 420 of these doses were stored (76% success rate) including 11 440 collected by 10 private veterinary practitioners.

In addition to A.F.S. sires owned by the Department, four privately-owned sires were located at the Herd Improvement Laboratory for unlicensed semen production. Young A.F.S. bulls were generally unsatisfactory as semen donors. The average age at entry was 18 months but consistent semen production did not occur until the animals were 24 to 26 months old.

INSEMINATOR TRAINING. The provision of initial and refresher training was the largest part of the Artificial Breeding Services field work. One hundred inseminators attended 10 refresher training courses on the Atherton Tableland and 136 people were trained as inseminators throughout the State (170 in 1977–78). Forty-seven of these attended courses at Wacol and the remainder received 'on farm' training. Eleven people were granted Inseminators Certificates.

The demand for training by farmers who wish to inseminate their own cattle has continued at a slightly reduced level even in areas with established A.B. services. This follows world-wide trends in the provision of A.B. services and will eventually lead to a much wider acceptance and use of A.B. with its many benefits.

A report on a survey of 'Do-it-yourself' (D.I.Y.) insemination was completed late in 1978. The main features were that an accurate assessment of operations was difficult because of inadequate record keeping. D.I.Y. inseminators were generally satisfied with their own performance with an 86% average conception rate after two services. Seventy-six of the 79 operators surveyed had done some inseminating.

Multiple suckling. Two A.F.S. calves and one Friesian calf are suckling a Friesian cow. This is now standard calf rearing procedure at Kairi Research Station.

STOCK NUMBERS. One hundred and nineteen bulls were housed at the A.I. Centre. Of these, 95 animals were dairy bulls and 24 were beef bulls. There was a slight reduction in beef bulls at the Centre.

Eighty-eight animals entered the A.I. Centres and 86 were disposed of.

Two hundred and six head passed through the H.I.L. Centre including 54 A.F.S. cows and calves enroute to co-operators' farms or research stations, 11 A.F.S. bulls for tick testing and unlicensed semen production, four privately-owned bulls for unlicensed semen production and 129 cows for A.I. training.

HEALTH. Both centres complied with all the requirements in 'Minimum Health Standards for Bulls Standing at Licensed Semen Production Centres' and certification was forwarded to other States by the Chief Inspector of Stock.

Dairy herd management services

PRODUCTION RECORDING. During the 1977–78 recording year, 38 887 cows completed lactations in 647 recorded herds. This represents 16·6% of the 3 897 Queensland dairy herds. Six hundred and thirty-seven herds were recorded in May 1979. A change in the reporting system to include in annual statistics only cows which completed lactations excluded cows with extended lactations from the 1977–78 summary. This change should be noted in comparisons with summaries of other years.

The average production of all herds was 2 537 *l* milk and 102 kg butterfat with a 4·1% test. A summary of production results by breed is provided in the table.

Breed	No. of Cows	Av. Lactation Days	Average Production		
			Milk *l*	Fat kg	Test %
Friesian ..	14 772	274	2 837	112	4·0
A.I.S. ..	10 398	265	2 632	103	3·9
Jersey ..	6 845	269	2 030	95	4·7
Guernsey ..	1 745	269	2 087	91	4·3
Ayrshire ..	648	276	2 335	93	4·0
A.M.Z. ..	25	257	1 776	74	4·1
A.F.S. ..	25	251	2 198	94	4·3

The recent increase in recording fees allied with a continued decline in dairy farm numbers has caused a net decline of 10 in the number of farms recorded. It is considered that a further 30 herds may be withdrawn from recording when the new fee structure becomes operative on 1 July 1979.

OUTSTANDING PRODUCTION RECORDS. The highest quantity of milk and fat produced was by the A.I.S. cow 'Wilmington Plum'. This cow owned by Messrs L. W., M. J. and G. F. Peters produced 11 146 *l* milk and 540 kg fat in 300 days surpassing the previous butterfat record of 536 kg fat held by 'Woodlin Reunion Leila' a Friesian cow owned by Messrs J. and G. Wood, Mutdapilly.

CENTRAL TESTING LABORATORY. A total of 428 502 milk samples was tested for butterfat and protein determination compared with 451 221 in 1977–78 and 454 800 in 1976–77. The decline in samples tested reflects partly the withdrawal of herds from the scheme and partly the exercise of the option to not introduce fresh cows in the interim period of transition to the new fee structure (30 herds). Ten of these 30 have already indicated their intention to register their herds for the year ending 30 June 1980.

HERD RECORDING SYSTEMS. Data processing programmes introduced in July 1977 provided additional flexibility to the recording system, and aspects of dairy farm management other than production are now being monitored.

Five trial groups (28 members) have been testing 'Farmers Own Sampling' system. This service will be introduced on 1 July.

REVISED HERD RECORDING SCHEME. On 1 March 1979, a new system of recording charges was introduced. The programme for this changeover operated smoothly, but did involve significant clerical effort.

Dairy breed improvement

BULL PROVING. Evaluations of sires used in 1974 were again made by using the contemporary comparison method. '500' series proofs were completed in the A.I.S. and Friesian breeds. Insufficient daughter lactations were available to determine a proven bull in the Jersey breed. The A.I. Proven A.I.S. and Friesian bulls were Wongalea Envoy 21 and Glenroy Reflection Teddy.

A field day for both users and non users of the scheme was held at Wacol Centre on 30 May 1979: attendance of 180. The consensus at this day confirmed the adequacy of existing bonus arrangements and the need for improvement in calf rearing. It also highlighted the importance of the breed society role in ensuring that only the best available cattle are offered as dams of proving bulls. The contract breeding scheme was commended.

Dairy breed development

TICK RESISTANT DAIRY HERD PROJECT. This programme has now been satisfactorily established in 12 co-operators' herds. Since inception the following matings have been made and progeny born:—

—	Sahiwal	A.F.S.	British Breed
Matings	256	261	306
Female progeny ..	61	48	63

Co-operating farmers have been encouraged to use semen from bulls in the Australian Friesian Sahiwal (A.F.S.) bull proving group.

All farms have been visited by tick extension officers for discussion on this phase of the programme. The strong support of these officers and the officers of Dairy Field Services Branch collaborating in the project is acknowledged.

A.F.S. BREED DEVELOPMENT PROGRAMME. The production of base F1 females from Friesian cows has been reviewed and reorganized to ensure that sufficient daughters of several Sahiwal bulls are available for daughter production comparisons and selection of superior sires. Friesian cows on Kairi and Ayr Research Stations, in the herds of co-operating farmers on the Atherton Tableland, and in co-operators' herds (Departmentally owned cows) in central and southern Queensland are used in this segment of the programme.

Continued progress in the development of the A.F.S. breed will rely mainly on the application of sound selection criteria in the later generation animals These later generation animals are the basis of A.F.S. bull proving programmes which began in 1976. The first daughters of these 1976 bull proving team bulls (S1511, S1962, S2864) are being lactation-tested in 1979–80. All these heifers are being lactation tested in co-operators' herds in south-east Queensland.

The re-location of the A.F.S. nucleus or bull breeding herd in south-east Queensland, and the location of all potential nucleus herd replacements in that area, have placed increased emphasis on the basis on which bull breeding cows will be selected in co-operators' herds.

The role of co-operators, particularly in south-east Queensland, is vital to the continued development of the A.F.S. breed. Since December 1978, 36 nucleus cows and heifers have been transferred from Kairi to south-east Queensland.

On the research stations, Kairi Research Station has reported that calf rearing, and more particularly heifer growth rates, have achieved targets and the majority of heifers are attaining mating weight at 15 months of age.

Kairi Research Station will lactation-test 30 F1 A.F.S. heifers during August–December 1979.

A summary of lactation test results at Ayr during the year is—

—	Tested No.	Passed No.	Failed No.	Passed %
F1	49	27	22	55
F2	9	7	2	78
F3	14	13	1	93
TOTAL ..	72	47	25	

S1884 in the herd of Mr Stonehouse has again exceeded 5 053 *l* of milk and 203 kg of fat in 296 days. Of the A.F.S. cows, 30% had production yields exceeding 3 000 *l* of milk. Breed average was 2 387 *l* milk, 93 kg fat in 267 days.

Four bulls—S2619, S2643, 412, 436—remain as the 1979 A.F.S. bull proving team.

SAHIWAL BREEDING PROGRAMME. A purebred herd of 15 Sahiwal cows and heifers from C.S.I.R.O. was located at Ayr Research Station in November 1978. These animals have produced a small number of calves since arriving at Ayr, and four are being reared. Temperament problems made handling difficult early in the settling down period but the animals are now relatively tractable.

Sahiwal semen from the University of Sydney arrived at Wacol during December. This unlicensed semen represents a valuable reserve of some of the original genetic material imported and early generation progeny of those imported bulls.

Dairy herd health and reproduction

HERD HEALTH. The pilot herd health project based on manually-collected and processed records has been operating successfully on six co-operators' herds in south-east Queensland. Extensive records of reproduction and health status of all cows have been maintained.

Suboptimal cow fertility resulting from exended calving to conception interval has been identified as a major source of production loss on these farms.

The herd recording computer programme is being modified to accept herd health data and to provide a computerized management information service to the producers.

REPRODUCTION RESEARCH. Results of a pilot trial involving preservation of bovine semen indicate that a correlation exists between increased extracellular levels of some semen enzymes and sperm damage. An evaluation method, using levels of hyaluronidase, GOT and LDH to assess the extent of sperm damage during processing, is under investigation.

In another project, several semen diluents are being assessed for use in Custom Collection semen service. This trial is continuing satisfactorily.

BRAHMAN BULL SCROTAL CIRCUMFERENCE OBSERVATIONS. Observations on this project have been finalized and preliminary analyses of the data suggests that there is a correlation between scrotal circumference and sexual maturity of Brahman bulls.

Statistical analysis of data is not yet complete.

CYTOGENETIC RESEARCH. Cattle. Routine cytogenetic monitoring of bulls entering the A.I. Centre, Wacol, has continued and 56 bulls each with a normal karyotype were studied. Six abnormal cattle were studied. One exhibited sex chromosome mosaicism.

Further studies were continued on cattle previously identified as heterozygous for the 1/29 Robertsonian translocation.

C- and G-banding studies have continued and G-banding patterns of chromosomes from *Bos indicus* and cross cattle have been identified.

Pig. One of five hermaphrodite pigs studied exhibited sex chromosome mosaicism. The remaining four had normal female karyotypes.

Horse. Two infertile mares and one set of heterosexual twin foals were studied. All had normal karyotypes.

Dairy herd production methods

Trials concluded in 1976–77 and 1977–78 indicated that annual autumn sowings of irrigated rye grass and clovers had tremendous potential even in the tropics for increasing milk production during this period of the year. Industry acceptance has been rapid and widespread, particularly in central and northern Queensland. In the Mackay area alone, more than 70% of farmers have purchased irrigation equipment within the last 3 years specifically to grow these species. They claim that winter-spring is no longer a feed problem period.

This year, a major part of milking trial work at Ayr Research Station was designed to evaluate further the milk production potential and management requirements of irrigated ryegrass and clover areas.

A trial 'Milk Production from Friesians grazing Sod Sown Temperate Species' carried on for a second lactation. Its aim was to define the milk production potential of irrigated ryegrass, clover and ryegrass-clover areas sown into tropical pasture in April after minimal land preparation (slashing, burning and discing). Results were identical with those of the first lactation and showed—

- That ryegrass and/or clover areas produce between 11 000 and 17 000 *l* of milk per hectare from May to December.
- That this milk is produced at an average cost of 3·0 to 5·0c per *l*.
- That the daily milk production of Friesian cows grazing clover or ryegrass areas was 3 *l* per day greater than cows grazing irrigated nitrogen-fertilized tropical grass pasture. Milk production of cows on pure ryegrass was less than clover areas but was 2 *l* per day higher than N–tropical grass pasture.

A trial was completed which studied the effect of land preparation on milk production from ryegrass, or clover areas. Results showed that, where possible, thorough land preparation (slash, burn, rip, disc, rotary hoe) improved milk production by 20% compared with minimal preparation (slash, burn, disc). Although thorough cultivation gave more economical returns, results confirmed that minimal cultivation gives satisfactory milk production.

Demonstration areas of these species have been planted by the Department on a number of co-operator's farms in the Mackay and Atherton Tableland areas. These have shown—

- That milk production from irrigated ryegrass and/or clover pastures on commercial farms is similiar to that obtained on the Ayr Research Station.
- That clovers, where they will grow, well outproduce ryegrass.

NITROGEN FERTILIZER. The place of, and responses obtained from, nitrogen fertilizer on tropical and sub-tropical grass pastures were studied.

Milking studies on both the station and commercial farms have been designed to assess the value of nitrogen fertilizer application to tropical and subtropical grass pastures during different seasons.

A research station trial has shown that milk production from irrigated tropical grass pasture gave lineal increases with N fertilizer up to 55 kg of N per ha per month in winter but that the response falls off dramatically above 40 kg of N per ha per month in summer.

Irrigated grass nitrogen areas are becoming increasingly popular on Queensland dairy farms for producing more feed on the farm and for allowing the stocking pressure on dryland grass legume pastures to be lowered to a point where legume persistency will be enhanced.

SUPPLEMENTARY PROTEIN. The evaluation of supplementary protein requirement of calves between weaning (2 months) and 6 months of age was also studied.

To maximize lifetime milk production from their cows, farmers are advised by the Department to calve heifers at 2 years of age. For Friesians, 450 kg at parturition is recommended and, to achieve this weight, a growth rate of 0·6 kg per day is required. Earlier studies at research stations and on dairy farms in north Queensland have indicated that these growth rates can be achieved only if some form of energy supplement is given to yearling animals grazing tropical pastures.

In response to enquiries from farmers in the Mackay region, these experiments were designed to examine the effects of energy and protein supplements on growth of calves in the immediate post weaning phase.

Five isocaloric supplements containing varying amounts of maize and cottonseed meal were fed to calves from 2 to 6 months, and an unsupplemented control group was used in a trial. All animals grazed irrigated, nitrogen fertilized (336 kg N/ha) setaria pastures. Two drafts of animals were used. The earlier experiment examined growth of calves reared in spring (the period when highest growth rates occur); and this draft was reared during the summer wet season. Internal and external parasites were kept to minimal levels.

Growth rates of the summer-reared animals were 25% lower than the spring calves, and unsupplemented calves grew at only 0·24 kg per day. Grain improved growth rates by 72% to 0·40 kg per day while increased protein concentration lifted growth rates by a further 11% to 0·45 kg per day. A small amount of extra protein was sufficient to achieve this lift. Maximum grain of 0·47 kg per day was achieved by calves receiving the 5 parts maize, 1 part cottonseed meal supplement. Response to protein is of short duration and extra protein is not required beyond 110 kg liveweight in animals grazing irrigated nitrogen-fertilized tropical grass pastures.

Cow numbers and stocking rates have increased on dairy farms throughout Queensland, and in particular on the Atherton Tableland over the past 5 years. Tropical grass-legume pastures are unable to support stocking rates above 1·5 cows per ha on a long-term basis. This has forced many dairy farmers to use nitrogen-fertilized grass pastures because of their higher pasture production and carrying capacity.

No research has been done to define an optimum stocking rate for tropical grass pastures fertilized with different levels of nitrogen. An experiment using Gatton panic grass conducted over the past 2·5 years at Kairi is looking at that problem, with four stocking rates 2·0, 2·5, 3·0, 3·5 cows per ha and two levels of nitrogen fertilizer, 200 and 400 kg N per ha per yr. A comparison with a grass-legume pasture of Gatton panic, Tinaroo glycine–Greenleaf desmodium at 2·0 cows per ha, receiving no nitrogen has also been included.

Average milk yields ranged from 2 590 kg per cow at a stocking rate of 3·5 cows per ha (200 kg N per ha per yr) to 3 106 kg per cow at a stocking rate of 2·5 cows per ha (400 kg N per ha per yr). The margin per hectare ranged from $548 to $935.

Because of the high cost of nitrogen fertilizer, tropical grass pastures have to be stocked at 2·5 cows per ha to utilize the extra pasture produced and make the system more economic than a grass-legume pasture system. Stocking pastures above 2·5 cows per ha is not advisable because of the severe effect of the dry season on cow liveweights and the need for supplementation for 2 to 3 months.

The extra nitrogen fertilizer at the 400 N level did not pay for itself in extra milk produced but resulted in cows in better condition and liveweight at the end of the dry season and fewer weeds in the pasture.

Pasture production decreased in each year (summer through to spring) with frosts in winter of each year causing a rapid decline in pasture on offer. The high nitrogen level produced on average an extra 880 kg pasture dry matter per ha and resulted in fewer weeds especially at the higher stocking rates. The grass-legume pasture was suffering the effects of continuous overstocking with low pasture yields and high weed content.

A further experiment is planned to look at the effect of increasing the frequency of nitrogen fertilizer application on pasture and milk production.

Response to salt

The response in milk yield to supplementary salt (NaCl) was the subject of another study. This experiment set out to determine whether there would be a response in milk yield to feeding salt to cows grazing tropical grass-legume pastures.

Twenty A.F.S. and Friesian cows were blocked on the basis of breed, milk yield and stage of lactation into two treatments groups: A. no salt; and B. 40 g coarse salt per cow per day. Each cow was individually fed 1 kg of maize per day and the supplementary salt mixed in with the grain. Cows grazed as one group on Gatton panic–Tinaroo glycine pasture.

At the commencement of a salt feeding trial there was an immediate increase in milk yield of 0·9 kg per cow per day over the control group. This difference widened up to a maximum 1·5 kg per cow per day at week nine of the 12-week experiment. Average milk yields per day were 10·8 kg for the control group and 12·0 kg for the sodium supplemented group.

Dairy farmers using tropical pastures, especially those with a high legume content, should have salt available to their milking cows all year round.

Research work in south-east Queensland

All research work has to be conducted on co-operators' properties in south-east Queensland as there is no dairy research station in the area.

Six projects have been undertaken this year. Three are investigating the milk production from cows grazing nitrogen-fertilized kikuyu grass and three are monitoring milk production from cows grazing kikuyu grass and fed with a molasses supplement (two at Gympie and one at Grantham).

Intensive utilization of irrigated nitrogen-fertilized tropical grass for milk production with molasses fed as a winter supplement.

A farm in south-east Queensland at Ma Ma Creek, Grantham, has been used by the Department to gain further basic information on the productivity of irrigated kikuyu grass when grazed by dairy cows. This trial is now in its fourth year. The pasture is well established and can be considered to be a pure stand of kikuyu. Basic fertilizer dressings of superphosphate, muriate of potash and nitrogen were applied.

The irrigated kikuyu pasture at Ma Ma Creek, Grantham, of 4·9 ha is grazed continuously by 20 cows known as the Government herd. This is a stocking rate of 4·1 cows per hectare. These animals have been paired with 20 other cows in the rest of the herd which graze other mixed pasture on this farm. This stocking rate is 1·8 cows per hectare.

Four years' milk production figures have been obtained from this pure stand of irrigated Whittet kikuyu pasture.

Production per ha (litres) from both pastures for the last 4 years is—

Year	Whittet kikuyu		Other pasture	
1975–76	S/R 4·45	10 367	S/R 1·8	4 207
1976–77	S/R 4·19	11 659	S/R 1·8	5 137
1977–78	S/R 4·0	12 864	S/R 1·8	4 630
1978–79	S/R 4·1	12 785	S/R 1·8	5 422

The cows last year were fed during the winter 5 460 *l* of molasses *ad lib* in the irrigated kikuyu paddock from 15 June 1978 to 3 October 1978 for 110 days. By the end of the winter, the Government cows were in markedly better condition than the remainder of the herd and this was reflected in their milk production.

In addition, the irrigated kikuyu paddock has been able to grow away much earlier this spring because it was not being grazed so hard during the winter. For the 1978–79 season, there was a positive response to molasses supplementation in the immediate post winter period.

—	Irrigated kikuyu	Other pasture
Production per cow (*l* milk) ..	1 622	1 540
Production per cow (kg fat) ..	64	62
Production per hectare (*l* milk) ..	6 619	2 772

It has been normal practice to compare milk production figures from the end of February each year. The full effect of the previous winter's supplement will not be evident until the end of these current lactations.

STOCKING RATE TRIALS. Observations on the growth rates of Friesian heifers grazing kikuyu pastures were initiated in four Queensland areas in 1973. At each site three farms in close proximity each carried two groups of five heifers at two stocking rates. Thus each site contained two replications of the stocking rates 2·5, 3·1 and 4·2 heifers per ha described as low, medium and high.

The results indicated that well fertilized kikuyu pastures were capable of supporting 4·2 heifers per ha at an annual liveweight gain of 0·45 to 0·50 kg per heifer per day.

In one area only was it possible to extend the observations on three farms to lactating dairy cows to determine the effect of stocking rate on milk production. This area is on the properties of Messrs E. R. Andrews, Peachester, T. Deans, Maleny district, and R. Tumbridge, Mt. Mee. As indicated in last year's report the trial on Mr. Deans' property was terminated after the second lactation of the herd.

Average production per cow on the Medium Stocking Rate (3 374 *l*) is consistently better than that of the Low Stocking Rate (3 091 *l*).

This year, there was a drop in production from both stocking rates. However, the drop in production from the higher stocking rate was half that from cows on the lower stocking rate.

In spite of this, there was an advantage of 2 732 *l* of milk and 95 kg of fat for cows grazing at the medium stocking rate (3·1 cows per ha) compared with the low stocking rate (2·5 cows per ha).

In financial terms, this could mean an increased return of approximately $340 at 12·55c per *l* net farm gate prices based on the Queensland State average for all milk received during this period.

This result is consistent with the previous two lactations and most dairy farmers should with good management be able to increase their stocking rates consistent with the trial results.

HEIFER GROWTH RATES. Observations were continued to determine growth rates of Friesian heifers in south-east Queensland. Here the effects of high and low stocking rates on heifer growth rates are being investigated. Liveweight gains indicate a growth rate ranging from 0·39 kg per day to 0·55 kg per day.

Synchronized mating was practised and all the heifers were inseminated on 7 December 1977.

Pasture on offer to the animals on the High Stocking Rate was limited during the year and was further affected by an invasion of weeds which were slashed in October by the co-operator. The growth rate of animals on the high stocking rate was again lower than on the low stocking rate. This was consistent with the previous year's liveweight gain on the trial area.

A liveweight gain of 0·39 kg per day is not sufficient for adequate growth to calve heifers at 2 years old. These animals were approximately 2½ years old when they calved.

The cows calved in good condition and are milking satisfactorily.

Dairy Research Branch

THE Dairy Research Branch through its well equipped complexes in Brisbane, Toowoomba, Malanda and Murgon provides technical laboratory expertise and support for the advisory and regulatory officers within the Division, and assists the dairying industry maintain and, when required, upgrade its quality standards to safeguard consumer health and welfare.

The range of services include evaluating dairy product quality, regular monitoring for residues, trouble shooting for the dairying industry as well as planning, executing and reporting research on projects designed to benefit the manufacturing segment of the industry, the producers and the general public.

In the last 12 months greater cognizance has been placed on the need to disseminate technical information to the layman (consumer, factory operative and farmer). As a consequence, officers of the Branch have participated in a wide range of activities to ensure that this objective is realized.

Systematization of in-service training continued during the year with priority being given to induction training for all staff within their first 18 months of service and adoption of a job specification and review system in which each officer and his immediate supervisor hold annual review discussions. Specific training for individual officers continued.

Senior staff continued to serve on committees of the Standards Association of Australia and other technical committees.

Dairy product evaluation

As part of the quality evaluation service, nearly 61 000 bacteriological analyses were performed on 29 000 samples and more than 60 000 chemical analyses on 23 000 samples. Though the total number of analyses was of a similar order to that of the previous year, the throughput of samples analysed by the Malanda Dairy Research Laboratory was curtailed because of a reduced but optimized rate of sampling and a more comprehensive quality testing programme being accepted by the laboratory staff of the Atherton Tableland Co-operative Dairy Association Ltd.

Results of tests were sent to producers, manufacturers and officers of Dairy Field Services Branch to assist them upgrade quality. The State-wide comprehensive market milk quality testing programme is carried out on behalf of the Queensland Milk Board to enable it to monitor raw and pasteurized milk quality efficiently. Consequently, the traditional and manual reporting system has continued to tax resources, particularly as during the year the monthly reporting system has been improved so that the minimum delay between sampling and reporting to the Board occurs. Priority is currently being given to the computerization of this system during the next financial year.

Raw milk

The bacteriological quality of raw milk as judged by the total bacterial count continued to improve. Of the farm tanker milks sampled, 92·1% conformed to the standard (⊅50 000 organisms per ml) and 76·1% of factory tanker milks passed the standard of less than 150 000 organisms per ml, compared with 66·5% and 36·9%, respectively, complying for the previous year.

During the first half of the year, samples of farm supplier milks were tested on behalf of the Queensland Milk Board as part of their penalty scheme. Later, the Metropolitan Milk Producers' Co-operative Dairy Association assumed responsibility for imposing penalties, and samples were analysed on their behalf. This arrangement is interim only.

There was a marked improvement in the chemical composition of raw milk during 1978–79 compared with the previous year. This was probably the result of the better season and consequently more abundant and better quality natural pastures present.

The Atherton Tableland experienced a freezing point problem during the later part of the year but this was not accompanied by an S.N.F. problem. The Darling Downs region appeared to have experienced no freezing point or S.N.F. problem during the year and a considerable improvement in the raw milk composition in south-east Queensland occurred.

Of the 220 samples failing the freezing point tests, 81 samples contained >1% extraneous water.

Pasteurized milk and cream

All products from all factories in Queensland were regularly sampled and tested. In addition, samples were received from interstate and included Norco thickened cream and fortified flavoured milks as well as Bulla thickened and synthetic cream. An increasing number of factories is now producing flavoured dairy drinks as well as, or instead of, flavoured milks.

Most samples passed the total bacterial count standard, but coliforms were found in many products from many factories. Products from three factories were most frequently contaminated with coliforms, such results being indicative of inefficient pasteurization or post pasteurization contamination.

A marked increase in the numbers of pasteurized milks failing the keeping quality test occurred. The failures at one factory were found to be caused by spores, which supports findings of earlier investigations in this country and overseas.

Phosphatase failures (4% of samples tested) in creams processed at one factory were the result of enzyme reactivation.

Chemical composition of the pasteurized milks improved with four samples failing standards for solids-not-fat and 377 failing the freezing point test. Of the sub-standard freezing point results, 74·86% contained greater than 1% extraneous water. A significant number of skim-milks sampled were sub-standard for solids-not-fat.

Butter

During 1978–79, one factory (Gympie) ceased butter production and overall Queensland butter production increased by approximately 28% compared to the previous year. There were increased receivals of Queensland butters by the Butter Marketing Board during the last 12 months, while interstate shipments received were less than in the previous year. This represents a reversal of the situation which occurred during 1977–78.

Bacteriological and chemical analyses of Queensland butters showed that quality was similar to that found during 1977–78. Extraneous matter results showed an improvement but moisture distribution results deteriorated slightly compared with the previous year. The percentage of butter samples (from both Queensland and Victoria) which were found to be over-moisture was less than that obtained in the 1977–78 year.

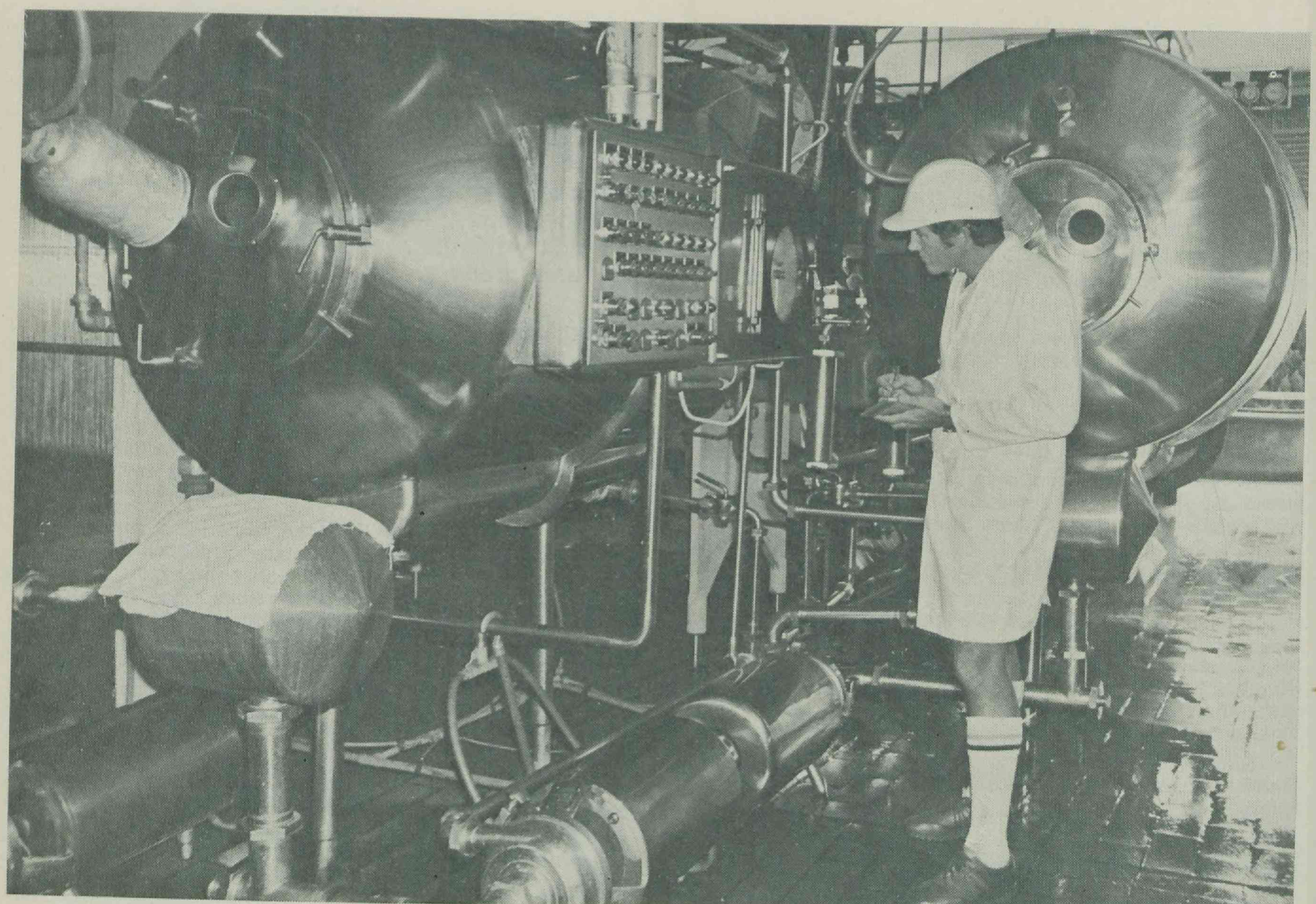
During the year, the old chemical extraction-colorimetric procedure for determining copper in butter was discontinued in favour of a new atomic absorption spectrophotometric method.

At the request of the Butter Marketing Board, 141 butters that the Board found to be overmoisture were check tested. Only 34 (27 were from Victoria) of these were subsequently found to be overmoisture.

Cheese

Two factories exported cheese to Japan during the year. The marked increase in the number of cheeses sampled (294 as compared with 100 for the previous year when drought conditions prevailed in south-east Queensland) indicated a favourable export market during the past 12 months. Results showed most cheese complied with required standards.

Regular sampling and analysing of all cheese manufactured locally (which included cheddar, Cooloola, pizza, haloumi, feta and mozarella) continued through the year. In addition, testing of cheese imported from Denmark, Norway, Germany, France, Holland, Austria, Switzerland and the United Kingdom was started. Sampling is now being carried out regularly at the various importers' warehouses. Some imported cheeses were sub-standard for fat, moisture and were classified as dirty, whereas the chemical composition of the locally-produced cheeses was better than for the previous year.



Milk concentrate temperature of a double-effect plate evaporator being recorded as part of the D.R.C. project 'Design of sampling programmes for liquid and powdered milks'.

Cultured milk products

Regular testing of all products continued. Yeasts and moulds were again found to be the main contaminants in yoghurts as more than 50% of all those tested were found to be contaminated. Furthermore, 16% of the samples did not meet the fat requirements for their particular type of yoghurt. Bacteriological quality of other cultured products was satisfactory but samples of various types of fresh cheeses failed the moisture standards (80%).

Desserts

Four brands of dairy desserts are now available. Coliform contamination was continually found to be a problem in two brands.

Milk powders, casein and junex

These products were exported during the year. Most samples conformed to the relevant standards which continue to be strictly supervised by the Australian government.

Apart from organoleptic staleness as noted by the graders, the presence of traces of antibiotic residues in some milk powders was the main defect of milk powders. One sample of casein contained Salmonellae.

Residues monitoring

PESTICIDES. Two hundred and eighty-five samples of raw and pasteurized milk and raw cream were tested for the presence of pesticides. Nineteen samples contained more dieldrin than the maximum level recommended by the National Health and Medical Research Council. Three samples contained more than the maximum recommended limit for lindane.

IODINE. A total of 3 589 samples was analysed on a routine basis for iodine level during the past 12 months. In the previous year (1977–78) a total of 1 579 analyses was carried out. The large increase in the total number of samples tested was due to the commencement of routine monitoring at the Toowoomba, Malanda and Murgon Dairy Research Laboratories. Continued improvement in iodine levels has been observed in all sample types (that is, pasteurized whole and skim-milks and raw milks). For instance, approximately 99% of raw milk samples tested were less than 500 μg per l while the figure for pasteurized milks approached 95%. Studies were also undertaken on factors affecting the iodine level.

AFLATOXINS. In view of the negative results obtained for aflatoxins in 1977–78, no aflatoxin analyses were performed in 1978–79.

NITRATE. Eighty-six samples of imported cheeses were tested for nitrite and nitrate. Nitrite was detected in seven of these samples with levels ranging from 1 to 40 p.p.m. Nitrate was detected in 33 of these samples with levels ranging from 5 to 175 p.p.m.

HEAVY METALS. Three surveys have been conducted to determine levels of heavy metals (copper, chromium, nickel, zinc, lead, iron, mercury, cadmium) in Queensland dairy products. The level of contamination with these metals did not appear to be high apart from mercury in casein which was only slightly above the maximum permitted level. The source of mercury contamination in casein was traced to the sulphuric acid used in manufacture.

ANTIBIOTICS. A total of 8 826 samples was tested for antibiotics. Of these, 48 were positive for penicillin and 12 for other inhibitory substances, making a total of 60 positive. While the percentage of samples free from antibiotics has been more than 90% during the last 3 years, the incidence of penicillin has decreased and there has been a concurrent increase in the detection of other inhibitory substances.

Margarine quality

Only one sample of margarine was tested this year. Methodology involving the analysis of the amount of cis-methylene interrupted double bonds and the level of cholesterol has now been resolved in preparation for a higher sample throughput in the following 12 months.

Technical Services to Industry

EQUIPMENT DEVELOPMENT. Last year, the development of equipment for whipping and dispensing cream was reported and promotion of the commercial use of this equipment was in progress.

This year's work was highlighted by the national launching of the commercial manufacture of the equipment, which C.I.G. Ltd. have undertaken to assemble and market. This will assist the dairying and catering industries.

MILK DRINKS. A series of trials was carried out to assist a dairy co-operative association to overcome stabilization problems with their thick shake products. Consumers had complained of noticeable gelling of these products.

The trials, conducted in the pilot plant at Otto Madsen Dairy Research Laboratory, were designed to affect alginate gelation by changing the product formulation. It was found that the defect was influenced by seasonal variations in milk composition and ionic calcium.

The addition of small amounts of phosphate acted as a sequestrant for calcium ions and controlled the gelling problem. Whipping trials carried out in parallel confirmed that over-run and stand up characteristics which had been seriously affected were restored by the phosphate adjustment.

Discrepancies occurring between bacteriological results obtained within the Dairy Research Branch and those at industry laboratories on duplicate samples have been a cause of contention in the past. On this occasion, an investigation was conducted into the reasons for differences between coliform results obtained on supposed duplicate samples analysed at the Otto Madsen Dairy Research Laboratory and an industry laboratory.

Though a considerable amount of time was spent investigating reasons for the discrepancies, no definite factor could be isolated for the difference in counts. However, the method utilized in the factory laboratory was different from that laid down in Australian Standard Methods 1095 in a number of ways. It was therefore recommended that the factory laboratory adhere exactly to the method prescribed in the Australian Standard.

WHIPPING CREAM. Because of the relatively high incidence of positive phosphatase tests in 35% whipping cream from one processing plant, investigations were instituted. These revealed that the phosphatase enzyme had been reactivated as a result of the high post pasteurization temperatures and finally slow cooling of the product.

NEW FOODS. Requests for work to be carried out on new food products, previously developed by the Branch, ranged from a quarg-based spread, to a cheese confection and a high protein snack.

Service work for other Branches

Apart from providing officers of Dairy Field Services Branch with the results of required laboratory analyses as part of the various quality improvement schemes, officers continued to provide service work to other Branches of the Department. In particular, all dairy herds on the Atherton Tableland were monitored quarterly as part of the brucellosis eradication programme.

Because no significant trends were evident from previous milk composition analytical results, testing for the Kairi stocking rate-nitrogen trial has been scaled down. Analyses for fatty acid composition also started.

The effects of winter feeding of maize silage on bulk farm milk composition were investigated on the Atherton Tableland. Solids-not-fat levels were maintained on the trial farms but decreased gradually on the control farm where no silage was used.

Over 1 750 sets of individual sows' milk were analysed for the presence of mastitic pathogens as part of the C.E.S.G. funded project 'Mastitis detection and control'. The predominating type of mastitic pathogens present and the number in the herd affected vary from farm to farm. Work is continuing and the results are to be compared with those analysed by conductivity, NAGase and the Fossomatic cell count methods. Factors such as seasonal changes, length of lactation and type of breed will also be considered.

Research

Research facilities comprise a pilot plant capable of manufacturing a wide range of dairy products on a semi-commercial scale and laboratories for bacteriological or chemical investigation. Pilot plant scheme incorporated butter trials, production of low, medium and high heat milk powders, as well as an extensive programme of cheddar and eye type cheese manufacture.

A significant portion of the research carried out in the Branch continues to be supported by funds provided by the Dairying Research Committee. As a consequence, funds were available to enable senior officers in the Branch to visit interstate research institutes and to attend and participate in appropriate workshops, conferences and professional meetings.

Milk enzymes

A grant of $7 900 was provided by the Dairying Research Committee in the 1978–79 year for investigations into problems related to enzymes in milk and dairy products. The major concern in this area is lipolysis in raw milk caused by the natural milk lipase and lipolysis in butter during storage caused by bacterial lipases.

During the winter months of 1978 one area of south-east Queensland experienced severe lipolysis problems in milk. Farm, tanker and factory milks were regularly monitored for free fatty acids in a programme carried out in conjunction with officers of Dairy Field Services Branch.

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Lipolysis in butter caused by bacterial lipases continues to be a problem. 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, esterase and phospholipase have been studied in order to devise sensitive assay techniques and possible control measures.

Butter has been experimentally manufactured from cream deliberately inoculated with lipolytic bacteria and its organoleptic and chemical quality assessed during storage. In these trials the creams contained c.10^7 c.f.μ./ml of lipolytic psychrotrophs before pasteurization, although lipase activity could not be detected in these creams. Lipolysis occurred during storage of the butters manufactured from them. More sensitive procedures for the detection of these lipases have been investigated.

The aqueous phase of butter contains a mixture of proteins and lipoproteins which could be potential substrates for hydrolytic enzymes originating from contaminating psychrotrophic bacteria. The major proteins in butter serum include the caseins and the whey proteins B-lactoglobulin and lactalbumin. Another complex that has been identified is a low density lipid-protein complex consisting of casein, B-lactoglobulin, milk fat globule membrane proteins, triglycerides and phospholipids.

A complex similar to this one found in commercial butter has been isolated from raw washed cream but it has no casein or B-lactoglobulin. It is possible that the complex in butter is formed as a result of the heat treatment of the cream before churning and the final amount occurring in the butter may be one of the factors determining the storage stability of the butter.

The degree of pre-heat treatment of milk before powder manufacture determines the type or classification of the final powder (that is, low, medium or high heat powder). The chemical test (namely, when whey protein nitrogen index, WPNI) used to distinguish between these powder types is tedious and its validity has been questioned because of the large seasonal fluctuations in the whey protein nitrogen levels in raw milks. A new test, involving the measurement of the extent of denaturation of two milk enzymes (acid phosphatase and α-mannosidase) has been developed at O.M.D.R.L. At present its use in commercial powder manufacturing is being assessed.

Cheese ripening (enzymology)

An allocated sum of $3 700 was provided by the Dairying Research Committee for a project designed to develop methods for accelerating the rate of mature flavour development in cheddar cheese. During the past year, two acceleration methods have been investigated in more detail.

Firstly, the addition to milk of a high inoculum of a non-acid producing, non-proteolytic mutant of *Streptococcus lactis* has been studied. Substantial acceleration of the ripening rate was achieved using this procedure, which could be improved by initially storing the cheese at 20°C for 1 month.

The second acceleration method studied involved the addition of an enzyme extract from the yeast *Kluyveromyces lactis* to the milk before cheese manufacture.

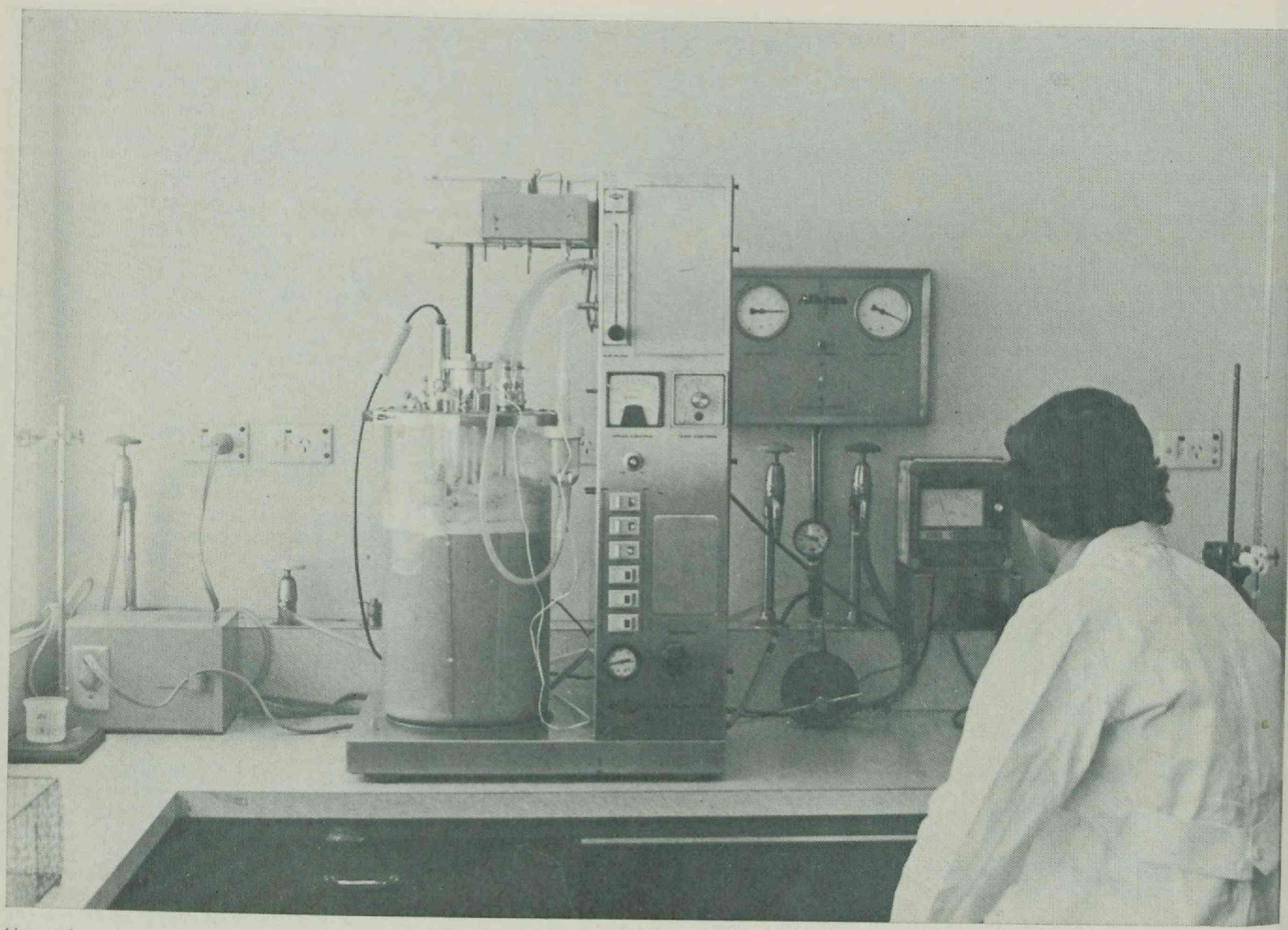
Three commercial trials have been carried out to date and the results have not been as good as expected mainly due to variability of the yeast enzyme extract which is obtained commercially. In order to overcome this problem, production of a more suitable extract has commenced in this laboratory, utilizing various strains of the yeast *Kluyveromyces lactis* and *Saccharomyces cerevisiae*.

In conjunction with this work, chemical methods for determining the state of maturity of the cheese are being examined. For instance, a simple method for the determination of free amino acids in cheese has been developed, while compounds which are thought to be responsible for actual 'cheddar' flavour (that is, methane thiol) have been determined using head space analysis on a gas chromatograph equipped with a flame photometric detector.

A mutant of a cheese starter, *Streptococcus cremoris* EB6 which did not utilize lactose (lac−) and was able to break down protein (prt+) was obtained by repeated subculturing in lactose free broth at 30°C. Four experimental cheeses were made with a concentrate of this mutant together with a normal inoculum of starter.

One of the cheeses showed an advancement of 1 week at 1 month but only 2 weeks at 3 months. As this mutant was unstable in maintaining its desirable properties, work is continuing to produce stable lac−prt+ mutants of two *S. cremoris* strains EB6 and E8.

In a retarded cheese ripening trial, a lac+ prt− E8 culture was used as a starter but the cheese ripened at a normal rate.



Use of a fermenter for cultivation of starter bacteria.

Starter cultures

Routine maintenance of the starter collection as well as troubleshooting investigations were carried out. New methods of storing starter cultures and activity testing were studied. Starters were also supplied to industry and to the general public.

Milk quality

An allocation of $5 300 was provided by the Dairying Research Committee for the project 'Design of sampling programmes for liquid and powdered milks'.

Objectives were threefold: to develop a sampling programme for milk and milk powder from production to transport, storage and processing; to establish controls for storage and handling of raw milk prior to processing; to establish the significance of processing conditions in relation to compliance of milk powders with microbiological specifications.

Work this year was centred on the effect of bacterial clumping (during storage of raw milks) on the total and psychrotroph counts and effect of storage times and temperatures on final raw milk quality. Various tests to evaluate the keeping quality of pasteurized milks are also being assessed.

Trials at commercial milk powdering plants have established that pathogens were absent and contaminants occurred only rarely, and in small numbers. Total and thermoduric counts decreased during processing. On occasions when long continuous runs were involved, thermophiles built up to significant levels. The officer in charge of this project found, after visiting Victoria, that the results of the Queensland work could be applied nationally.

Sub-normal milk composition

A final report on the D.R.C. project 'Investigations into Sub-Normal Milk Composition' has been finalized. A recommendation has been made that the freezing point standard for milk be altered from –0·540°C to –0·528°C.

Mastitis

An allocation of $3 000 was provided by the Dairying Research Committee for the project 'Enzymatic Studies on the Detection of Secretory Disturbances in the Bovine Mammary Gland'. Considerable progress has been made on this and related projects towards improving the approach to the diagnosis of bovine mastitis.

For example, a fully automated procedure for the measurement of the level of the enzyme N-acetyl-B-D-glucosaminidase (NAGase) in milk has been developed. The level of this enzyme in milk is a measure of the degree of damage inflicted upon the udder epithelial cells during a bacterial infection of the mammary gland. The automated procedure is capable of analysing up to 100 samples per hour, and the cost of the complete apparatus would be considerably less than currently available commercial instruments used in mastitis monitoring programmes.

Work being carried out using milk samples from four commercial dairy farms has been aimed at establishing the normal and abnormal range of certain milk constituents.

These include sodium, potassium, conductivity, glucose, blood serum albumin and selected enzymes (namely, NAGase, lactate dehydrogenase, glutamateoxaloacetate transaminose and arylesterase). As a result of these studies it has been possible to assign 'Threshold' values to most of these constituents, so that their value as diagnostic tools can be better assessed. It appears that the most suitable tests are NAGase and conductivity.

Work carried out at the Malanda Dairy Research Laboratory has been aimed at studying the change in the level of milk constituents at parturition. The results have shown that in healthy udders, components such as somatic cells, and NAGase fall rapidly from the day of calving and level out by about the fourth day.

Manufacture of eye-type cheese

Work on this project has been carried out by a multidisciplinary team including technologists, bacteriologists and chemists.

CHEESE WITH IRREGULAR EYES. As a result of work in the pilot plant, a new product called Cooloola cheese has been developed. Guidelines for its manufacture and compositional control are available on request.

CHEESE WITH REGULAR EYES. In the type of cheese under investigation, two basic types of bacterial cultures are employed. These are lactic acid bacteria and propionibacteria.

Microbiological work conducted on this project has involved developing methods for enumerating these types of organisms in cheese, isolating and identifying organisms from commercially manufactured cheese and a study of the growth characteristics of species of propionibacteria employed in the project. Propionibacteria have been enumerated in both pilot plant and imported cheese. A sodium lactate agar was utilized in this work.

The most important organisms for flavour and eye formation in Swiss-type cheese are the propionibacteria. The growth of these organisms is known to be affected by several factors such as salt, pH, temperature and substrate. Growth experiments have been conducted to establish this effect of salt concentration and pH on the growth of propionibacteria in cheese.

Vat trials were carried out to determine appropriate rates and combinations of starter addition for the manufacture of this cheese.

A 40-point cheese grading system was developed based on 10 points each for eye formation, body and texture, flavour and condition. As a result, attention can be focused on eye formation and flavour development.

Chemical analyses revealed that the levels of proline, acetic acid and propionic acid have a direct influence on the desirable flavour of Swiss type cheese. Manufacturing conditions to produce the correct levels of these components are being investigated.

Information obtained from this work has been disseminated to the Queensland industry and a feasibility study has revealed the financial benefits occurring from the manufacture of this cheese, which has highlighted the practical value of the development of this work to aid the dairying industry. A series of six trials was undertaken at a Queensland cheese factory. Modification to existing equipment has been recommended before continuing further commercial manufacturing trials later in the year.

Low fat spreads

Manufacture of low fat spreads was initiated in an attempt to produce a low 40% fat spread with a stable water-in-oil emulsion. Processing involves mixing selected ingredients, heating, homogenizing and packing. Fourteen experimental batches were prepared and stored for assessment.

Stabilized whipping cream

This project was initiated to meet industry needs for a stabilized, whipped, natural cream for use on bakery products, dairy desserts and other products.

In initial trials, blended gums and carageenans were whipped with cream in cream dispensing equipment at 500 kPa.

Recombined butter

Trials continued during the year. It was found that creams containing up to 90% anhydrous milk fat churned well in the Contimab continuous butter making machine. Fat losses in the buttermilk were maintained at a satisfactory level until the substituted anhydrous milk fat was greater than 75% when losses would exceed 1·5%.

Tropical legume pastures have increased production in coastal dairying districts.

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 policy, extension, research, and regulatory functions of the Division are carried out by three Branches, Marketing Services, Economic Services and Standards. At 31 May 1979, 186 staff were employed in the Division of Marketing. Major staff changes during the year included the retirement of Mr A. C. Peel, Deputy Director of Marketing and Mr S. W. Ivers, Assistant Director of Marketing Services. Mr D. R. J. Densley was appointed as Deputy Director of Marketing, Mr W. Kidston as Director of Marketing Services, and Mr J. van Haeringen as Assistant Director of Marketing Services.

Marketing organization

Considerable attention was given during the year to a wide range of problems confronting organizations concerned with rural marketing. Improved growing conditions and prices resulted in substantial increases in production of grains, rice, cotton, fruit and vegetables and peanuts and required marketing boards, co-operatives and other rural organizations to provide additional facilities and grower advances for the marketing of these commodities.

During the year there were substantial changes introduced into the organization and marketing arrangements of many of our rural industries while further changes have been proposed in other industries.

The Division has been involved with the preparation of material and in discussions related to new wheat marketing arrangements, sugar industry organization, alternative wool marketing arrangements, beef marketing and stabilization alternatives, fruit and vegetable marketing procedures, potato industry organization, grain handling, cotton ginning, as well as the implementation of legislation concerned with access to the wholemilk market. The Division was also involved in providing advice on merchandising problems in the bread industry.

The Division has also played a major role with the Council of Agriculture and marketing boards in reviewing the effectiveness of these organizations which collectively market over half of the rural produce of Queensland.

Legislation

One of the most significant changes to marketing legislation was the amendment to the Primary Producers' Organization and Marketing Act in certain of the financial provisions of the Act. This amendment will enable marketing boards to utilize modern financial facilities such as Bills of Exchange and more adequately to accumulate reserves to finance the additional or improved facilities required to handle increased production.

This Act was also amended to provide for the reconstitution of the Queensland Cane Growers' Council from 17 representatives of District Cane Growers' Executive Councils to 15.

New legislation was enacted to provide for the establishment of a Bread Industry Committee. This Committee will bring together representatives of all sectors of the bread industry with the aim of achieving a more orderly approach to the marketing of bread.

The Milk Supply Act was amended to re-define and re-state responsibilities and procedures in the re-allocation of entitlements to market milk.

In line with a national objective of introducing a wheat varietal control scheme and to provide for State accounting for wheat handling and storage, amendments were made to the Wheat Pool Act and the Wheat Industry Stabilization Act.

To give primary producer co-operatives greater flexibility in their operations, substantial amendments were made to the Primary Producers' Co-operative Associations Act. These provided for a simpler procedure for interchange between co-operative association, company and society structure as well as allowing for the establishment of additional objects of associations.

Amendments have been made to the Wine Industry Act and associated amendments to the Liquor Act to bring the registration of wineries under the control of this Department. These amendments are seen as important in helping to foster the further development of the wine industry in Queensland.

The Agricultural Chemicals Distribution Control Act was amended with respect to the powers of inspectors and the purposes for which agricultural chemicals may be used by licensed operators. These amendments provide wider and necessary powers when dealing with complaints regarding the misuse of agricultural chemicals.

New Fruit and Vegetable Grading and Packing Regulations were issued to replace previous regulations in force since 1960. These new regulations take account of the many technological changes which have occurred in this industry over recent years.

Industry enquiries

During the year, submissions were made to the Industries Assistance Commission enquiring into the cheese industry and into wheat marketing arrangements to apply from 1979. As well, the Division presented evidence to the McKinnon Committee of Inquiry into the Sugar Industry.

Assistance was also given in the preparation of material to the Prices Justification Tribunal enquiring into the marketing of beef and into the processed food industry.

Economic and marketing studies

The Division, and in particular Marketing Services Branch, in 1978–79 prepared a report on the operations of the State's statutory marketing boards. This followed on from a survey of Boards and subsequent discussions and seminars with Board Chairmen, members and executives on the objectives of Boards, the problems they face, their effectiveness and possible areas for improvement. As mentioned, during 1979–80 the Division will be working closely with the Council of Agriculture and boards in attempting to resolve some of the areas of concern. Initially these efforts will focus on identified problems in the field of finance.

Other major studies included economic assessments of the Burdekin Falls and Barker-Barambah irrigation projects taking into account both primary and secondary benefits of the proposed schemes. A national inventory of electronic data programmes used in agricultural extension and farm management was prepared in conjunction with other States and Commonwealth Departments and educational institutions.

- A tobacco cost index, prepared at the request of the Australian Tobacco Board, played a significant part in the annual review of prices to be paid for Australian-grown leaf.
- In the poultry industry, a broiler industry survey to determine production costs in southern Queensland was undertaken to provide a basis for negotiations with processors in the determination of fees for growing stock.
- Costs of egg production in southern, central and northern Queensland were prepared as a basis for discussions within the egg industry in Queensland of the C.E.M.A. levy.
- In addition to industry studies, economic assessments at the farm level included pre-cooling of horticultural crops in the Gympie district, maize drying and the use of peanut pre-cleaners on the Atherton Tableland. Such studies provide practical advice to producers considering investment in such facilities.

Other studies included an examination of fruit and vegetable prices and quantities sold at Brisbane market, the alternatives in potato industry organization, the marketing options for rice, Australian wheat marketing arrangements, and a consumer survey on egg quality.

The Division also acted as co-ordinator of a national survey of deficiencies in present market reporting of fruit and vegetables througout Australia.

Extension activities

The rural recovery, particularly in the grain and beef industries, stimulated a demand for economic advice on capital investment in property improvements and new farm machinery. Advice was also sought on deferred property maintenance such as regrowth control. After many low-income years, producers were faced with the prospect of paying high taxation and advice was requested on strategies to maximize income after tax, consistent with sound property management. Through recent changes to the averaging system scope now exists to use income equalization deposits in a perverse manner to destabilize income in order to reduce tax liability. Through advisory leaflets and meetings, producers have been informed of the options now available.

An intensive programme to increase the quality and range of farm management publications has met with an enthusiastic response from primary producers, educational institutions and agri-business. Almost 50 000 extension series booklets and farmnote leaflets were printed through Information and Extension Training Branch and distributed during the year. Most of these went to primary producers. Extensive use was also made of the media for timely advice in business management.

An extension campaign was developed by Standards Branch officers and visits made to country centres to inform seed producers, merchants, seed users and Departmental officers of the 'truth-in-labelling' proposals relating to the marketing of agricultural seed for sowing. This proposal has the support of Australian seed testing authorities who see many advantages in the labelling of each package with information on physical content and germination capacity. It is envisaged that the buyer will be able to choose the level of quality of seed he desires and that price differentials for levels of quality will apply.

Considerable progress has been achieved by the Fruit and Vegetable Marketing Extension Service in overcoming many quality and presentation problems in both Queensland and interstate markets. Queensland growers have benefited from market information feedback received from the Victorian Department of Agriculture on the quality and condition of Queensland produce arriving in Melbourne.

During the rockmelon season, the Department of Agriculture, New South Wales, co-operated in a review of rockmelon maturity requirements. Officers of the Service also participated in a joint extension project with Horticulture Branch of this Department and with the Committee of Direction of Fruit Marketing on package rationalization and palletizing and unitizing procedures.

Throughout the year there was a further increase in demand for timely market intelligence and market reports. To meet the requirements of Departmental extension staff for brief overviews of current market developments, Marketing Services Branch began circulation of a monthly marketing newsletter. Mr A. Connor, of this Branch, visited the United States to examine latest developments in this increasingly important area of market information.

Considerable progress was made during the year towards implementing a market reporting service for meat and livestock. This is being developed by the Queensland Meat Industry Organization and Marketing Authority with assistance from the Division and should provide producers with a means of comparing prices quoted in a standardized format throughout Australia.

The Division is being increasingly called upon to provide guidance to marketing boards and co-operatives in many aspects of their financial management. The objective here is not necessarily to provide direct advice but rather to enable one organization to draw more readily upon the collective experience of other organizations in overcoming problems.

Agricultural chemicals

Increasing demands have been placed on staff of Standards Branch in the registration, control and distribution of various agricultural chemicals. These controls are considered necessary, not only to ensure the efficacy of the wide range of fertilizers, weedicides, pesticides, veterinary medicines and other chemicals used, but also to ensure that adverse effects on people, crops, animals and the environment are avoided.

Thirty-seven notifications of complaint on damage under the Agricultural Chemicals Distribution Control Act were received and investigated. Twenty-six of these related to crops grown in coastal regions. Two complaints related to stock and nine to ornamentals. As mentioned, the provisions of this Act relating to certain aspects of aerial spraying were amended during the year.

Training activities

Farm office management schools conducted during the year in far western and northern centres mean that this training programme has now been offered throughout the entire State. Since 1974, almost 3 000 producers and their wives have attended these schools and follow-up activity has confirmed the beneficial effect of this training programme.

New training programmes have been introduced on the Darling Downs for farmer groups interested in the selection, operation and financing of farm machinery and in understanding beef futures.

Training courses were again offered to directors and executive staff of marketing boards and co-operatives in various aspects of rural marketing. These courses together with specific workshops have proved of great value to all concerned in keeping abreast of the many rapid changes occurring within rural marketing generally.

The Division was again involved in providing an international training course in the marketing of agricultural products on behalf of the Australian Development Assistance Bureau.

Standards Branch organized an Australian Seed Testing Workshop on the return of an officer from the I.S.T.A. Workshop held in 1978 at Wageningen, The Netherlands.

Other activities

Of particular note with the Queensland Seed Certification Scheme have been increases in area planted and in certified production of hybrid maize, French beans, pasture species and of Approved Stout oats, a variety noted for its resistance to rust.

Of significance within the various inspection services operated by the Division was the seizure and destruction of some 21 468 packages of apples at the Brisbane Market and the rejection of 168 shipping containers, together with the withdrawal of 1 475 containers pending cleaning and repairs from a total of 2 962 shipping containers inspected in Brisbane.

Marketing Services Branch

THE principal function of Marketing Services Branch is to provide supporting services to the rural sector in Queensland in all aspects of the marketing of rural products.

In fulfilling this function, the Branch provides representation on statutory marketing boards, advice to Government and the rural sector on organized and orderly marketing systems, operates market reporting and marketing intelligence systems, undertakes market research, provides advisory services and fulfils a regulatory role.

The Branch has a total staff of 43, made up of 20 graduate marketing officers, 15 technical officers and eight clerical and regulatory staff. One officer was overseas on study leave during the year.

During 1978–79, the Branch continued to provide its comprehensive financial management service to rural organizations throughout the State. Training courses in marketing were conducted for executives and members of marketing boards and co-operative associations as well as Departmental extension and advisory staff.

An international training course in marketing agricultural products was conducted on behalf of the Australian Development Assistance Bureau of the Department of Foreign Affairs. This course attracted 16 participants from 11 developing countries of Africa, the Indian sub-continent, South-East Asia and Papua New Guinea. Workshops on remote sensing by satellite and on improving the operation and effectiveness of marketing boards were also conducted.

Following a review of its role and functions, the Branch structure was modified by re-designating and re-defining the responsibilities of the existing three sections as—

Commodity (including Finance and Management Services)

Marketing Intelligence

Economic Advisory, Research and Training.

Re-allocation of staff and responsibilities within these three sections was aimed at meeting expanding responsibilities in the fields of financial management advisory services, fruit and vegetable marketing, preparation of submissions to bodies such as the Industries Assistance Commission, review of marketing legislation, market research and extension training aimed at increased effectiveness of marketing systems, and provision of market information to a wide range of users.

The more formalized in-service staff development and training programme continued to operate successfully. This programme, which was developed in conjunction with marketing boards, allows younger staff members to have greater exposure to the increasing complexities of organized marketing, supply-demand management systems and Government intervention methods which now operate in many rural industries.

Branch officers attended training courses conducted both by the Public Service Board and the Information and Extension Training Branch of the Department. The Branch was represented also at the National Outlook Conference, the Australian Agricultural Economics Society Conference, the National Vegetable Panel, the Potato Research Conference, Management Accountant Course and the Marketing Board Workshop conducted under the auspices of the Economics and Marketing Committee of Standing Committee.

Commodities

While a significant upturn occurred in the fortunes of the beef industry during 1978–79, the Branch increased its efforts to achieve improvements in livestock marketing methods.

The Branch has been associated with the Queensland Meat Industry Organization and Marketing Authority in the planning, staffing and development of a Meat and Livestock Market Reporting Service for Queensland. This service will be capable of integration with other similar services being developed in other States. This service will use nationally standardized terminology and should provide cattle producers with a more useful means of comparison of cattle prices at different selling centres throughout Australia. The Authority expects to have the service operational early in the 1979–80 financial year.

Also in conjunction with the Authority, the Branch was involved in a thorough review of all beef industry stabilization and associated proposals submitted to date. During 1979–80, it is proposed to initiate industry discussion on the matters involved.

From the start of 1978–79, the Branch instituted a retail price collection for selected cuts of meats. Now that 12 months' data are available, publication on a regular basis will begin early in 1979–80.

The wheat industry required considerable attention during the year and a submission was presented to the Industries Assistance Commission Inquiry into Wheat Stabilization. In addition, submissions were presented to a working party set up by Standing Committee on Agriculture to examine the Commission's report on Wheat Stabilization. By the end of May, discussion was well advanced on the new Wheat Stabilization Plan to commence after 30 September 1979.

The Branch continued to be heavily involved in Commonwealth and State Government initiatives in introducing new marketing equalization for the dairy industry and especially Stage II arrangements as recommended in the 1977 Industries Assistance Commission report. Staff were involved in the formulation and implementation of legislation designed to give greater access to the Brisbane Milk Market by milk suppliers in south-east Queensland.

An extensive examination was made of the cotton industry with particular reference to the feasibility of establishing a cotton gin in the Emerald Irrigation Area of central Queensland. The Report was submitted to the Treasury Department in support of an application by The Cotton Marketing Board for a Government guarantee to establish the cotton gin at Emerald.

A study to identify market segments and to examine consumer attitudes towards eggs and egg quality was completed. This study has already been of assistance to The Egg Marketing Board in reviewing its marketing programmes.

Legislation

Legislative developments with which the Branch was involved included the following—

DAIRY INDUSTRY.—A major amendment to the Milk Supply Act re-stated the responsibilities of the Milk Entitlements Committee and clarified the procedures for re-allocation of entitlements. Other amendments created a Milk Entitlement Settlement Fund which allows the Committee, through the Land Administration Commission, to pay out producers who have ceased to supply and then offer the resultant quantity of milk to 'below average' processors for purchase. Previously, some difficulties had been encountered in ensuring that producers who had ceased to supply were fully compensated.

Provision also was made for the appointment of an Acting Chairman of the Committee who has the full powers of the Chairman when acting in that capacity.

WHEAT INDUSTRY.—Amendments to the Wheat Pool Act and the Wheat Industry Stabilization Act were passed to provide for wheat varietal control on a national basis and to facilitate State accounting under which each State meets its own storage and handling costs.

WINE INDUSTRY.—The Wine Industry Act was amended substantially to transfer control of the wine industry from the Licensing Commission to the Department in the area of registrations and in 'on-farm' operations. It is expected that the amendments will allow vignerons or winemakers time to establish themselves without having to bear the burden of heavy licensing fees. The Liquor Act was amended simultaneously to facilitate these amendments.

BREAD INDUSTRY.—In April 1979, legislation was introduced to provide for a Bread Industry Committee. The legislation was based upon the recommendations of a Committee to Inquire into Trading Practices in the Bread Industry. The aim of the Government in establishing the Committee was to provide a more orderly approach to the marketing of bread. The Committee will provide a forum for all sections of the industry to discuss matters relating to the industry.

PRIMARY PRODUCERS' ORGANIZATION AND MARKETING ACT.—The Act was amended to improve the financial standing of marketing boards. Boards were given the same powers as companies in relation to the drawing and accepting of Bills of Exchange. In addition, the maximum deduction that a board may make for the purpose of the Working Account Reserve Fund was increased from 2 to 5% of aggregate net realizations. This change was implemented to lessen the Board's dependence on financial institutions and to provide improved financial flexibility more in keeping with present commercial practice.

The Act was amended also to provide for an alteration in the membership of the Queensland Cane Growers' Council from 17 represenatives of District Cane Growers' Executive Councils to 15. The amendments also re-defined 'growers' so that companies formed by growers and their families are recognized as growers. Milling companies are excluded. In addition, bodies formed under the Act, not defined as Boards, were given the same investment powers as boards.

Finance and Management Service

The Finance and Management Service, which aims at providing management advice to boards and co-operatives has continued to be offered in increasing depth and scope. However, the most important emphasis of this Service continues to be the planning and feasibility studies associated with Government-guaranteed loans for major capital works projects. Some five boards and co-operative associations were assisted in this regard. One co-operative also applied for temporary assistance.

The Branch has a responsibility to monitor financial performance of rural organizations where Government guarantees are applicable.

In reviewing the financial operations of all boards and co-operative associations it has been possible to identify for some organizations, areas where financial management or accounting procedures can be improved or to draw attention to potential financial problems. There has been a growing demand from these organizations for this form of assistance.

During the year, a research project into aspects of taxation on co-operative associations was completed. This paper is to be circulated to the management of all Associations.

Market intelligence

Recent developments in the rural sector have further emphasised the importance of providing the means by which producers may be better informed on what is happening in various markets. Market developments and price changes vitally affect producer incomes and more complete information is necessary to enable producers to make better management decisions. The provision of market information remains one of the most important areas of Branch activity.

In the area of crop forecasting, the Branch issued 13 crop forecasts for the year, three each on summer grains and seeds, winter grains and seeds, and peanuts, navy beans and soybeans, and four on potatoes and onions. There is a continuing growth in demand from many people in the community for this information.

A monthly Marketing Newsletter circulated to Departmental officers in country centres appears to be providing these extension officers with the necessary brief comment on the latest developments and news from a marketing point of view.

The Weekly Trend Report which provides a brief up-to-date picture on the current situation in the State's major rural industries to individuals associated with rural industry continued to be published.

In keeping with developments in technology associated with the Meat and Livestock Market Reporting Service, preliminary work was commenced in 1978–79 designed to upgrade the existing Fruit and Vegetable Market Reporting Service. The Branch has been convener of an interstate examination of current deficiencies in the reporting of fruit and vegetable markets. As a result of a report resulting from this study, more attention is being focused on the question of standardization of terminology used throughout Australia in reporting these markets and on the technology employed. During 1979–80, the Branch will be involved with industry in seeking to establish the improvements necessary in current daily and weekly fruit and vegetable market reports.

The Branch also provides a member and secretary to the newly formed Departmental Rural Statistical Committee which is responsible for Departmental liaison on all statistical matters with outside bodies.

In order to keep abreast of developments in market and marketing information systems, an officer of the Branch began a study tour of associated organizations in Europe, United Kingdom and North America late in the year. Apart from a study of information systems, the officer will be paying particular attention to communication methods. On his return, the current Branch market intelligence programme will be reviewed with the aim of ensuring that the information supplied is relevant and readily available to users.

Training

During 1978–79, the Branch conducted two major training courses in rural marketing. The first was offered to directors and management of marketing boards and co-operatives as well as Departmental extension and advisory staff. It was designed to provide training in modern rural marketing practices and to provide a forum for discussion of related marketing issues.

The second course, conducted on behalf of the Australian Development Assistance Bureau, was an international training course in the marketing of agricultural products. The course drew 16 participants from 11 developing countries of Africa, the Indian Sub-continent, South-East Asia and Papua New Guinea. The course ran for 8 weeks and most Branch officers were involved in the preparation and presentation of material.

The objective of the course was to explain the theory and practice of Queensland agricultural marketing to provide a comparative basis for local application by participants.

A number of specific workshops also was conducted by the Branch in the areas of remote sensing by satellite and on improving marketing board operation and effectiveness.

Research and reports

During the year, officers of the Branch conducted a major study into the operations of the State's commodity marketing boards. The study had three basic aims—

- To identify the objectives which marketing boards should seek to achieve
- To determine the effectiveness with which boards achieve these objectives
- To identify the means by which improvements in their operations might be effected.

Chairmen, senior management executives and growers were interviewed and their opinions canvassed in a range of issues related to these aims. A draft report of the findings was subjected to examination by board members and senior management personnel at workshops conducted by the Branch in Townsville and Toowoomba. A final report will be available early in 1979–80.

The second part of this programme will focus on problems and issues already identified as affecting the effectiveness of board operations including optimal use of alternative sources of finance, long term planning, legislation procedures, board-management relationships and communications.

A report on the price and quantity of the principal fruit and vegetable products sold on the Brisbane Wholesale Market was released. It brought together price and quantity data so that farmers, Departmental staff and others concerned with horticulture can analyse market trends and be in a position to make better informed decisions.

A thesis on Regulation and Regulatory Modes in Canadian Agriculture was completed by an officer who spent 2 years in Canada on study leave. A report on remote sensing in crop forecasting also was finalized.

Other studies including an examination of the rice industry, Australian wheat marketing arrangements and a consumer survey on egg quality were published.

The Branch is currently examining the optimal size and location of grain storages in Queensland, changes in Queensland's trade pattern with the E.E.C., the marketing of dairy products, future fuel needs by industry demand loads, as well as evaluating the various training courses conducted by the Branch.

With greater pressure from the rural sector, especially the organized marketing component, for increased and more incisive market and marketing information and advice and with the absolute limit on resources, the Branch has adopted a policy of continuously reviewing its priorities in this area. This review during the year resulted in certain functions being deleted in favour of more pressing or significant demands.

In view of the many changes taking place in all aspects of rural marketing, the Branch considers that the allocation of appropriate resources to provide training to Branch officers and to ensure that similar training is available to members and executives of industry marketing organizations remains a high priority.

Economic Services Branch

ECONOMIC SERVICES BRANCH plays an educational role in farm business management and undertakes agricultural economics research for advice to primary producers, industry organizations and agri-business and to government in policy matters.

To fulfil these functions the Branch has 24 regional agricultural economists in 17 centres with a support staff of 11 graduates and six clerical staff in Head Office involved in research and administration.

Extension activities

The rural recovery, due to good seasonal conditions, improved prices and markets, has stimulated a demand for economic advice on property purchase and investment in farm improvements and new machinery. The upturn in profitability has also allowed attention to be given to deferred property maintenance.

Higher incomes also generated considerable interest in taxation aspects of primary production. Following changes to the averaging system in November 1977 scope now exists to use income equalization deposits (IEDs) in a perverse manner to destabilize income in order to reduce tax liability. In view of the complexity of the interaction between tax averaging and IEDs, producers were advised to consult their accountants before investing in them.

Regional agricultural economists are actively involved in departmental extension activities particularly through industry committees at a district level. Timely advice is given on a wide range of topics through the mass media and in direct contact with farmers. Each economist received more than 50 enquiries from producers and averaged 40 farm visits. Group activities include participation in producer organization meetings and field days. Farm management discussion groups are proving mutually beneficial in the Moreton and Burnett regions.

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

State coverage has now been achieved in a series of farm office management schools initiated in 1974 and attended by almost 3 000 farmers and their wives. Schools were conducted during the year in north Queensland and in the far west at Boulia and Thargomindah. Follow-up activity to previous schools was undertaken in other areas. An evaluation of this training programme on the Darling Downs is nearing completion.

In view of the increasing capital investment and operating costs of farm machinery, a new training programme is under way for farmer groups on the Darling Downs to assist producers in the selection, operation and financing of farm machinery. A group training programme has also been introduced on the Darling Downs to help producers with beef futures.

Many local and interstate producers attended the Sixth National Conference of the Australian Farm Management Society held for the first time in Queensland at the Queensland Agricultural College, Lawes in January 1979. The Conference focused on decision making in property management.

Farm management publications

A comprehensive range of farm management publications has been prepared to meet an increasing demand from producers, educational institutions and agri-business. Fifteen major bulletins and reports were released during the year including a national inventory of electronic data processing programmes used in farm management and agricultural extension in Australia.

Almost 9 000 extension series booklets were distributed during the year covering topics such as income equalization deposits and farm machinery economics. It is estimated that 75% went direct to farmers. Forty-thousand farm note leaflets covering 45 topics were printed through Information and Extension Training Branch. Most of these have been distributed.

Relevant farmnote material is also published through producer organization journals.

Where appropriate, leaflets on topics such as taxation and farm machinery are combined in a series particularly for use in training programmes.

Leaflets were prepared on farming syndicates in response to a growing interest in group farming activity as a means for cost reduction. A conference sponsored by the Kellogg Rural Adjustment Unit at Roseworthy, South Australia, in November 1978 was attended to review developments in group farming throughout the Commonwealth.

The fifth annual costs and returns budget supplement was prepared for the *Queensland Country Life* newspaper and extracts were published for the first time in the *Queensland Graingrower*.

Farm Management Accounting Service

The Farm Management Accounting Service offering monthly recording and annual summary services was converted to run at the new State Government Computer Centre. Further improvements were effected to the report formats and comprehensive booklets were distributed to members to outline the options available and to assist in interpretation of the results. Membership has stabilized around 75 producers.

A new computerized Dairy Farm Management Accounting Service has attracted a membership of 50 farmers from central and southern Queensland.

In a combined project with the University of Queensland and Bureau of Sugar Experiment Stations a computer package programme is being developed for pilot testing on minicomputers in rural accountants' offices. This field has potential for future development in farm management accounting.

Regional studies

A detailed economic assessment was undertaken of the Burdekin Falls project for agricultural development and possible hydro-electricity generation. The analysis, based primarily on expansion in the sugar and rice industries, was incorporated in an inter-departmental report to State Cabinet in December 1978.

A similar economic assessment has been undertaken of the Barker-Barambah irrigation project in the South Burnett relying mainly on grain production with a soybean-barley double cropping programme.

These irrigation studies entailed an analysis of both primary and secondary benefits to assess the full impact of the proposed development.

An assessment of different water allocation policies in the St. George Irrigation Area was undertaken at the request of the Water Resources Commission. A computer simulation study was involved to determine an optimum allocation policy. Also, in the St. George area, a benefit-cost study on eradicating weed sorghum is nearing completion.

The effects of a wide range of alternative financing arrangements for soil conservation work on the Darling Downs were analysed and ensuing policy recommendations were generally supported by Soil Conservation Advisory Group Committees.

In a co-ordinated soil and water conservation programme on the Darling Downs and West Moreton, economists are working with officers of the Division of Land Utilization in developing economic water harvesting techniques for grazing and cropping systems in intensively farmed areas.

Structural change in the rural regions of Queensland was examined in a paper presented to the third annual conference of the Regional Science Association in Melbourne in December 1978. Evidence was given of the severity of adjustment problems when economic pressures on agriculture are intense.

Assistance was given to the University of Queensland in a study undertaken for Comalco Ltd. and the Department of Commercial and Industrial Development in analysing the impact of an aluminium smelter, cement clinker plant and a thermal power station on the local, regional, State and national economies.

Industry studies

Agriculture

A Tobacco Cost Index was prepared at the request of the Australian Tobacco Board. This index monitors cost movements and plays a significant part in the annual review of prices to be paid for Australian-grown leaf. This Department is responsible for the overall construction of the index and for the specific Queensland and New South Wales sections.

At the field level further data were collected from growers to examine economic aspects of bulk curing in different sized barns and split-plantings of tobacco.

An economic study has been undertaken of the tea industry in Far North Queensland utilizing research results and commercial experience as a guide to potential investors.

Other research studies included the development of a Demand-Supply Model of the Australian Oilseed Market. At the farm level, the economics of on-farm maize drying and use of peanut pre-cleaners were studied on the Atherton Tableland as a guide to producers considering acquiring such facilities.

Preliminary investigations are complete for a survey of peanut growers in the South Burnett to be undertaken at the request of the Peanut Sub-Committee of the Queensland Grain Growers' Association with financial support from local authorities. The survey, which commenced in mid 1979, will focus attention on level of capital investment and operating costs of farm machinery according to property size and location. Factors contributing to declining peanut yields in the Burnett region will also be examined.

Assistance was given to the Queensland Grain Growers' Association in assessing the impact of higher fuel prices on grain production costs. Efficiency of fuel usage on grain farms on the Darling Downs will be studied in a farm machinery cost survey early in 1980.

Horticulture

Costs and returns prepared for a wide range of horticultural crops throughout the State are being updated regularly.

An economic appraisal of avocado growing on the Atherton Tableland was well received by members of the local growers' association.

At the request of the Department of Aboriginal and Islanders' Advancement, a share farming agreement was prepared to assist aboriginal banana growers on the Yarrabah Aboriginal Reserve to become financially independent.

A small survey was undertaken of citrus growers in the Central Burnett to assess profitability and managerial requirements. Assistance was provided to improve the standard of farm records.

The economics of on-farm pre-cooling of horticultural produce were studied in the Gympie district. Evidence favoured the adoption of this post-harvesting technique by producers in a position to undertake the additional investment required.

Cannery pineapple growers' costs of production were monitored in a small survey of growers in the East Moreton and Near North Coast Regions. Comparative analysis revealed considerable variation in key parameters affecting profitability.

Livestock

The upsurge in beef prices has stimulated renewed interests in economics of regrowth control, pasture improvement, crop fattening and improved fencing and watering facilities. Lower grain prices have also encouraged some feed lotting on the Darling Downs. However, when other costs are taken into account, it costs around $130 to fatten a steer for 100 days and this level of expenditure is likely to inhibit large scale feed lotting.

A computer model of a beef property was developed to assist in the determination of optimum stocking rates and pasture development. Other computer programming activities in the beef industry included the R.N.A. carcass competition, analysis of data on rail movements of cattle in Queensland and preliminary work to establish a livestock market reporting service.

A benefit-cost study was undertaken of the development and introduction of a new vaccine against bovine babesiosis and a paper presented to the Second International Conference on Epidemiology and Economics in Canberra in May 1979.

Through involvement in the Queensland Carcass Classification Working Party cost-benefit pilot studies of classification trials have been initiated at district abattoirs. Further study has been undertaken of a range of beef stabilization proposals.

An increase of $2.50 to $5 per hectare in land values in the Central and Far South West over the past 6 months reflects a growing confidence in the wool industry. Wool prices are 18 to 20% higher than last year. With the strong demand, particularly from southern buyers, sheep prices around Charleville have increased more than 50%. To offset these price increases, production costs continue to rise and shearing costs average $1.50 per sheep. Excluding labour, the cost to run sheep in south-western Queensland now ranges from $5 to $7 per sheep per annum.

A comparative study of wool marketing arrangements in Queensland generated considerable interest from both producers and marketing organizations.

A survey was undertaken of profitability in livestock production in the mulga zone east of Charleville. Interest was centred on social and economic aspects of rural adjustment. Estate planning arrangements are also being studied to acquaint producers with the advantages and disadvantages of the more common forms of asset ownership and transfer between family members. Papers on the impact of taxation changes, particularly on investment decisions, in the pastoral industry were presented to two national conferences, namely the Australian Agricultural Economics Society (Canberra) and Australian Rangelands Society Conference (Bourke).

Future economic research in the wool industry is being centred on Charleville and will include a sheep industry survey to provide information on stocking rates, productivity, management practices and capital investment. Survey analysis will involve grouping land systems into land management units to indicate the different managerial requirements and financial resources for efficient production in distinct land resource areas.

The current decline in beef consumption induced by high meat prices has created a favourable climate for rapid expansion in the broiler industry. A survey was undertaken of the broiler industry in southern Queensland late in 1978 to assess costs of production as a basis for negotiations with processors in the determination of a growing fee in 1979. Financial support for the survey was received from the Chicken Meat Industry Committee.

A survey of egg producers in central and northern Queensland was undertaken late in 1978. Data obtained were incorporated in a cost of production model to provide a uniform basis for comparing production costs in central and northern Queensland with the model already established for southern Queensland. This information will form the basis for discussions within the poultry industry on policy aspects related to the CEMA levy.

Strengthening of the domestic demand for pig meat and lower feed prices encouraged limited expansion in the pig industry, but high capital costs remain a deterrent to producers wishing to take up or expand intensive piggeries.

A manual piggery production and breeder assessment recording system has been developed in co-operation with Pig Section. Recording books have been distributed widely both locally and interstate. Work is progressing on the development of a computerized system of physical and financial recording and performance analysis.

Pig industry publications included an economics segment for an Australian Manual of Pig Husbandry being prepared by the Australian Pig Industry Research Committee. Journal articles on a gilt pool case study and a survey report on the cost of selecting breeding stock using on-farm performance testing were published.

The movement of small-scale milk and cream producers out of the dairy industry continued. Institutional changes permitting the sale of milk quotas for re-allocation under the Milk Entitlement Scheme proved sufficient incentive to encourage some small-scale milk producers to give up dairying.

In an annual review of dairying in the Gympie district, gross margins varied between 30% and 60% of gross income per kilogram of butterfat depending upon farming system and production efficiency. This on-going review is now incorporated in the Dairy Farm Management Accounting Service.

Other studies included an economic assessment of irrigated and fertilized ryegrass for winter—spring milk production in the Mackay region in preference to hand feeding high levels of grain-based rations.

A literature review is being compiled on labour productivity along with a list of current research and extension projects in this field in Queensland as part of a national review being undertaken by the Standing Committee on Agriculture Committee on Extension.

Staff

Post-graduate training

Mr T. D. Wilson, Agricultural Economist, Division I, formerly Rockhampton and now stationed in Brisbane, completed a Masters' Degree in Extension Education at the University of Guelph in January 1979 under an A.M.R.C. studentship. On his return he undertook a short study tour on extension evaluation in the United States in preparation for his secondment to the newly established Extension Evaluation Unit in Extension Services Section.

Mr L. E. Williams, Supervising Agricultural Economist, was granted a year's special study leave to undertake a post-graduate diploma in business administration at the Queensland Institute of Technology in 1979.

Mr W. E. Holmes, Agricultural Economist, Division I, Charleville, should complete a Masters' Degree in Agricultural Science (Extension) at University of Melbourne in August 1979 under an A.W.C. studentship. Commonwealth support was obtained for Mr L. G. Clarke, Agricultural Economist, Division I, Brisbane to also undertake this course in Melbourne for completion in August 1980. These officers are undertaking research theses in the sheep and poultry industries respectively.

Study tours

Mr R. B. Bartholomew, Agricultural Economist, Division I, Brisbane, undertook a short study tour to New South Wales, Victoria and South Australia in May 1979 to discuss methodology used for economic assessment of research projects.

Inservice training

A centralized workshop for branch staff was held at Alexandra Headlands in March 1979. Smaller workshops were held for selected branch personnel at Gympie in irrigation economics and beef profitability assessment. Branch industry specialists also attended workshops conducted by technical branches.

To keep up to date with developments in farm management and agricultural economics, the Branch was represented at one international and 10 national conferences and interstate meetings. Staff also participated in 10 departmental training activities covering fields such as extension methods, rural marketing, biometrical analyses and management development. Three external courses were attended in government accounting, computer analysis and management development. Industry conferences such as the Poultry Information Exchange were also attended.

Agricultural economists continue to provide training in farm business management for regional extension staff as required and participate in international marketing courses for overseas personnel. A budgeting workshop was conducted for dairy extension officers in central Queensland at Rockhampton. A training component is also incorporated in on-going departmental activities such as the Dairy Farm Management Accounting Service and the combined soil and water conservation programme.

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Standards Branch

THE prime objective of the Standards Branch is to protect producers and consumers by the maintenance of prescribed practices and standards for agricultural requirements and agricultural produce.

Under State legislation, the Branch exercises regulatory control over the quality of defined agricultural requirements, and fresh fruit and vegetables offered for sale in Queensland.

The Branch administers the legislative requirements of agricultural chemical registration and provides secretarial and technical support in the control of the distribution of agricultural chemicals.

Seed testing laboratories operated by the Branch at Indooroopilly, Toowoomba and Mareeba supply information to support regulatory activities relating to seeds, and also provide seed analysis results to facilitate commercial seed transactions at both local and international levels. Queensland Seed Certification Schemes administered by the Branch also rely on quick and accurate seed analysis results.

Branch services which supplement the regulatory function include free tests to farmers on seed bought for their own use, research in seed technology, an advisory fruit maturity testing service, and the supervision of fumigation for fruit fly disinfestation of certain kinds of fruit and vegetables moving to southern States. A Fruit and Vegetable Marketing Extension Service operates in co-operation with some other Branches to assist all segments of the fruit and vegetable industry in improving marketing procedures.

The Branch also administers Commonwealth legislation concerning export requirements for grains, flour, seeds, fruit and vegetables as well as miscellaneous commodities such as birdseed, mung beans, nuts and propagating material.

Staff

An inspector has been stationed at Bundaberg to service the Burnett region and to assist with the inspection of export grain from the Gladstone terminal. In consequence of this transfer it has been possible to reduce the number of resident inspectors in Rockhampton from two to one.

With the seed testing laboratory at Mareeba nearing completion, an officer was transferred to that centre to provide Branch inspectorial services and to assist in developing local seed testing facilities.

'Refrigeration retains freshness' has been the theme adopted in recent joint D.P.I.-industry exhibits in the Fruit and Vegetable Pavilion at Royal National Association shows. The exhibit has been staffed by D.P.I. officers who have given information to Brisbane consumers on the care of fresh produce in the home.

Agricultural standards

An important objective under 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 5 117 applications for registration, including re-registration and renewal was processed. This represents an increase of 202 over last year. Approval was also granted for the supply of four special mixtures of pest destroyers and 27 special mixtures of fertilizers.

AGRICULTURAL REQUIREMENTS BOARD—Before registration by the Branch, the Agricultural Requirements Board considered the claims made by manufacturers regarding the efficacy of 1 944 preparations. The Board also considered requests for approval of 29 Departmental recommendations.

The enforcement of the registration of veterinary 'ethicals' continued to provide increased numbers of veterinary medicines for consideration by the Board. This is resulting in delays in achieving the 3-year registration review of veterinary medicines commenced in January 1978.

The following table provides an indication of the Board's activities—

—	1975–76	1976–77	1977–78	1978–79
Pest destroyers	881	1 111	509	830
Veterinary medicines ..	555	282	919	924
Stock foods	82	88	162	117
Fertilizers	11	16	47	43
Growth regulating materials	8	17	37	30
TOTAL	1 537	1 514	1 674	1 944

The beginning of 1979 saw the commencement of the 3-year registration period for pest destroyers. The applications for re-registration of preparations containing DDT have been considered and the only claims now acceptable to The Agricultural Requirement Board are—

- native budworm, corn ear worm, cotton tipworm and pink spotted bollworm in cotton.
- banana fruit caterpillar, banana silvering thrips, banana scab moth in bananas.
- dimple bug (apple dimpling bug) of apples and pears.

INSPECTION OF AGRICULTURAL REQUIREMENTS.—The following table sets out details of action taken by inspectors on agricultural requirements not complying with legislation—

ACTION FOLLOWING NON-COMPLIANCE WITH LEGISLATION

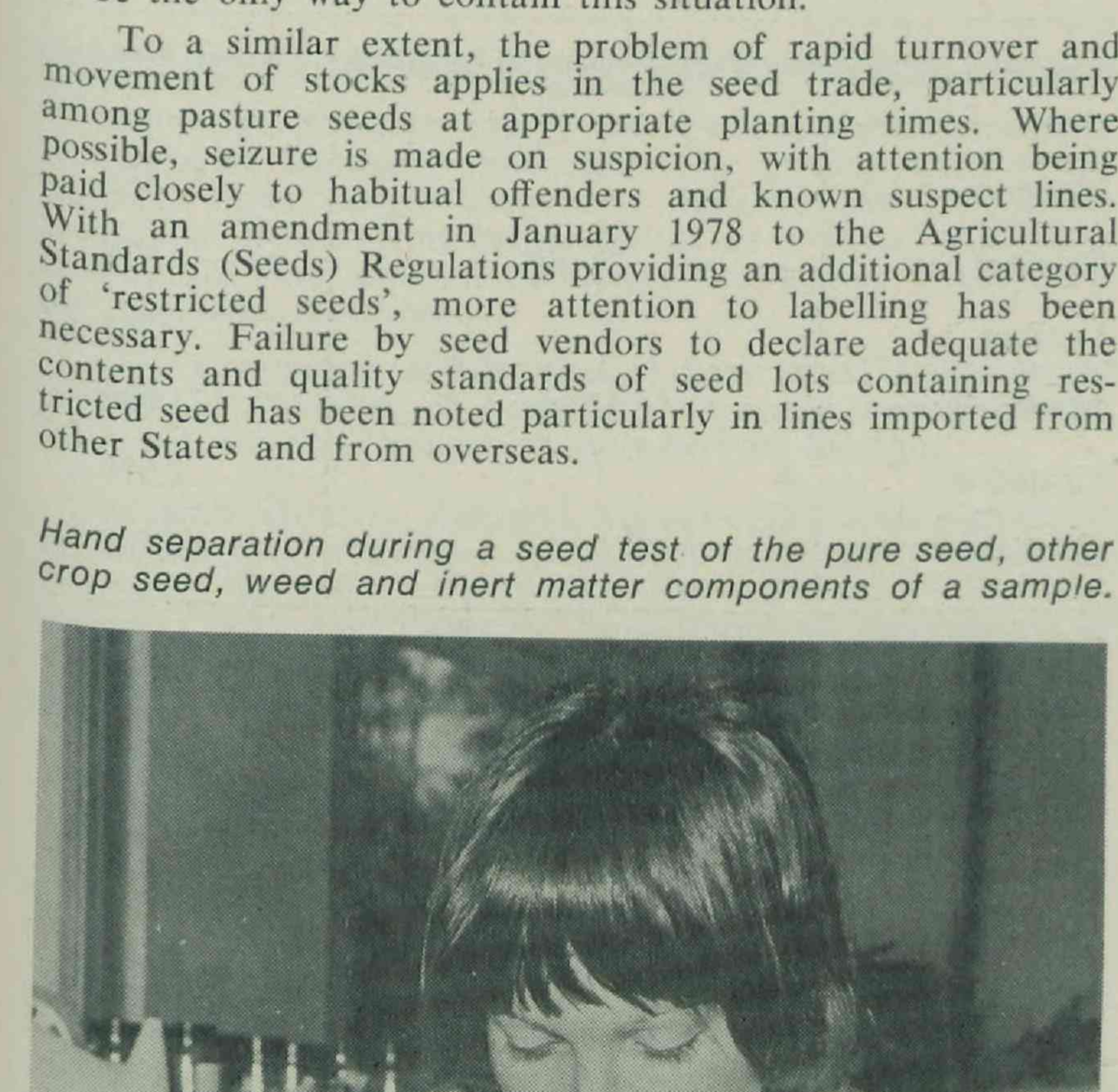
Particulars of Action Taken	Packages				
	Fertilizers	Pest destroyers	Veterinary medicines	Stock foods	Seeds
Initial action					
Seized by Inspectors	1,193	806	755	430	1,015
Otherwise Withdrawn from Sale	..	..	..	..	342
Subsequent action					
Destroyed ..	..	120	..	20	235
Recleaned/ Fumigated					
Reformulated/ Fumigated	..	8	23	207	76
Processed for Stock Food	..	..	..	..	190
Registered and/or Relabelled	1,116	..	15	48	65

Because of apparent difficulties experienced by stock food manufacturers in maintaining uniform composition within their final products, a more intensive programme of sampling has been initiated, whereby more analytical work is performed on fewer overall samples. In many cases of non-compliance, difficulties are experienced in seizing all articles comprising the offending line after non-compliance has been detected by sample analysis.

The movement of these materials is rapid and turnover is such that original stocks are rarely accessible more than a week or so after the initial inspectorial visit. Constant surveillance and repeat visits to known habitual offenders seems to be the only way to contain this situation.

To a similar extent, the problem of rapid turnover and movement of stocks applies in the seed trade, particularly among pasture seeds at appropriate planting times. Where possible, seizure is made on suspicion, with attention being paid closely to habitual offenders and known suspect lines. With an amendment in January 1978 to the Agricultural Standards (Seeds) Regulations providing an additional category of 'restricted seeds', more attention to labelling has been necessary. Failure by seed vendors to declare adequate the contents and quality standards of seed lots containing restricted seed has been noted particularly in lines imported from other States and from overseas.

Hand separation during a seed test of the pure seed, other crop seed, weed and inert matter components of a sample.



SEED CERTIFICATION.—Seed certification activities increased during 1978–79. Increases in both areas planted and total production have been recorded in hybrid maize, French beans, and pasture species. Substantial reductions have been recorded in navy beans and tomato seed certification.

Interest has been maintained in Rhodes grass cv. Callide where demand for certified seed has outstripped supply. Many growers have elected not to continue in the registration of their areas of *Panicum maximum*. *Leucaena leucocephala* has been accepted into the scheme to allow the newly released cultivar 'Cunningham' to retain its varietal integrity.

Some 804 hectares were planted to approved Stout oats last season, of which 525 hectares were accepted as approved seed, and 279 hectares were rejected.

Sweet corn was accepted into the Seed Certification Scheme, under the Hybrid Maize Seed Certification Rules. One variety (QK 467S) has since been accepted into the scheme and a total of 150 kg was produced from a very late planting in 1978.

FEES.—A significant change has been made in the way seed certification fees are charged.

For French and navy beans, a fee of $9.30 per hectare is payable at the time of registration. From April 1979, no charges will be levied for final labelling and sealing of bean seed. This rate was calculated as being the average collected per hectare for all bean seed certified in the previous three years. The overall revenue is expected to remain the same.

Fees for all certified crops were increased in August 1978. These were—

hybrid maize—30c to 35c per 25 kg

tomato—$2.00 to $2.50 per kg

pasture species—3·5c to 4c per kg

SEED PRODUCTION FROM AREAS REGISTERED FOR SEED CERTIFICATION

Certified seed	1976 (kg)	1977 (kg)	1978 (kg)
Hybrid maize	203 290	144 946	160 699
Hybrid sweet corn	..	..	150
French beans	52 114	43 030	57 723
Navy beans	27 800	47 416	18 000
Pasture species	981	1 704	5 880
Tomato	495	358	29
Special mother bean seed			
Stage A	3 014	1 180	770
Stage B	6 586	7 587	9 122
Sub-total	9 600	8 767	9 892

Approved oats	1976 (ha) Accepted	1977 (ha) Accepted	1978 (ha) Accepted
Stout	31	394	525

Fruit and vegetable quality

Surveillance of fruit and vegetable quality at both wholesale and retail levels was maintained throughout 1978–79 under the provisions of the *Fruit and Vegetable Act* 1947–1972.

Inspections were carried out at 1 625 shops in 545 suburbs and 477 directions were made.

Good supplies of most fruits and vegetables were maintained throughout the period with a notable oversupply of apples, particularly the red varieties.

The following table outlines the total quantities of fruit and vegetables on which inspectors at the Brisbane Market took appropriate action.

ACTION ON FRESH FRUIT AND VEGETABLES NOT COMPLYING WITH LEGISLATION

Action	No. of packages involved	No. of bins involved	Vegetables in bunches	Loose lots by count	Loose lots by weight (kg)	Calculated total weight of produce affected (kg)
Fruit and vegetables condemned and destroyed						
Fruit	44 993	64	..	1 452	296	933 020
Vegetables	45 842	113	7 871	7 857	..	993 010
Fruit and vegetables ordered to be reconditioned						
Fruit	5 256	..	..	..	..	105 120
Vegetables	21 581	11	..	..	..	433 820
Fruit and vegetables ordered to be regraded						
Fruit	13 535	..	..	..	..	270 700
Vegetables	9 600	5	..	..	..	194 500

Large quantities of rockmelons were received at the market in poor condition, with ground rots and other fungal infections.

Considerable quantities of cucumbers and capsicums were received in poor condition due to excessive rains.

Other produce requiring particular attention were broccoli; lettuce, mostly from the Lockyer district; and radish.

An overall improvement in quality was noted in all varieties of stone fruit and below average losses were recorded.

Apples were carried over on many occasions and 21 468 packages were seized and destroyed, mainly resulting from over storage. In addition, 2 299 packages were regraded and 206 packages were picked over.

From the inspections of heavy produce, it was necessary to order 22 196 kg to be picked over with the resultant loss of 8 015 kg which were seized and destroyed. These figures represent an increase on last year's figures.

Breaking down a sample into smaller representative samples during a seed test.

Fruit maturity testing was carried out on growers' samples selected by inspectors. The number of samples tested was 251 grapes, 132 citrus, 114 avocados, 17 pineapples and 28 mangoes.

Supervision of ethylene dibromide (E.D.B.) fumigation, to control fruit fly infestation, was carried out in conformity with legal requirements of southern States, at fumigation rooms at Clapham Junction, and at Gayndah, Mundubbera and Bundaberg. The following fruit were fumigated:—

Fruit fumigated	Gayndah/Mundubbera/Bundaberg (packages)	Clapham Junction (packages)
Mangoes ..	..	23 465
Oranges ..	33 006	5 826
Lemons ..	..	385
Mandarins ..	52 946	11 890
Grapefruit ..	..	2 098
Capsicums ..	..	43 543

Certificates were issued for 254 consignments comprising 19 720 cartons of bananas which were dipped under supervision for transport to the Murrumbidgee Irrigation Area.

Inspection of 740 consignments of southern stone fruit were checked under the provisions of the Diseases in Plants Act, for accompanying *Sclerotinia laxa* certificates. In addition, 928 consignments of grapes for southern States were checked for Phylloxera certificates.

Plant Pathology and Entomology laboratories staff provided invaluable assistance in identifying insect pests and diseases associated with fruit and vegetables. During the period, 91 samples were forwarded for identification.

Valuable assistance was also provided by officers from the Sandy Trout Food Preservation Research Laboratory in problems and enquiries associated with the storage and processing of fruit and vegetable products.

In February 1979, the amended Fruit and Vegetable Grading and Packing Regulations were published. Some of the amendments contained in these Regulations are greatly different from previous requirements and considerable time and effort has been expended by all inspectors in ensuring their smooth introduction. Individual growers have been contacted and advised of regulation changes in relation to their products and considerable improvements have been noted particularly in the areas of packaging and grading.

Queensland export citrus being loaded into a shipping container at a Central Burnett packing shed. During the 1978–79 season, 300 000 cartons of Queensland citrus were exported to Europe, Canada, South-East Asia and New Zealand. All the fruit is pre-cooled before being stowed in the containers. Fruit temperature and quality are checked and the method of stowing supervised by Queensland fruit inspectors on behalf of the Commonwealth Government.

Fruit and Vegetable Marketing Extension Service

An encouraging increase in interest in post-harvest aspects of marketing extension was shown by greater co-operation between State Departments in endeavouring to attain uniformity in marketing requirements, as well as by industry itself in the formation of the Australian United Fresh Fruit and Vegetable Association.

The Committee of Direction of Fruit Marketing and the Queensland Chamber of Fruit and Vegetable Industries also sponsored training courses in post-harvest handling.

MARKET QUALITY ADVISORY SERVICE—The most significant development in the area of market information feedback to growers has been the assistance received from horticultural inspectors with the Victorian Department of Agriculture in respect to the quality and condition of Queensland produce arriving in Melbourne.

Details of weekly condemnations are being received from Melbourne during periods of heaviest supplies. Regular contact is being maintained with Victorian horticultural inspectors and details of poor out-turn have been telephoned through for immediate action.

During the rockmelon season, close contact was also maintained with the Sydney market inspectors in an attempt to standardize actions taken in respect to rockmelon maturity. On the request of Queensland growers, a special visit was made to the Sydney Flemington Market in December 1978 to clarify the requirements regarding rockmelon maturity.

CO-ORDINATED EXTENSION PROJECTS—'Packaging, Pre-cooling and Distribution of Fruit and Vegetables from the Granite Belt' is the only registered regional extension project that the service was involved in during this period.

Following a review of rockmelon maturity on the Sydney market, an immediate extension exercise was carried out in conjunction with officers of Horticulture Branch. The objective was to explain the requirement of the New South Wales rockmelon maturity regulations to growers in these districts.

In addition, a joint project with the New South Wales Department of Agriculture was initiated to determine the practicability of Queensland growers being able to meet the New South Wales standard. Rockmelon maturity has subsequently been reviewed with research officers in Queensland and New South Wales with a view to standardizing maturity standards before the 1979–80 season.

TRANSPORT AND HANDLING—This year, officers of Standards Branch co-operated with Horticulture Branch in a joint project 'Horticultural efficiency through mechanization and post-harvest technology'.

There is a continuing increase in the use of refrigerated transport for fresh produce both into and out of the Brisbane Market. However, in spite of expanded facilities, a high percentage of unchilled produce leaving the market is still being loaded into cold wagons and heavy losses are experienced in country centres through deterioration and shortened shelf life of this produce.

Operating a laboratory seed blower to remove lighter, inert material from a sample of pasture grass seed.

Little progress has been made in respect to unitization of consignments and greater emphasis will be given to this aspect in the next 12 months.

WHOLESALE—Significant progress in the Brisbane wholesale market during the last 12 months has seen the expansion in cool storage facilities. The C.O.D. high humidity and fast cooling rooms are now operational and seven other agents have constructed additional cool room facilities.

RETAIL—During the year, extension duties were combined with normal inspection visits to retail fruit and vegetable outlets. Regular extension articles are now being written for the Retailers' Newsletter and to date five items have been printed. Three meetings with retail distribution chains on handling, storage and transport conditions were arranged.

Agricultural Chemicals Distribution Control

Standards Branch provides secretarial and technical support to the Agricultural Chemicals Distribution Control Board which was formed under the *Agricultural Chemicals Distribution Control Act* 1966–1978. The Board is responsible for the licensing of agricultural pilots and commercial weed control operators, for the issuing of statements on investigations into cases of damage alleged to have been caused through the commercial use of agricultural chemicals and for recommending controls on the use of these chemicals in the State.

Branch activities included the issue and renewal of licences for agricultural pilots and weed control operators; ensuring that contractors hold 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—Fifty-three examinations for unrestricted licences were held in 19 centres during the year. Ninety-six applicants for commercial operator's licences and five for pilot chemical rating licences were examined. From these and earlier examinations the following licences were issued or renewed—

131 unrestricted commercial operator's licences issued
97 restricted commercial operator's licences issued
1 009 commercial operator's licences renewed
12 pilot chemical rating licences issued
57 pilot chemical rating licences renewed.

INVESTIGATIONS—Thirty-seven notifications of complaint on damage were received and investigated during the year. Nine of these related to injury to ornamental plants and shrubs growing in home gardens. Of the remaining 28, two related to stock and 26 to agricultural and horticultural crops from throughout coastal Queensland.

PERMITS—Fifteen applications for the issue of permits for the distribution of restricted weedkillers in Hazardous Areas were received. Seven of these applications were for the distribution of ester formulations of 2,4-D and 2,4,5-T onto approximately 2 300 hectares of forest in Hazardous Area No. 1. Of this area, approximately 850 hectares were treated from aircraft.

Six of the remaining eight applications were for the use of ester formulations of 2,4,5-T in Hazardous Area No. 2.

CHANGES TO LEGISLATION—The Board considered a submission from cotton growers in the Duaringa Shire for control over the use of 2,4,5-T ester for brigalow control in that Shire. As a consequence, the Act is now applicable in that part of the Duaringa Shire south of the Capricorn Highway. It is also in force in the previously exempted small part of the Emerald Shire.

During the year, alterations were made to the Act's provisions which relate to records of aerial and ground distribution, powers of inspectors and the purposes for which agricultural chemicals may be used by licensees. One of the new provisions requires aerial agriculture operators to submit prescribed records of their work. Operators raised objection to this requirement at a meeting with representatives of the Board.

Export supervision

Inspections are carried out at Metropolitan and major country centres under Commonwealth Export Regulations, relating to the export of seed for sowing, birdseed, barley, wheat, sorghum, flour, fruit and vegetables, nuts, and seed for culinary purposes.

Other duties include the inspection and, if necessary, the fumigation of ships before carrying cargoes of grain. Ninety-one ships were inspected in the Port of Brisbane and 30 ships inspected at Gladstone. Regular hygiene inspections are carried out at grain terminals.

Stock food supplies for livestock exported overseas are inspected and plant health certificates issued.

Shipping containers are now used almost exclusively for the export of plant products. During the year, 2 962 containers were inspected, of which 168 were rejected and 1 475 withdrawn from use pending cleaning and repairs.

SEED AND GRAIN.—Of seed for sowing, carpet grass (*Axonopus* spp.) remained the main species exported. Shipments of mung beans intended for sprouting increased from 7 051 bags in the previous year to 27 211 bags. The export of other kinds of seeds for culinary purposes, as well as macadamia nuts, showed increases over the previous year. Exports of peanuts decreased slightly.

Total shipments of barley increased to 303 667 tonnes, almost three times the tonnage of barley exported in 1977–78. Sorghum shipments in excess of 500 000 tonnes and wheat in excess of 700 000 tonnes also showed increases over the previous year.

Exports of flour totalling 27 356 tonnes showed a slight decrease when compared with last year. About one quarter of these flour shipments in the current year were Australian gifts to developing countries.

FRUIT.—Favourable markets again existed in Europe for Valencia oranges but frosts in growing areas were responsible for a drop in production and the export figure of 61 000 cartons was only 75% of that of the previous year. A similar reduction occurred with mandarins—the lighter crop of Ellendales permitted only 181 000 cartons to be exported. This figure was 90% of the total mandarins exported.

A small but significant variation in export varietal pattern was the 32 000 carton component of Navel oranges exported to New Zealand, out of a total Navel export figure of 56 000 cartons. This New Zealand shipment is believed to be the first ever and is seen by the industry as a welcome sign to future trade in this variety. Noteworthy also is the trend to regular air freight consignments of pineapples to New Zealand as against conventional shipping containers.

Seed testing

The following table indicates the extent of general seed testing carried out conjointly during the year by the Queensland Seed Testing Station at Indooroopilly, and the Seed Testing Sub-station at Toowoomba.

Samples received at Indooroopilly during the year were predominantly pasture grass seeds, the main species being *Panicum maximum*. The Toowoomba sub-station analysed the bulk of cereal, birdseed and oilseed samples with total tests numbering in the vicinity of the Indooroopilly totals for grass seed samples.

Source of sample	No. of samples
Inspectors	
(a) Survey/official samples	3 297
(b) Samples of seed for export	2 082
(c) Samples of imported seed	98
Government Seed Certification Scheme ..	375
Seed research officers	321
Samples submitted by—	
(a) Farmers	1 121
(b) Merchants	5 607
(c) Departmental	907
(d) Other Departments and scientific institutions	84
TOTAL	13 892

Besides providing information for regulatory purposes and verifying seed quality for research purposes, the seed testing service aims at assisting the intending purchaser in selecting seed of an appropriate quality for planting. Tests on seed submitted by an owner for his own sowing are carried out free of charge.

Research and publications

Research programmes have tended in recent years to become more concerned with long-term projects dealing with major economic problems of the seed industry rather than with short-term projects dealing with the lesser problems which affect industry. A number of long term projects reached the stage of completion in 1978–79. These are now in the process of being analysed or results are being prepared for publication.

The projects covered such diverse species as *Phaseolus vulgaris, Cenchrus ciliaris, Brachiaria decumbens, Stylosanthes humilis* and *Parthenium hysterophorus.*

Major findings from these projects are—

1. Low seed moisture content at threshing is the major cause of seed quality losses in bean seed.
2. There is poor correlation between establishment and harvest parameters with beans, undoubtedly due to the ability of the plant to undertake yield compensation.

3. Several laboratory tests (namely, standard germination, single seed conductivity and water immersion) are highly correlated with field performance of bean seed under certain circumstances.
4. Buffel grass has a short term dormancy lasting up to 3 months. During this period, predrying at 40 deg C improves germination. The dormancy mechanism is located within the caryopsis rather than the glumes or fascicle.
5. Two types of dormancy were identified in *Brachiaria*—
   (a) Physiological dormancy lasting 6 months which responded to potassium nitrate and light.
   (b) Physical restriction due to lemma and palea—reduced by acid treatment.
6. Hard seed content of Townsville stylo was reduced from 65% to 19% by dry heat treatment of 75 deg C for 8 hours, with rapid cooling at 0 deg C.
7. After 2 years' exposure to field conditions, viability of *Parthenium* seed fell from 70% to 30%.

Four research papers dealing with seed vigour, the germination criteria of Siratro seed, a fast green test for *Phaseolus vulgaris* and the loss of quality in machine-threshed bean seed were published during the year. The publication on machine-threshed bean seed was included in the Annual Report of the Bean Improvement Co-operative, New York, U.S.A.

Standards Branch Pamphlet No. 74 was expanded by the addition of information on 31 pesticides. This pamphlet, published as an information service within the Department, presents technical information in the form of data sheets on many of the pesticides sold in Queensland.

Other activities

Mr R. L. Harty, accompanied by Mr T. E. Friend as an observer, represented this Department at the first meeting in 1979 of the Australian Seeds Committee, which comprises representatives of seed testing and seed certification interests in the States and C.S.I.R.O., together with representatives of the Commonwealth Department of Primary Industry and the Commonwealth Department of Health. This Committee is closely associated with the seed industry through the Australian Seed Industry Advisory Committee. Reports and recommendations of the Australian Seeds Committee are forwarded to the Plant Production Committee of the Standing Committee on Agriculture.

An extension campaign to provide information on seed quality to users, industry and Departmental officers was completed during the year. Seed services made available by the Branch were explained and proposed changes to seed legislation were discussed with the seed industry.

Following the return in 1978 of Miss H. Low, Seed Analyst, from the ISTA Workshop held at Wageningen, The Netherlands, an Australian Workshop was held in Brisbane to acquaint participants from the Australian States and the A.C.T. with progress made at Wageningen in achieving uniformity of seed testing procedures.

With the approval of the Chief Quarantine Officer (Plants) Queensland, funds were made available for Mrs J. Fanton, Seed Analyst, to visit the Plant Introduction Centre, C.S.I.R.O., Canberra, to study the weed seed collection there and to obtain specimens of prohibited seeds for the Indooroopilly weed seed library.

Participants of various International Training Courses as well as students from the Queensland University and Colleges of Advanced Education visited Indooroopilly for discussions and demonstrations of seed technology. A notable visitor was Miss Ratana Pawana of the Thai-Australian Land Development Project in Lumpang, Thailand.

Departmental approval has been received for Mr C. H. S. Beavis, Seed Technologist, to commence a 12-month course of study at Edinburgh University in September 1979 with a view to his obtaining a Master of Science degree in Seed Technology.

Inspectors J. Easton and H. Bernon were both granted short extensions to recreation leave while overseas, to study activities of direct interest in their work. Mr Easton visited stock food processing establishments in the United Kingdom while Mr Bernon visited grain storage and export installations in France and Germany.

Submissions by industry to the Technical Committee on Agricultural Chemicals for the clearance of 71 new pesticides and new uses of pesticides already being sold were referred to Standards Branch. The Branch subsequently called on appropriate consultants within and outside the Department for evaluation of their respective places in agriculture, horticulture and domestic situations.

Drafts of the second and third addenda to the Australian list of Recommended Common Names for Pesticides were considered on behalf of the Standards Association of Australia.

Standards Branch provides secretarial and technical support to the Agricultural Chemicals Distribution Control Board. One of the Board's functions is to license agricultural pilots.

Division of Land Utilisation

DURING the year emphasis has been placed on achieving the following objectives:—

- Consolidating the Statutory Soil Conservation Programmes on the Darling Downs and in the Burnett Region.
- Publicizing the recommendations of the Commonwealth–States Collaborative Soil Conservation Study Report.
- Assisting with the preparation of the Burdekin River Project Report.
- Liaison with other Agencies concerning agricultural land suitability.
- The continuation of Natural Disasters administration activities.
- Providing an Advisory Service for an increasing number of agricultural engineering enquiries.

Progress in soil conservation

The progressive total of land protected by soil conservation measures throughout Queensland now stands at 767 000 hectares. The total area treated with soil conservation measures for 1978–79 was 43 871 ha which represents a 9% decrease on the previous year. However, soil conservation activities reached an all-time high in the Capricornia Region where 17 711 ha of land were protected by contour measures.

A period of consolidation with the Darling Downs statutory soil conservation subsidy programme has been achieved. Subsidy payments for soil conservation works in Division 4 of the Rosalie Shire in the South Burnett and for soil conservation works in the Gin Gin Area of Erosion Hazard in the Burnett Region were made during the year. Details are set out below.

STATUTORY SOIL CONSERVATION PROGRAMMES 1978–79

—	Units	Darling Downs	South Burnett	Burnett	Total
Requests from farmers	Number ..	1 055	27	226	1 308
New co-operators	Number ..	111	1	16	128
Implementation					
Intensive measures	Hectares ..	8 375	209	51	8 635
All measures	Hectares ..	10 766	209	551	11 526
Project plans					
Number of farms	Number ..	92	35	11	138
Area	Hectares ..	4 666	2 620	535	7 821
Provisional project plans					
Number of farms	Number ..	270	2	2	274
Area	Hectares ..	49 814	205	52	50 071
Subsidy payments	Number ..	490	3	1	494
Payments	Dollars ..	182 462	1 434	651	184 547

Commonwealth-State Collaborative Soil Conservation Study

The main report of the Commonwealth and State Government Collaborative Soil Conservation Study 1975–77, titled 'A Basis for Soil Conservation Policy in Australia', 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. The purpose of the study was to provide the Commonwealth and State Governments with information for the formulation of policy on soil conservation and associated land and water management programmes. The study report is now being considered by the Commonwealth and State Governments. In Queensland, the report is being considered in conjunction with other policy studies completed during the year.

The report contains 32 recommendations—one basic recommendation of national application, six concerning Commonwealth action, five concerning Commonwealth–State relations, 12 related to the activities of State Governments, six concerning State-Regional-Local relations and two concerning local government.

The basic recommendation proposes that 'soil conservation activity in Australia be extended and intensified and better integrated with policies for rural industries and planning for coastal, urban, recreational and mining areas.' Two of the recommendations directed at the Commonwealth deal with financial assistance for soil conservation. The first recommends 'that the Commonwealth provide increased funds to the States for soil conservation'. The second recommends reinstatement of the pre-1973 taxation provisions applying to soil conservation.

Burdekin River Project

An inter-Departmental Committee under the chairmanship of the Co-ordinator-General has prepared a detailed report relating to a water resources development project in the Burdekin Basin. The report has been widely released to the public, relevant Government Departments, Local Authorities, Industry Associations and Libraries for information and comment. The scheme provides for the irrigation of an additional 45 125 ha annually at full development and would involve the creation of about 660 new farms.

Information relating to agriculture, soils, land use and economic evaluation inputs was contributed by officers from Agriculture, Agricultural Chemistry, Development Planning and Economic Services Branches.

Liaison with other agencies

LIAISON WITH OTHER AGENCIES CONCERNING AGRICULTURAL LAND SUITABILITY. Land classification to define suitability for specified purposes is a prerequisite for the initiation of a rational system of land use and development. In closely settled areas, particularly along the coast and hinterland, competition for land for differing purposes is becoming more intense. Development Planning Branch has been collaborating with Local Authorities and organizations having a vital interest in future land use in areas where rationalization would appear to offer a means of meeting the needs of all interests.

Land suitability maps of both the Central Moreton (Nambour) and Rocky Point (Woongoolba) sugar producing areas have been completed and work is currently in progress in the Mackay area. While the land suitability classification is designed primarily for rural use, it also provides a general basis for extrapolation to other purposes.

Drought and Natural Disaster Administration

The Drought Secretariat continued to play an effective role in co-ordinating the administration of natural disaster measures for primary producers during the year.

At the start of the 1978–79 financial year, drought conditions existed over large areas of the State with 33 local authority areas being officially declared. Areas most affected were the Darling Downs, Burnett, south-west and parts of north Queensland.

However, winter and spring rainfall was well above average in much of the State and drought conditions were progressively relieved during 1978–79. By March 1979, all declarations had been revoked.

Expenditure on relief measures available during the drought was—

Assistance Measure	Expenditure ($m) to 30 April 79
Road transport concessions	2·210
Rail transport concessions	0·881
On-property slaughter subsidy	0·532
Relief loans	4·177
TOTAL	$7·8

The 1978–79 summer season has been a mixed one with north Queensland experiencing well above average rainfall while large parts of southern Queensland have recorded deficiencies ranging from 20 to 30%. Early winter rainfall has also been well below average. Applications for drought declarations have been received for Shires in the far south-west and the south-east.

In December 1978, citrus orchardists in the Gayndah area sustained severe damage from an intense hail and wind storm with considerable damage occurring to trees as well as fruit. A survey indicated that the gross value of the fruit lost was about $750 000. A scheme of low-interest loans was implemented through the Agricultural Bank to assist affected farmers. Approvals under this scheme totalled $132 400 as at 30 April 1979.

Two major cyclones, 'Peter' and 'Kerry', affected primary producers in north Queensland during 1978–79. Peter produced wind damage and flooding on the wet tropical coast and in the Cairns Hinterland and Tablelands. Kerry caused major flooding in the Bowen to Sarina coastal areas. Relief loan schemes were implemented through the Agricultural Bank to assist affected primary producers.

In the 1978 Federal budget the 'trigger points' for Commonwealth assistance to Queensland for core measures was doubled to $4m for overall expenditure and $400 000 for a single event.

Agricultural engineering enquiries

A demand for more sophisticated agricultural engineering information has been received from forward-thinking farmers. Engineering extension services have been diversified to include the design of farm sheds, ferro-cement buildings and feed processing facilities. Because of the diversity in demand, it has been necessary to make greater use of mass media for the dissemination of information. Numerous addresses to industry group meetings have been undertaken throughout the State to reduce the number of personal enquiries.

Development Planning Branch

THE principal responsibility of Development Planning Branch is to undertake land resource investigation and to identify opportunities for development of such lands throughout the State. The Branch was involved in 65 projects this year.

Investigations undertaken included the evaluation of irrigation projects, resource assessment and planning in the agricultural and grazing areas of the State, and land management research activities.

Planning and evaluation

Planning activities this year were associated with the investigation of irrigation proposals in conjunction with the Water Resources Commission. The Branch assembles land use and resource information in association with other Branches of the Department so that detailed joint reports can be prepared for government decision making and funding.

Barker-Barambah Creek Study

A joint feasibility study of land use aspects for alternative irrigation proposals for the Barker-Barambah Project was undertaken in conjunction with the Agricultural Chemistry, Economic Services and Agriculture Branches. The Agricultural Chemistry Branch undertook a soil survey of the Byee Area.

An assessment was made of current land use practices and the irrigation potential for an aggregate area of some 7 000 hectares of suitable land at Byee, Redgate and Windera.

St. George Irrigation Area

At the request of the Water Resources Commission, a preliminary analysis was undertaken, with Economic Services Branch, to assess water allocation policies for this established irrigation area. The main objective was to assess the increasing risk of water shortage caused by increasing the area irrigated.

A monthly simulation analysis based on historic streamflows and rainfall was used to evaluate the economic effects of irrigation deficits on cotton and soybean production. The results indicated that mean net income could be increased by about 14% if the irrigated area was increased by 20%.

Evaluation of potential irrigation lands

This project with the Water Resources Commission is aimed at assessing irrigation potential for a range of possible dam sites, so that they may be ranked according to their priorities for agriculture. An assessment of the Wide Bay-Burnett region is nearing completion.

A planning document for each catchment region will be produced and will include maps of existing water resource projects, irrigated agricultural development features and the priority areas for future agricultural development.

Resource assessment and planning

Resource studies show that large areas in Queensland still have the potential to be developed further for irrigation, dryland cropping and improved pastures. However, these resource studies also indicate that many of these lands need special management practices to maintain productivity. Many of the areas to be developed have soils which are less fertile than currently-used soils and are prone to soil erosion.

In the more populated areas there are many users of land and, as conflict for land for different uses increases, the demand is increasing for agricultural land resource information for planning, zoning and land management by Local Authorities, Water Resource Commission, Co-ordinator-General, Water Quality Council and industry organizations.

Sugar industry land use studies

The sugar industry in Queensland is established in the high rainfall coastal belt where competition for land is high. The industry has an excellent record in its ability to improve efficiency of operations through increased scale of operations and improved technology. It has been able to compete with other agricultural industries and expand onto new lands. A number of approaches has been made for detailed land use studies to identify those areas suited for growing sugar-cane. These land use studies are used by the industry and local authorities in planning land use policy and thus reducing conflict.

In 1976, studies began in both the Moreton Central and Rocky Point Mill Areas following representations from the Southern District Cane Growers' Executive for detailed assessments of the suitable and available sugar land within defined areas.

The report on the Moreton Central Mill Area indicates that there are approximately 15 300 hectares of suitable land available for sugar-cane within a 35-kilometre radius of the mill. However, due to the needs of urban development and other uses, it is estimated that only 67% of this land will remain available for sugar-cane production in the foreseeable future.

In the Rocky Point Mill Area it has been estimated that 2 884 ha are available for future development. It was concluded that maximum future production at the mill area could be as high as 45 000 to 50 000 tonnes 94 nt sugar.

In 1977, a request was received from the Queensland Cane-Growers' Council and the Maryborough District Canegrowers' Executive for the Division to undertake a land suitability study of the steep, stony and eroded assigned land within the Maryborough district. Preliminary studies indicated that approximately 65 farms (34 Hervey Bay, 16 Yerra-Pilerwa, 15 Bauple) needed to be assessed. To date, field work has been completed on 12 of these properties and, from these studies, it appears that total farm transfers may be desirable in at least four cases.

A team of four officers has been established at Mackay to identify the lands suitable and available for sugar-cane growing and the relative suitability of these lands for sugar production. This project was established following approaches by the Queensland Cane Growers' Council, the Mackay District Canegrowers' Executive and millers. Co-operation given by these groups in the planning stages of the project has been excellent. The assistance of the Bureau of Sugar Experiment Stations is appreciated. It is planned to have results and maps for the whole District by early 1981. The industry and Local Authority will be kept informed of progress and results by consultation at regular intervals.

Western Arid Region Studies

This project, which has the objective of mapping and describing the resources of 60m ha of Queensland's arid and semi-arid lands, began in 1970.

Field work on this project is now complete and it is proposed that maps at a scale of 1 : 500 000 covering the whole area will be available by mid 1980. At this stage, printed maps are available for Parts 1, 2 and 4. Dyeline maps at a scale of 1 : 250 000 are available for Parts 3 and 5. Reports have been published for Parts 1 and 4. A draft report has been completed for Part 2. Reports on Parts 3, 5 and 6 should be completed by mid 1980.

A draft composite land type map for the whole area has been prepared for the Department of Lands. This map will show the distribution of the major land types and indicate their potential and management needs. The reports and maps from this study have been in constant demand and Part 1 is now out of print. Much time has been spent providing information and guidance to research and extension officers and officers of other Departments.

It is planned to undertake a property planning exercise in western Queensland to demonstrate the preparation and use of property plans. These show land resources, property improvement and development and an outline of property management strategies which are consistent with long-term productivity. These plans will utilize Land Use Study data assembled for the Western Arid Study. Two property plans have been prepared in association with graziers and other departmental officers. These plans have been well received by graziers.

Moreton Region Studies

The Moreton Region is an important agricultural region which is highly developed. It is close to large centres of population and is subject to continued land use change and conflict as high value agricultural land is subject to urban pressure for subdivision. Other areas are lost to production due to land speculation.

In addition, parts of the area have been overdeveloped through clearing and cultivation of steep slopes without adequate management and this has caused soil erosion, landslip, salinity and siltation problems.

The region is also the major source of water for rural, city and industrial use in south-east Queensland. It is clear from these factors that land resource and land management information is needed to plan for rational development of the region and maintain both agricultural production, water quality and quality of life.

Important projects being undertaken by Branch officers include the Bremer and Lockyer Land Degradation Studies and a major involvement in the Co-ordinated Soil and Water Conservation Study in association with officers of the Soil Conservation Branch and the Water Resources Commission.

A study relating to the development of 12 000 ha of land on the foreshores of Wivenhoe Dam is being prepared for the Wivenhoe Dam Management Advisory Committee.

Salinity investigations at three localities in the Bremer and Lockyer catchments are providing data on ground water quality and ground water movements related to dryland salinity outbreaks. These indicate that in the catchments poor quality ground water (4 000 p.p.m. total dissolved solids) is associated with particular sedimentary rocks. Sodium chloride is the dominant salt present. Where saline ground water rises to within 0·5 m of the surface, concentration of salts gives rise to dryland salting outbreaks. Such occurrences are associated with poorly drained clay alluviums in catchments with considerable clearing.

Staff from the Agriculture, Horticulture, Agricultural Chemistry Branches, the Queensland Agricultural College, Water Resources Commission and Mines Department have been co-ordinated to provide information on the extent and seriousness of the problem and to consider action which could be taken to correct or alleviate the soil salinity and water problems.

Wide Bay Region Studies

The Co-ordinator-General's Department has co-ordinated an Inter-Departmental project which aims at cataloguing and publishing information on the resources of the Wide Bay–Burnett Region. Development Planning staff have contributed a section on Soils and Rural Land Use for Volume 2 Land Resources. The contribution included discussion on soil groups, current land use, land degradation and possible agricultural land use changes. In addition, a map of soils and the major areas of cultivation was prepared.

Branch officers are undertaking a series of resource studies which will eventually cover the whole of the Wide Bay–Burnett Region. The present study involves the mapping and description of the highly productive land in the South Burnett Region. To date, half of the field work has been completed and mapping units for the whole of the southern portions of the area have been transferred to 1 : 100 000 cadastral map sheets.

Special activities

The computing group in this Division has been responsible for developing computer techniques which can be used to improve access to data collected during land resource activities. In this work, the group is developing practical and cost-effective techniques which, over the last 5 years, have been utilized not only by this Branch but by other Branches, other Departments and interstate organizations. The techniques developed have improved user access to resource data and this will develop further as techniques improve.

The officers have developed a computer-based information system to assist in the monitoring and planning of Area of Erosion Hazard Programs. In addition, they have also evolved a full Erosion Index analysis for 54 rainfall recording stations in Queensland.

Soil Conservation Branch

THE prevention and mitigation of soil erosion is the main duty of the Branch under *"The Soil Conservation Act of* 1965". Related duties include research and investigations into the nature and extent of soil erosion.

Nature and extent of soil erosion

The findings and recommendations of the Commonwealth–States Collaborative Soil Conservation Study were tabled in both Federal and State Parliaments during the year in the form of a report, titled 'A Basis for Soil Conservation Policy in Australia'.

The report shows that 42% of the State's agricultural and pastoral land requires treatment for land degradation. In the non-arid part of Queensland, three-quarters of the intensive and extensive cropping lands require treatment with either land management works, erosion control works or land management practices. It is estimated that further works are required on 57% of the 2·4 m ha of extensive cropping land and 53% of the 450 000 ha of intensively cropped land. Costs of construction of these works are estimated at almost $43m.

Erosion occurring in the State is predominantly due to water. The variability and high intensity of Queensland's rainfall mean that severe damage can occur within a very short time.

Field observations

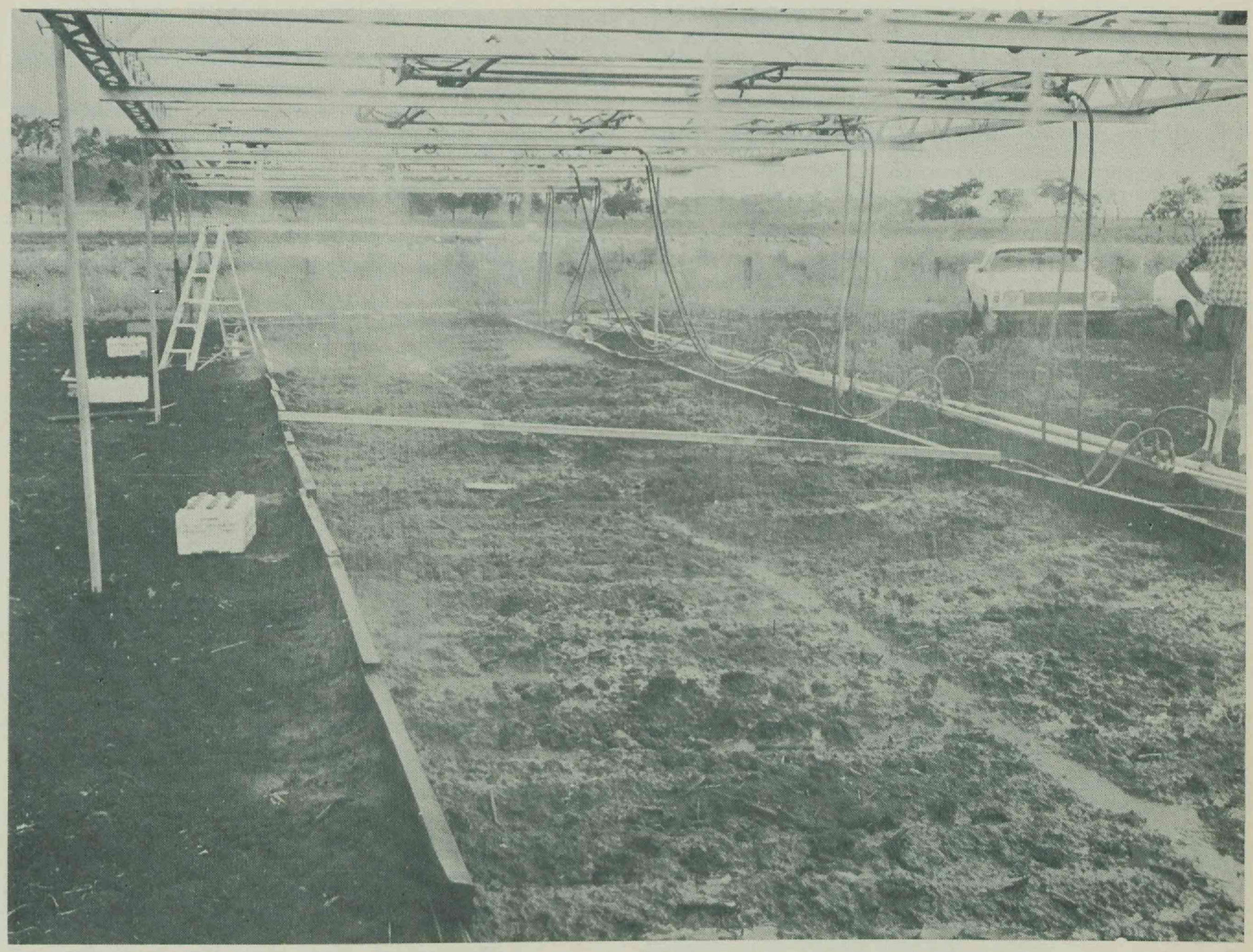
The most severe erosion during the year occurred in northern Queensland as a result of heavy rains accompanying cyclone Peter in January. Rainfall intensities were up to 150 mm in 2 hours and record falls were registered including 3 000 mm at Kuranda for the month of January and 2 000 to 2 200 mm in 3 weeks at Mackay.

Soil losses sustained during cyclone Peter on unprotected cane lands on steeper slopes were estimated at 150 tonnes per ha.

Serious stream and riverbank erosion occurred in many coastal streams. Roads, bridges and cane tramlines were considerably damaged. On the Atherton Tableland, the severity of the erosion on farm lands and the subsequent damage to roads and public utilities by siltation has prompted the Atherton Shire Council to seek the declaration of the Atherton Shire as an Area of Soil Erosion Hazard.

Isolated high intensity storms during November and March caused moderate to severe erosion in a number of areas throughout the State. Falls from 60 to 130 mm per hour were recorded in the Pittsworth district during March. Soil losses associated with these intensities sometimes were severe where croplands were bare at the time of the rainfall events.

On the Darling Downs erosion was severe in unprotected upland areas, valley floors and plains in the Pittsworth area during the March rains. The flow in Rocky Creek appeared to reach record levels. Crops in the flood path were flattened and major crop losses recorded.



The Rainulator. A large, portable rainfall simulator used for studies of erosion processes, soil erodibility and stubble mulch tillage. Part of the Surface Management Programme, a joint Development Planning—Agriculture Branch programme at the Queensland Wheat Research Institute.

Land use and conservation practices

A major objective of the Soil Conservation Branch is to encourage landholders to maintain soil cover and apply conservation land management practices.

The need for increased use of land management practices to combat erosion, even where contour banks are used, has been stressed for agricultural areas in the State. In this respect, the reported increase in the adoption of stubble mulch techniques in grain-growing areas of the State is a gratifying development. The effectiveness of stubble and standing crop in the control of soil erosion was again demonstrated. However, the increased planting of sunflower crops reported from both the Central Highlands and Darling Downs causes some concern because of the limited ability of this plant to provide soil cover.

In Far North Queensland, Mackay and the Moreton Region, urban development and rural subdivision increasingly impinge on productive agricultural areas. Co-ordination of erosion control and drainage works is made more difficult where rural lands have been subdivided into smaller blocks.

Soil conservation land management works (contour banks) were effective where the works were up to specification. Some bank failures or silting problems were associated with high intensity storms on the Darling Downs, Central Burnett and Upper Burnett where double-spaced banks were used. Earthworks in Far North Queensland stood up remarkably well under adverse conditions caused by cyclonic conditions. A demand for contour grass strips in the Waggamba Shire in preference to contour banks continues to exist.

Extension, landholder interest and financial assistance

A positive campaign to stimulate the interest of landholders and the general community in correct land use and management by means of on-farm discussions, group extension activities, mass media, booklets and film production has been undertaken during the year.

Property visits provide a valuable avenue for stimulating interest as well as providing a service to farmers. A total of 6 567 visits was made during the year (some 12% fewer than last year).

Extension activities to groups of farmers and to the community in general were carried out through 49 field days, 14 show displays, 114 meetings, 43 talks to schools and university students and 39 conducted tours. The mass media efforts included 112 press articles, eight radio talks and four television segments.

On the Darling Downs, some extension initiatives undertaken in the previous year were continued or completed. One such project was the preparation of three extension booklets, one of which deals with soil conservation on the Darling Downs and the others on the construction of soil conservation earthworks. A series of five articles dealing with Advisory Group Committee activities and another series of 10 articles for the 'Save our Soil' campaign in the local newspaper were prepared.

In the sugar-cane growing areas of the State, the main extension thrust was towards the promotion of soil conservation practices in cane lands by the use of articles in newspapers and in cane growers' journals. In addition, use was made of photo displays at field days, Bureau of Sugar Experiment Stations farmer meetings, Mill Suppliers' Committee meetings and service club meetings.

Conservation farm planning, waterway stabilization, stubble mulching, stubble mulch machinery, land management and electric fencing techniques featured prominently in extension activities through mass media, educational institutions and meetings in other regions.

Seasonal conditions and cropping trends had a marked effect on the enquiry rate in some regions. On the Darling Downs, the frequent rainy periods, harvesting operations, the unusually large area under crop, as well as double cropping activities, kept many farmers from spending time on soil conservation works. However, the number of requests for service within the Capricornia Region was the highest for the past 5 years.

Financial assistance is available to landholders as a dollar-for-dollar subsidy in declared Areas of Soil Erosion Hazard and loans through the Agricultural Bank in all areas of the State.

Subsidies totalling $184 547 were paid during the year for contour banks, diversion banks, waterways, grass strips, tillage machinery for conservation farming and dozer blades purchased for contour bank construction. Additionally, a total of $50 393 was paid in financial assistance to Local Authorities for road cross-drainage structures required in approved Soil Conservation Schemes under section 58 of *"The Soil Conservation Act of* 1965".

During the year, five farmers obtained approval for loans totalling $20 889 from the Soil Conservation Assistance Fund established in the Agricultural Bank under the Soil Conservation Act. Total commitments from the Soil Conservation Assistance Fund at 31 May 1979 stood at $31 073.

Planning

Farm planning, generally on a sub-catchment basis, is essential for the successful adoption of soil conservation in an area. Considerable effort is invested by the Branch in ensuring that plans developed in areas where soil conservation is mandatory are understood by farmers and are developed in consultation with them.

On the Darling Downs, the gazettal of advertised plans was delayed by a number of problems associated with the control of water discharge from the uplands onto flood plains, the presence of townships with complicated drainage problems within Project Plan areas, and the greater number of objections received to some plans. A recurring problem also was the desire of some landholders to effect modification to already gazetted plans after changes in ownership.

In the Burnett Region, priority has been given to obtaining planning information needed to enable soil conservation plans to be developed adjacent to irrigation channels under construction in the Gin Gin District.

On the Darling Downs, 270 property plans were prepared covering an area of 49 814 ha. This was 40% more than the area programmed for 1978–79 and was due to a high level of achievement in the Oakey district. Two provisional project plans, comprising 52 ha, were completed in the Burnett Region, while two provisional project plans, comprising 205 ha, were completed in Division 4 of the Rosalie Shire.

The documentation of resources and planning of the Ross Gully Catchment Area at Wandoan were completed and discussed with individual landholders. A start was made with the preparation of soil conservation specifications and cost estimates. These specfications and estimates will be made available to landholders to enable them to make a decision concerning the implementation of a voluntary group scheme or alternatively a project area under section 73 of the Soil Conservation Act.

A total of 55 conservation plans, comprising an area of 24 275 ha, was prepared elsewhere in the State.

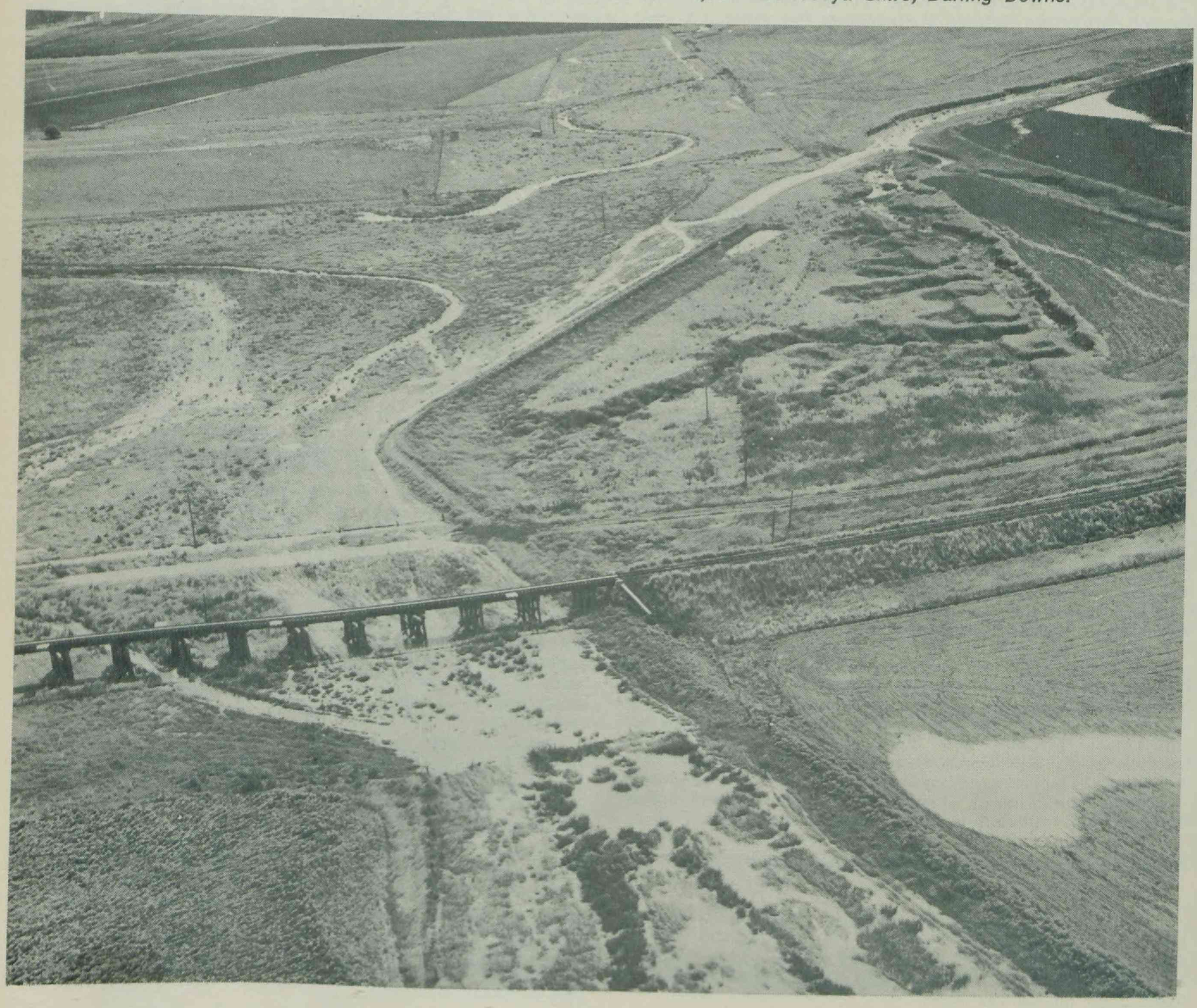
Implementation

The total area of cropping land which requires land management and soil conservation work is estimated to be 2·5m ha. The progressive total of land already protected by recordable soil conservation measures throughout Queensland now stands at 767 000 ha. Of this total, 476 000 ha of extensively cropped land are protected by contour banks. Thus, 1·73m ha of cropping land remains to be treated.

The most significant feature of implementation over the last few years has been the increasing preference by farmers for contour banking as the basic control measure rather than measures such as grass strips with contour ploughing. The figures for 1978–79 show a continuation of this trend with an area of 35 980 ha treated with contour banks and only 7 891 ha treated with 'other contour measures'. The total area treated for 1978–79 of 43 871 ha with soil conservation measures represents a 9% decrease on the 1977–78 figure.

A slight downturn in soil conservation activity was experienced in all regions except Far North Queensland and Capricornia. Implementation of contour banks reached an all-time high in the Capricornia Region with a total of 17 711 ha of land being protected by contour banks. Of this total, some 11 000 ha of land were protected with contour banks in the Central Highlands.

Successful completion of Stage 1 of the Emu Creek Stabilization Project—Cambooya Shire, Darling Downs.



Special activities

Liaison activities—Soil Conservation Authority

Soil conservation activities involve considerable liaison with other Departments, authorities and organizations.

Two meetings of the State Advisory and Co-ordinating Committee on Soil Conservation were held during the year. The first meeting established an administrative mechanism to enable a soil stabilization project adjacent to a railway bridge at Emu Creek, near Cambooya, to be undertaken. The second meeting discussed various Departmental reports relating to alternative forms of financial assistance for farmers undertaking soil conservation work in declared Areas of Erosion Hazard on the Darling Downs.

Each of the four Advisory Group Committees on the Darling Downs met at intervals of approximately 3 months. These committees, comprising landholders and Local Authority representatives, provide advice to the Soil Conservation Authority on the development and implementation of the Darling Downs statutory soil conservation programme. Financial aspects of the programme were discussed at two combined committee meetings in September 1978 and March 1979. The first meeting was chaired by the Minister for Primary Industries and the second by the Soil Conservation Authority.

New Zealand work interchange

With the financial assistance of the Department of the Public Service Board, a 3-month staff exchange was initiated during the year between Mr D. Begbie, Soil Conservationist, Toowoomba, and Mr R. Paulin, of the New Zealand National Water and Soil Conservation Organisation.

Mr Begbie, during the period of attachment with the South Canterbury Catchment Board, has been examining the financing, co-ordination and community participation in soil conservation schemes within New Zealand and the likely application of these activities to the Darling Downs Statutory Soil Conservation Programme.

Mr Paulin has been engaged in a joint Department of Primary Industries—Queensland Water Resources Commission Project aimed at integrating soil and water conservation measures for project plans within the Darling Downs Statutory Soil Conservation Programme.

Co-ordinated soil and water conservation

This project, funded from the Commonwealth Extension Services Grant, began in response to wider recognition by farmers of the inter-related nature of the agricultural production problems associated with drought, soil erosion and salinity. In the uplands of the West Moreton and Darling Downs, many former dairy farms are too small and too steep to support a viable and stable agricultural enterprise without adequate water storages and improved land management.

The nature of the project, involving as it does the development of soil and water resources in a whole-farm and whole-catchment context, required that the research and extension aspects of the project be developed at a number of levels ranging from farmer group activity to inter-branch and inter-departmental co-ordination. In the first year of the project, several major initiatives have been made in the development of technical and administrative procedures.

Environmental impact statements

In its role as an advisory body, Soil Conservation Branch has been required to make comment on a number of Environmental Impact Studies. Nine projects were commented upon during the year including those dealing with power transmission lines, quarrying, coal mining, road, railway and oil shale projects.

Soil conservation land management research

Land management research is aimed at determining the significance of land degradation in Queensland, describing the mechanisms involved and developing and extending practical management systems which ensure long-term land productivity.

Degradation investigations

Degradation investigations include Land Degradation Assessment activities aimed at assessing the significance and causes of land degradation, and Erosion System Research activities aimed at developing mathematical event models of erosion systems and management effects.

Water erosion on Mackay cane lands

The objectives of this project are to develop and test methods of measuring soil erosion in cane lands, to quantify soil losses and to evaluate soil conservation practices. Work has been in progress for 3 years and considerable advances in methodology have been achieved. Annual soil movement from cane rows during the 1976–77 and 1977–78 seasons ranged from 42 to 227 tonnes per ha on soils varying in texture from sandy clay loams to sands and slopes of 2 to 11%. Such soil losses are inconsistent with sustained long-term land productivity. Because of the short period of results and the interaction between factors, no consistent effect of land slope or soil type has been found.

Soil loss measurement in pineapples—Nambour

The monitoring of soil loss in pineapples grown at the Maroochy Horticultural Research Station was continued in 1978–79. The cumulative soil losses over 2 years since monitoring commenced are—

Annual Soil Losses Over Two Years From Pineapple Rows located on various side slopes of a 25% slope at Maroochy Research Station—

Row Gradient %	Equivalent Dry Soil (tonnes/ha)		
	1977–78	1978–79	Total
4	93·2	39·8	133·0
8	76·8	15·2	92·0
12	93·3	32·7	126·0
20	113·2	38·8	152·0

The soil losses occurred only in the period from November to March. The results show that a major portion of soil loss (75%) occurred in the first year when the ground was loose and plant cover was minimal.

Water erosion in extensive cropland

Water erosion affects the productivity of virtually all cropland and the causal factors are generally known. However, there is little quantitative information available on the causal factors. Erosion assessment in cropland is therefore being conducted to provide quantitative data. Such work is part of broader studies into erosion systems and management practices.

On the Darling Downs, four contour bays on two sites (a black earth and a grey clay) have been instrumented to measure runoff and soil erosion under grain cropping. The four treatments used at both sites are: wheat crop—stubble mulched; stubble incorporated; stubble burnt; and sorghum crop—stubble mulched.

The treatments were implemented for the 1978–79 summer fallow period, during which time 31 individual runoff events were recorded from the eight instrumented areas. Results for this season showed considerably greater runoff and soil loss from burnt plots in comparison with all other plots. Runoff seepage from surface soil after major runoff events has contained up to 23 p.p.m. chloride and 31 p.p.m. nitrate nitrogen.

Water erosion in grazing lands—Upper Nogoa catchment

An erosion survey of the Upper Nogoa catchment in 1972 indicated that some 30% of the area comprised unstable land types which had been severely eroded and that overstocking was a major contributing cause. A pilot erosion assessment study was commenced in 1975 to test techniques for measuring soil erosion in remote, semi-arid grazing lands. The pilot study identified many inadequacies with simple manual approaches to runoff measurement and sediment sampling, and indicated the need for unattended automatic instrumentation.

Sediment sampling and depth recording equipment has been installed in a grazed and a non-grazed catchment, both of approximately 12 ha. This equipment will ensure that all runoff events are adequately monitored and will provide comparative data on runoff and soil erosion from the two catchments.

Erosion system research

A method of estimating or predicting soil loss under specific soil-climatic-management conditions is necessary for the efficient development of conservation management systems. Erosion by water is related to the soil's tendency to produce runoff and its ability to resist the forces acting to move individual particles. Both runoff potential and particle resistance to movement are influenced considerably by management practices. While the general effects of management practices on soil erosion are known through empirical relationships such as the Universal Soil Loss Equation, the quantitative application of such relationships in Queensland is prevented by the lack of data applicable to local soil-climatic conditions.

An alternative approach is to study the infiltration-runoff-erosion processes in detail and develop an understanding of the effects of management on them. This information can then be used to develop a mathematical event model of the complete erosion system which can then be applied in any situation provided key input data are available. This approach should produce a useful model in less time and with less cost than the traditional approach.

The structural stability of surface soil under simulated rainfall is being examined in relation to infiltration and erodibility characteristics using the rainfall simulator at Indooroopilly.

Studies into the detachment and transport of soil by water are being undertaken on the Darling Downs using the 23 m x 5 m field plot rainulator. This work began in 1978 and has concentrated on preliminary investigations of the erosion processes in cultivated soils. Erosion rates were compared at two sites (a black earth and a red loam) on a 4% slope. Results are—

Mean Sediment Concentrations (p.p.m.) at Similar Runoff Rates in Rill and Interrill Flows on Two Soils of a 4% Slope

Soil	Rill Concentration (p.p.m.)	Interrill Concentration (p.p.m.)
Irving (black earth) ..	100 000	21 000
Krasnozem (red loam)	40 000	9 000

These results show that rill erosion is the dominant erosion process operating in these soils and that considerable differences exist in erodibility between the red loam and the black earth.

Preliminary work has also been commenced to investigate the effect of stubble cover on erosion of a black earth. Soil loss was measured from 23 m x 5 m plots with wheat stubble at 3 000, 2 000 and 1 000 kg per ha, in comparison with stubble burnt plots.

The results showed that surface stubble increased infiltration and reduced soil loss in comparison with the burnt plots. Average soil loss rates from the three stubble plots were 20% of those from the burnt plots, with little difference in rates between the different stubble levels.

Land management system development

The development of conservation management systems for any situation must take into account the need for erosion control and any specific agricultural and conservation management requirements of the soils. This involves the integration of both land resource and management practice data, and is a critical step in the practical application of these data.

The development of management systems for the important agricultural soils has been of high priority in recent years. This has resulted in the publication of a handbook on the description and conservation management requirements of the soils of the Basalt, Poplar Box Walloon, Marburg Formation and Softwood Scrub Walloon land resource areas of the Darling Downs.

Conservation cropping systems

A comprehensive programme, aimed at developing a conservation cropping system including both summer legumes and winter grain, is in progress in the South Burnett Region. This programme is testing all likely crops under stubble mulched conditions, developing techniques for tillage, weed control and sowing crops, and evaluating selected systems under commercial conditions.

Stubble mulching is becoming widely practised in the grain growing areas of southern Queensland, following the availability of suitable tillage machinery identified by the Departmental Machinery Evaluation Programme. The successful adoption of this practice and the use of machinery presents many problems to conventional farmers. For this reason, considerable effort has been directed towards training Departmental extension staff in stubble mulching practices, and providing detailed advice where necessary to farmers. A 2-day stubble mulching training workshop was run in Toowoomba for southern Queensland extension officers and three field days were addressed on the same subject.

A Machinery Management Survey was completed during the year, which collected data on tillage machinery use in the Central Highlands, and farmer attitudes to conservation tillage techniques. The major findings of the survey were that farmers were purchasing high clearance, low inversion tillage machinery (for example, blade ploughs) for their mechanical performance, but were not stubble mulching. In addition, some 70% of the area cultivated is used for summer crops of sunflowers or sorghum, which have low residue levels (sorghum stubble is grazed). The survey highlighted the lack of erosion control provided by existing cropping practices and indicated the need for the development and adoption of practical conservation cropping systems to maintain the productivity of these relatively shallow sloping soils.

Management practice evaluation

The waterway investigation carried out last year showed that the incidence of waterway failure in Queensland was very high and that management was the key factor in determining the efficiency and stability of waterways. It was therefore considered necessary to subject other soil conservation measures to similar scrutiny.

The aim of this programme is to document, evaluate and, whenever practicable, improve the performance and efficiency of major soil conservation measures in Queensland.

Engineering Services Section

THE principal responsibility of this Section is to provide a wide range of agricultural engineering advice and guidance to farmers and those Departmental branches requiring specialist engineering services.

This year saw the extension activities of the Section increase, together with a demand for more sophisticated engineering information particularly from forward-thinking farmers. The Section's efforts have been diversified into fields of engineering including the design of farm sheds, ferro-cement buildings and feed processing facilities.

Because of the diversity in demand, it has been necessary to make greater use of mass media for the dissemination of information. Numerous addresses to industry group meetings have been undertaken throughout the State to reduce the number of personal inquiries, thereby enabling the engineers to devote more time to research and development and data gathering activities.

Special research projects

APPLICATION OF NEW TECHNOLOGY TO FRENCH BEAN SEED INDUSTRY. This is a co-ordinated project with Horticulture and Standards Branches which is being financed by the Reserve Bank's Rural Credit Development Fund. Engineering field trials of a modified commercial pea-vining machine are being undertaken to determine whether bean seed pods can be harvested at a higher moisture content thereby eliminating mechanical damage to the seed at threshing time.

METHODS OF DISINFECTING WHEAT HARVESTERS. This project was funded by the Wheat Industry Research Council. A revised final report was prepared outlining the methods whereby insect populations in harvesting machinery could be significantly reduced. Cleaning demonstrations were carried out in a number of centres to show farmers how simple and practical techniques can be used to clean harvesters to a satisfactory level.

CALIBRATION AND TESTING OF THE TRACTOR POWER MONITOR. Field trials have demonstrated the reliability and application of the tractor power monitor at the farmer level. Further field work and refinements are planned for the coming year using funds provided by the Wheat Industry Research Council. It is intended to publicize details of the power monitor in the hope that it will be taken up commercially and marketed as widely as possible.

Extension activities

Technical communication with farmers is becoming increasingly important as a means of disseminating engineering advice. Specialist lectures and demonstrations for a wide range of farmer schools and workshops have been prepared, numerous field days and seminars have been attended; and addresses given on a variety of subjects.

Farmnotes are an important media for disseminating agricultural engineering advice on subjects ranging from the calibration of boom sprays to sunflower drying and on-farm storage of grains.

Workshop facilities

The addition of a large second-hand lathe to the existing workshop equipment completed the major equipment purchasing programme. The agricultural engineering workshop at Toowoomba now has the capacity to undertake a diverse range of tasks. For example, a cattle crush was fabricated and the electronic components of the tractor power monitor were assembled during the year. The major role of the workshop relates to the fabrication and development of prototype equipment for experimental purposes.

Branches served

SOIL CONSERVATION BRANCH. Activities undertaken for the Soil Conservation Branch included—

- Studies in land use in Upper Hodgson's Creek Catchment to determine runoff co-efficients.
- Advice on the refinement and development of a tractor mounted automatic survey staff.
- The design of a mobile surveying platform mounted on a trailer.
- The preparation of plans for modifications to the Rainfall Simulator at the Hydrology building at Indooroopilly.
- The design of an extension to the truck crane boom to handle the mobile Rainfall Simulator at Toowoomba.

AGRICULTURE BRANCH. Some of the principal activities undertaken for Agriculture Branch included—

- A study of existing soil sampling equipment leading to the design of a high level machine capable of sampling soils in tall growing crops. A report has been compiled on sampling equipment and tubes for obtaining bulk densities at 2 m depth with 50 mm diameter core tubes.
- Continuation of the work in the tractor-implement matching project with special emphasis being placed on effect of tractor-implement operation on fuel economy.
- An evaluation of resilient tapered cone seed thrashers has been carried out.
- The completion of a study on seed metering work.
- The development of a tine dynamometer to collect data on soil breakout forces and characteristics of the tine being tested.
- The development of an experimental planter suitable for conventional and zero tillage plot work in a variety of soils.
- The redesign and modification of a plot planter to carry a new range of openers and press wheels for the Emergence Enhancement Trials at the Queensland Wheat Research Institute. It is planned to use this machine on some zero tillage plots.
- The development of a minimum tillage machine, which performs a multiple range of activities in one tillage operation, has been developed for use in the Lower Burdekin rice industry.

HORTICULTURE BRANCH. Activities undertaken for Horticulture Branch included—

- An investigation of water sensitive papers for assessing spray coverage in horticultural crops.
- The construction of a controlled droplet applicator boom spray for testing on a number of crops.
- Advice on the construction of a boom mist sprayer for use by a farmer at Bowen.
- The development of an electronic eye strawberry runner counter.
- Assistance with conveyor modifications at the Committee of Direction's Tropicano Packing Plant at Rocklea to enable a commercial colour sorting unit for tomatoes to be demonstrated at future field days.
- The design of a fresh bean picker for plot work to determine the suitability of new breeding lines for mechanical harvesting.
- Development of an airflow cabinet for meristem tissue work in the laboratory.

PIG AND POULTRY BRANCH. Activities for Pig and Poultry Branch included—

- The preparation of six more plans for piggeries for addition to the standard drawing library.
- The preparation of plans for a poultry shed truss and a poultry cage support frame.

DAIRYING. Activities for Dairy Field Services Branch included completion of a report on guidelines for all-weather on-farm roads, and the arranging of demonstrations in the use of metal formwork for constructing concrete water tanks.

SHEEP AND WOOL BRANCH. Air blast nozzles for delivering insecticides through the fleece onto a sheep's skin were designed for use with the 'Air Mister' developed by officers of the Sheep and Wool Branch.

Drafting Section

THE Drafting Section performs a most important service function in preparing land resource maps and plans to accompany reports prepared by the Division of Land Utilisation and to service the needs of Soil Conservation Branch.

The technical skills of the Section's cartographers and draftsmen are widely used by other Divisions of the Department. About 28% of the drafting and mapping activities are devoted to work for other Branches and Divisions.

Project mapping work has increased this year and accounts for 57% of the total work time. Technical services work accounts for 43% of the total work time and is largely devoted to servicing the needs of Soil Conservation Branch.

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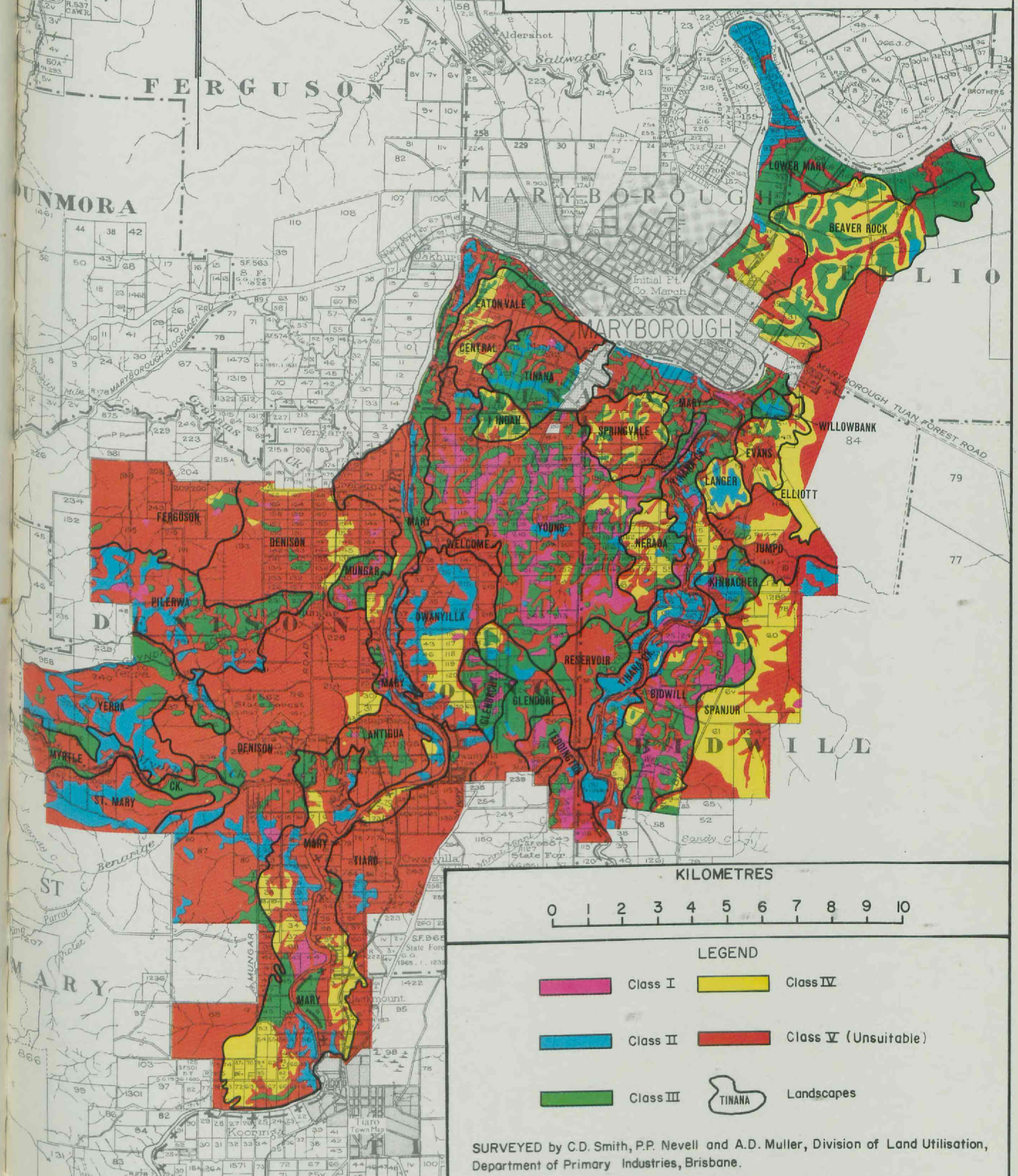
QUEENSLAND
DEPARTMENT OF PRIMARY INDUSTRIES

LOWER MARY RIVER IRRIGATION PROJECT

LAND SUITABILITY MAP



KILOMETRES

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LEGEND

- Class I
- Class II
- Class III
- Class IV
- Class V (Unsuitable)
- TINANA — Landscapes

SURVEYED by C.D. Smith, P.P. Nevell and A.D. Muller, Division of Land Utilisation, Department of Primary Industries, Brisbane.

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