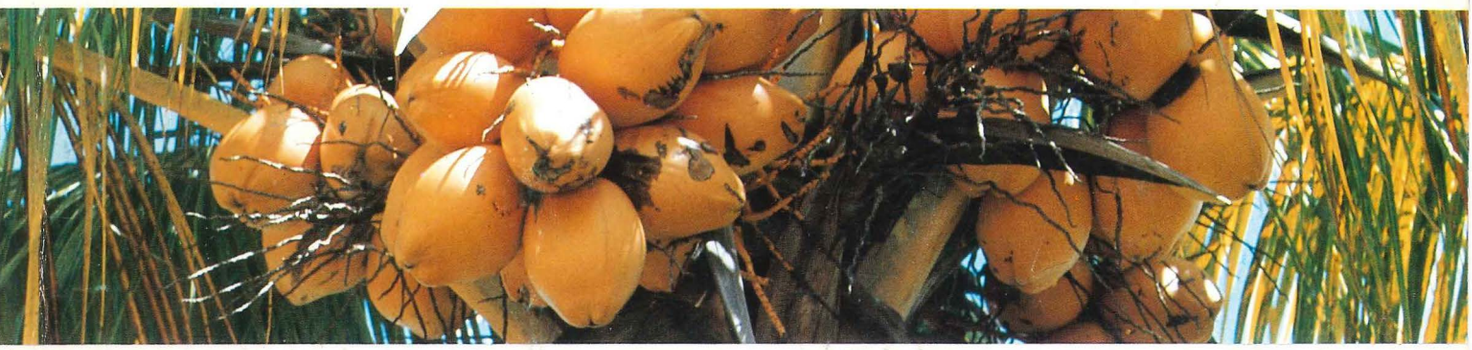
QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

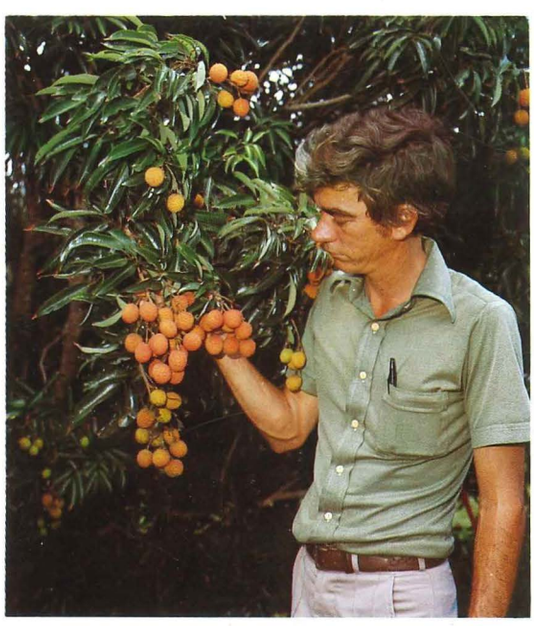
Annual Report 1980–1981



Presented to Parliament by Command

A Fisheries Research Branch diver weighs a giant clam under water, using a spring balance suspended from an air bag.

Each year, Australia imports 28m kg of black tea costing $50m. Research and commercial plantings have shown that much of this could be produced in Far North Queensland. The picture shows an experimental crop being harvested in north Queensland.



The litchi is one of the tropical and sub-tropical tree crops being studied in Queensland by the Department's Horticulture Branch. Researchers are seeking cultivars and management techniques that will allow reliable commercial production in this State.

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QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

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as at 30 June 1981

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Queensland Department of Primary Industries

Annual Report 1980–81

To the Honourable the Minister for Primary Industries
Sir,

My report for the year ended 30 June 1981 shows that the gross value of rural production in Queensland for the year is expected to reach $2,363m, marginally above the previous year's level of $2,353m. This was achieved despite severe drought conditions in many parts of the State.

This increase was principally due to the significant improvement in the value of the sugar crop from $529m to $741m. A small increase was recorded by the horticultural industries from $174m to $207m. However, the pastoral sector recorded a decline from $989m to $732m mainly because of drought conditions in producing regions.

The figure below shows the gross values on a proportional basis. As can be seen, the greatest relative changes were in sugar (up from 22% to 31.4%) and pastoral (down from 42% to 31.0%).

Weather conditions

Rainfall during July 1980 ranged from well below average in the far north and north-west to above average in the Central Highlands, southern interior and North Coast Herbert districts. Light to severe frosts were experienced in most southern and central districts. Throughout August, the weather remained fine and stable for much of the State. The only significant rainfall was restricted to the Tully–Babinda section of the tropical coast. Frosts were common on the Darling Downs.

The lack of rainfall continued during September with all districts recording well below average falls. However, during October, eight districts recorded above normal district average rainfall totals. This was the most useful rainfall since May 1980 and the districts which benefited the most were the southern border districts eastward to the coast.

During November, below-average rainfall was recorded over the whole of the State and this, with accompanying hot conditions, destroyed the benefits of the drought-relieving rains received in October. However, with the exception of the south-west quarter, the remainder of the State benefited to varying degrees from widespread showers and thunderstorm activity. Average to above-average district totals were recorded in the southern border districts from the Warrego to the Coast and extending to include the Curtis.

Above-average rainfall was received in the northern half of the State during January with the Peninsula North and the North Coast Herbert districts receiving the highest January rain on record. Heavy flooding over a wide area of the north coast of the State and the north west was associated with high rainfall.

The presence of three tropical cyclones during February yielded average to above-average rainfall throughout most of the State with the coastal and hinterland districts recording the better falls. Heavy flood rains occurred on the Darling Downs and Moreton Regions and brought severe flooding to Dalby and surrounding areas.

March was significantly drier with all districts recording below-average rainfall. Rainfall during April was variable throughout the State. Best falls were restricted to the south-east quarter with the Darling Downs and Maranoa recording nearly twice the normal. Useful to excellent rain fell over a wide area of the State during May with best falls occurring over the northern and central sectors. With good falls received in all winter grain and seed growing districts, prospects for the coming season have brightened, and record plantings are possible.

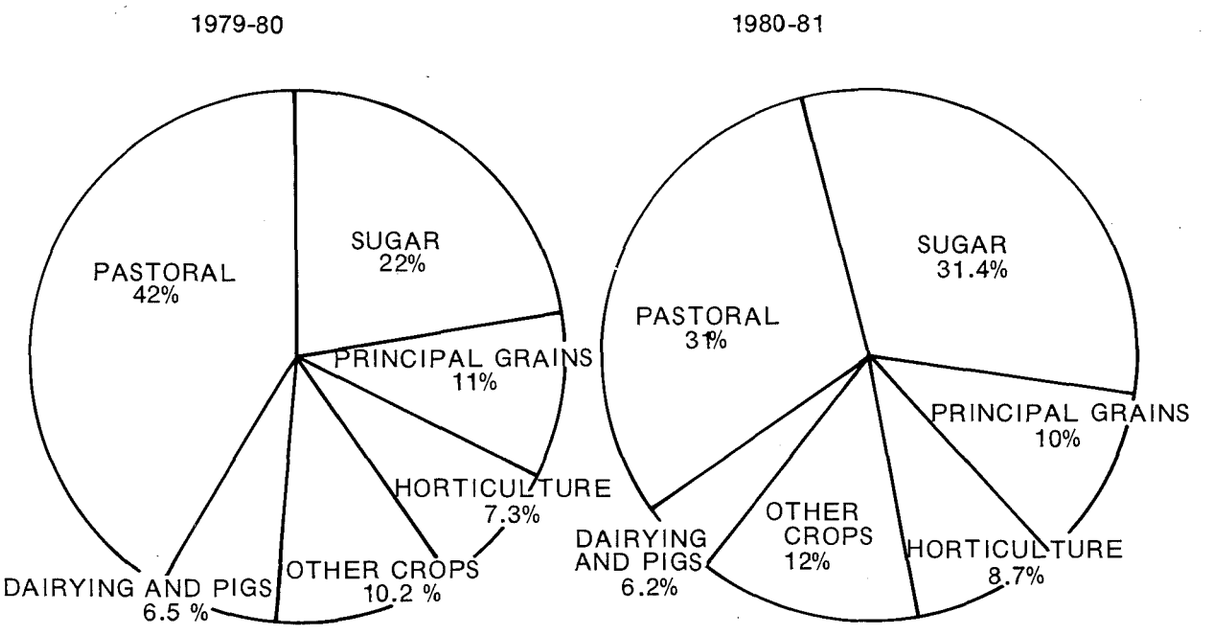
With good falls of rain during January and February the general pastoral conditions improved substantially compared with the hot dry conditions evident at the end of 1980.

As at 30 June 1981, Balonne, Bendemere, Booringa, Bungil, Inglewood, Murilla and parts of the Bulloo and Murweh Shires were declared as drought stricken.

Pastures and fodder crops

The pastoral situation continued to deteriorate over much of the State during the second half of 1980. Below-average rainfall resulted in low surface water supplies and poor pastures. However, good to excellent rainfall up until May 1981 has improved the pastoral situation. Only the lower southern inland areas remain dry to drought stricken. Pastures elsewhere have responded well to the good rainfall and a moderate to good body of green feed has provided excellent grazing.

The rain produced good growth in established summer fodder crops and enabled further plantings to be made.



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

Although the cattle market continued in a weakened state in 1980–81, the gross value of beef production was $810m. This was only marginally below the $820m recorded in the previous year.

Beef

Although the northern part of the State received adequate rainfall during the year, many areas in the southern inland were still suffering from the effects of drought at the end of the period.

Queensland's beef cattle herd at 31 March 1981, estimated at 9.349m head, was 6.1% down on the 9.956m head recorded a year earlier.

The estimated gross value of $810m for Queensland cattle and calves slaughtered or exported live was marginally below the $820m recorded for the previous year.

The number of cattle and calves slaughtered in Australia decreased from 11.35m in 1978–79 to 8.55m in 1979–80. Beef and veal production decreased from 2 017 986 t in 1978–79 to 1 557 405 t in 1979–80. Beef and veal exports decreased from 813 700 t in 1978–79 to 580 800 t net shipped weight in 1979–80.

The number of cattle and calves slaughtered in Queensland decreased from 3.3m in 1978–79 to 2.61m in 1979–80. Beef and veal production decreased from a record 662 152 t in 1978–79 to 515 732 t in 1979–80. Beef and veal exports decreased from 325 700 t net shipped weight in 1978–79 to 266 300 t in 1979–80.

The cattle market continued in a weakened state as values followed an easing trend. Although saleyard numbers were down, they had not declined sufficiently to prevent prices falling as a result of the limited demand. At Cannon Hill the price for cows (321 to 480 kg) score 3, fell from an average of 73¢ per kg liveweight in November to 52¢ per kg in mid May. A similar trend was evident for bullocks (561 to 640 kg) score 4, with the average market price falling from 95¢ per kg in November to 69¢ in May.

This declining trend followed a similar pattern to that experienced in 1980 when prices did not begin to firm until June. Although the price trends for this year and last year may have been the same, the industry was more concerned this year because of the lower absolute prices which were offered.

Cattle prices have continued to fall despite a reduction in yardings due to improved seasonal conditions towards the end of the period. The fall in prices could be attributed to the dramatic fall in both domestic and import prices in the United States. The export price decline mainly reflected the depressed U.S. cattle market where demand was weakened by heavy supplies of domestic cattle, high interest rates and strong competition from pork and poultry meats.

The downtrend in cattle prices for Australian beef on the U.S. market made it uneconomic for many meat companies to export meat to America and resulted in the closure of a number of meatworks.

As from 1 January 1981, the Metropolitan Public Abattoir Board was abolished and the Cannon Hill Abattoir, from that date, came under the control of the Queensland Meat Industry Organization and Marketing Authority.

Following the success of trials conducted by the Queensland Meat Industry Organization and Marketing Authority and the Department of Primary Industries, representatives from all sectors of the Queensland cattle industry agreed to adopt the wet curfew system of liveweight cattle selling. Under the system, water would be available to cattle up until the time of weighing.

Australian Agricultural Council gave the go-ahead for the further development of plans for a national uniform carcass classification scheme. Council considered that the technical feasibility of the manual scheme had been well demonstrated in trials such as those conducted at Bundaberg and Kilcoy and that emphasis should be shifted to testing its commercial use. Council recommended that a further grant of up to $150,000 be provided by the Federal Government to assist volunteer meatworks willing to test classification on a commercial basis.

A Committee of State and Federal representative was set up to study the options for future meat inspection services. The options were either that the Commonwealth delegate responsibility for export inspection to those States wishing to assume it or that the Commonwealth assume total responsibility for inspection at export establishments. It was expected that Australian Agricultural Council would make a final decision on this matter at its August 1981 meeting.

The Canadian Government introduced a new Canadian Meat Import Bill which was based on a counter cyclical formula similar to that used in the U.S. Meat Import Law. Under the formula used to calculate the import level of beef and veal for any given year, the access level for 1981 would total 65 800 t. Both the United States and Canada estimate that imports will be below their respective trigger points and therefore would not restrict imports of chilled or frozen beef and veal during 1981.

Sheep

Preliminary figures released by the Australian Bureau of Statistics showed that the number of sheep and lambs in Queensland at 31 March 1981 decreased by 14.5% to 10.397m head.

The number of sheep and lambs slaughtered in Queensland decreased from 1.442m head in 1978–79 to 1.378m head in 1979–80. Mutton and lamb production in Queensland fell from 26 528 t in 1978–79 to 23 793 t in 1979–80.

Lamb prices fluctuated throughout the period. However, average values for April 1981 for the descriptions quoted were all higher than for the same month last year. Lambs (16 to 19 kg) score 4 values for April 1981 averaged 146¢ per kg compared with 140¢ per kg for the same month in the previous year.

The European Economic Community sheepmeat regime commenced on 20 October 1980 and all subsequent imports of sheepmeat into the E.E.C. will be subject to negotiated voluntary restraints. The regime covered fresh, chilled and frozen mutton, and lamb and goat meat. Australia gained an annual access to the E.E.C. of 17 500 t of sheepmeat from 1 January 1981. Signatories to the agreement were granted 'compensation' for their voluntary restraint in the form of a cut in the Common Customs Tariff on sheepmeats from 20% to 10% *ad valorem*.

On 12 May 1981, a Fat Lamb futures contract was listed on the Sydney Futures Exchange. The contract was for 260 live lambs carrying not less than 6 weeks' wool, either female or castrated male lambs between fat score 3 and 4 under the N.S.W. Department of Agriculture/Meat Industry Authority system with an estimated dressed weight of 17 kg.

The value of wool produced in Queensland in 1980–81 is expected to be $112.9m. This is a drop of $27.5m on the previous year's return and reflects the generally dry season.

Wool

The Australian Wool Corporation set the minimum reserve price of the Market Indicator at 365¢ per kg clear for the 1980–81 season. Although the Market Indicator at the beginning of the season opened 5¢ below the closing level of 401¢ for the 1979–80 season, by the end of 1980 it had increased to 410¢. With the resumption of rates in mid January, the market opened strongly and by the end of January the indicator had risen to a seasonal high of 427¢.

The strong market tones appeared to have been based on fears of shortfalls in supplies of key Merino wools after Easter. However, during February and March, an over-supplied market resulted in an easing in prices until heavy intervention by the Australian Wool Corporation checked the falling trend. The market then showed a former tendency to close at the end of March at 410¢. Prices continued to firm during April and May and by late May the market indicator had risen to 423¢.

The buoyant selling season in 1979–80 returned the reserve price trading operations of the Australian Wool Corporation a record profit of $24.3m and boosted the total market support fund balance to $370.2m. This was an increase of 54% on the previous year's balance and exceeded growers' total contributions since 1974 by $27m.

The Wool Council of Australia has decided to support a trial of integrated centralized selling of wool. The trial was to test the economic advantages of Brisbane wool being sold in Sydney and Adelaide wool being offered in Melbourne. It was expected that the trial will result in a greater concentration of wool in the market, provide for more sales and allow for a more even flow of wool.

The Australian Wool Production Forecasting Committee estimated Australian shorn wool production for 1980–81 to be 682.9m kg with dead and fellmongered wool production expected to be 66.7m kg.

The Australian Bureau of Statistics reported that Queensland's wool production in 1979–80 at 59.0m kg was 7.5% below the previous year's production of 63.8m kg. Queensland's wool production in 1979–80 realized an estimated gross value of $138.6m which was $11.1m or 9% above the estimated value of the production from the previous season. Preliminary estimates indicated a value of $112.9m for all wool produced in Queensland in 1980–81.

During 1979–80, nine auction sales were held in Brisbane. A total of 295 364 bales was sold at an average price per kg of 238.08¢ which was the second highest on record. The highest was 260.83¢ during the 1950–51 wool boom.

The number of sheep and lambs shorn in Queensland during 1979–80 was 12.027m, 12% below the 13.734m shorn in the previous year. The average fleece weight was 4.58 kg, slightly higher than the 4.32 kg in the previous year.

The Australian Wool Corporation was a net seller of wool during 1979–80 with stocks at the end of the period totalling 208 497 bales compared with the 353 915 bales at the opening of the season. During the first half of the 1980–81 season, stocks continued to fall and by January were down to 157 683 bales. Strong buying by the Corporation to restrain the price downturn resulted in stocks increasing to 215 181 bales at the end of April.

Pigs

The number of pigs slaughtered in Australia increased from 3.6m in 1978–79 to 3.8m in 1979–80. Pig meat production also increased from 198 562 t in 1978–79 to 216 874 t in 1979–80.

The number of pigs slaughtered in Queensland increased from 721 000 in 1978–79 to 813 000 in 1979–80. Following this increase, pig meat production increased from 43 030 t in 1978–79 to 50 322 t in 1979–80.

From the commencement of the period to early September, prime baconers continued to attract a first advance payment of $1.16 per kg hot dressed weight. During September, payments increased to $1.31 per kg and in October went up to $1.50 per kg. For the remainder of the period, the price fluctuated between $1.45 and $1.55 per kg to close at $1.50 per kg at the end of March.

Shortages of feed grains were experienced early in the period but supplies improved substantially with the commencement of an expected record summer sorghum harvest in February. While falling feed values have provided some relief to pig producers, these have been counteracted by recent depressed pig sale prices.

The domestic canning industry was concerned over the impact of imported canned ham from Eastern Europe. The Federal Government has announced that it will give short-term protection to the canned ham industry. The Government will hold discussions with the major foreign suppliers with a view to restraining imports to 14% of the Australian market per year. This should reduce the level of imported canned ham from the 1980 level of 900 t to 800 t. The Government's decision to protect local canners was subject to the outcome of the Industries Assistance Commission's long-term report on prepared meat products which is due towards the end of 1981.

Poultry meat

Chicken slaughterings in Queensland during 1979–80 increased by 18.2% on 1978–79 figures to 33.6m. Queensland chicken slaughterings represented 15.1% of total Australian slaughterings in 1979–80. Total Australian poultry slaughterings increased by 18.4% in 1979–80 to 222.5m compared with 187.9m in 1978–79.

Chicken meat production in Queensland increased by 17.3% to 44 242 t in 1979–80 compared with 37 722 t in 1978–79. Total Australian chicken meat production increased by 17.6% from 239 743 t in 1978–79 to 281 899 t in 1979–80.

Dairying

Queensland wholemilk production has fallen by about 6% when compared with the previous year and this has been reflected in the production of major manufactured products. Sales of the more profitable market milk which includes pasteurized, low-fat, modified, flavoured and long-life milk have, however, increased by about 4%.

Butter production at about 2 700 t was some 23% down on last year's figure. The Butter Marketing Board continued to obtain supplies of butter from Victoria for its domestic market shortfall and for exports of butterfat. In addition, three southern companies have entered their own brands of butter on to the Queensland market.

The Minister for Primary Industries (Hon. Mike Ahern, right) and the Director-General, Department of Primary Industries (Dr. G. I. Alexander) at the official opening of extensions to the Wacol A.I. Laboratory in November 1980.

In an attempt to avoid a total Australian shortfall in butter production during the year, the Australian Dairy Corporation cancelled export permits for butter and butterfat products and manufacturers were encouraged to divert milk into butter production. As a result, the shortfall was avoided.

Queensland cheese production at about 9 000 t was some 15% down on last year's production of 10 547 t.

During the year, the Milk Entitlements Committee continued its programme of redistributing market milk access among processors, and hence producers, in south-east Queensland.

Stage 1 of this programme was aimed at bringing below-average processors within south-east Queensland, based on 1977–78 financial year figures, up to the average of 44.2% of market milk to milk intake. This was achieved by 1 October 1980. Under Stage 1, a total of 89 138.71 litres was acquired and distributed, consisting of 66 498.71 L of drop-out market milk and 22 640 L of growth. A total of $3.6m of Government funds was allocated to achieve Stage 1 objectives.

Stage 2 commenced on 1 October 1980. An amount of $800,000 of Government funds was allocated (in addition to carry-over funds of $275,064.50) to enable the purchase and distribution of a further 20 000 L of drop-out milk. At 1 May 1981, 11 978.25 L of drop-out milk had been distributed to eligible processors. The Stage 2 distribution of approximately 21 500 L is expected to be completed by October 1981.

During the year, legislation was passed to wind up the Dairy Products Stabilisation Board. The Board had operated for more than 40 years as a support mechanism for the operations of the voluntary equalization scheme for butter and cheese which was administered by the former Commonwealth Dairy Products Equalization Committee Ltd. The Board's main function was to promulgate intrastate sales quotas for butter and cheese. This function is no longer required under the present Commonwealth marketing arrangements.

The assets of the Board have been transferred to the voluntary association of manufacturers, the Queensland Dairy Product Manufacturers' Co-operative Association.

Egg industry

Egg production in Queensland in 1980–81 is estimated at 7.5% above that for 1979–80. Egg sales by The South Queensland Egg Marketing Board are expected to be about the same as that for 1979–80. Sales by The Central Queensland Egg Marketing Board are estimated to be 4% above those for 1979–80. The substantial sales increases achieved in 1979–80 have not been attained this financial year and a larger proportion of production has been disposed of on the export market.

However, the egg industry stabilization scheme continues to have an important influence on the industry's outlook with a better matching of production and demand expected in 1981–82. Due to the operation of the supply management scheme, it is expected that returns to producers will continue to increase in accordance with general inflationary levels.

A seasonal quota reduction applied during the period August 1980 to January 1981. Quotas were reduced by the Hen Quota Committee by 8.5% in south-east Queensland and 4% in the remainder of the State. Quota reductions in south-east Queensland were staggered so as to reduce peaking of demand for hatchery and abattoir facilities.

A controlled transfer of quota scheme has continued to operate. This gives producers the ability to dispose of their quotas to the Committee separately from the land and enables certain smaller producers to increase their quotas to more economic levels. Since the inception of this scheme, some 34 000 hens have been re-allocated to smaller producers as a result of the surrender mechanism.

Wheat

Queensland wheat production in 1980–81 is currently estimated at some 510 000 t from a planting of some 730 000 hectares. Although plantings were only marginally lower than in 1979–80 production was some 40% down following a large percentage of abandonments.

The relative distribution of receivals at State Wheat Board depots by grades in 1980–81 (with 1979–80 figures shown for comparison) was as follows:

PROPORTIONAL RECEIVALS BY STATE WHEAT BOARD

Classification	Percentage	
	1979–80	1980–81
Prime Hard	24.9	23.4
No. 1 Hard	24.8	25.0
Australian Standard White	37.3	13.2
No. 2 Hard	1.1	21.4
General Purpose	10.2	13.8
Seed	1.7	3.2
	100.0	100.0

Dr J. Syme, Supervising Plant Breeder at the Queensland Wheat Research Institute, inspects a promising crop of Banks wheat, his latest release.

The export market for Australian wheat remained strong throughout the season. The Australian Wheat Board's asking price for Australian Standard White wheat opened at a low for the year of $143.10 per t on 1 July 1980 and rose to a peak of $169 per t in late November. For the remainder of the season the price fell, but in the main still exceeded $150 per t.

Exports of Australian wheat this season are expected to reach 10.3m t compared with 13.1m t in 1979–80. For the first time in three seasons, the Australian Wheat Board expects to clear all major stocks of wheat.

Growers' return from the 1980–81 crop are expected to be similar to the 1979–80 growers' returns estimated at some $120 per t, port basis.

Barley

The adverse climatic conditions led to a significant reduction in yields and production in 1980–81 compared with the previous season. Early season estimates placed the area sown at 170 000 ha compared with 194 000 ha in 1979–80. However, as the season progressed, at least 25 000 ha were abandoned. Eventual production totalled 145 000 t compared with 346 500 t in 1979–80. Average yields in 1980–81 were slightly under 1.00 t per ha compared with an average yield of 1.78 t per ha the previous season.

Receivals by The Barley Marketing Board totalled 95 000 t compared with 235 353 t in 1979–80. Approximately 50 000 t were exported at excellent prices which contributed to a record first advance payment of $115 per t on all grades compared with the previous record of $82 per t in 1979–80.

Grain sorghum

Grain sorghum production in 1980–81 was estimated at 1m tonnes from 510 000 ha. This compared with 711 315 t from 368 698 ha in 1979–80.

In south Queensland, The Queensland Graingrowers' Association expects to receive in excess of 300 000 t of which the majority will be exported.

The Central Queensland Grain Sorghum Marketing Board estimates that receivals could reach a record 410 000 t of which just under 400 000 t is expected to be exported. Last season 252 000 t were exported from receivals of 265 000 t.

Grain sorghum is the most widely grown summer grain crop in Queensland. This excellent crop of Texas 610 was grown on the Darling Downs.

Maize

Maize production in 1980–81 totalled an estimated 123 000 t from sowings estimated at 46 000 ha. In 1979–80, 41 205 ha produced 97 914 t. On the Atherton Tableland, production is expected to be about 22 000 t slightly higher than last season's 20 414 t.

Rice

The rice industry continued its expansion in 1980–81 with further land being cropped under rice in both the Burdekin and the Mareeba districts. The 1980 winter rice harvest produced 9 918 t compared with 6 190 t in 1979. The 1980 summer harvest reached 14 613 t. This represented a slight decrease on the record 1980 summer harvest of 14 730 t.

In terms of area, 2 800 ha were sown to rice for the 1980 winter harvest compared with 1 605 ha in 1979. For the 1980 summer harvest, 2 600 ha were sown compared with 2 510 ha for the previous summer harvest.

First advance payments made to growers by The Rice Marketing Board were $110 per t for the 1980 winter harvest and $105 for the 1980 summer harvest.

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

The Queensland rice quota for the 1981 season remains unchanged at 30 000 t.

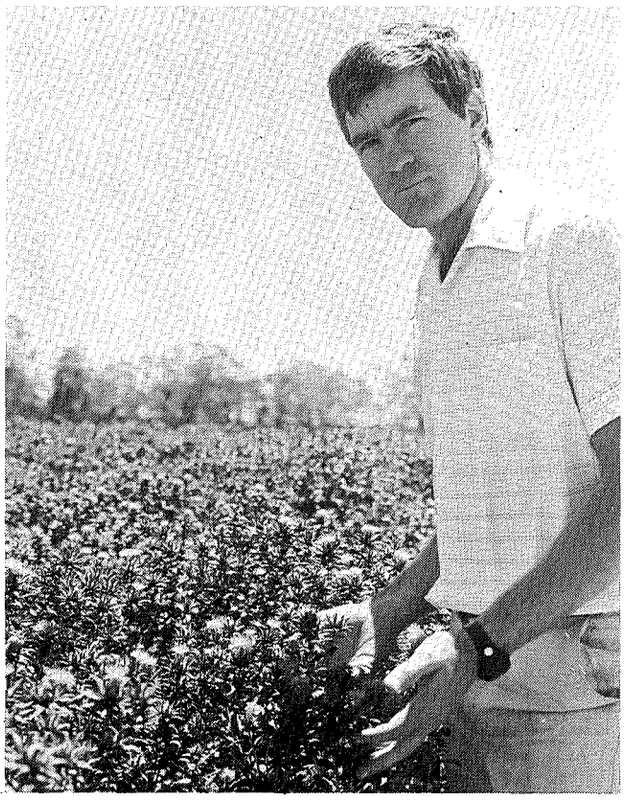
Oilseeds

Sunflower production in 1980–81 is estimated at 108 000 t compared with 96 666 t in 1979–80. The area planted is estimated at 149 000 ha compared with 158 736 ha in 1979–80. Returns to growers are expected to be $230–$235 per t, on farm. Crops are progressing favourably and average to above-average yields are expected.

Soybean plantings are currently estimated at 32 000 ha from which 47 000 t are expected to be produced. Conditions have been variable and yields are likely to be below average. In 1979–80, 41 688 t were produced from 34 503 ha. Returns to growers are estimated at $280–$290 per t, on farm.

Production of linseed in 1980–81 is estimated at 2 000 t from 3 500 ha. This compares with 3 800 t from 5 000 ha in 1979–80. Harsh seasonal conditions led to the abandonment of around 400 ha of the crop. Returns to growers are estimated at around $270 per t, on farm.

Attractive returns from alternative crops of wheat and barley and a reduction in plantings in south Queensland contributed to reduced overall safflower plantings of 6 300 ha compared with 12 300 ha in 1979–80. However, more favourable conditions than in the previous season led to a production estimate of 37 000 t compared with 2 800 t in 1979–80. Returns to growers are estimated at $260 per t, on farm.



Safflower is a promising winter oilseed crop in the Inglewood district. This crop yielded 2.75 t per ha.

Sugar

Despite good rains being received in northern areas during the early months of 1980, the weather in most cane growing areas was less than ideal for optimum production. The Bundaberg region was badly affected by drought for most of the year, although late rains improved crop conditions to some extent.

The removal of I.S.A. restrictions helped boost the 1980 harvest to the largest on record in Queensland. A total of 22 540 963 t of cane was milled, which was 210 196 t greater than the previous record achieved in 1977 and 2.6m t or 13.5% greater than the harvest in 1979. The tonnage produced 3 146 917 t of 94 n.t. sugar, an increase of 12.09% on production in 1979 but 1.94% lower than the 1977 record.

The c.c.s., at 13.21, was down 0.21 units on the previous year and 0.61 units on the 1977 season. The lower c.c.s. yield was a direct result of the poor growing season.

The 1980 productivity values were 82.17 t of cane and 11.47 t 94 n.t. sugar per ha.

Total cane harvested for crushing in Australia was 24 050 725 t which produced 3 328 247 t of 94 n.t. sugar.

Peanuts

The area planted to peanuts in Queensland for the 1981 season is estimated at 28 000 ha, nearly 11% less than the 31 273 ha planted in 1980, and about 24% below the record plantings of 36 601 ha in 1979. The decrease has occurred mainly in south Queensland with growers there reducing the area planted to peanuts by about 12% by comparison with the previous season. Peanut plantings in north Queensland were also reduced slightly this season. In south Queensland, competition from grain sorghum and maize, combined with increasing costs of producing peanuts, diverted land use away from peanuts.

Overall, growing conditions during 1981 were better than in the previous season, and, in spite of reduced peanut plantings, the crop is estimated at 41 500 t or nearly 8% more than the 38 466 t produced in 1980.

On the basis of the forecast for peanut production in 1981, receivals of peanuts by The Peanut Marketing Board this season are likely to total 35 000 t, nut-in-shell, compared with the 34 519 t delivered in 1980.

The average return to growers for the 1980 season is likely to be around 44¢ per kg or an increase of about 17% on that of the previous season. Reflecting record prices for peanuts on the world market, the first advance to growers for the 1981 season is 42¢ per kg. The Peanut Marketing Board's operating expenses in 1981 are expected to be virtually the same as those of 1980 at approximately 14¢ per kg.

Navy beans

Plantings of navy beans in the 1980 season amounted to 4 244 ha which was well below the 10 000 ha required to meet the domestic market requirement of 6 000 t per annum.

As a result of poor seasonal conditions, the average yield was only 354 kg per ha giving a total production of 1 504 t.

Early seasonal conditions in the 1981 season favoured the planting of alternative crops such as sorghum, maize and peanuts with the result that the area planted to navy beans is only 3 500 ha. It is expected that the total production will be around 2 000 t depending on weather conditions at harvest time.

The Navy Bean Marketing Board is actively promoting the crop in areas outside the South Burnett especially in the Inglewood irrigation area.

Returns to growers for the 1979 season were finalized at 41.25¢ per kg. The Board has successfully negotiated a price increase for the 1981 crop and it is anticipated that the total return will be in the vicinity of 58¢ per kg.

Cotton

Production of raw cotton in Queensland for the 1980–81 season is estimated at a record 95 000 bales, each of 225 kg, or nearly 10 000 bales more than the previous record output of 85 655 bales in 1979–80. The prospective increase in production is attributed largely to the concerted efforts of the growers in all major cotton-producing areas of the State towards expanding cotton cultivation. Aggregate cotton plantings in the State this season were estimated at nearly 22 500 ha, about 50% more than those of a year earlier.

Early in the season, the cotton crop progressed extremely well, raising the hope that the production target of some 105 000 bales would be achieved. Later, however, an extended period of wet weather reduced yield prospects for some major cotton-producing areas, especially the Dawson-Callide Valley district in central Queensland and, as a consequence, the production estimate was revised downwards to 95 000 bales. The persistent rain also delayed early harvesting operations in a few districts, and this had some adverse effect on the quality of the cotton produced.

By far the largest production increase is projected for the Emerald Irrigation Area. Here, the availability of additional irrigated land, combined with generally favourable growing conditions, resulted in cotton production this season increasing to 30 000 bales from last season's 26 030 bales.

In the Dawson-Callide Valley district, production of cotton is likely to remain at the previous season's level of 15 000 bales as unfavourable weather conditions reduced yields of cotton considerably.

By contrast, on the Darling Downs, the average yield of cotton per hectare improved despite the adverse effects of hail and wet weather conditions early in the growing season, and production is expected to reach 20 000 bales, compared with the 17 340 bales produced in 1979–80.

The area planted to cotton also expanded in the St. George district and a 10% production increase is expected to be attained in the region, bringing the cotton harvest to 30 000 bales.

With respect to production prospects, The Cotton Marketing Board projects an increase in cotton plantings in the Emerald Irrigation Area and on the Darling Downs.

On the basis of these forecasts for cotton plantings, the Board has predicted that production of cotton during the mid 1980s will probably reach 130 000 bales a year.

Even though the international trade in cotton remains slow, prospects for exports of Queensland-grown cotton are still optimistic. With another record cotton production predicted in Queensland this season and a stable demand for raw cotton on the Australian market, the volume of cotton available for export in Queensland will probably increase during the 1981–82 marketing year to around 77 000 bales from the relatively low level of 45 249 bales in 1978–79.

The volume of cotton actually committed for export had reached 32 349 bales by the end of May this year with sales being arranged for deliveries later in the year to Japan, Korea, Hong Kong, Taiwan and Indonesia. On the basis of the contract prices of the cotton already committed for export, the gross value of the 32 349 bales contracted forward is estimated at $12m.

Overall, therefore, the gross value of the anticipated 77 000 bales of cotton available for export this season is expected to reach $30m compared with $25m in the 1980–81 marketing year.

The trend in the Australian cotton market is still towards stable domestic consumption and, as a consequence, The Cotton Marketing Board's quota of raw cotton for sale on the Australian market for the 1981–82 marketing year remains virtually unchanged at 18 000 bales. The gross value of these domestic sales is estimated at $8m, bringing the value of the season's anticipated production of 95 000 bales of raw cotton in Queensland to an estimated $38m compared with $31m in 1979–80. In addition, gross proceeds from the sale of oil mill products are expected to realize around $3.5m. Thus, the gross value of the 1980–81 cotton crop is likely to reach $41.5m.

In the world cotton market, the price weakness prevailing early in the year continued into June largely in response to economic uncertainties, particularly exchange rate variations and increased interest rates and other costs of holding cotton.

The monthly average of the Liverpool C.I.F. Index for Strict Middling 1 1/16 inch which had ranged between U.S. 95.85¢ per lb and U.S. 91.70¢ per lb during February and March this year declined progressively throughout the first half of the year to reach U.S. 86.90¢ per lb towards the end of May.

Ginger

Production of ginger from the 1980 crop totalled 6 540 t from 214 ha. This represented a significant increase on the previous season's production of 5 205 t from 150 ha.

The 1981 ginger crop is expected to exceed 8 100 t from a planted area of 231 ha. The early harvest intake for the 1981 crop was a record 3 935 t and of excellent quality.

Domestic and export markets for ginger products have exhibited strong growth in recent years and this trend is expected to continue in 1981. For this reason, it is unlikely that difficulties will be experienced in disposing of the heavier supplies projected for 1981.

Fruit and vegetables

The estimated gross value of horticultural crops for 1980–81, at $213m, represents a 23% increase over 1979–80. This has occurred despite expected reduced production of most crops and reflects a substantial increase in wholesale prices of nearly all fruit and vegetables.

Domestic fresh and processing prices are expected to rise in 1980–81 because of the sustained high level of domestic demand for citrus fruit. However, owing to increased competition on export markets, average unit returns from export sales are forecast to be lower than last year's levels. The value of citrus production is estimated to rise some 22% in 1980–81 due mainly to these higher prices, especially for mandarins.

Cabbage variety assessment allows recommendations to suit each growing season.

Production of the other major horticultural lines, bananas and pineapples, is expected to be lower in 1980–81 due to the dry conditions, and for pineapples due to the abnormally high production in the previous season. Pineapple prices have not varied significantly from last year and a reduced value of around $18m is expected. Bananas, however, have reflected the general trend and high prices should boost their value of production to nearly $22m.

Valencia oranges output is expected to fall in 1980–81, which in effect will be a return to normal yields, while Navel orange output is likely to increase substantially, together with smaller rises in lemon and grapefruit production.

An 'on' crop apple year, combined with substantially higher prices is expected to boost the gross value of apples in 1980–81. Apples, along with pears, stonefruit and grapes, were affected by the dry weather and also by severe hail storms. However, higher prices are expected to lift the estimated gross value of these commodities.

Queensland apple production is forecast at 2m boxes (1.9m last year) and pears 227 000 boxes (222 000 boxes in 1980). The Australian Apple and Pear Corporation is gearing up for a strong local promotional campaign and is expecting shipments to Europe to prove viable again this year if quality and presentation improvements continue.

The processed Apple and Pear Sub-committee of the Standing Committee of Agriculture, which is comprised of processor and grower representatives, has established recommended minimum prices to be paid for apples and pears for processing during the 1981 season. The prices are as follows:

At factory gate within 48 km of mainland capital city

Juice apples—$82.50 per t
Juice pears—$68.50 per t
A grade canning apples—$110.00 per t
B grade canning apples—$98.10 per t

The strong demand for white grapes is expected to continue, with prices in 1980–81 forecast to increase by about 10%. The demand for red grapes used in the production of bulk wines is expected to continue to decline and the average price of red grapes is forecast to remain at around last year's level.

The markedly reduced spring potato crop has fetched exceptionally high prices reflecting the Australian-wide shortage of potatoes. Given an average autumn crop and a maintenance of the current price trend, the gross value of potatoes will reach a record $26m.

Although the southern tomato crop has been reduced by the dry conditions, the northern crops have faired well. Prices to date have also been significantly above last year's and a $28m crop is a reasonable prospect.

The prevailing dry conditions generally reduced the production of most other vegetables but, as previously outlined, higher returns have increased the estimated value of all but a few vegetable lines.

The tomato is Queensland's leading vegetable crop returning $28m last year. Continued tomato variety assessment ensures that the best varieties are available to the industry.

The Department submitted evidence to the Industries Assistance Commission on a number of industries which included strawberries, passionfruit, pineapple, apples and pears, papaws, melons, and stonefruit. Collectively, these industries make a significant contribution to horticultural production in Queensland.

New crop management techniques are improving yields from custard apple crops in Queensland.

Tobacco

Sales of tobacco leaf during the 1980 Queensland selling season amounted to 7 890 154 kg at an average price of 388.8¢ per kg and a gross value of $30.7m. This compares with 8 198 461 kg sold in 1979 for a gross value of $30.1m and an average price of 367.5¢ per kg.

The official level of the Australian marketing quota for the 1981 selling season was set at 14.9m kg which represented a decrease of 1.3% on the previous season. This has resulted in Queensland's quota being reduced from 8.1m kg to 8.0m kg. However, the minimum average reserve price for the 1981 selling season has been increased to 429.7¢ per kg compared with 406¢ per kg in 1980.

Both the quota level and price movements are reviewed each year, the former in accordance with movements in consumption and manufacturers' stockholdings while the latter takes into account among other things growers' costs of production. There is continuing concern in the industry regarding future quota levels as consumption of tobacco products has failed to show any increase over recent years. This has led to surplus stockholdings by manufacturers and voluntary short delivery of quota by growers.

Division of Animal Industry

In the year under review, the continuing drought in the southern part of the State created many problems not only for the pastoral industries but also for the intensive animal industries by creating shortages and high prices for feed ingredients. Allied to this were instability in the economy of the beef industry and marketing problems in the chicken meat industry. Despite these problems, which created an extra workload for advisory staff, new initiatives were developed and progress was achieved in many areas. The following paragraphs highlight these achievements.

Pastoral industries

Taxation concessions conceded in the 1980 Budget, enabling internal fencing and yards erected for the purpose of brucellosis and tuberculosis eradication to be 100% deductible in the year expenditure was incurred, has resulted in considerable property improvements being erected for the purpose of eradicating these diseases. The Brucellosis Provisionally Free Area was expanded to include the Veterinary Divisions of Toowoomba, Maryborough and part of the Roma Division, while the remainder of the State was brought under active eradication during the year. Blood samples were collected at abattoirs from 94.2% of available breeders, which is an increase of 10% on the previous year and easily surpasses abattoir surveillance in other States and Territories of Australia.

The Ulam strain of amidine resistant ticks has been identified on five associated district properties in the Ulam area near Bajool. Control measures to restrict the spread of these parasites were implemented. The Wacol Tick Fever Research Centre continued the development of methods for the adaptation of the tick fever organism, *Babesia bovis*, to an *in vitro* tissue culture system. This could eventually lead to the development of a killed vaccine which would overcome many of the problems of a fragile live vaccine.

A filaroid parasite (*Stephanofilaria*) not previously recognized in Australia, was recovered at the Oonoonba Veterinary Laboratory from ringworm like lesions on *Bos indicus* type cattle in northern Queensland. It appears that the emergence of this parasite has resulted from the need for less dipping with the widespread use of *Bos indicus* cattle in the tick areas of the State.

The recent drought saw the widespread use of molasses in supplementary feeds as a means of feeding drought stricken stock.

Alkali treatment of native pasture hay at Swan's Lagoon resulted in significant increases in intake and digestibility and this represents a promising area of continuing research.

The growth promotant, zeranol, has been widely used in many countries of the world and has been shown to increase weight gain by 10 to 15% and feed conversion by 8%. Twenty-four trials were undertaken in Queensland under a range of grazing conditions and in all cases positive liveweight responses occurred. Implanted animals gained from 10 to 40% more weight during the 80 to 100 days following implantation than untreated controls.

For animal welfare, as well as economic reasons, the saleyard curfew issue was the subject of much debate. As a result of trials conducted by this Department in conjunction with the Queensland Meat Industry Organization and Marketing Authority, it was agreed to adopt the 'wet' curfew and sale system for selling cattle by liveweight, although individual saleyard operators may decide whether or not to accept the decision. It is expected to receive fairly wide adoption, especially for saleyards accepting cattle which have travelled long distances.

Advisory work on drought management of stock occupied a large and important aspect of husbandry officers' time. As well as making a drought film late in 1980, a weekly 'drought bulletin' was featured on the Toowoomba A.B.C. morning programme to assist producers.

The Air Mist Sheep Race was used successfully on eight properties to eradicate lice burdens from 22 000 sheep. The machine was also evaluated as a means of applying insecticides for protection against blowfly strike at the Ciba-Geigy insectory at Kemp's Creek, New South Wales. The investigations demonstrated that the Air Mist Machine can provide protection against strike for a period of 9 weeks after treatment. This degree of protection is similar to that obtained by hand jetting, a procedure that is more labour intensive and uses more insecticide.

Trapping of blowflies as an aid to predicting the likelihood of a blowfly strike wave showed that under the drought conditions prevailing in western Queensland fly densities were markedly higher along shaded watercourses than at sites 0.5 to 1 km away.

Screen testing of a new anthelmintic which is being developed by commerce indicated that it was very effective against the strains of *Haemonchus contortus* and *Trichostrongylus colubriformis* which have shown in sheep and goats to be resistant to many of the anthelmintics currently on the market.

The importance of providing an adequate water supply for lambs reared in western Queensland during the summer months was demonstrated. Over a range of dietary regimens, ewes with two functional teats supplied approximately 65% of their lamb's fluid requirements in the form of milk while ewes with only one functional teat provided only 50%. In addition to milk, the lambs required between 400 and 800 mL of water each day.

Sets of four management discs outlining practical techniques which can improve sheep production in the semi-arid tropics were distributed to producers in central and northern Queensland. These discs were well received by the industry and have been instrumental in initiating numerous requests for further technical information.

The recovery in tissue culture of a retrovirus from arthritis in goats, one of the manifestations of a disease which may also produce encephalitis and/or pneumonia and subsequent experimental inoculation trial, indicate that this virus is the cause of the condition. The epidemiology of the disease is complex. It appears to be restricted to goats.

Lophyrotomin, the toxic principle of sawfly larvae (*Lophyrotoma interrupta*), appears to have similar action to the peptidic toxins isolated from Amamta species of mushrooms. As sodium hemisuccinate silybin has been used successfully as an antidote for the acute hepato toxicity of Amamta poisoning in man, it will be screened for a possible beneficial effect in sawfly toxicity in cattle.

Intensive animal industries

With the proposed development of further irrigation in north Queensland it is expected that rice could become available as an animal feed. A series of trials terminated during the year demonstrated that, although rolled rough rice (grain in husk) had a lower digestible energy than other cereal grains, it could be a useful component of pig diets depending on the purchase price in relation to energy content and slightly increased overheads from slower growth. The inclusion of the husks in the diet led to the production of a larger volume of faecal material.

With the isolation of *Brucella suis* from a further four piggeries (in three of the four piggeries, the source was probably feral pigs) efforts have been intensified to identify and control the disease. Infected herds will be quarantined. Quarantine will be removed after a property has been destocked, cleaned and disinfected and spelled for a minimum of 2 months in an intensive unit and 3 months for other units. Serological testing of samples collected from domestic breeder pigs killed at abattoirs and from feral pigs killed at abattoirs and in the field was continued to define the incidence of the disease in pigs in the State.

The supply and price of red meat continued to adversely affect the demand for poultry meat. The clearing of the large stocks of frozen birds by sale throughout the State at discount prices created marketing problems for some local processors.

The continuing trend for consumer preference for the fresh product exacerbated the market problems for frozen poultry.

The survey of all the layer and broiler breeder flocks in Queensland and one-third of the commercial layers for Newcastle disease virus antibodies showed that 26% of the flocks had been exposed to the lentogenic strain of the virus. This monitoring is to be done at regular intervals to determine the level of protection or the level of masking which may exist should the severe form of the virus enter Australia.

A similar survey for antibodies of haemagglutinating adenovirus of poultry which may cause decreased egg production showed that the broiler breeder farms of one franchise had been exposed to the virus. An egg drop syndrome had occurred in these flocks.

Queensland has agreed to participate in a joint layer management recording study with the New South Wales Department of Agriculture. Following discussion with the Queensland egg producer groups, 10 producers will form the study in its first year. Comparative analysis of flock physical and financial performance data enables participants to identify weaknesses in their farming operation and to apply corrective measures.

Quarantine and exotic diseases

The Exotic Diseases in Animals Act was assented to on 14 April 1981 and replaces previous legislation embodied in other separate Acts. This should update and streamline procedures for the control and eradication of exotic disease outbreaks should they occur.

Routine animal quarantine activities again increased during the year, as did investigations of breaches of the quarantine barrier. Surveillance activities in Cape York peninsula and the Torres Straits were stepped up and screw worm fly trapping was commenced. New appointments of port quarantine officers were made at Brisbane, Mackay and Townsville.

Progress was made in exotic diseases planning with emphasis on the establishment of organizational structure and role definition.

Livestock exports remained at a high level of 34 000 cattle exported, more than 13 000 breeding cattle were destined for Indonesia and new contracts have been negotiated by exporters for larger numbers during 1981–82 to this destination. Progress has made in standardizing export procedures and in developing welfare codes for the export of sheep, horses and cattle.

Veterinary public health

A feature of the year was the uncertainty arising from consideration of the Kelly Report on meat inspection. The future of the State Meat Inspection Service has been under a cloud but this has not unduly affected the standard of service provided. One positive outcome has been agreement to rationalize re-inspection fees on interstate meat over a period of 2 years.

The serious drought in southern Queensland and the southern States caused shortages of better quality meat, shortened the killing season and resulted in an increase in grain finished beef. The drought and the fall in cattle numbers, coupled with increases in slaughtering capacity over recent years, led to extended closures of several abattoirs.

Regional meat areas at Cairns and the Sunshine Coast were gazetted, the latter to commence on 30 September 1981. Progress was made in the policy of gradually freeing up the movement of meat within the State.

Following the declaration of deer to be stock under the Meat Industry Act, small-scale slaughtering of deer for domestic consumption was commenced.

A feature of the year was a substantial increase in the pet food industry, particularly in the number of retail outlets throughout the State.

A problem detected during the year was heavy microbiological contamination of mechanically boned meat. The problem remains unresolved but processors have agreed to use the product solely for cooked products.

Progress was made in co-operation with the Queensland Meat Industry Organization and Marketing Authority towards improved colour identification of young beef and lamb, and beef treated to improve tenderness and beef from grain fed cattle.

Further progress was made with manual carcass classification trials and in reaching national agreement on procedures for its voluntary adoption. Considerable advances were made in the use of pig carcass classification. Introscope measurement of backfat is carried out in most bacon factories.

Facilities and staff

As part of a wider review of accommodation needs for the Department in the Brisbane area, the development programme for the Animal Research Institute, Yeerongpilly, was reviewed. This has resulted in modifications to the institute's programme with a delay to the former schedule, but will rationalize accommodation problems in many areas.

Construction of additional facilities for pig research at the Biloela Research Station neared completion. When the facilities are in operation, the pigs at the Hermitage Research Station will be transferred to Biloela and the Hermitage piggery will close.

With funds provided by the Wool Research Trust Fund, a property 'Croxdale' has been leased in the Charleville district. The property has several land types which are typical of large areas of south-west Queensland. As its carrying capacity is 2 000 sheep, it is to be used for demonstration research under commercial conditions of information arising from a variety of our other research programmes.

Senior staff changes during the year included the appointment of Mr B. A. Woolcock as Director of the Division, following the promotion of Mr J. W. Ryley, and the appointments of Mr S. G. Knott and Mr I. D. Wells as Deputy Director of the Division and Director, Veterinary Services Branch respectively. Mr W. T. K. Hall, Director of Pathology and Mr C. W. R. McCray, Director, Biochemistry Branch, retired.

Chemical residues in animal products

Monitoring of the organochlorine and organophosphate residues in cattle slaughtered in Queensland to assist the industry to meet the quality control standards implicit in the statutory limits for pesticide residues which are set on a basis of good agricultural practice continued throughout the year. After reviewing the results of the previous 2 years, the sampling procedure was modified for this year and had a bias to particular shires in specific regions of the State to ensure more indicative sampling of possible problem areas. The closure of some works and decreased throughput in others resulted in changes to sampling to maintain the most efficient system.

This year's sampling resulted in 8 000 fat samples being analysed for 23 pesticides and as a result of trace back a further 326 samples of either biopsied fat, milk, grass, soil, water or dip sludges were analysed.

These analyses showed a 99.8% compliance for the organochlorines pesticides and a 99.5% compliance for the organophosphate pesticides and indicated a general responsible use of these chemicals.

Analytical methods were developed for determination of a wide range of phthalate plasticizers which may leach into vacuum-packed pig products. Samples of meat analysed contained one or more plasticizers at a total concentration of up to 20 micrograms per gram.

Animal welfare

Concern with the scientific and legislative aspects of animal welfare both in Australia and overseas continued to be an area of involvement for staff of the Division. The ethologist in the Pig and Poultry Branch continued studies on chicken behaviour which has an important welfare component. She was involved in an education role for producers and professional societies in Queensland and interstate on many aspects of animal welfare.

Aspects of animal welfare in relation to exports of livestock received considerable publicity in the media. The Royal Queensland Society for the Prevention of Cruelty and the Transported Animals Protection Society liaised with the Department in improving the welfare of export animals in transit. Commonwealth and State authorities standardized procedures for the export of animals to ensure their humane transportation.

The Queensland Meat Industry Organization and Marketing Authority, in association with the Department, published the findings of a survey of railed-cattle losses in Queensland and indicated changes to improve the conditions of cattle railed in Queensland.

A sub-committee of the Animal Health Committee with representatives from all Departments of Agriculture, Commonwealth Department of Primary Industry and C.S.I.R.O. was established during the year to advise the Australian Agricultural Council on all aspects of animal welfare.

Division of Plant Industry

Horticultural research

Significant contributions to industry are flowing from horticultural research in variety improvement, production systems and post-harvest handling.

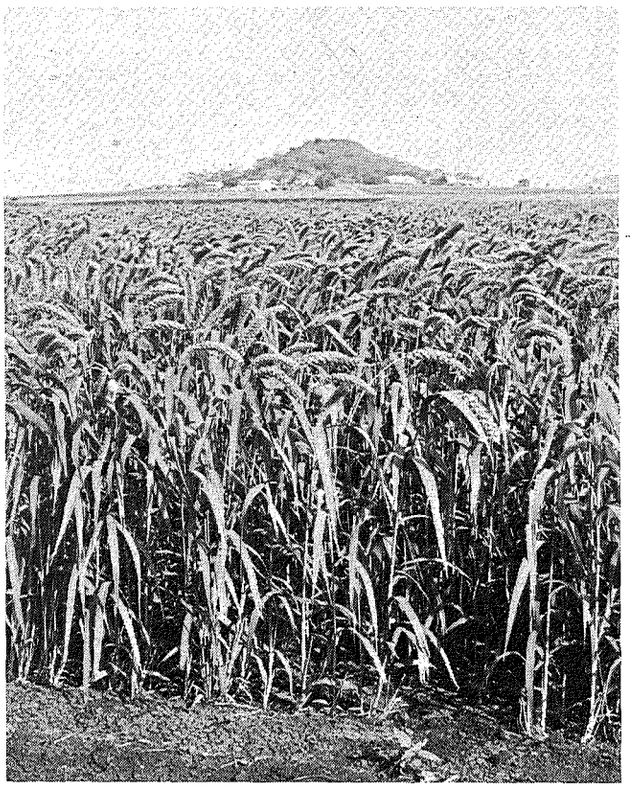
New varieties of cold tolerant stringless French beans, processing peas and summer cabbage are expected to lift the productivity of these crops in south Queensland, while good progress has been made in breeding tomatoes resistant to Fusarium wilt.

Litchi production has been unreliable in southern Queensland. A new variety with a superior cropping pattern has been identified. Management strategies have been developed to promote bearing in shy-bearing cultivars. This should pave the way for expanded production of litchis in Queensland.

An alternative system for producing tomatoes on raised beds under plastic mulch with trickle irrigation overcomes fruit rots and gives positive control over vegetative and reproductive growth of the crop. The method is also proving effective for rockmelons.

The biennial bearing problem of Imperial and Murcott mandarins has been overcome with etephon sprays. Maturity bronzing of bananas has been associated with water stress just after bunch emergence, throwing new light on this serious disorder. Blackheart in pineapples has been shown to be identical with symptoms of chilling injury, and chilling resistant clones have been selected to evaluate for resistance to black-heart in the field. Tissue culture research has developed procedures for rapid cloning of superior pineapple clones.

After several years of research and extension activity, industry is adopting precooling of produce as a routine operation. Coupled with other advances such as package design for forced air cooling, forced air ripening of bananas, and fungicide dips for controlling post harvest disease in papaws, mangoes and avocados, the high quality of produce reaching markets can be assured.



Panorama panicum is a useful, short-term, opportunity summer crop on the Darling Downs.

Disease resistance breeding

Sources of resistance to yellow spot (*Pyrenophora*) of wheat have been identified. This resistance will be an important adjunct to stubble mulching practices for control of soil erosion. Line R266 and Hysun 30 exhibited effective resistance to a new race of sunflower rust (*Puccinia helianthi*).

Phytophthora stem rot of soybean has become more widely distributed with some severe crop losses. Two races of the pathogen have been identified and the variety Davis has effective field resistance. Resistance is also available in the advanced soybean population breeding programme.

Elite genotypes of lucerne are being progeny tested for field resistance to anthracnose, Phytophthora root rot and to the spotted and bluegreen alfalfa aphids. These are leading to a replacement for Hunter River lucerne which is required for irrigation and for extending the persistence of dryland lucerne.

European brood disease of bees

In November 1980, the causative organism of European brood disease, *Streptococcus pluton*, was detected in an apiary at Yelarbon. By the end of May 1981, the disease had been diagnosed at Kilcoy and Kenilworth, but otherwise was restricted to apiaries in the Yelarbon, Millmerran and Toowoomba districts.

Interstate quarantine was lifted in February but movement of hives into Queensland require a certificate of health.

The Department assists disease control by positive diagnosis and advice on antibiotic treatment of infected hives.

Farm machinery extension

In a sample of Darling Downs grain farms, machinery overhead costs averaged $107 per ha compared with fixed costs of $21 per ha and variable costs of $71 per ha. This illustrates the significance of machinery in costs of production and indicates the need for sound advice on tractor performance, implement matching and scale of mechanization.

An extension specialist in farm mechanization has been appointed to the Darling Downs, western downs and Maranoa region to provide resource support for extension staff in this important subject.

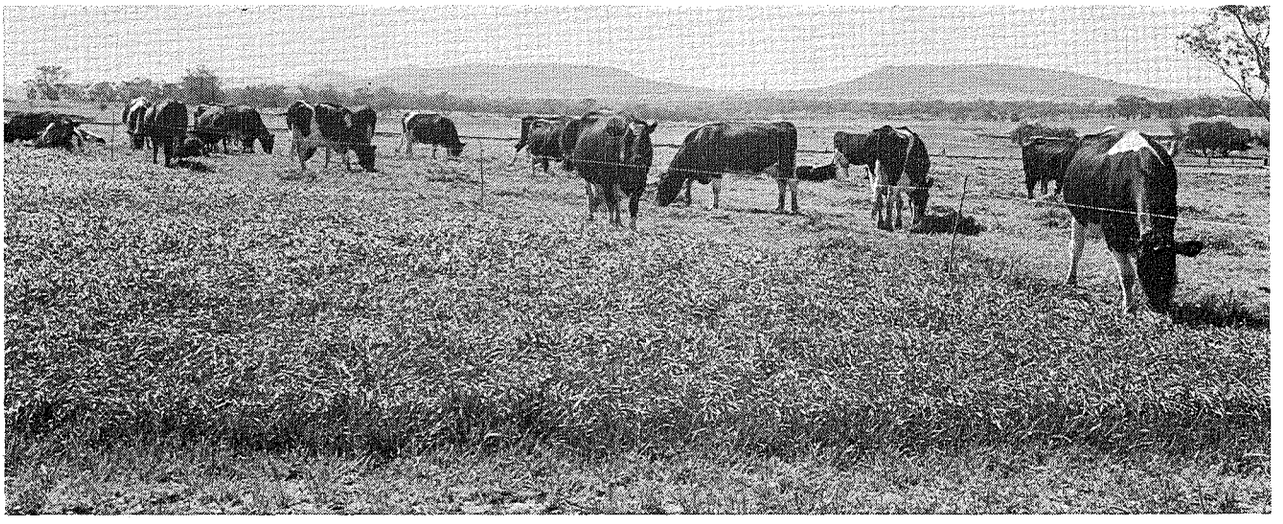
Land degradation studies

Physical and chemical deterioration of arable soils is the subject of increased research effort.

Soil salinity in dryland and irrigated areas is emphasized in the Lockyer Valley, Darling Downs, Emerald Irrigation Areas and in the Lower Burdekin. Physical deterioration of peanut and potato soils has been identified, and structural improvement of heavy cereal soils with gypsum has reached significant commercial proportions.

The Division is involved in major collaborative programmes of research, development and extension for improved surface soil management with the Division of Land Utilisation.

Floriculturist Miss Margaret E. McKay is checking seedling growth in the recently updated propagating facility.



Heavily fertilized, irrigated ryegrass has significantly boosted available forage and dairy production in winter.

Division of Dairying and Fisheries

During the year, the Queensland Fisheries Service was transferred from the Department of Harbours and Marine to the Department of Primary Industries and was incorporated with Dairying to form a new Division of Dairying and Fisheries. The new Division now has four Branches and three Sections.

The Dairy Produce Regulations were gazetted on 14 June 1980 and these new regulations have been used to provide a valuable framework to assist the dairy industry from farm to consumer. It is expected that the Artificial Breeding of Stock Act, which was assented to in December 1979, will be proclaimed shortly together with regulations under this Act.

Artificial breeding

As a culmination of a series of events to celebrate 25 years of artificial breeding in Queensland, it was appropriate for the Minister for Primary Industries to officially open alterations to the Wacol A.I. Centre. As part of the celebrations to mark this event, two open days were held at the Centre, and there was a good response from both dairy and beef producers.

The Australian Friesian Sahiwal breeding programme to provide tick resistant dairy animals has continued and there are now more than 30 dairymen in Queensland co-operating by maintaining approximately 350 AFS cows and heifers in commercial herds.

South-east Queensland Research Station

With the purchase of several properties in the Mutdapilly-Harrisville area, a new dairy cattle research programme has commenced in south-east Queensland. The 28-unit rotary turnstile which was erected on the Ayr Research Station has been transferred and re-erected, together with a new milk room on the new station. This station will provide avenues for a wide range of pasture studies and other field investigations.

Milk production

Total milk production for 1980–81 was 506m L, a decrease of almost 6% on that of the previous year, due primarily to the severe drought conditions which affected most regions. The decline in dairy farm numbers continued and there are now only 2 940, a decrease of 12% on the previous year's total.

In spite of the reduced numbers and production difficulties, production was maintained at a reasonable level. The demand for pasteurized milk and fresh and cultured milk products has increased during the year by 4.3% to a level whereby approximately 60% of milk was used for liquid milk products. The critical supply situation in central and north Queensland resulted in the Minister announcing that new registrations would be allowed in these regions subject to certain conditions.

Interstate dairy produce

The supply of butter from interstate has continued to augment local production and, because of the decreased amount of milk available for cheese manufacture, cheese has also been imported from as far away as Western Australia. Three interstate companies are now marketing retail packages of butter in Queensland directly under their own brand name. In addition, some milk for manufacture purposes is being imported from New South Wales.

Northern Fisheries Research Centre

A modern fisheries laboratory was opened on 17 June 1981 as part of a marine operations complex at Aumuller Street, Cairns. The laboratory will serve as base for a variety of research programmes covering fisheries in the Gulf of Carpentaria, Torres Strait, Great Barrier Reef and north Queensland rivers. The complex which has covered accommodation for a number of launches up to 8 m in length, and jetty facilities to handle up to two 18 m vessels, will be shared with Harbour Master's staff and Boating and Fisheries Patrol Officers of the Department of Harbours and Marine.

Research vessel

The 18-metre trawler 'Iron Humphrey', one of the top producing fishing vessels in the southern Queensland prawning fleet, was also acquired in June 1981 and will be stationed at the Cairns complex after modifications and refit to convert her to a research trawler. It is intended to use her in research and exploratory fishing in support of a variety of programmes based on the Cairns laboratory, but particularly in support of the Gulf prawn investigations during the coming year.

Barramundi management programme

The principal fisheries regulatory initiative during the year was the introduction of a management programme covering the barramundi fishery. Two limited licence regimes were set up, one covering the Gulf of Carpentaria, and the other the Queensland east coast as far south as Baffle Creek, and relate to the use of set-gill nets.

In the former area where barramundi is overwhelmingly the target species, entry criteria have been very stringent, but on the east coast, a looser arrangement has been agreed, as barramundi becomes more of an incidental catch in higher latitudes.

The full programme, which is being introduced progressively during 1981, includes a closed season for barramundi, a bag limit for recreational anglers, some modifications and additions to present net fishing closures, and changes in the specifications of some types of set gill nets.

Northern Saratoga, a large, tropical freshwater fish.

Land Utilisation Division

Soil erosion affects an estimated 31% of the non-arid grazing lands in Queensland and 90% of the land currently used for cropping. The direct costs of erosion are felt by individual primary producers through decreased yields and increased costs of production, and by the wider community through damage to public utilities.

Indirectly, soil erosion contributes to increased food prices and, if unchecked, will seriously affect the agricultural productivity of Queensland.

Landholder involvement

Because of increasing landholder interest in soil conservation across the State, the implementation of soil conservation works is currently limited by the ability of soil conservation officers to plan and locate such works in the field. As land management practices can be implemented by landholders with minimal assistance from soil conservation schemes was continued in order to determine the place and achieving a degree of erosion control in the short term.

The Soil Conservation Branch programme for 1980–81 concentrated on increasing the efficiency of programme operations in order to allow an expansion of soil conservation activity across the State without increasing programme costs.

Initial planning in a number of group or catchment soil conservation schemes was continued in order to determine the place and scope of this approach in improving the efficiency of planning and implementing soil conservation measures. Requests for similar approaches were received from landholders in the Billa Billa catchment near Goondiwindi, the Mackeys Creek catchment near Gordonvale, wet tropical coast, and Boonah-Kalbar. Soil conservation Advisory Group Committees were established in the Isis Area of Soil Erosion Hazard and in the Gin Gin Area of Erosion Hazard.

The first landholder poll to seek support for a Soil Conservation Project Area was held in north Queensland. Landholders in the Cherry Creek catchment area of the Atherton Tableland voted in favour of establishing such an area. If a decision is made to continue with the Project Area this will be the first time that landholders have been eligible for grants outside Areas of Erosion Hazard.

Extension

Interest in soil conservation by individual landholders, industry groups and local authorities increased significantly during the year, particularly in the grain and cane growing areas of the State. The Queensland Graingrowers' Association displayed increasing concern with soil conservation matters in district and State council meetings through its soil conservation committee and through the formation of a Soil Conservation Advisory Committee by the Central Highlands Branch of the Association.

During the year, Soil Conservation Branch, in co-operation with Agriculture Branch, initiated a major conservation tillage extension project to provide information needed by farmers to adopt conservation tillage practices.

A soil conservation information services project, supported by Commonwealth Extension Services Grant funds, continued with the objective of educating the community about erosion and the need to conserve the soil resource. Branch officers in country centres directed their extension activities to landowners, with emphasis on the maintenance requirements of soil conservation structures, and the need to protect new cultivation at the time of development.

As a direct result of Branch activities, 493 landholders implemented soil conservation measures on their land for the first time, bringing the total number of landholders employing soil conservation measures to 19 820. This represents approximately one-half of the properties affected by erosion in the cropping areas of the State and indicates a considerable need for greater landholder adoption of both soil conservation works and practices.

Branch officers received 4 876 requests from landholders for information about the control of soil erosion, or assistance in the planning and setting out of soil conservation measures, representing a 21% increase over the record number of requests received in 1979–80. Of the 1980–81 requests, 3 940 were from landholders already practising soil conservation and 936 were from landholders who had not previously implemented soil conservation measures.

Soil Conservation officers made a record 7 858 property visits to provide the advice on assistance requested by landholders. Despite this high level of field activity (17% more farm visits than in 1979–80), there were 505 outstanding landholder requests at the end of the year (one-third greater than at the same time the previous year). Branch staff were unable to handle effectively the high level of landholder interest in 1980–81.

Three field days of significance were held during the year. The Royal National Association field day on the property of the Producer of the Year, Mr H. Todd, Jondaryan, featured soil conservation as a major theme. A field day was also held to mark the progressive payment total of $1m in landholder subsidy to Mr J. Kundie, Cambooya. A very successful field day held by the Southern Downs Advisory Group Committee marked the presentation of the Best Soil Conservation Farmer in Southern Downs award to Mr Berry, Clifton.

Other organizations

Discussions have been held with Mines Department, Queensland Graingrowers' Association and mining companies on prevention of erosion caused by the activities of mining survey lines. This Department can offer technical assistance in the development of guidelines for this area.

Assistance was given to the Central Cane Prices Board in its attempts to arrange for the 8% increase in cane assignments granted to the sugar industry in two sections during the year. This Division is presently aiding in the selection of the most useful land and the prevention of assignment of land with problems. This involves simply the inspection, on request, of land and a report on its suitability for cane. This operation has already increased the work load.

Land use advice was given to private companies interested in large-scale development of cassava and to the Land Administration Commission in the subdivision of Crown land suitable for sugar-cane at Mount Ossa, Mackay. Soil conservation requirements are now included in some conditions attaching to lease of Crown land such as for a cassava plantation at Miriam Vale.

Co-operating with Queensland Water Resources Commission in irrigation land evaluation took considerable time. Investigations were carried out in south-east Queensland, lower Mary River, Proserpine River and the Gap Dam site near Rockhampton.

Dalby floods

Floods in the Dalby area in early February caused massive losses to farmers, householders and public facilities in the area. A total of 220 000 ha was affected; crops were destroyed by floodwaters or silt, farm dams failed, roads and railways were damaged and Dalby itself was severely flooded. Total damage to local authorities and government facilities was estimated at $3.6m and to farms about $2.2m.

The value of properly constructed soil conservation measures in minimizing the effect of flood water was demonstrated. The greatest assets, however, were properly designed strip cropping installations on plains land. These clearly spread water flow, slowed its speed and reduced soil erosion effects to almost zero. This evidence has caused considerable interest among landholders in flood plain and valley floor situations.

The effects of the floods and the results of some soil conservation measures were collected as photographs and published in a Darling Downs Flood Pictorial which has drawn much favourable comment.

Commonwealth involvement

Following the Collaborative Study on Soil Conservation, the Commonwealth was expected to take a catalytic and co-ordination role in the national soil conservation scene by providing funds to the States for the development of catchment and other group schemes. Queensland had hoped for about $450,000 in the first year with subsequent rises as our ability to expand services grew. The Commonwealth Government has now decided to provide funds to the State but in an unmarked form for redistribution by the State in accordance with its own priorities.

State and soil conservation development

Massive development of the cropping industries are expected in central and southern Queensland in the next few years. Already an average increase of 64 000 ha a year has been developed for cropping over the last 5 years. Of this, some 90% requires protection against erosion. This rate is expected to grow significantly in the future. This suggests that the State is already falling behind in its efforts to keep up with protection of land. This year a total of 61 447 ha of land was given protection. There will have to be some dramatic increase in the Department's ability to service this need as the area under crop continues to grow.

Part of the increase of course is in newly-assigned sugar-cane land. Sugar country is often difficult to treat for soil conservation and rate of progress in these areas is slow. In 1980–81, a total of 2 643 ha of intensively cropped country was treated.

Estimates show that 53% of the extensively cropped land which requires intensive treatment has now received treatment, as has 23% of intensively cropped land requiring simple practices for control, and 14% of intensively cropped country. The number of new co-operators during this year was 307 compared with 234 last year, but 700 requests for new services were received.

Land management research

The effects of surface cover on the surface sealing of swelling clay soils was clearly demonstrated in preliminary rainfall simulator studies. As a result of these effects, infiltration was greatly increased under straw mulching.

Tillage across the slope was also shown to delay run-off and to decrease total run-off. Erosion control benefits of zero tillage on a black earth soil appear to be entirely due to the maintenance of a good stubble cover.

The benefits of stubble retention on crop yield, soil moisture retention and soil loss reduction continued to be very evident in grain cropping on Darling Downs black soils. Trials this year resulted in wheat yield increases from 1.5 to 2.0 t per ha when zero till methods were used instead of burning stubble. Significant wheat yield reductions where stubble was removed were shown to be due mostly to increased run-off and reduced fallow water accumulation. Loss could be as much as $40 per ha in wheat yield alone.

Work has continued to study management and structure design characteristics for central Queensland. As well, the effects of clearing country on water run-off are being studied in a sophisticated project on Brigalow Research Station.

A network of piezometers has been established at Barmoya and Tanby in the Rockhampton area to measure changes in groundwater levels with time and with changes in vegetation cover and the relationship of these changes with salinity.

Clearing 50% of a sub-catchment in the Bremer-Lockyer has been found to initiate salting. The source of salt is saline groundwater and is virtually infinite. Affected areas in this district are spreading at an average rate of 5 to 10% a year.

The effectiveness of strip cropping has been shown to depend on width of strip employed, crop rotations practised, stubble management and obstructions to uniform water flow. Waterway failures have been associated with poor design, poor construction, farmer management and maintenance. Field manuals are being prepared and updated. Indian blue grass (*Bothriochloa pertusa*) has been the most promising grass species for waterway and land stabilization. It will grow on a wide range of soil types and fertility levels and can usually receive contour bank discharge within 12 months.

Engineering

Data collection to assist with implement matching extension have been collected. This has implications for energy savings as well as for farm economics. In similar vein, an engineer is a member of a team studying spray application technology, and several drying systems are

being examined. Research and extension activities relating to the conservation of energy are strongly promoted by this Section.

New machines designed by Departmental engineers have been built and are being tested. These include a towermister for pest control in orchards, a modified pea viner for harvesting bean seed, a drier for handling cattle rations which contain cassava and an on-farm peanut curing unit.

Important studies under way include initial designs of a revolutionary materials handling approach to fruit and vegetable wholesaling and retailing. A prototype bulk bin has been built for testing as part of this system.

Engineers have become part of the investigating team of the Department with projects involving planting equipment for minimum tillage and the design of specific equipment for experimental purposes. Another joint project is a greenhouse for ornamental production designed for low cost erection and operation.

Engineers are now available for contact at a number of country centres and the demand for their assistance on advisory and consulting bases to farmers and associated industry is already as much as they can handle.

Economic Services Branch

A comprehensive survey of milk production costs, involving more than 100 producers throughout the State, was conducted on behalf of the Queensland Milk Board. Smaller cost of production surveys were undertaken in the tobacco and egg industries for consideration by the respective marketing boards in price determination.

A national review of cost of production methodology was sponsored in a workshop session at the Australian Agricultural Economics Society Conference in New Zealand in February 1981. All States contributed to this review outlining their involvement in these studies. This information, along with the proceedings of the workshop, will be published in a Branch bulletin.

A major research bulletin was published demonstrating the application of input-output analysis to evaluate structural relationships in the north Queensland regional economy based upon survey work undertaken in the early 1970s. This innovative study was utilized to estimate the impact, in terms of secondary benefits, of agricultural development in the Burdekin River Project on other sectors of the economy. When the scheme is in full operation, the total annual increase in regional output (based on the increase in gross value of agricultural production of over $150m a year) should exceed $375m annually.

A mango survey of more than 300 commercial growers in north Queensland is being undertaken as part of an overall study of horticultural development in the Bowen-Burdekin region. The survey will establish the production potential for mangoes and the possible need for a processing facility.

With 22 regional agricultural economists located in 18 centres, advice on farm business management is now being provided throughout the State, with visits being undertaken during the year to remote centres in the Gulf and Peninsula areas and in far western Queensland. Increased demand for advice, training and publications in farm business management reflect a growing awareness of the importance of economic considerations in primary production.

Escalating land prices are generally in excess of productive values. This upward movement in land values, combined with higher interest rates, have eroded the feasibility of a young farmers establishment scheme intended to assist experienced young people with limited equity to purchase their first viable property.

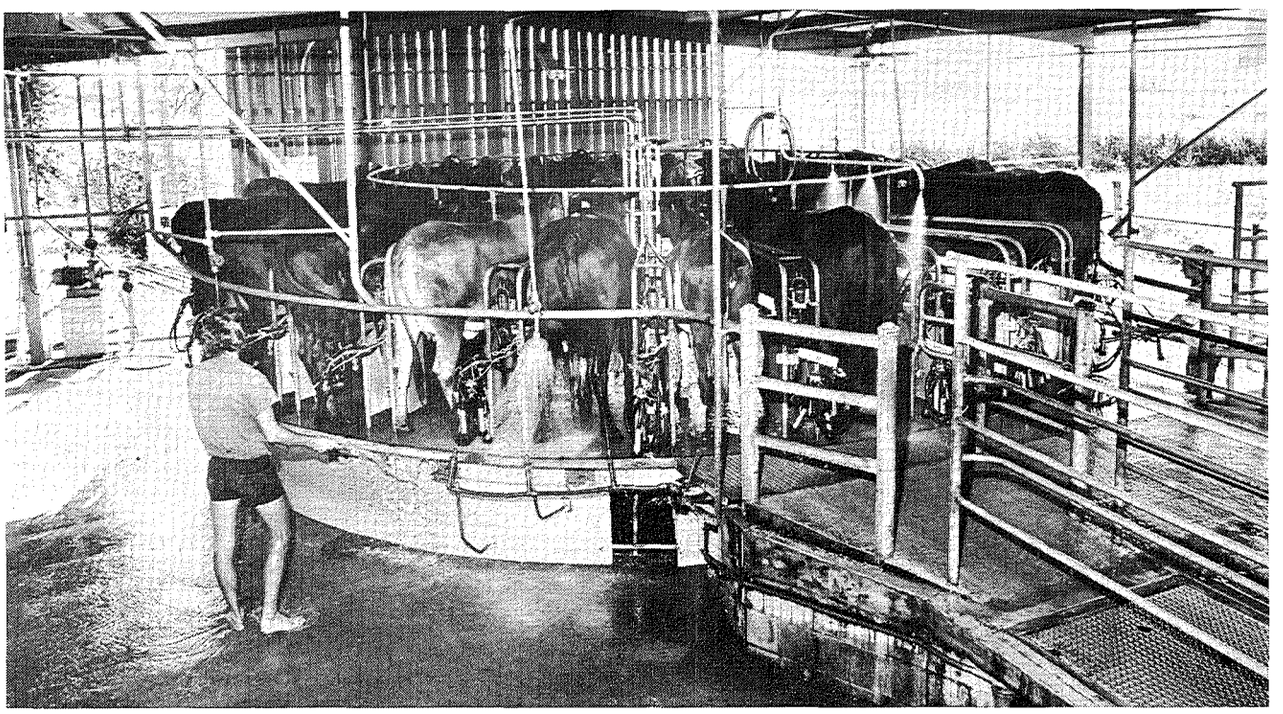
A microcomputer has been purchased with Commonwealth assistance to assess the suitability of this equipment for on-farm use. Considerable interest is evident in micro-computers and software programmes will be developed with industry-wide application and in the fields of farm management accounting and machinery investment decisions.

Mr S. J. Mill, Agricultural Economist, was seconded to the Queensland Meat Industry Organization and Marketing Authority for 4 months to assist in the economic evaluation of carcass classification trials. Assistance was also provided in computerizing the Livestock Market Reporting Service which should be fully operational in mid 1981.

Mr J. S. Dickinson, Agricultural Economist, was seconded as Chief Economist to the Northern Territory Department of Primary Production for 12 months.

Mr I. F. Whan, Agricultural Economist, Goondiwindi, undertook an overseas aid assignment in water resource economics in Thailand under the auspices of the Australian Development Assistance Bureau.

Apart from secondments and post graduate study leave the Branch is now at full strength following the appointment of Mr I. B. Robinson, former Senior Agricultural Economist with the Drought Secretariat, as Supervising Agricultural Economist (Research). This position has been vacant since Mr Moorhouse's appointment as Assistant Director in May 1980.



This rotary dairy shed at the Ayr Research Station has now been transferred to the newly-established Mutdapilly Research Station in south-east Queensland.

Research Stations Section

Between July 1980 and April 1981, the Department took possession of five properties in the Mutdupilly-Peak Crossing-Warrill View area. Operations on these properties were integrated to permit development of the Mutdapilly Research Station. Work on this new Station will be directed towards the dairy and beef industries.

Establishment of the new Station was part of an attempt to rationalize the Department's animal husbandry research activities. Development of Mutdapilly Research Station will permit total relocation of the dairy programe previously undertaken at Ayr and progressive phasing out of beef research at Coolum and at Rocklea. Milking operations at Mutdapilly were scheduled to begin in July 1981.

The future of Queensland's peanut industry appeared to be sufficiently promising to justify the implementation of a peanut plant breeding programme. Because there was a shortage of suitable land available at the J. Bjelke-Petersen Field Station, a further area of

about 30 ha was purchased. The new area lies about 5 km from the main Station and waterways were constructed before the land was planted to a test crop early in 1981 to assess soil fertility gradients.

Demands for research outstripped available resources and placed more pressure upon station managers, Research Station Committees, Industry Consultative Committees and the Research Stations Board. All of those groups had responsibilities for ensuring that available resources were used efficiently and effectively. There was a deepening concern that costs of buildings, equipment, materials and services were increasing at a rate greater than the rate of increase in money available. There were signs that it was no longer possible to maintain an adequate replacement rate of expensive items such as headers, trucks and tractors.

Several field days were conducted and, in almost all cases, attendances were most heartening. The enthusiasm of many producers trying to keep pace with research findings suggested that attempts to keep them well informed were justified. Most interest appeared to be focused upon new enterprises, new species or varieties of fruits, field crops and pasture plants, and genetic improvements in animals.

The Department's intentions to withdraw from research with pigs at Hermitage and to consolidate at Biloela has progressed appreciably. Construction of new facilities at Biloela is expected to be completed in September 1981, and the transfer of pigs from Hermitage will be completed before March 1982.

Substantial improvements in water supplies were undertaken on three Stations. These improvements were aimed at livestock supplies on Brigalow Research Station, at irrigation on Gatton, and at domestic and general purposes at the Hermitage Research Station.

Seasonal conditions were not helpful over much of 1980–81. Drought conditions and heatwaves caused concern at Hermitage, Gatton and Kingaroy. The wet season arrival was very late at Kairi, Walkamin and Millaroo. Excessively wet conditions adversely affected crop and pasture growth at South Johnstone and Ayr in January. Despite these upsets a very good record was achieved in the establishment and successful completion of research projects.

Acknowledgements

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

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

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

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

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

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

Yours faithfully,

G. I. ALEXANDER,
Director-General.

Mr Jonathon Adebayo Adeyemi, of Nigeria, shares a joke with the Minister for Primary Industries (Mr Mike Ahern) at a reception to welcome 20 overseas dairy technologists at present studying in Queensland. The 3-month course provided experience in dairy manufacturing techniques for technologists from African and Asian countries.

Division of Administration

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

Central Administrative and Accounting Services

Staff establishment in the Central Administrative and Accounting Services at 1 July 1981 compared with the previous year is shown in the following table—

—	As at 1-7-80	As at 1-7-81
Ministerial staff	6	7
Departmental directorate and internal audit	7	9
Brisbane administration and records	55	55
Commercial, despatch and stores	13	13
Country support staff	108	110
Accounting and finance	65	67
TOTAL	254	261

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

General overview

The 1980–81 Report briefly reviewed the major investigation made into Departmental operations as part of a long range plan to provide appropriate management systems.

Central to the success of the whole development is:

1. the gaining of acceptance for and development of managerial capacity to develop, evaluate, monitor and review results-orientated programmes, sub-programmes and projects;
2. the development of information processing and distributing systems with the capacity to supply timely up-to-date management reports of appropriate content to all levels of management and for distribution to remote centres;
3. to establish appropriate cost centres or responsibility areas to allow adequate forward planning and management of developmental and of operating overhead costs associated with Departmental research, laboratory, administrative and other centres throughout the State;
4. definition of project and overhead costs of Departmental centres in such a way that dysfunctional effects are minimized while at the same time attempting to optimize responsibility for the estimating and controlling of these costs through structures which permit their effective management.

Progress during 1980–81 has been limited to items 1 and 4 above. Development of items 2 and 3 can follow only after the acquisition of suitable computer hardware and associated software. Processing of present management accounting information is performed either manually or on obsolete accounting equipment, some of which is now up to 15 years old and some of which has been acquired as discarded equipment from other Departments.

During 1980–81 an Organisational Services Branch was established. The Branch comprises the Personnel Administration, Personnel Development and Programme Planning and Methods Sections. The Branch brings together some of the people who have been involved in recent formal management training with the objective of planning and co-ordinating the activities of sections which will play a significant role in the development of the future management systems referred to earlier in this section of the Report.

During 1980–81, development of computer programmes for a register of the Department's plant and equipment was completed. This development is now undergoing a successful implementation phase. Virtually all plant and equipment in the Brisbane area as defined by Treasurer's Instruction 221 under the Financial Administration and Audit Act has now been placed on the computer file. Training has been completed for centres south of Mackay and is planned for extension to the rest of the State by the end of September 1981. It is expected that this development will be completed in 1981–82. In addition to providing an inventory of items, it will provide information on existing equipment to permit its more optimal utilization throughout the State. It also will assist in planning funding requirement for replacements. This is a major problem at present. Data now becoming available will allow the need to be far more objectively assessed.

Concurrent with the Management Development Training for senior staff as discussed in the Information and Extension Training Section of this Report, emphasis has been placed on an Administrative Development Programme. This programme complements and prepares junior staff to efficiently and effectively assist in the general administration of non-technical systems. During 1980–81 the programme has involved Role Specification for clerical and administrative personnel, identifying systems requiring attention and addressing the training needs of clerical officers. The programme creates a climate of involvement in the development of new systems and facilitates acceptance of the changes which evolve.

Departmental staff

The approved permanent salaried staff establishment of the Department for 1980–81 compared with the previous year is shown below:

—	As at 1-7-79	As at 1-7-80	As at 1-7-81
Consolidated Revenue Fund	2 317*	2 321†	2 323
Trust and Special Funds	287	286	293
Commonwealth Funded	131	132	137

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

During the 1980 academic year, 302 officers were undertaking approved study courses ranging from Senior to Doctor of Philosophy. Of these, 40 officers completed their courses. Approvals granted for courses commencing in 1981 total 54.

Retirements

A total of 29 staff resigned or retired during 1980–81 after attaining 60 years of age. Officers who retired after more than 25 years' services were: Messrs E. O. Burns, Director-General and Under Secretary, F. W. Butcher, District Adviser, Horticulture Branch; L. F. C. Dale, Assistant Administration Officer; G. L. Duffy, District Inspector, Veterinary Services Branch; L. F. Dunbar, Herd Recorder, Dairy Cattle Husbandry Branch; W. T. K. Hall, Director of Pathology; M. D. Kirwan, Farm Supervisor, Research Stations Section; J. W. Littler, Senior Agronomist, Agriculture Branch; A. B. Lowry, District Inspector, Standards Branch; C. W. R. McCray, Director, Biochemistry Branch; J. F. Meehan, District Inspector, Veterinary Services Branch; P. D. Steele, Accountant-Member, Central Sugar Cane Prices Board; S. R. Walsh, District Adviser, Agriculture Branch; C. R. Watson, District Inspector, Veterinary Services Branch; C. I. Younger, District Adviser, Sheep and Wool Branch.

Accommodation

Completion of the Mareeba District Office Complex early in 1981 with the erection of Stage II of the Complex has enabled all Mareeba Departmental services to be accommodated at the Complex. A more efficient service to the farming community in Mareeba and the surrounding rural areas should result.

Much needed extensions and renovations to the Office-Laboratory Complex at Rockhampton and the Wacol Artificial Insemination Centre have been provided. The official opening in November 1980 of the Wacol Centre marked the twenty-fifth year of the Department's services in artificial breeding in Queensland.

In order to provide disease-free birds for routine diagnostic work and research, the facilities at the Animal Research Institute at Yeerongpilly have been expanded with the erection of medium security and conventional poultry sheds.

Unless additional funds become available to the Department to meet the cost of providing new facilities and the replacement of others no longer viable, services will no longer be able to meet the reasonable demands of the rural community.

Finance

During 1980–81, the operations of the Department were under considerable restraint due to staff ceilings and funding limitations imposed through Commonwealth and State Government policies and industry economics.

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

Natural disasters again placed heavy demands on finances. Administration of the joint Commonwealth-State Disaster Assistance Scheme inspections and processing of payments were met wholly from Departmental funds. Actual assistance payments made by this Department and subject to cost sharing arrangements amounted to $11,709,648 compared with $1,644,553 in 1979–80.

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

Vote Sub-Division	1979–80	1980–81
Payments authorized by special acts	$	$
Grant in Aid of the Banana Industry Fund	70,048	90,887
Department of Primary Industries		
Salaries	32,798,332	38,286,438
Contingencies	17,162,026	20,856,452
TOTAL	$50,030,406	$59,233,777

The Queensland Fisheries Service was transferred to this Department during the year. The above figures in regard to 1980–81 include financial transactions of that Service from 1 February 1981. Expenditure on behalf of the Queensland Fisheries Service from the Consolidated Revenue Fund amounted to $455,507 and $328,022 in respect of Salaries and Contingencies respectively.

Payment of compensation within the Bovine Brucellosis and Tuberculosis Programme amounted to $1,515,910 during 1980–81 compared with $631,333 in 1979–80. For the year 1979–80, the State's share of the Commonwealth-State Bovine Brucellosis and Tuberculosis Eradication Programme amounted to $2,101,178 of a total expenditure from Consolidated Revenue Fund of $7,210,771. General direct operating costs for the year ended 30 June 1981 totalled $3,998,175 and direct salary costs amounted to $1,864,170. Indirect costs and charges had not been assessed at the time of preparing this report.

Transactions in respect of the Trust and Special Fund as compared with the previous year are shown in the following table—

Trust and Special Fund	1979–80	1980–81
	$	$
Department of Primary Industries Special Standing Fund	4,295,887	13,658,810*
Banana Industry Fund	224,161	208,869
Commonwealth Agricultural Extension Services Fund	1,379,257	1,276,373
Commonwealth Poultry Industry Assistance Fund	2,634,584	3,354,784
Commonwealth Quarantine and Export Inspections Fund	2,096,694	2,478,936
Commonwealth Rural Industry Grants Fund	2,066,587	2,072,292
Fisheries Research Fund	. .	184,164**
Meat Inspection Account	2,374,051	2,787,543
Poultry Inspection Fund	530,910	561,610
Stock Compensation and Stock Improvement Fund	11,980	23,585
Stock Fund	285,972†	. .
Sugar Cane Prices Fund	1,182,600	1,614,313
Swine Compensation Fund	11,793	31,438
TOTAL	17,094,476	28,252,717

* Includes $11,709,648 on account of Disaster Assistance Scheme.
** This fund transferred to this Department from 1 February 1981.
† Transfer of Balance of Fund to Consolidated Revenue Fund.

As a result of the transfer of the Queensland Fisheries Service to the Department, expenditure of $374,868 was incurred on behalf of that Service through the Loan Fund from 1 February 1981 to 30 June 1981.

Technical Support Services

Research Stations Section

ACQUISITION of commercial properties in the Mutdapilly-Peak Crossing-Warrill View area paved the way for the preliminary development of the Mutdapilly Research Station. This brought to 12 the number of Stations operated by Research Stations Section.

Facilities and equipment on these Stations are used for conducting research projects on the Stations and, under approved circumstances, on certain commercial properties in the surrounding districts.

Research Stations Section is concerned with Stations at Kairi, Walkamin, South Johnstone, Ayr, Millaroo (near Ayr), Brigalow (near Theodore), Biloela, Coolum, Kingaroy, Mutdapilly, Gatton and at Hermitage (near Warwick).

Administration

The Section's facilities and resources were used to implement projects which fell within the broad objectives of research programmes endorsed by a Research Stations Board. The Board was established in 1961 and was, until January 1981, normally under the Chairmanship of the Deputy Director-General. As a consequence of restructuring in the Department's Central Management Group, the Assistant Director-General responsible for research became Chairman of the Board from 20 January.

The Board, made up of its Chairman and the Directors of each of the five Divisions, met on nine occasions during the year. One of these meetings was held at the Mutdapilly Research Station and included a close inspection of the soils, topography and physical improvements on the newly acquired properties.

Each Station has a Reviewing Committee which is responsible for examining proposals submitted for inclusion in that Station's research programme. The Committees allot priorities to individual project proposals so that the resources and facilities available on Stations can be used effectively.

Demands on Research Stations continue to expand and to intensify as pressures mount to develop the State's land resources, as producers in established areas request assistance aimed at ensuring their long-term viability, and as research workers seek to upgrade their activities by taking advantage of technological advances. These demands for expanded services are being made in a period when inflation and 'no-growth' policies are combining to cause a contraction of real funds available.

Industry Consultative Committees at Kairi, Brigalow, Biloela, Kingaroy and Hermitage include progressive, influential primary producers. The practical, commercially-oriented experience of these producer members is particularly useful to Station Committees and to the Research Stations Board in determining priorities consistent with effective use of limited resources.

A mature stand of Makueni guinea grass under grazing at the Utchee Creek sub-station. Originally from the highlands of Kenya, Makueni shows superior winter growth to other guinea grasses on the Queensland wet tropical coast.

Notable events

Field days and demonstrations proved to be well worth the effort. From the numbers of producers attending and from the animated and sometimes prolonged question periods, it was clear that there were many producers keen to adopt new technology and to attempt new ventures. Events warranting particular mention were—

An open day at Hermitage (attended by more than 500) at which the entire research programme was thrown open for inspection and discussion.

A stubble-mulching and soil surface management field day at Biloela.

Horticultural tree-crop field days at Walkamin where particular attention was devoted to mangoes, litchis and to avocados.

The annual inspection of beef pastures on the wet tropical coast and the tabling of accounts relating to the Utchee Creek grazing demonstration.

Pasture research on the wet tropical coast has proven fattening to be a commercially viable proposition even when market prices are low.

Demonstrations in navy bean growing areas of direct harvesting equipment developed by the Kingaroy Engineering Works and the Navy Bean Marketing Board with assistance from staff at the J. Bjelke-Petersen Research Station.

A field day at Millaroo staged for the benefit of rice growers and highlighting advances in weed control, fertilization and variety testing.

Research Station managers met to discuss a wide range of topics. Emphasis was placed on developing means of increasing efficiencies in the use of resources, of sharing equipment between Stations and of making better use of established workshops. Labour relations and the control of staff were also highlighted and the participation by representatives from the Australian Workers' Union and the Department of the Public Service Board in those discussions was welcomed.

Land acquisitions and disposals

Five commercial farming properties were purchased in the Mutdapilly-Peak Crossing-Warrill View area. Four of these properties were contiguous and clustered around Churchbank Weir on Warrill Creek. The fifth property, about 12 km away at Warrill View, draws irrigation water from Warrill Creek. Two of the five properties purchased held milk quotas and three held significant irrigation water allocations.

The Mutdapilly Research Station was taking shape at the end of June. Most old subdivisional fencing had been removed, boundary fences had been renewed on portions east of Churchbank Weir, new paddock layouts had been designed, and the rotary dairy previously operated at Ayr Research Station had been re-assembled at Mutdapilly. Milking operations at Mutdapilly were scheduled to begin in July 1981.

Mutdapilly Research Station was established to permit the Department's dairy research programme to be re-organized. Dairy research work at Ayr Research Station was terminated in December 1980 and staff and animals were progressively transferred to Mutdapilly during the first half of 1981. The Ayr Research Station became available for re-development to service new research needs created by the decision to proceed with the construction of a major dam on the Burdekin River.

The Mutdapilly Research Station also caters for research work with beef cattle and permits remobilization of resources based at Coolum Research Station. This rationalization will permit Coolum Research Station to be closed during 1981–82.

At Kingaroy, an important peanut plant breeding programme gained momentum. Limited availability of suitable land at the J. Bjelke-Petersen Field Station made it necessary to acquire two adjoining parcels of land, totalling some 30 ha, approximately 5 km from the main Station. Also at Kingaroy, four allotments adjacent to the building area on the main Station were acquired to improve security over the Department's property and trials. Access to the new land permitted relinquishment of areas previously leased on the Kingaroy Industrial Estate.

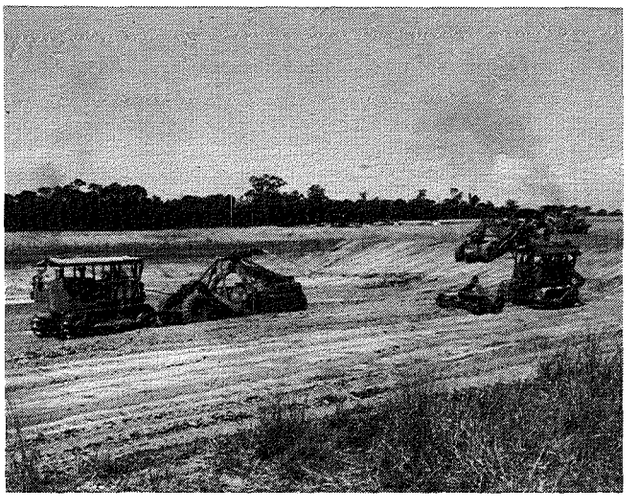
New facilities and equipment

Financial limitations and inflation-induced increases in costs curtailed development. Under these circumstances, Stations expanded research programmes only at the cost of abandonment of realistic equipment replacement strategies. Operating costs for new projects came largely from funds that should have been set aside for the maintenance of plant and machinery and for replenishment of material stocks.

Fortunately, the Department's senior management was able to gain recognition of the critical stage that had been reached early in 1980 and special funds were released to permit some restocking and essential repairs.

New items commissioned in 1980–81 included: additional spray irrigation equipment at Biloela; a combine harvester, trashworker and disc harrows at Brigalow; tuber harvester, small tractor and slasher at Gatton; tractor, hayrake and plot grain harvester at Hermitage; 2 x 23 tonne maize silos, a slasher and improved molasses handling equipment at Kairi; a rotary hoe at Millaroo; a plot harvester, light tractor and rake at Walkamin; a gas-fired drying chamber at Kingaroy.

Department of Works projects undertaken included: two controlled environment growth cabinets and improved water supply facilities at Hermitage; a new irrigation bore at Gatton; a new piggery building at Biloela; construction of a new dam and significant extension of an existing dam at Brigalow Research Station to ensure 3 years' supply of water for livestock; erection of the dairy at Mutdapilly and renovation of dwellings on newly-acquired properties; renovation of buildings and resurfacing roadways at Millaroo; re-modelling of the office-administration building at South Johnstone; construction of six new fish ponds at Walkamin; upgrading of electrical reticulation and water supplies at Kairi.



Constructing a dam on Brigalow Research Station. Works completed in 1981 will provide water for livestock throughout a drought lasting 3 years.

Achievements

Research Stations Section is predominantly associated with the servicing of research programmes. Details of research achievements appear in Divisional contributions to this Report.

In 1980–81 a very high proportion of projects was successfully serviced despite adverse seasonal conditions.

At Coolum, impending closure of the Station caused labouring staff to resign as alternative job opportunities arose. Despite a high proportion of inexperienced staff, the research programme proceeded as scheduled.

Dry conditions at Brigalow Research Station led to heavy damage of crop plantings by marsupials, pigs and birds but grain quality was excellent and cattle performance was better than normal.

Grain from this wheat fertilizer trial harvested at Brigalow Research Station in October 1980 was of excellent quality.

Frequent failures of aged equipment at Biloela caused a lot of frustration but almost all trials were successfully concluded. A special task force was established to plan the redevelopment of Biloela Research Station to improve drainage and irrigation layouts and to overcome sharp variations in soil fertility. Lucerne hay grown at Biloela saved drought-affected animals at Brigalow, Ayr, Mutdapilly and Hermitage.

South Johnstone suffered from extremely heavy rainfall in January and cassava stands were damaged by excessively wet conditions. Earlier in the season, excellent results had been obtained with banana, sweet potato and pasture trials.

Commercial producers assessing the prospects for coffee in north Queensland obtained further supplies of seed from Kairi. The old plantation on Kairi was cleared of shade trees to permit tests to be conducted with a mechanical harvester being developed by a commercial coffee producer.

Clearing and cultivation of new ground at Walkamin was intended to overcome the critical shortage of land available for pasture seed production studies and for increasing seed stocks of promising lines of pasture legumes.

At Kingaroy, alternating periods of drought and extremely heavy rains did not prevent an almost perfect record in trial establishment and harvest. Peanut seed handling equipment operated well after some modifications and handling systems were devised which would cope with demands expected to be made by the expanding plant breeding programme.

Patchy rains on the Darling Downs as the area emerged from severe drought conditions caused Hermitage staff to chase the storms. This was done so successfully that an excellent success rate was achieved with off-Station trials. Improved seasonal conditions were welcomed and the 1981 winter programme on the Station was successfully established.

Gatton felt the full effects of drought conditions, heat waves and a damaging hail storm. Nevertheless, significant progress was made with most research programmes. Successful commissioning of the Wuhlmaus tuber harvester permitted some impetus to be given to soil physical studies.

Information and Extension Training Branch

DIRECTION of effort in Information and Extension Training Branch remained unchanged in 1980–81. As in the past, its principal functions were: 1. to disseminate agricultural information in the community, paying special attention to the rural sector; and 2. to provide training programmes to develop in Departmental staff management and extension methods skills.

To carry out these basic aims, the Branch supplies support services in publications, still and cine photography, art, duplicating, audio-visual equipment, and library services.

Total staff of the Branch stood at 65 on 31 May 1981. Of these, seven were officers of Public Relations, Government News and Information Services, Premier's Department; 12 were librarians from the State Library; and one was a printer from the Government Printing Office.

Major innovations were the expansion of the newspaper special features to include a monthly page for the *National Farmer* and an increase in editorial work on books for sale.

Information section

Editorial. Six issues of the *Queensland Agricultural Journal* were published during the year under review. This magazine remains the Department's principal extension publication though there is a disturbing tendency for some Branches to publish in ephemeral duplicated formats.

A change in technology at the Government Printing Office permitted the introduction of a new, modernized format for the *Journal*. Branches that continue to publish in the *Q.A.J.* can be confident that their articles are placed in a modern, prestige publication.

In the last year, 79 major articles were published in the journal, covering such topics as: beef cattle breeds, pig raising, tea in Queensland, cattle fencing and plum growing.

Editorial staff co-operated with Branches in editing, recording and producing 142 new Farmnotes and 39 Refnotes.

As noted in last year's report, most subjects that readily lend themselves to Farmnote presentation have been covered. The rate of new accessions is slowing, but the number of reprints and revisions is increasing.

Farmnotes, where they consist of no more than two sheets, are the fastest and most economical means yet adopted of conveying written information to producers. Beyond two sheets and a printing run of 500, delays occur and costs rise. More economical means of handling bigger jobs will be investigated during the coming year.

Editorial staff had a much greater involvement in producing 'for sale' publications for use by farmers, agribusiness and home gardeners. Nineteen titles are at present being offered for sale and sales totalled 3 988 volumes in the year under review.

A further 12 titles are in press and are expected to be on sale before the end of the 1981 calendar year. Besides completing those in press, a further five are in an advanced stage of planning.

The increased editorial needs have led to re-structuring of the Branch's journalistic staff. Duties of a vacant position of Agricultural Journalist were changed to those of a book editor without any change of designation or classification. An appointment is expected early in the new financial year.

The increased book editing has created a greater demand for Cataloguing-in-Publications data from the National Library and the allocation of ISSN and ISBN. This has fallen within the orbit of the book editor, as has preparation of title pages following the reorganization of D.P.I. publications into new and more appropriate series.

The editorial section also had major commitments in handling the work of the journalists and in preparing for publication the Department's Annual Report to Parliament. Officers of this section also provided the service of preparing speech and background notes and special articles for the Governor, State Cabinet Ministers in various Departments as well as the D.P.I., and the Director-General.

The Assistant Director, Senior Information Officer, and Editor, *Queensland Agricultural Journal*, attended the Australian Agricultural Editors' Workshop at Glenormiston Agricultural College, Victoria, from 18 to 22 May 1981.

Press. The demand for the weekly bulletin of press items continues to increase. It is now sent to 131 media outlets, both in Queensland and interstate, made up of 100 provincial and metropolitan newspapers, 25 radio stations and six television stations.

Agricultural news featuring the Department's role in Queensland's primary production appears regularly in provincial newspapers. Some items with wide appeal are used by metropolitan newspapers.

Besides this coverage, feature articles are prepared for newspapers both at their request and at the initiation of the journalists.

Newspaper coverage in *Queensland Country Life* continued throughout the year. This rural weekly with a circulation of 30 000 is an ideal vehicle for carrying stories on the achievements of D.P.I. research to the agricultural and pastoral community.

This principle of supplying a special service to selected newspapers was expanded during the year. The *National Farmer* offered to publish one page per month of extension material supplied by the D.P.I. Since February 1981, the monthly page has appeared under the Department's banner.

National Farmer's circulation policy puts a copy free of charge into every farm home in the State—some 35 000. The value of this type of coverage to the Department is enormous.

Radio. The main radio output of the Branch is a weekly 15-minute programme which is sent to 16 rural radio stations in Queensland. This programme has been re-organized this year in response to a survey of the radio stations who use it. It now consists of five segments each week, including a news report and four interviews.

Officers from Marketing Services Branch continue to use Information Branch facilities to tape a 2-to 3-minute talk each week for the A.B.C. Country Hour.

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

Television. The restricted requirements of the metropolitan channels which are serving a predominantly urban audience have not encouraged the expansion of television coverage.

Provincial television, however, provides a limited coverage.

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

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

The aim of the regional information is to support the Department's extension programme in the areas served.

Art. In 1980–81, commercial artists engaged on publications work produced 340 pieces of art work for publication through the Departments' in-plant duplicating service and through the Government Printing Office.

The display artist again set up a first-class display at the Royal National Association's Exhibition. This officer also handled displays at 14 district shows. To date, more than 50 000 people have passed through the State's static helicopter display.

In-plant duplicating. The requirements of Branches for large-scale duplicating show no signs of slackening. Some relief occurred towards the end of the year when the Government Printing Office developed a 'fast print' service. This enabled work beyond the capacity of this Department's equipment to be diverted to the Government Printer with the client receiving a speedy service.

Production in 1980–81 was 7.5m printed pages. This puts the value of duplicating Branches received in excess of $67,500 on current Government Printing Office rates. In addition, most of the work was collated free of charge to Branches.

Photography. A major increase in the requests for colour photography was a feature of the work performed by Photography Section during the year. The number of colour prints supplied increased by 620% and most location shooting was on colour film rather than black and white. This change has greatly improved the appearance of the various Branch and show displays.

Another area of major increase was the use of mural prints. The increase here was 350%, mainly because of improved design in displays at shows, field days and various branch offices.

One area of improvement in the quality of the work produced has been in the area of sound production for both film and audio visual displays. The recent purchase of major recording equipment and the current rewiring of the sound room will increase both the capabilities and final standard of recording performed here.

A new area of endeavour has been in the field of video production. During the year, this section produced five video tapes for Departmental use internally and in conjunction with outside organizations promoting agriculture and primary industry.

Major projects completed during the year were: Parthenium in Perspective (a 24-minute film), The Biggers' Method of Spraying (a 12-minute film), five video tapes, 3 audio-visuals (slide-tape) presentations for Sheep and Wool Branch, 2 audio-visual presentations for the Department of the Public Service Board, film and video presentations for Quarantine during the hamster scare, and 5 major photography expeditions for various branches. At present, six film projects are in various stages of production.

General inquiries. The average number of inquiries per day at the Information Centre on Floor 10, Mineral House, is 18. About 80% of the inquiries are answered with information available at the counter and 20% are directed to other locations.

The appointment of the horticulture adviser has greatly increased the number of telephone inquiries coming to the Branch. The average number of phone inquiries per day is 50 of which the horticulture adviser answers about 45. The remaining 10% are handled at the counter.

An average of 20 letters a day is sent in answer to requests for agricultural information.

The Branch continued to handle sales of Departmental publications. It assumed this responsibility in November 1979 and the success achieved so far augurs well for the future when more 'for sale' publications become available.

The move has shown the need for the enlarged central distribution centre which is proposed for 1981–82. On present indications this section will handle the distribution of all Farmnotes and Refnotes produced by the Department.

Total book sales from the 19 titles handled during the year stood at 3 988 on 31 May 1981.

Audio-visual equipment loan service. The Branch continued to conduct a centralized audio-visual loan service from Brisbane to ensure efficient use and servicing of equipment. Most loans are made in areas close to Brisbane, although equipment is also sent to country centres.

A C.E.S.G. grant of $1,000 was used to replace and upgrade equipment. A special Treasury allocation of $12,000 was used in the previous year to replace obsolete and unserviceable equipment in country centres. This has reduced the cost of freighting equipment to distant centres and has increased the efficiency of the service.

The service made 1 147 loans during the year as well as servicing and repairing equipment.

Training

Training Section activities were designed to increase the job effectiveness of individual officers and work groups throughout the Department.

Separate courses were tailored for the different needs of officers in the areas of research, extension, regulation, administration and management.

Courses for research, extension and regulatory officers concentrated on communication theory and practice. These courses highlighted common work situations. The extension course emphasized communications with primary producers, the research course dealt mainly with seminar work, and the regulatory course concentrated on regulatory interviews.

The management training programme is continuing. The core activity is a 12-day course divided into three time blocks interspersed with follow-up consultations. Additional training was provided through short courses on specific topics for managers who had completed the basic course and who sought more detail in selected areas.

The Training Section assisted the administrative and clerical staff to design and implement a programme of courses for non-technical staff. This programme should continue through 1982.

In addition to running the centrally organized courses, training staff conducted activities designed to meet the needs of individual sections and Branches of the Department. These activities included workshops of various types (writing, role specification) and consultations with line managers to help them facilitate organizational changes.

The training section monitored relevance and quality of training by keeping close contact with Departmental managers and course participants, both before and after each major activity.

Library

The library, with a staff of 26, is numerically the biggest section of the Branch.

The major project in the year under review was the cancellation of journal subscriptions to the value of $20,000. This occupied one librarian for 3 months, and problems arising from the cancellation were still occurring at the end of the year.

As a result of the problems perceived during the cancellation project, a computerized listing and accounting system has been designed for journal subscriptions:- Serials Accounting Recording Automation (SARA).

A user proposal and feasibility study for this project have been produced and approved. Input of records began in May 1981 and should be completed in 5 months.

Bibliographies. Volume 1 of the Department's computerized List of Bibliographies was produced in April 1981.

This Volume contains a complete list of bibliographies compiled by D.P.I. library staff and a list of bibliographies received from other sources since January 1981. It contains 906 references. Cumulations will be produced regularly.

Fisheries Library. In February 1981, Fisheries Service Library was incorporated in the Department of Primary Industries. Fisheries Library now comes under the jurisdiction of the D.P.I. Central Library. It is staffed by a librarian from the State Library and a stenographer.

Ordering and cataloguing services, which were once the responsibility of the Fisheries Librarian, are now done by Central Library staff.

Library accommodation. The new library at Mareeba is finished and the collection is now organized in one location for the first time.

Statistics. The statistics of library operations are—

Accessions: Central Library 1 217 books, 65 journals.
Loans: Central Library 5 009, Branch libraries 8 723.
Inter-library loans: Central Library 847 loans, 1 379 borrowings; Branch libraries 1 105, 2 536.
Contents pages circulated: Central Library 22 972.
Articles copied from contents pages: Central Library 8 322.
Bibliographies (manual): Central Library 14, Branch libraries 20.
Computer searches: Central Library 8, Branch libraries 23.
Books catalogued: Central Library 2 620 (new and revised), 1 867 (added copies).
Total pages photo-copied: Central Library 115 628.

Biometry Branch

PROVISION of a biometrical consulting service to the Department's research staff is the major activity of Biometry Branch. Consulting includes: definition of research problems; collaboration in experimental and sampling designs; advice and assistance with statistical analysis; data analysis and interpretation; research participation and co-authorship; and refereeing manuscripts for statistical appropriateness.

Consultation before formal approval of projects continues to be essential to ensure that appropriate experimental designs are used and to ensure that data can be analysed efficiently. The inservice training programme and the decentralization of the Branch have been key factors contributing to a more effective consulting service.

During 1980–81, 335 new research projects were submitted to the Branch for comment on experimental design. The reduction of 15% compared to 1979–80 is, in part, attributable to an increasing tendency to present proposals on a programme rather than a project basis. The increases of about 6% in data submissions and analyses completed indicate the increasing workload being handled by the Branch.

The following table summarizes work undertaken during the year—

BIOMETRICAL WORK SUMMARY 1980–81

Region	Projects approved	Data submissions	Analyses completed	Analyses outstanding
North Qld	92	185	192	12
Central Qld	52	54	31	42
Darling Downs	115	157	166	14
South-east Qld	76	254	261	61
TOTAL	335	650	650	129

The variation in complexity and analysis time across the range of projects submitted to the Branch limits interpretation of the above data. Job turn-around times have generally been lower in the regional centres. However, in Brisbane it has still been possible to complete most of the smaller jobs in less than a month. The workload in Brisbane has meant that biometricians are more fully committed to servicing client needs. They have thus had less opportunity to contribute to more general problems warranting biometrical research.

The biometricians were ably supported by the three technical assistants at Toowoomba, Townsville and Rockhampton. In the Darling Downs region, regional, strain and screening trials for wheat, barley, chickpea and sorghum with wheat are conducted on an annual basis. These data are numerous and are analysed using Biometry Branch's own suite of programmes for randomized block designs (RANB), balanced factorial designs (BALF), lattice designs (LATT) and grid-plot designs (GRDP). Field-books for recording data for proposed trials were also printed using FLDB, a programme written for this purpose by Biometry Branch.

In the north Queensland region, similar work was done for the maize breeding programme. In central Queensland, assistance was given to users in running the computer package TAXON which contains classification and diagnostic programmes. These were used to classify and interpret qualitative and environmental data. Vegetation density and composition were computed from data obtained by the point centred quarter method. A programme especially written for this purpose was used.

Projects undertaken

The vast number of diverse projects handled by the Branch makes it difficult to report comprehensively on the contributions made by biometricians to Departmental research. The following projects have been selected to illustrate the range of statistical methodology employed.

Conductivity experiments. Analyses of data from an experiment to investigate the effect of reducing steeping times on the accuracy of the conductivity test for bean seed quality showed that conductivity was related to time.

Linear relationships were found between conductivity measured at 24 h, the traditional steeping time, and at reduced steeping times. High correlations indicated that a steeping time lower than 24 h could be used. Consideration of the analyses allowed a recommendation that steeping time be reduced to 4 h.

Dairy pasture utilization and management practices. The data set for the dairy pasture utilization and management practices project was collected from a sample of pastures being planted under an improved pasture subsidy scheme. Every feature of the site and management which could conceivably affect the pasture performance (about 200 in all) was monitored annually for up to 5 years. About 180 pastures were involved. The aim of the survey was to highlight the major

factors affecting pasture establishment and persistence and to suggest areas for further research. The main variable of interest was the 'general state of the pasture'—a three-category rating made at the end of each year. Most other variables were also categorical. The assessment was complicated because each pasture was usually a mixture of species of both legumes and grasses with up to five legumes and four grasses planted at each site. Assessments for each species were also made. Checking the data for consistency and editing it after matching back against the original survey forms were major tasks.

The statistical package for the social sciences (SPSS), developed at Stanford and Chicago Universities, was used to tabulate the data by the various sites and management practices. A special computer programme was written to tabulate the data to show what happened to each species. Simple associations have been used to screen factors related to change in the general state of the pasture, and it is intended to use a similar approach on the more common species before attempting to relate the performance of these species to more than one factor at a time. The initial results have been promising, confirming some expected patterns and suggesting others, so that the further analysis seems warranted.

Rate of decay of organisms. Laboratory experiments were carried out to determine the effects of three different soil types and three water potentials on the survival of two different biovars of *Pseudomonas solanacearum*. Each of these 12 combinations was represented by four bags of soil, with infestation levels adjusted at the beginning of the experiment to be as equal as possible. Levels of the organisms in each bag were monitored over an 18-month period. Exponential decay relationships were fitted for each bag. This was followed by analysis of variance to examine the effects of soil type, water potential, biovar, and their interaction on rate of decay. Adjustments to the analysis were made for counts which were too low to be detected by the method used.

Survey of trace metals in cattle. This trial covered 10 districts throughout the State. In each district, between 12 and 25 cattle were slaughtered, and measurements on eight heavy metals were taken from three tissues (muscle, liver and kidney) of each animal. As approximately 60% of the data were less than the detection limit of that particular test, non-parametric tests, in particular the Kruskal-Wallis and median tests, were used. The analyses showed that the kidney frequently had significantly higher metal levels than the liver, which in turn was often significantly higher than the muscle. Comparing districts, Mount Isa was consistently in the top two or three districts for each metal and tissue, although in relatively few cases were differences between districts significant. When the new maximum recommended limits for these trace metals are received from the Department of Health, Canberra, it will be determined whether the values for districts and tissue exceed these limits.

Railed cattle losses in Queensland. In a Statewide cattle train survey, approximately 97 000 head of cattle were surveyed and 101 deaths were recorded. Rothamsted general survey programme (RGSP), developed at Rothamsted Experimental Station, U.K., was used to derive the contingency tables examining the factors associated with transit deaths. The effect of factors such as transit time, sex, temperament, breed, condition, mustering method, time held in property yards, time in railway yards, loading density, temperature, wagon type, origin and destination of cattle, feed and water availability, on losses was investigated. The low mortality (0.1%) made it impossible to build any model to explain deaths-in-transit of railed cattle. However, the Queensland Meat Industry Organization and Marketing Authority was able to give recommendations aimed at reducing losses among rail transported cattle in Queensland.

Tick infestation. The effects of various chemical treatments on the number of ticks dropped by cattle after infestation with different strains of ticks infected with certain parasites were investigated. There were serious restraints on the experiment. As the animals must never have been tick infested before the experiment they could be used only once. The animals had to be quarantined and kept in individual pens designed so that the number of ticks dropped each day could be measured. There was only a limited number of suitable animals available and there were only six suitable pens. The experiment was lengthy and the pens were in demand for other projects. The experiments were usually repeated when the results of the first trial justified it. The experiments were completely randomized with two treatments (treated and control). It was possible to use conventional analysis of variance methods, since large differences were expected.

Bruising study at Roma meatworks. Bruising of carcasses is a serious problem to both beef producers and processors. The cost to industry was estimated as $27m in 1975. The level of bruising, its distribution on the carcass and the severity of bruises were assessed, using the Australian Carcass Bruise Scoring System, for 35 085 cattle at Roma Meatworks Pty Ltd between mid April and late October 1975. The statistical package for the social sciences (SPSS) was used to analyse this survey data, which consisted of 17 different bruising measurements and 11 classification variables for the carcasses. Difficulties in analysis were mainly associated with the sheer size of the survey, identification of confounding, and inevitably, code validation and correction. This study confirmed that bruising causes substantial costs to industry, including that of a national average of about 1 kg bruise trim per carcass. The results also indicate that animal-related factors, such as horns and class of animal, are more important than transportation and selling aspects.

Best linear unbiased prediction. Generalized linear squares theory has been extended by C.R. Henderson and colleagues at Cornell University to enable genetic selection. This allows sires to be ranked on performance of their offspring as well as their own performance. In this way, successful breeding programmes may be maintained. This method has been widely used in the dairy industry in the major dairy producing countries. A suite of skeleton computer programmes which can be expanded for each application has been developed and is available to the Department. However, this approach of expanding programmes means that no user can analyse his data using the programme instructions like a recipe but must be totally conversant with computer programming as well as the theory. Data from C.S.I.R.O. Australian Milking Zebu project were analysed and this illustrated that the technique was very expensive in computer time and man hours.

Rust susceptibility. In a wheat breeding programme to transfer rust resistance from variety Gala to variety Puseas, a series of 37 separate crosses was made. Rust susceptibility data were collected on 250 plants of each 'parent' line, and on 50 plants from each cross. In addition to overall average response, there was interest in the variability exhibited within each cross, and hence comparisons of both mean and variance were made. Some of the data related to percentage of tillers that were infected. As there were only about five tillers per plant, this was really a discrete distribution. The biomedical computer programmes (BMDP), a suite of programmes developed by the Department of Biomathematics, School of Medicine, University of California, was used to do non-parametric tests. These results were used to check the conventional analyses of variance.

Prediction of development rate in wheat. A non-linear relationship was postulated to predict development rate from environmental indices: mean daily temperature, day-length, and photoperiod response (a varietal characteristic).

These variables were observed at five sites for five to 12 varieties planted a varying number of times. This gave a data set of 259 observations. An iterative regression approach was used to estimate daily development rates for each observation. These rates were summed over the time period, yielding a predicted stage of development for each observation, which should equal unity. The squares of the residuals were summed over all observations giving a 'function value' which was minimized with respect to the model parameters. The analyses to date indicate that development rate is a function of temperature only for the first 15 to 20 days, followed by a period of interaction between temperature and photoperiod, with a short phase just before flowering where photoperiod is again non-operative. There also appear to be periods of zero rate which are dependent on conditions immediately after the initial temperature phase and on the variety's susceptibility. Diminishing day-lengths do not decrease the rate.

Monitoring blue mould for resistance to Ridomil. Blue mould, which is a fungal disease in tobacco, can be economically disastrous when an outbreak occurs. For the last three seasons, it has been effectively controlled by the systemic fungicide, Ridomil. Manufacturers of Ridomil are concerned that blue mould strains resistant to this fungicide may eventually appear. To provide a basis of comparison for relative susceptibility to Ridomil of blue mould isolates collected in future seasons, an ongoing series of trials was designed. These determined a Ridomil-blue mould L.D.50 (the dose which will provide a response in 50% of the population) for currently occurring strains. Using MLP, the maximum likelihood programme from Rothamsted, good fits of the normal sigmoid to the graph of percentage non-infected plants against logarithm of the dose, were obtained for two of the three successful trials to date. The L.D.50 values from the two trials were significantly different and the statistical comparison of the two transformed curves showed that the lines were parallel but that they differed in position. This meant that the relative potency was constant and independent of dose rate. On investigation, it was found different inoculum concentrations (72 000 spores per plant and 2 500 spores per plant) were used in the two trials. Thus the importance of confining the inoculum concentration in a designated range has been demonstrated and further trials are planned.

Egg quality survey. A longitudinal study which examined eggs in four grades (45 g, 50 g, 55 g, 60 g) established that trends in grade differences for haugh units and eggs weights were similar in north Queensland to trends in southern surveys. Samples for this survey were only from retail outlets as in the southern surveys.

A more comprehensive survey sampling 55 g eggs from farms, wholesale outlets and retail outlets was then conducted to present a balanced, composite picture of egg quality in north Queensland. Satisfying results were obtained for yolk colour, blood and meat spots, and cracked shells. Conversely haugh unit values, soiled and underweight eggs were shown to be areas which need attention if egg quality is to be improved.

This survey was carried out in Townsville and Cairns in summer. A similar survey is planned for winter. In addition to demonstrating both quality and measuring techniques to producers and creating an awareness of current egg quality and factors influencing it, the survey identified trouble spots for individual farmers.

Grazing systems. Ten experiments were conducted over the period 1973–79. The work was a study of a grazing system in which the limiting effect of seasonal under-nutrition in growing cattle grazing native pasture had been ameliorated by allowing grazing access to leucaena in winter-spring and/or a supplement of urea-molasses. The net result was to reduce age of turn-off from 3½ to 2½ years. Analyses of variance were carried out on liveweight, rate of change of liveweight, and to biochemical data.

Leptospira project. *Leptospira pomona* and *L. hardjo* have both been implicated as causes of abortion in cattle. Over a 4-year period, routine blood testing had shown a prevalence of positive titres to *L. pomona* and *L. hardjo*. Each blood tested could be described by a number of attributes. A computer programme was written to compile contingency tables. Log-linear models were used to describe these tables. The analyses of deviances were constructed using the generalized linear model section of GENSTAT, a general statistical programme written by the members of the Statistics Department, Rothamsted Experimental Station. Beef and dairy cattle were analysed separately. For the majority of the bloods, only the herd history of abortion was known. However, in some cases, aborting cows had been individually identified. Hence, analyses were carried out on all the data on a herd basis and on a subset of the data when the abortion category contained only those bloods from aborting cows.

Soil shrinkage calculations. Thirty soil cores down the profiles of three cracking clays in the Emerald Irrigation Area were gradually dried out and the change in volume noted regularly using nine points on each core. There was a differing number of observations on each core. A parameter S which indicated the amount of structural water loss which can occur in the soil (that is, water which can be lost without shrinkage occurring) was estimated for a relationship which should hold if equidimensional shrinkage occurs.

A custom-built computer programme was written to perform the calculations and to tabulate the results. The graphing facilities on Biometry Branch's general purpose data manipulation programme, PREP, were then used to graph the results.

Systems research and modelling

Branch staff have continued to play a collaborative role in several projects developing computer simulation models of bio-economic systems. Results of the project modelling lamb and wool production for a breeding flock in north-west Queensland have been reported on at two national conferences.

Grain production model. The major Branch activity in 1981 is in developing a grain industry model for the Planning Committee on Future Grain and Oilseed Handling, Storage and Transport in Queensland. The Planning Committee is producing an integrated plan of infrastructure developments required for the grain industry to meet the large increase in volume of production anticipated to the year 2000. Because of the complexity of the system, for example, possible substitution between storage and transport developments, and the need to identify the most cost-effective development options, a simulation model of the system is being developed.

The model is being developed for the Co-ordinator-General's Department by a firm of consultants. The Branch Director is a member of the steering committee for the model. The major Branch input has been in developing the future grain production model using historic data supplied by the Division of Marketing. The Branch also has a key role in ensuring transferability of the model programmes following completion of the consultant's contract.

Forty-eight shires were grouped into nine regions comprising the seven regions proposed by the Wheat Board with two regions subdivided. Correlations between yield of a grain type and proportion cropped to particular grain types of total cropped land were computed. On the basis of these results, the two terms were regarded as independent. Proportions cropped are generated as a number of vectors of correlated normal variates from multivariate normal distributions with mean proportions based on historical data. Intercrop and spatial correlations were preserved where possible.

Analyses of trend lines of yield showed that, in some areas, yield increased at a very high rate while in other areas yield stood still over the past 20 years. As this was considered unlikely to continue for the next 20 years, rate of increase for each grain and region was considered as an input variable to the model. Variations about past trend lines were considered largely due to the weather and it was assumed this variation would continue for the next 20 years. Intercrop and spatial correlations between residuals from past trend lines were preserved. Yield was generated as a number of correlated normal variates from multivariate distributions with mean yield represented by predicted yield in 1980 increased by the relevant rate. The model is a stochastic simulation model so that run several times it illustrates the variation that can occur. The predictions for yield and proportion cropped demonstrate the required characteristics.

Response surfaces. Quadratic response surface techniques were applied in two computer simulation projects to approximate a response function generated by an underlying model and thus to estimate the stationary point and to describe the form of the surface. In the first project, long term mean cost per tonne of forage production was related to various production factors. The surface description was used to determine a set of the factors which led to near minimum production cost. In the second project, the financial returns to a beef producer for varying stocking rates for different classes of cattle are being modelled, with sale prices and fertilizer costs as other independent variables outside the control of the producer. The technique has been useful in describing a very complex relationship simply and well over the region of interest.

Biometrical research

Research initiated by biometricians has recently been given higher priority to provide an essential complement to the traditional service and consulting role in Departmental research. Topics include applied research of direct relevance to Departmental research programmes and evaluation and development of new statistical methodology. The research activity is giving Branch staff a valuable opportunity to develop experience and responsibility in initiating, implementing and reporting on research projects.

Review of numerical classification. The mathematical formulae needed to perform and interpret a classification have been collated. The methodology of W. T. Williams and his colleagues of C.S.I.R.O., Townsville, was used. Five measures of dissimilarity were discussed and their mathematical formulae given for three types of attribute. The mathematical formulae of seven fusion strategies were presented in the section on hierarchical agglomerative procedures while four methods used in hierarchical divisive procedures were discussed. Methods of interpreting a classification were given. Finally, hierarchical and non-hierarchical programmes available on CSIRONET were presented with most attention being given to the TAXON library. A small data set was used throughout to illustrate the mechanics of a hierarchical agglomerative procedure. This work will be published in the Branch's first research bulletin scheduled to appear in mid 1981.

Comparison of methods for analysing repeated measurement data. Multivariate methods of analysis, based on multivariate analysis of variance (MANOVA), principal component scores and classification techniques, were compared with the univariate split-plot analysis with the repeated measure as the sub-plot factor. For each method, the assumptions and statistical tests of the analysis were given and the techniques illustrated with a set of data from a soil management experiment.

It was concluded that the split-plot analysis provides the simplest summary of the data but in many cases some of the hypothesis testing will be invalid. The same hypotheses can be tested under more general assumptions using MANOVA with standard profile tests. Further appropriate hypotheses may also be tested in this way. The other multivariate techniques appear less useful as they can be difficult to interpret and cannot take account of the natural ordering of the variables.

Validation of visual estimation techniques. An initial screening of sampling techniques to assess the rapidly growing, highly seasonal and morphologically diverse pastures of the wet tropical coast of north-eastern Australia showed no method more accurate than visual estimation.

Four methods of visual estimation based on dry weight ranking procedures were evaluated. Although the usual procedure was unsuited to the pastures, which were dominated by sown grass and included a sown legume as a minor but important component, two cumulative ranking methods and one with cumulative rankings and divided ranking were able to assess the pastures accurately. The number of quadrats required for acceptable accuracy on both major and minor species was calculated from these experiments.

Total dry matter yield was estimated by the comparative yield method. The relationship between yield and visual rating was linear. Coefficients of determination were calculated for individual operators.

Other biometrical research projects being undertaken include the following: study of the growth of body components over time using data measured on magpie geese; investigation of programme to fit Mitscherlich curves; determination of repeatability and heritability of tick resistance; calculation of the number of sites and years required for the maize breeding programme; investigation of the analysis of a series of variety trials; display and analysis of residuals from linear models; algorithm for orthogonal polynomial regression; use of elementary transformation matrices (Householder and Givens Matrices) in statistical computations; analysis of multi-dimensional contingency trials using log-linear models; and variables affecting pregnancy rate in *Bos indicus* cross Herefords.

Development of statistical programmes

Computer programmes for the statistical analysis of data are developed by Biometry Branch for use by both members of the Branch and other departmental officers. They cover a variety of methods, and are the programmes most commonly used for statistical analysis within the Department.

The amount of use in the 12 months to November 1980 of the general purpose programmes is reflected in the following table—

STATISTICAL PROGRAMMES—AVERAGE WEEKLY ACCESS (November 1979 to November 1980)

Programme	Main purpose	Accesses/ week
PREP	Data summary, preprocessing of data for other programmes	62
RANB	Analysis of variance or covariance, randomized block and latin square designs	41
BALF	Analysis of variance or covariance, balanced factorials	40
HARVEY*	Least squares analysis, unbalanced factorials	13
MEAN	Tables of means of several variables ranked on a selected variable	10
FLDB	Field-books	6
FSCREEN	Evaluation of all possible combinations of independent variables in multiple regression	6
LATT	Analysis of variance or covariance, lattice designs	6
SITE	Table of means over sites ranked on average over sites	2
LSML76*	Least squares analysis, complicated unbalanced factorials	<1
	TOTAL	187

*Averages calculated for period Aug.–Nov. 1980.

The programmes were transferred from the normal permanent file disc storage to a leased area of disc storage in July 1980. This has the advantage of lower cost and immunity to system purging. A number of less commonly used programmes can now be held on file and so made continuously accessible. Access to and use of the programmes was at the same time simplified by setting up a file of access procedures.

Further improvements to the regular programmes were made during 1980–81. The following changes were of particular importance.

Extra analysis features in BALF. These included basic multivariate analysis of variance facilities, and control of missing value estimation.

Improvements to PREP, RANB, BALF and LATT. General data handling routines, in particular input error diagnostics, were improved and new features for simple data summary included.

Graphical features in PREP. These provide a simple yet general means for producing graphs on either the line printer or plotters and have already proved very popular.

Extra facilities in the least squares programme. These include the capacity to read binary files, which in some cases can substantially reduce processing costs, and the calculation of residuals.

A programme for the analysis of point centred quarter data has been developed. The programme calculates relative frequencies, relative densities, shoots per square metre and importance values for the various species of vegetation.

Code for enhancements to the classification diagnostics programmes developed by the Agriculture Department, University of Queensland, and to the wool testing programmes developed by N.S.W. Department of Agriculture have been received and are being incorporated into the CSIRONET versions.

Most of the important changes to the Biometry Branch programmes identified in a review early in 1979 have now been made. Work on the remainder will continue. Improvements to the documentation of the programmes to include the modifications and to generally make it more usable and complete now has high priority and will be a major task for the coming year.

EDP services

The principal activity in electronic data processing services (EDP) is that leading to the computerization of the Department's financial accounting processes. An in-depth investigation of the existing methods of accounting has been undertaken to establish the terms of reference and work is in progress to specify the requirements of the computerized system.

Work in the development and maintenance of more generally oriented computer systems has continued. New systems undertaken for development during the year are:

1. the manipulation of data to aid in the statistical analysis of the Australian Bureau of Statistics Rural Census Data (undertaken with Marketing Services Branch);
2. the recording of information relative to training, both internal and external to the Department, by Departmental officers (STATREC); and
3. the recording of information in the Serials Collection of the Departmental Library to facilitate its management (SARA).

The Plant and Inventory Recording System (PIQUIP) now has reached an advanced stage of implementation. All items of equipment purchased by the Department from July 1976 to date and covered by the guidelines of PIQUIP are recorded by the computer system. Lists of plant and inventory by location have been produced by the system to aid each location in the physical stocktake of items of equipment existing in the Department but purchased before July 1976. Comprehensive documentation of the PIQUIP system was undertaken during the year.

Documentation was completed for the ACDC system for registration of operators, equipment and chemicals approved for commercial application of herbicides.

Computer facilities and operations

Biometry Branch has a number of specific Departmental tasks coordinating purchase of computer equipment, monitoring usage, and processing accounts for computing services. The more urgent requirements in metropolitan and major regional centres have now been met by a basic network of terminals and nodes. Emphasis in provision of hardware has now shifted to more specialized applications, upgrading facilities and to provision of basic computing facilities at country centres and at Departmental research stations. Further developments thus depend on clarification of longer term Departmental needs to establish priorities for the scheduled purchase of equipment over the next 5 years.

Computer hardware

A computer-based digitizing system was installed in June 1981 at Indooroopilly for use in the Division of Land Utilisation's land resource mapping programme. The digitizer records spatial coordinates and computes areas of mapping units. The system is based on the LSI-11/23 computer (the chip version of the PDP-11/34) with 128 KB of main memory and 10 MB of mass storage on hard disc. Peripherals include a plotter, printer, and graphical VDU. The system can be used either as a stand-alone device or can be used for communication with CSIRONET.

A data capture system was purchased for the Herd Improvement Laboratory at Wacol to capture milk quality data from three Foss machines. The equipment includes a micro-computer, one MB disc storage and a VDU. Major data processing will be carried out by transmitting files to the State Government Computer Centre.

Three micro-computers were purchased in June 1981 to evaluate their contribution to meeting Departmental computing needs, particularly in regional centres. Biometry's evaluation will concentrate on the capabilities of micro-computers for the statistical analysis of research data. Economic Services Branch will evaluate the role of micro-computers in the extension of farm management advice to primary producers. The three systems cover a range of CPU size from 48 to 64 KB and disc storage from 286 to 1 000 KB.

During the evaluation period, the micro-computers will be located for periods in country centres, including Rockhampton and Biloela. The evaluation will also need to consider the broader implications including benefits, costs and staff training needs.

During the year, negotiations were held with the Department of the Public Service Board on a number of other proposals including the word processing system for Botany Branch. The major hardware requirements for the livestock brands system have now been installed. Additions to the network during 1980–81 included a further six Apple II micro-computers. Software development remains the major task to be undertaken to achieve a fully operational system.

Computer operations

The major change in computing activity during 1980–81 was the rapid increase in computing undertaken at the State Government Computer Centre (SGCC). Expenditure approximately doubled so that Departmental computing expenditure is now about equally

divided between SGCC and CSIRONET. An 85% surcharge was again imposed on expenditure from funds other than consolidated revenue to ensure that other funds also contributed proportionately to Departmental EDP overheads.

Data preparation services were provided by three operators in Brisbane who also operate and maintain Biometry computing equipment in Mineral House. During 1980–81, 1 526 sets of data were prepared onto punch cards. With the exception of brief periods, turn-around of jobs was generally maintained at high levels throughout the year. Appointment of an operator at Toowoomba now leaves Rockhampton as the only regional centre lacking full-time data processing support for biometricians.

The number of registered users of CSIRONET and SGCC systems provides a further indication of the growth and dispersion of computer applications in the Department. There are now 140 users of the CSIRONET system and 42 users of the SGCC. Almost one-half of the CSIRONET users are from non-metropolitan centres.

Training and staff development

The objective of the Branch's technical training programme is to enhance biometrical and data processing skills in the Department generally. This objective is met by internal Branch activities and by external training provided by the Branch for Departmental staff. Significant training activities during the year were the review of the major biometrical training programme conducted over the period from 1973 to 1979 and the beginning of a series of computer appreciation courses for Departmental staff.

External training—biometry

During 1980, a review was undertaken of the biometry inservice training programme to determine future training activity. From 1973 to 1979, about 500 Departmental staff attended workshops in biometrical methods. Most workshops were funded by a Commonwealth Extension Services Grant. Participation for the basic series of workshops was as follows—

Workshop title	Number of workshops	Number of participants
Biometrics and research design	10	258
Introduction to statistical analysis by computer	11	159
Introduction to biometrics for livestock industries	3	63
TOTAL	24	480

In addition to the above, there were a number of workshops on special topics such as simulation and modelling, multiple regression, and visual estimation of pasture. These workshops were usually conducted in response to specific requests from interested groups or branches.

By 1979, nominations for workshops had declined, indicating that the bulk of the demand for basic training had been met. The review concluded that, apart from an expressed need for training in use of computers, needs for in-depth training are very diverse and the audience is widely scattered.

During 1981–82, it is expected that three courses on 'Statistical Analysis by Computer' will be offered. Other training needs are being determined by a survey of Departmental research officers. It is expected that the initiative for future courses will generally come from regional research staff. Where numbers are sufficient to justify a course, the Branch will generally be able to respond to specific training needs. Where the demand is more scattered, more informal training methods will be investigated.

Food Preservation Laboratory workshop. This workshop was conducted over four mornings during April 1980. It followed a request from technicians at the Laboratory for training in biometrics. The topics included general statistical concepts and others such as tasting experiments which are frequently conducted by the Laboratory. The workshop was attended by 11 technicians.

Toowoomba CSIRONET workshop. Following a request from the Director of the Queensland Wheat Research Institute, a 1-day seminar was held for 25 research staff from Darling Downs centres. The workshop aimed to enhance users' knowledge of file management, accounting procedures, and programme availability.

External training—EDP

State Government Computer Centre. The Branch has continued to co-ordinate training of Departmental officers in data processing techniques. During the year 21 officers participated in one or more of the 11 different courses offered by SGCC. The four most popular courses were: computer appreciation, basic computer concepts, executive control language, and programme design.

Computer appreciation courses. As a result of problems in satisfying demand for SGCC courses, the EDP section has taken the initiative to provide a series of introductory courses broadly equivalent to the SGCC 'Appreciation of Computers' and 'Basic Concepts' courses. With assistance from the Departmental training group and feedback from earlier courses, the EDP section is presenting a series of 2-day workshops. More than 50 Departmental clerical and technical staff have attended the workshops during 1981. The workshops have been valuable in preparing a wide range of Departmental staff for greater involvement in computing generally.

Internal staff training

A Biometry Branch workshop provided a valuable opportunity for biometricians to review and plan a range of activities including statistical programming needs, systems research and training. The workshop also gave staff who had attended national conferences the opportunity to present conference reports. The major theme of the workshop was 'Data Base Concepts'. The development of a data base schema, file manipulation techniques and FORDATA, the CSIRO data base software, were covered.

National conferences attended by Branch officers during 1980–81 included: Australian Society of Animal Production Conference, Perth; Simulation Society of Australia Conference, Brisbane; Fifth Australian Statistical Conference, Sydney; Seminar on 'Best Linear Unbiased Prediction', Armidale; Eighth World Computer Congress, Melbourne; Structured Analysis and Design Workshop, Brisbane; and the refresher course 'Interpretation of Plant Response and Adaptation to Agricultural Environments', Brisbane.

Extension Services Section

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

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

General comments

The trend of organizing extension planning operations on an 'industry' rather than a 'district' basis has continued. 'Industry extension groups' have been formally established in three regions and several more are being established in other regions. This has meant that local producer organizations can now more readily relate to the extension service as a service and have an influence on the issues which receive in-depth attention by it.

There are, however, still some situations where the organization of our extension services needs to be on a geographical basis, for example, in mixed farming districts or on a common interest base, and where soil conservation or animal disease issues are to receive priority.

Each Regional Extension Leader strives to maintain some balance across the conflicting demands for the Department's extension resources and has to report annually on a number of issues in his Region. Among these, he has to report on the priority accorded particular extension projects and the degree of producer involvement in establishing the industry and district needs on which the projects are based.

From the limited number of reports already to hand, it has been gratifying to note some of the examples of fruitful collaboration that have been organized. That associated with the far northern banana industry and that associated with the beef industry in the wet tropics are but two examples.

The Department's policy of involving producers in the work of its extension service is a natural consequence of its policy of developing close communications with the State farming industries.

District officers currently produce about 30 newsletters on a regular basis. These newsletters go to thousands of producers and are

an efficient way for staff to contact growers and receive relevant feedback. They are of particular importance where there are few other ways of contacting producers such as in the Far South West, North West and in the Mackay hinterland.

Evaluation Unit

As primary production is carried out in a climate of uncertainty—changes are always occurring in seasonal conditions, market forces, finance availability, land use patterns and in technology—it is important that extension staff have a detailed appreciation of the situation facing producers at all times.

In the past, most extension officers have done this intuitively as a consequence of their many contacts with individual growers. Currently, the Department is encouraging its staff to base their appreciation of industry situations on more factual information.

One of the principal responsibilities of the two-man Evaluation Unit within the Section has been to carry out the collection and analysis of this information or to help staff do this for themselves. In this regard, the Unit also develops and trials various techniques that could be useful in this type of work.

A report on the Unit's work with the passionfruit industry to the near north of Brisbane as outlined in last year's report has now been published and a similar undertaking involving a beef producing area in north Queensland is currently being planned in co-operation with local staff.

The Evaluation Unit has also undertaken a number of other activities during the year.

A major commitment has been the evaluation of a beef carcass classification trial in an area near Brisbane. Surveys of producers and meat retailers were undertaken and comprehensive reports were produced for use by the Beef Carcass Classification Working Parties in Queensland that are responsible for this trial. A report on extension research and evaluation activities in New South Wales, Victoria and South Australia was also prepared following a study tour of these States.

A considerable amount of time of the officers in the Unit was spent in giving colleagues advice on the design and conduct of surveys and on the analysis and interpretation of the data collected. Some of the projects involved include:

a comprehensive evaluation of a beef producers' seminar; and

a study aimed at providing data to guide research and extension activities in the macadamia industry.

Co-ordinating extension activities in developing agricultural areas poses some problems. Many producers are undertaking new enterprises and the problems they face are often complex. In addition, the Department has only a limited number of experienced staff located in these areas. Measures to overcome the problem include special staff training programmes and surveys of producers to define what they see as the most pressing problems. Such a survey was conducted among Nebo–Broadsound graingrowers in 1980.

Priority areas

Some priority areas for extension during the year were:

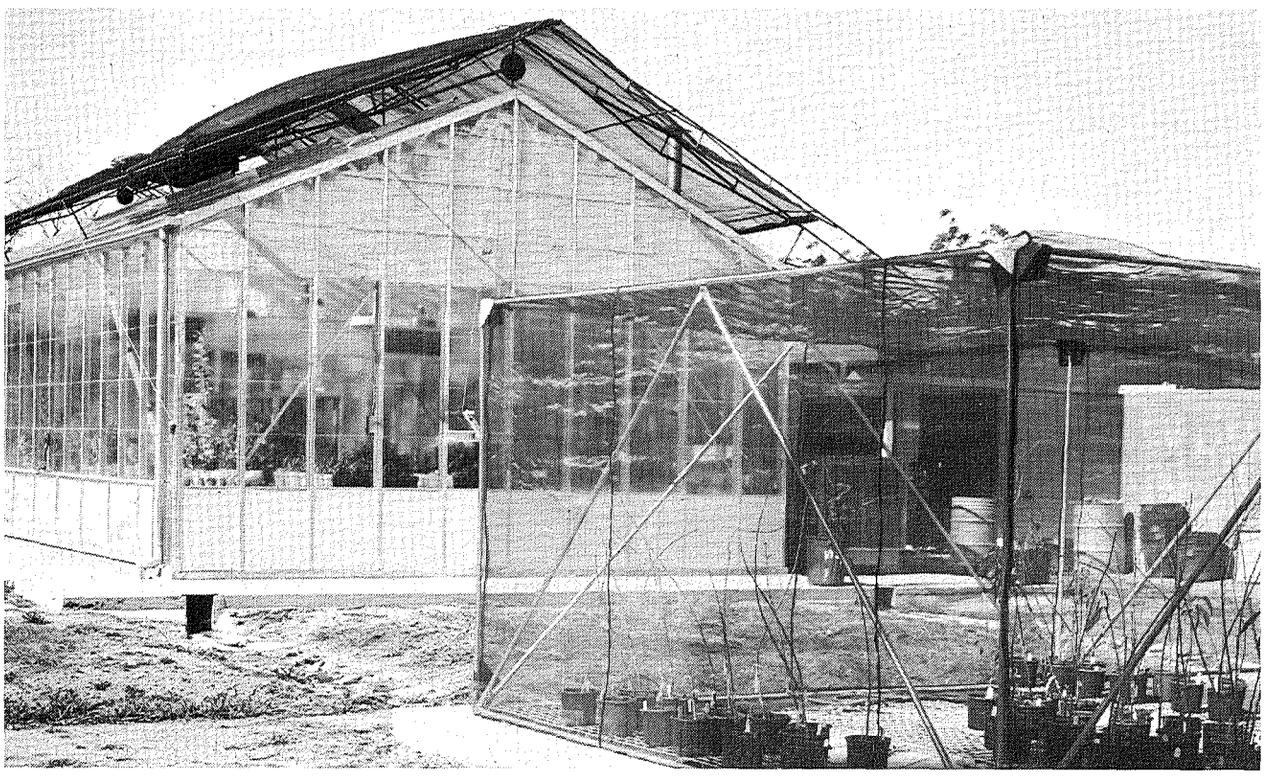
High priority had to be given to extension of drought mitigation measures in the southern inland.

Continuing emphasis was given to education on the responsible use of agricultural chemicals.

Tick control by selecting for tick resistant cattle is a long-term project that is making steady progress. This results in reduction of chemical use as well as other management benefits.

The major project of eradication of bovine tuberculosis and brucellosis made favourable progress with commendable co-operation from the great majority of producers.

Expansion of the area under cropping in various areas of the State has emphasized the need for cropping systems that will conserve the soil while still being productive. Emphasis on extension of conservation cropping techniques is evident in most regions.



One of the responsibilities of the Department of Primary Industries in serving agriculture in Queensland is to carry out research programmes. For these to be successful, modern facilities like this glasshouse complex are necessary.

Division of Animal Industry

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

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

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

Division is continuing to provide efficient advisory, regulatory, diagnostic and research services to the livestock industries against a background of increasing financial stringency. Branches have responded by instituting economies consistent with continuing efficiency. It is causing Branches to review their activities and to continue to restrict or withdraw some services which the public have come to expect and this may cause some inconvenience in the first instance. The withdrawal of direct Commonwealth Extension Services Grant support to many activities has caused a deal of concern, which will not abate until alternative arrangements are decided upon. The continuing and severe drought during the past year made it a difficult one for producers and increased the demand for advice and assistance from officers of this Division.

There were few changes in senior staff during the year. Following the promotion of Mr J. W. Ryley to Central Administration, Mr B. A. Woolcock was appointed Director, Division of Animal Industry, Mr S. G. Knott, Deputy Director, Division of Animal Industry and Mr I. D. Wells, Director of Veterinary Services.

Two stalwarts of the Division retired during the past year, and both had given meritorious service over many years. They were Mr W. T. Hall, Director of Pathology, and Mr C. R. W. McCray, Director, Biochemistry Branch, at the Animal Research Institute.

Amendments to legislation

Acts. *The Exotic Diseases in Animals Act* 1981 was assented to on 14 April 1981. It replaces the *Foot and Mouth Disease Expenses and Compensation Fund Act* 1958–1969 and *The Stock (Prevention of Blue Tongue) Act of* 1965, plus some provisions of the *Stock Act* 1915–1979. The new Act updates and streamlines procedures for the control and eradication of outbreaks of exotic disease and the payment of compensation incurred thereby.

The *Foot and Mouth Disease Expenses and Compensation Fund Act* 1958–1969 and *The Stock (Prevention of Blue Tongue) Act of* 1965 were revoked on assent of the new Act, and relevant provisions of the Stock Act will be omitted or amended on a date to be proclaimed, which will coincide with the Gazettal of the Exotic Diseases in Animals Regulations. In the meantime, these provisions of the Stock Act and relevant Regulations will continue in force.

The *Meat Industry Act Amending Act of* 1981 was promulgated during the year. It relates principally to amendments to the constitution and functions of the Queensland Meat Industry Organization and Marketing Authority, which will come into effect on a date to be proclaimed.

Regulations, Orders-in-Council, Notifications. The Stock Regulations of 1935 were amended to conform with amended provisions of the Stock Act promulgated in 1979. These included necessary machinery provisions relating to control of the activities of Authorized Veterinary Surgeons operating under approved disease eradication programmes and to extended controls on the introduction and usage of animal pathogens and biological preparations.

In other amendments, restrictions were eased on the introduction of day-old chickens and hatching eggs from approved flocks in other States; a number of new medicaments were approved for treatment of stock; and compensation for brucellosis and tuberculosis-affected animals raised in line with increased market values for cattle. Provision was made to compensate owners for costs incurred in private transport of reactor cattle to slaughter and a new saleyard tail tag was introduced to enable positive identification of untagged cattle arriving at saleyards in otherwise identified drafts.

A number of redundant regulations and associated Schedules was repealed, the provisions relating to control of outbreaks of exotic disease strengthened, as were controls on the keeping and feeding of food wastes containing animal matter.

The Meat Industry Regulations, 1973 were amended to exempt eggs from storage under refrigeration in butchers' shops; to provide for a meat market containing an aggregate of butchers' shops; to allow shop doorways to remain open in certain circumstances and to control the external fixing of appliances. Inspection fees were increased, and provision made for use of pictorial signs to indicate a prohibition of smoking or the presence of dogs in licensed butchers' shops. In other changes, provision was made for usage of quick recovery hot water systems and approved sealed unit motors were defined. In addition, the onus of blame was placed on a person who places meat on the floor of a shop or vehicle, provision was made for full time inspection services at certain Class 1 and Class 2 slaughter-houses and a prohibition was placed on the introduction into or sale of putrefying or decomposing flesh from pet food shops.

The Regulations under the *Brands Act* 1915–1979 were amended to give effect to amendments to the Act in 1979 relating to introduction of tattoos for the identification of pigs. These covered the prescribed shapes of pig tattoo brands, relevant fees and necessary amendments to pertinent forms. A further amendment made provision for the use of a special brand to identify Angus cattle affected with Mannosidosis.

Orders-in-Council were promulgated under the Stock Act to declare Mannosidosis to be a disease; to declare additional chemical residues to be a disease for the purposes of the Act; and to exempt bees from the requirement that movements be accompanied by a relevant permit and waybill.

By Orders-in-Council under the Meat Industry Act, deer were declared to be stock, thereby legalizing their slaughter on registered premises and sale of the meat through licensed butchers' shops. The Metropolitan Public Abattoir Area and the Metropolitan Public Abattoir Board were abolished and the Metropolitan Regional Meat Area declared in lieu, under the control of the Queensland Meat Industry Organization and Marketing Authority. Subsequently the Authority was empowered to borrow funds by sale of Debentures to pay the balance owing on construction of the Cannon Hill Abattoir.

Under the provisions of the Stock Act, notifications were gazetted repealing all previously declared protected and infected areas for brucellosis and tuberculosis, and declaring the whole State to be a Protected Area in relation to brucellosis and an Eradication Area for tuberculosis. Movement conditions were also amended to relate to the status of the property-of-origin rather than to the status of the area, for both intrastate and interstate movements. An area of southern Queensland was also declared to be a bovine brucellosis provisionally free area, in view of the excellent progress of control and eradication measures.

By notifications under the Meat Industry Act, the Cairns and Sunshine Coast Regional Meat areas were declared and members of the Queensland Meat Industry Organization and Marketing Authority were appointed for a further three year term.

Animal identification

Computerization of brands. During the last 12 months the Brands Office completed the implementation of their accounting functions onto a computer-based system. All new applications and fees are now being entered, and can be instantly traced and balanced. This has allowed a marked increase in work flow in this particular area.

The placing of the actual Brands records on the computer is still being programmed and tested, it is hoped to begin entering the data for pig brands very soon.

Registration. Horse and cattle and sheep brand registrations totalled 2 423 (3 156 in 1979–80), transfers 1 910 (2 768) and alterations 2 337 (923).

Regulations under the Brands Act were altered to allow for the use by the Department of a brand to denote bovine Mannosidosis.

The registration of pig brands commenced in September 1980, with the legislation requiring compulsory sale branding of pigs taking

effect from 1 January 1981 and to date some 3 000 pig brands have been registered.

Cattle identification. Overall, Queensland continues to maintain a high standard of tail tagging with an average loss of 5.7% from cattle slaughtered during the year. Due to the fact that there had been some long-standing anomalies, which were strongly suspected of having led to some erroneous trace-backs with non productive testing, the 'saleyard tag' was developed and introduced on the 1 January, 1981. The introduction of this tag was designed to cover tag loss from saleyard drafts consigned by stock owners, and for dealers who purchase cattle at western saleyards and drift them eastward to other selling centres within 40 days.

The saleyard tag has been available since 1 January 1981, and is a black and white tag in the district tag format, but prefixed 'S' and not 'Z'. Supplies of these tags are held at saleyards, and are sold to agents-owners at $2 per tag for application under supervision. Hopefully, in the ensuing 12 months, an accurate traceback in excess of 96% will be possible for all facets of disease control for cattle producers within the State.

Following industry group discussions, Slaughtering and Meat Inspection Branch, in consultation with the Queensland Meat Industry Organization and Marketing Authority, organized a system for positive identification of grain-fed cattle going to slaughter through saleyards. The purple tail tags used for this purpose are applied additionally to registered tail tags.

Animal quarantine and exotic diseases

Quarantine activities. There was a further sharp increase in quarantine activities during the year justifying fully the planned increase in staff. Additional Port Quarantine officers were appointed to Brisbane (three), Mackay and Townsville. The staff position is therefore much improved and the efficiency of this service will be enhanced as new appointees complete their initial training.

Illegal imports. Quarantine staff were engaged in several incidents involving breaches of the quarantine barrier. One involved the illegal importation of fertile hen eggs hatched at a Bundaberg suburban property. The progeny of the eggs imported from Switzerland were destroyed under quarantine orders but after thorough disease testing of these and other birds on the property, the quarantine was lifted. The importer was successfully prosecuted.

In conjunction with Customs investigators, quarantine officers were involved in a major exercise in detection and destruction of some 450 hamsters and 47 gerbils illegally imported into Australia. This was a time-consuming operation involving quarantine and other staff over a period of several weeks. A feature of the operation was the excellent publicity generated through all forms of the media and the dissemination of film and photographic material through the education systems. The public response to the appeal for co-operation was excellent. There is little doubt that most, if not all, of the illegal rodents held by pet shop operators and householders were surrendered. However, acting on information received, hamsters were trapped in the Mt. Glorious area following which an intensive poisoning programme was undertaken in order to eliminate the colony allegedly released by a person known to be involved in breeding and selling these animals.

During the year 194 197 air passengers and 1 020 sea passengers terminated international travel at Queensland ports. Of these, 15 933 persons carried items of quarantine interest and prohibited imports were seized from 1 122 travellers. These comprised 551 kg of meat and meat products, 417 eggs, 46 kg of egg products, 143 kg cheese, 25 kg butter and 76 kg of milk and yoghurt. Seventeen persons were successfully prosecuted for illegal importations of animal products. The highest penalty was a fine of $400 for importing four eggs. Seven involved illegal importations from Europe and six from Asia. Two involved animal products from New Zealand and one person was convicted of importing eggs from the U.S.A.

Only one foreign fishing vessel was arrested during the year. Foodstuffs seized and destroyed included 49 kg fresh pork, 28 kg pickled pork, four frozen poultry, 50 tins of pork and 130 g egg noodles.

Animal imports. During the year, 687 dogs and 341 cats were imported through Queensland ports. Of these, 515 dogs and 321 cats arrived from New Zealand. The balance required a period of quarantine at the Lytton Quarantine Station. They comprised 70 dogs and 19 cats from Papua New Guinea, 94 dogs from the United Kingdom, five dogs and one cat from Fiji, two dogs from Hawaii and one dog from Norfolk Island. Seven Jersey cattle and nine pigs were imported from the U.K. and Canada respectively via Torrens Island Quarantine Station.

Imports of tropical gold fish were lower than in the previous year. Of 1 391 632 fish imported, 1 036 266 were tropical species. The vast majority originate from Singapore, with significant numbers of gold fish being imported from Japan and Hong Kong. Little progress was made in revising protocols and procedures for the importation of fish and the treatment of the water imported with the fish.

Other imports included 121 mice, 12 guinea pigs, 31 queen bees, 6 418 straws of bovine semen and 30 straws of canine semen.

Animal products imports. A total of 272 919 kg of cheese was imported from 12 countries. New Zealand supplied 53 960 kg fresh beef, 3 881 kg fresh lamb and 1 744 kg meat pies. Other imports included 340 kg tinned ham from the U.K., 29 065 kg steak and kidney pie from the U.K., 3 980 kg pate de foi and 5 200 kg canned duck.

Quarantine surveillance. Surveillance of high risk areas in north Queensland by quarantine staff was increased during the year. Officers made regular trips with the aerial surveillance programme organized by the Commonwealth Department of Transport. Similarly, more frequent trips were made by ship to visit isolated islands and mainland communities and to contact surface vessels operating in the area. Several responses were made as the result of sightings. The officer at Thursday Island also made regular visits by sea and air to inhabited Torres Strait Islands and established a working liaison with Island Chairmen and other officials.

Unfortunately, it has not been possible to arrange through the Department of Aboriginal and Islander Advancement for the projected conferences with Island Chairmen to formalize their appointment and duties as temporary quarantine assistants.

The normal routine surveillance was undertaken at all ports including the newly-established first port for the Qantas Service to and from Townsville. The co-operation of the other branches of the Australian Quarantine Service, Customs and Australia Post in surveillance activities was maintained and strengthened.

Exotic diseases. Mr J. C. Walthall, Senior Veterinary Officer, returned from a 6 months' study tour of the U.S.A. and Mexico. His report on the screw worm fly programme in those two countries details all aspects and his experience and knowledge has been drawn upon for detailed planning to deal with any incursion of this exotic parasite.

The screw worm monitoring programme in Torres Strait and Cape York was enhanced by the commencement of trapping, monthly in higher risk areas and quarterly elsewhere. This is being undertaken in conjunction with trapping by C.S.I.R.O. in coastal areas of the western province of Papua New Guinea.

The domestic dog and feral animal control programmes in Torres Shire were commenced. Considerable progress was made in controlling the domestic dog populations and in protecting this population against distemper and other virus diseases.

There was again considerable activity in extension and education of the public in exotic disease dangers and the need for vigilance and early reporting. This was achieved through numerous film showings, media releases, the distribution of attractive brochures and the involvement of secondary students.

Lessons learned from the simulated Newcastle disease exercise of the previous year have been taken into account in the establishment of an organization structure appropriate to the management of a major exotic disease episode. Future exercises will be devoted to testing this organization and management aspects rather than the application of disease technology. Appropriate evaluation will be built into such exercises.

Livestock exports

During the year, 34 070 cattle, 191 horses, 6 mules, 4 buffalo and 440 sheep were exported to overseas destinations from Queensland. Details of class and destination of cattle exports are shown in the following table—

	Breeding	Feeder	Slaughter
Japan	–	6 669	120
Malaysia	3 385	–	4 762
Philippines	4 076	–	–
Indonesia	13 127	–	–
Solomons	1 902	–	–
Papua New Guinea	29 (bulls)	–	–
	22 519	6 669	4 882

Poultry industry exports comprised 84 053 day old chickens, 66 160 fertile eggs, 19 ducks and 9 geese. A total of 25 455 bees was exported. Bovine semen straws totalling 59 057 were despatched to overseas destinations, including 47 492 straws of Sahiwal semen to New Zealand. Among more unusual exports were 4 704 toads and frogs, 13 tigers to Japan and 4 kangaroos.

Animal welfare. Aspects of animal welfare in relation to exports of livestock received considerable attention during the year. The Department co-operated with welfare groups in improving the welfare of animals being exported. State and Commonwealth veterinarians met in Canberra for the purpose of standardizing export procedures and discussing animal welfare in relation to care of export livestock. In collaboration with other exporting States, standards for the carriage of sheep, horses and cattle were drawn up in order to ensure the humane transportation of animals for export.

Dressing a red deer at an abattoir. Deer are stock under the Meat Industry Act and must be slaughtered at licensed premises.

Fauna and feral animals

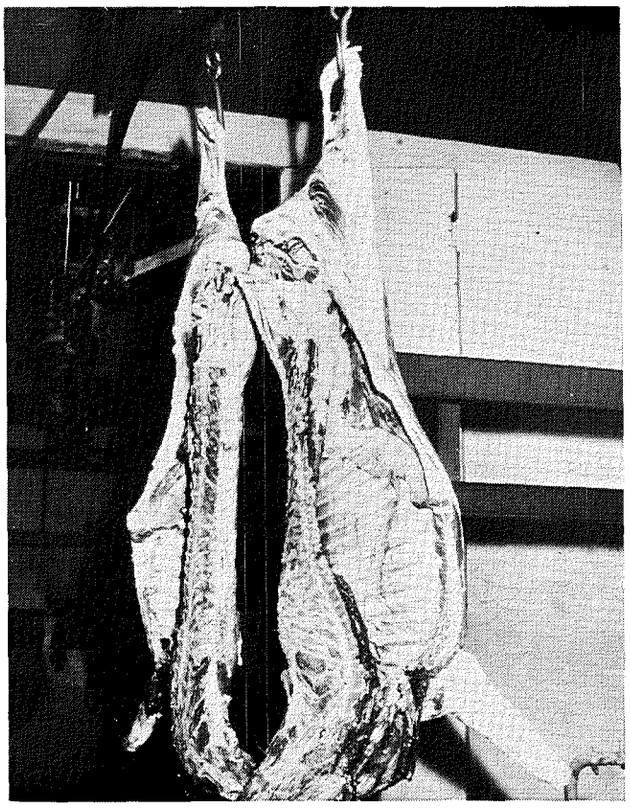
Deer. There are 48 premises registered by the National Parks and Wildlife Service for the purposes of farming deer. The numbers farmed vary from several up to more than 400.

Velvet prices have retracted considerably but there is as yet an untapped market for venison. Deer were listed as stock under Meat Industry Act during the year, thereby legitimizing the slaughter of deer in abattoirs and sale of venison in butcher shops.

Most of the farmed deer are red deer, although a shipment of rusa deer from Prince of Wales Island in the Torres Strait was introduced to two deer farms in south-east Queensland for trial purposes.

A disease survey of deer is presently in progress and results should be available for the next report.

Feral pig survey. Further to previously confirmed porcine brucellosis in feral pigs from the Shires of Taroom, Belyando and Livingstone, *Brucella suis* was cultured also from feral pigs from the Emerald Shire.



The carcass of a red deer ready to enter the chiller after dressing and inspection.

Environmental studies

Chemical residues. The project monitoring the organochlorine and organophosphate residues in cattle slaughtered in Queensland to assist the industry to meet the quality control standards implicit in the statutory limits for pesticide residues which are set on a basis of good agricultural practice continued through the year with support from industry through funds provided by the Australian Meat Research Committee. The project is one with collaboration between Slaughtering and Meat Inspection, Veterinary Services and Biochemistry Branches. After reviewing the results of the previous 2 years, the sampling procedure was modified for this year and had a bias to particular shires in specific regions of the State to ensure more indicative sampling of possible problem areas. The closure of some works and decreased throughput in others resulted in changes to sampling to maintain the most efficient system.

This year's sampling resulted in 8 000 fat samples being analysed for 23 pesticides and, as a result of Veterinary Services trace-back, a further 326 samples of either biopsied fat, milk, grass, soil, water or dip sludges were analysed. From the fat samples analyses, the percentage compliance with standards for the various organochlorine pesticides was dieldrin (99.4), DDT (99.8), BHC (99.7), heptachlor (99.9), lindane (100) and methoxychlor (100); and for organophosphate pesticides, ethion (99.2), bromophos ethyl (99.4) and chlorpyrifos (99.9). These results indicate a general responsible use of chemicals.

The sources of both the organochlorine and organophosphate residues continued to be similar to those reported last year. Buffalo fly control was the most important contributor to the DDT residues. The extension programme developed to educate producers on the methods of avoiding unacceptable chemical residues in animal production was maintained at a very active level.

In a random survey of chemical residues in poultry products, 186 samples representing 59 growing sheds were analysed as a preliminary investigation of the residue status of the chicken meat industry in Queensland. Although levels were generally below the Maximum Residue Limit, there was a low incidence of residues in dieldrin and DDT isomers.

Investigations were done on one layer farm where mistakenly endrin instead of malathion was used to spray manure under the cages in a shed of 15 000 layers to control fly breeding. As soon as the error was discovered, the manure was stockpiled outside the sheds and will be disposed of when regular monitoring has indicated that endrin disassociation has advanced to an acceptable level. Analysis of tissues and eggs from the birds indicated negligible pesticide residues.

A survey of heavy metal concentrations in Queensland cattle was completed by Biochemistry Branch. Liver, kidney and muscle samples of 540 cattle from 10 areas of Queensland were analysed for arsenic, cadmium, chromium, copper, lead, mercury, selenium and zinc. Zinc levels in the muscle tissues of cattle from all areas and in the livers of cattle from Mt Isa, Charleville, Mareeba, Gympie, Mackay and Dalby were slightly higher than expected—mean values in the districts ranged from 40 to 85 mg zinc per kg fresh weight. Copper levels in liver samples from Mt Isa and Charleville areas ranged up to 110 mg copper per kg fresh weight. Both copper and zinc are important nutritional elements. No levels of any of the elements were sufficient to suggest excessive intake.

Investigation into leaching of plastic components into vacuum packed pig products continued by Biochemistry Branch. Analytical methods have been developed for determination of a wide range of phthalate plasticizers. Approximately 5 000 separate analyses have been performed in the developmental work and analyses of approximately 150 packs of meat. The majority of samples contain one or more plasticizers at a total concentration of up to 20 $\mu g\ g^{-1}$. Chemicals associated with areas of coloured plastic have also been detected along with pesticides in many samples. The investigation of the effects on gas permeability of fat migration into the plastic wrap has been commenced. This project was generously supported by the Australian Pig Industry Research Committee.

Effluent management and piggery siting. Pig Section staff maintained liaison with the Water Quality Branch of the Water Resources Commission and Shire authorities in matters of piggery establishment and effluent disposal. A number of Shire Councils re-drafted by-laws in respect of pig keeping. Where these have been prepared in consultation with producers, their organization or this Department, few problems occurred. In the limited cases where conflict has existed, negotiations have continued between producers and the Shire authority with staff of the Department acting in an advisory role.

Interest in the use of piggery effluent as a fertilizer was reawakened following addresses on the subject by Professor Muehling of the U.S.A.

Development of facilities

As part of the development programme at the Animal Research Institute, the conventional poultry building and the medium security poultry building were completed.

The development programme for the Animal Research Institute site was reviewed during the year as part of a wider review of accommodation and functional needs of Branches not only in the Division of Animal Industry but also other Divisions whose staff are presently located in the city or near city environs. As a result of this review, major changes to the programme have been proposed to improve accommodation, integrate services and enhance the efficiency of operation of the library, photography, printing and stores groups of the Department, production branches of the Divisions of Animal Industry and Dairying, field and laboratory disease control branches of the Division of Animal Industry and the Institute's Administration. It is disappointing that the modification has had to delay the former schedule particularly in providing more suitable accommodation for the Institute library and Pathology Branch but the new proposal will rationalize accommodation problems in many areas.

Planning for the relocation of the units at the Animal Husbandry Research Farm Rocklea has continued. Plans for the poultry unit to be relocated at the Redlands Horticultural Research Station are well advanced and land has been acquired and preliminary works completed at Mutdapilly for the relocation of the beef cattle unit.

A new residence for the manager, Toorak Research Station was completed during the year.

Construction is well advanced for the provision of additional facilities for pig research at the Biloela Research Station with the view to translocation of the breeding programme currently conducted at the Hermitage Research Station. When these facilities are in operation and the pigs transferred, the piggery at the Hermitage Research Station will close. It is expected that this will be early in the new year.

In January 1981, the Department leased the property 'Croxdale', Charleville, to serve as a research centre for south-west Queensland. The property has an area of 4 000 ha and is capable of running 2 000 sheep. A wide range of country types is found on 'Croxdale', namely Mitchell grass downs, Warrego River frontage, sandy cyprus pine grassland and mulga and gidyea woodlands. Such a mixture of country provides researchers at Charleville with the opportunity of following up previously-obtained research findings under more extensive and practical field conditions. Funds for the lease of the property are being provided by the Wool Research Trust Fund.

Training programmes

In a period when changes and improvements in technology are occurring rapidly, it is important for the Division of Animal Industry, the majority of whose staff have scientific or technical training, to have an active continuing education programme if the Division is to provide the optimum service to the animal industries and the general public. All staff have access to standard texts and journals but staff are scattered throughout the State and it is essential in the continuing education programme that they be able to attend and participate in workshops, seminars, conferences, field days and be able to visit other scientists both interstate and overseas and be host to scientists from other areas. As the Division is the largest within the Department, it is important also that its administrative, technical and clerical staff not only have technical training in their specific disciplines but also management training to continually improve the efficiency of the Division's many operations. In the stringent financial environment, it is becoming increasingly difficult to maintain adequate continuing education programmes. During the past year, however, staff of the Division participated in several aspects of training and were able to assist in training of personnel from overseas countries.

As part of management training the Division agreed to introduce a role-specification programme. The first stage in its implementation was a series of workshops involving members of all branches to familiarize them with the procedures and techniques to be used in the programme. The workshops were conducted by staff of Information and Extension Training Branch with assistance from staff of branches in the Division. A series of workshops, short courses or seminars on a variety of topics was conducted by Information and Extension Training Branch and attended by staff of all branches of the Division.

Several of the field branches conducted technical workshops for their own staff and staff of other branches. In many instances for economy purposes, these were held on a regional basis. Slaughtering and Meat Inspection Branch held legal and general training workshops in three divisions and conducted a workshop on canning organized by staff who had attended a Hawkesbury Agricultural College short course on the subject. Beef Cattle Husbandry Branch conducted three workshops on beef production and marketing in the northern, southern and western areas of the State. Pig and Poultry Branch held two workshops in Toowoomba on breeding and extension programmes and carcass classification. At Sheep and Wool Branch's workshop on wool harvesting a programme for the extension of the information in the Wool Harvesting Notes was developed.

Veterinary Services Branch's Divisional Veterinary Officer conference discussed and formulated policies on many aspects of animal disease control in Queensland. Tick extension officers of Veterinary Services Branch at their workshop reviewed programmes on control of acaracide resistant ticks, breeding tick resistant cattle, field efficacy testing of new acaracides and buffalo fly control. Staff of several branches were able to participate in short workshops conducted by other organizations within the State and in one instance interstate. Topics included many aspects of computer use, operation and maintenance of sophisticated analytical equipment, laboratory safety, preparation and use of rural radio broadcasts and electric fencing.

Only a limited number of officers was able to present papers at interstate conferences, to undertake short interstate study tours, or to attend or present papers at external short courses. Fortunately there was good representation by staff of the Division at the Australian Beef Cattle Review Conference, Glenormiston, Victoria, and the Sheep and Wool Refresher Course in Melbourne. Two staff presented papers at International Conferences in New Zealand.

Staff of the Division participated in two training courses for personnel from developing countries as part of this country's aid programme. The courses held in Queensland were on Management of Arid and Semi-arid Grazing Lands and Pig Production. The first was held at Griffith University and the second at the Queensland Agricultural College, Lawes. Scientists from Uruguay, Indonesia, Argentina and South Korea received on-the-job training at Departmental laboratories or research stations for periods varying from 2 weeks to 1 year. These scientists were trained in sheep husbandry, pesticide chemistry, general toxicology, mycotoxin toxicology and pathology laboratory technology. Farmers from India visited the 'Toorak' Research Station and Charleville Pastoral Laboratory.

Several prominent overseas scientists visited staff and facilities of the Division during the year. These visits provided a beneficial two way flow of information. Almost all had been sponsored by their own organizations.

Cattle industry

The year was marked by the continuation of severe drought conditions over parts of southern Queensland, and considerable uncertainty in the cattle market. Many districts in the south had received no effective summer rain for up to 4 years and this resulted in heavy depletion of herds through stock losses and forced sales and associated loss of production and markedly reduced income. Added to this was the cost of drought mitigation measures both to pastoralists, and to Government through drought assistance schemes, and the effect on local communities of reduced trading.

Once again, instability in the economy of the beef industry became apparent during the year. Following a spectacular recovery in the beef market from the beef depression of the mid 1970s to record price levels in January 1980, market values have fluctuated markedly since that time. The decline in values, which was evident at the close of last year, stabilized in the opening stages but again strengthened during the second quarter, peaking in November when yearlings, bullocks and cows were realising 165, 161 and 149¢ per kg carcass weight, respectively. This strengthening in values occurred despite a reduction in competition due to the early closure of several export meatworks and reduced kill at others. A shortage of well-finished cattle and the expansion of liveweight selling centres attracting cattle away from direct consignment possibly influenced the strengthening trend in market values.

However, following the November peak, slaughter cattle values began a progressive decline and by the end of May at 140, 120 and 115¢ per kg carcass weight respectively, were slightly below the closing values of last year with no real indications of any strengthening, at least in the short term. However, despite marked instability, current values are at a level to support economic viability for producers at present, but with continuing cost increases any marked drop in values could result in a reversion to a depressed industry situation similar to that of the mid 1970s.

With present sound and stable economic conditions in the sheep industry and because of drought and instability in the beef industry, there is a trend back to sheep particularly on the 'red' country in the southern inland. This is in contrast to movement out of sheep into cattle in the early 1970s when the economy in the two pastoral industries was reversed.

Although property sales continued during the year, the volume eased slightly due to drought conditions both locally and in the southern States. Nevertheless, land values continued to strengthen and high prices which southerners are prepared to pay is making it difficult for local landholders to compete.

There has been continued interest in intensive feedlot fattening and there now are several permanent feedlots in operation, which are maintaining a steady supply of grain-fattened cattle for the domestic trade as well as for specialized export markets. In addition, a number of small opportunity feedlots was set up to ensure turn-off of cattle which could not be finished on failing grazing crops. With high grain prices and an unstable market, profit margins were, at times, very doubtful. However, because of a shortage of well finished young, lightweight cattle, there has been a steady demand from the domestic trade for grain-fattened cattle at values significantly above those obtained for plainer grass-fattened animals. On present indications, it seems that intensive fattening has become established as a permanent industry.

Beef industry statistics

During the period, Queensland cattle numbers continued the decline that first became significant in 1978. Preliminary figures for March 1981 indicate that Queensland now has 9.7m cattle. This is a reduction of 614 000 on numbers at March 1980 and represents a 5.9% reduction in total cattle. This reduction was unexpected to most observers. With a marked reduction in slaughtering in 1980 and a lowering of female slaughter rates, it was thought that a herd rebuilding phase had commenced. As late as January 1981, the BAE at the National Outlook Conference had forecast only a 1.6% reduction in the national herd to March 1981.

However, the apparent continuation of liquidation may have been involuntary and need not indicate producers' intentions. Due to the drought, brandings have been below normal and mortalities have also been high.

Breeder numbers also have been declining for the past 5 years and had fallen to 4.4m at March 1981. This represents a decline of 4.9% on the 1980 figure. However, as a component of the State herd, breeder numbers have increased from 46.4 to 48.0 to 48.5% in the years from 1979 to 1981. This indicates that, in spite of the drought, there was a preference to retain breeders.

The Queensland slaughter rate continued to decline relative to the peak in 1978. Slaughterings in the period from 1976 to 1978 were abnormally high due to an involuntary build up in cattle numbers following the crash in prices in 1974. Relative to the peak in 1978, the 2.5m cattle slaughtered in 1980 represents a reduction of 24% on 1978 and a reduction of 16% on 1979 slaughtering.

The female component of total slaughtering continued to decline from the high of 91% of male slaughtering at peak slaughtering in 1977–78 to 78% and 72% in 1979 and 1980. It now stands at 67% for the first 4 months of 1981, so there has been a marked reduction in female slaughtering in spite of the drought.

The main influence on cattle prices is the level of export demand, particularly from the U.S. market, and seasonal conditions in Australia. With all things equal, an increase in demand increases price and conversely, with a deterioration in seasonal conditions, more cattle come onto the market and prices fall. In the past 12 months, the numbers of cattle coming onto the market have declined and prices have fallen, indicating the main influence on price trends has been a lowering export demand.

During 1980, only 278 000 Queensland cattle crossed the border into southern States while numbers entering the State increased, so that net movements out of Queensland came only to 6 110 head. Net movements were down 98% on movements during 1979 and reflect the influence of the drought in southern Queensland and north and central N.S.W. Overseas livestock exports amounted to 36 000 head and were similar to the 1979 figures.

Tuberculosis and brucellosis eradication

Despite extensive drought during the past year, satisfactory progress was made towards the eradication of these two diseases under the National Tuberculosis and Brucellosis Eradication Scheme. It is anticipated that Provisional Freedom will be reached by 1984 for both diseases, when steps towards complete freedom will be undertaken. The I.A.C. has already called for submissions with a view to establishing a funding policy for the 7 years following 1984.

Expenditure for the financial year in Queensland was nearly $7.9m, with an additional $1.56m being paid to producers as compensation for the destruction of diseased animals. The expenditure per unit of activity has increased to $2.72, compared with $1.98 in 1979–80. However, this is to be expected as the campaign contracts towards the extensive areas of western Queensland.

Taxation concessions conceded in the 1980 Budget enabled internal fencing and yards which were erected for the purpose of eradication to be 100% deductible in the year in which the expenditure was incurred. Considerable interest has been shown in this and has resulted in much increased activity in the more extensive areas of the State. As at 1 May 1980, 45 properties had applied for concessions under this Section, and their financial commitment was $2.6m.

Destocking has now become an acceptable means of eradicating these diseases from many herds. With the average cost per unit of activity for eradication testing approaching $3, a sum which does not include the on-farm costs of mustering, destocking, either partial or total, is being accepted as a realistic alternative to repeated testing.

Brucellosis. The Queensland Provisionally Free Area was expanded during the year to include the Veterinary Divisions of Toowoomba, Maryborough and the Shires of Bungil, Bendemere, Warroo and Booringa. These Divisions and Shires represent 15 000 herds, which means that over half of all Queensland herds and breeding stock are now in a Provisionally Free Area.

The remainder of the State was brought under active eradication during the year. Included in these declarations was the Channel Country, which represents what is expected to be the most difficult and expensive area to clear of the disease.

The following table indicates the number of herds of a particular status in Queensland over the past 3 years—

Progress status	No. of herds (%) 1-7-78	No. of herds (%) 31-3-79	No. of herds (%) 31-3-80	No. of herds (%) 31-3-81
Not assessed	23 659 (59.6)	15 499 (41.9)	6 966 (21.1)	1 633 (5.2)
Suspect	2 944 (7.4)	2 281 (6.2)	1 209 (3.7)	621 2.0)
Infected	1 457 (3:7)	1 492 (4.0)	1 229 (3.7)	717 (2.3)
Restricted	467 (1.2)	634 (1.2)	561 (1.7)	468 (1.5)
Provisionally clear	201 (0.5)	687 (1.9)	1 043 (3.2)	785 (2.5)
Tested negative	9 106 (22.9)	13 365 (36.1)	17 154 (51.9)	20 246 (64.2)
Monitored negative	946 (2.4)	1 360 (3.7)	2 361 (7.1)	2 918 (9.3)
Confirmed free	635 (1.6)	1 251 (3.4)	1 629 (4.9)	3 051 (9.7)
Accredited free	281 (0.7)	444 (1.2)	906 (2.7)	1 090 (3.5)
TOTAL	39 696	37 013	33 058	31 529

The number of 'non assessed' herds fell during the year from 21% to 5% of the State's herds, leaving only 1 633 herds still to be assessed and many of these are expected to be herds which no longer have breeders. One of the requirements for provisional freedom is that all herds are assessed and it is expected that this will be achieved well in advance of the target date of 1984.

State herd registrations continued to fall, as many small herds, particularly in the Brisbane Division, were found to no longer exist. One of the more gratifying aspects of the campaign has been the steady decline in the number of infected (infected, restricted and suspect) herds. Since July 1978, the number has fallen from 4 868 to 1 806 in March 1981. This is particularly significant when it is considered that during the same period more than 22 000 herds were assessed and a proportion of these would have been classified as infected.

The Bovine Brucellosis Accredited Free Herd Scheme is continuing to maintain popularity. However, it is expected that the number of new herds wishing to join the scheme will decrease as the availability of stock from clean herds increases and the need for the accredited status is reduced.

For the year, 2.3m blood samples were tested for brucellosis.

Field testing is expected to slowly decline as there are very few herds left to be assessed. However, the need to continue eradication testing in infected herds, monitoring herds with adequate abattoir throughput and test herds which become suspect, will give rise to continued field activity for some years to come. Abattoir monitoring resulted in 93.8% of all eligible breeders being sampled.

BOVINE BRUCELLOSIS ACCREDITED FREE HERDS ( ) = 1978–79 figure

	Bris.	Twba.	Roma	M'boro.	R'ton.	T'ville.	Cairns
Beef	206 (114)	292 (218)	50 (27)	110 (81)	118 (53)	2 (1)	5 (3)
Dairy	159 (124)	87 (75)	- (-)	38 (20)	12 (7)	- (-)	- (-)
TOTAL	365 (238)	379 (293)	50 (27)	148 (101)	130 (60)	2 (1)	5 (3)

Grand Total = 1 079 (723) herds accredited.

MILK AND CREAM RING TESTING—SUPPLIERS AT 31 MARCH

	March 1980				March 1981			
Division	Positive	Suspect	Negative	Total	Positive	Suspect	Negative	Total
Toowoomba	6	–	784	790	6	9	708	723
Brisbane	49	5	760	814	15	11	732	758
Maryborough	2	–	562	564	1	2	565	568
Rockhampton	–	–	403	403	–	1	394	395
Cairns	–	–	263	263	–	1	255	256
Cream suppliers (State)	2	4	320	326	3	4	238	245
TOTAL (State)	1.8% 59	0.28% 9	3 092	3 160	0.84% 25	0.95% 28	2 892	2 945

Greater emphasis has been placed upon milk and cream ring testing, as a monitoring device during the year. The number of tests per head per year has risen from three to five during the past 2 years.

The table exhibits comparisons on a divisional basis for March 1980 and 1981 respectively.

Progress has been satisfactory as the number of infected dairy herds recorded continues to fall. With south-east Queensland being brought into the Brucellosis Eradication Scheme, the number of infected milking herds in Brisbane Division has dropped from 49 (6%) in March 1980 to 15 (1.9%) in March 1981.

A total of 550 116 blood samples has been collected to date (9 months) during 1980–81 at Queensland meatworks. The total represents a drop of 3% from the previous 9-month period and can be attributed to a downturn in production.

The most significant statistic is that 94.2% blood samples were collected from available breeders, which is an increase of nearly 10% on the previous period. The improvement can be attributed to better tail tagging and the conscientious efforts of disease control staff. Rose Bengal testing has now been phased out of all meatworks. This has been largely due to the operation of the third testing laboratory at Rockhampton.

A total of 1 847 brucellosis reactors was slaughtered at four abattoirs for the 9-month period in 1980–81.

Abortion investigations are increasing, in response to the considerable efforts which have been put into promoting and encouraging them. During 1979–80, 24 such investigations were conducted, compared with 202 in 1980–81.

Professor Cunningham (Dublin University) visited Queensland and visited country centres including Roma, Charleville, Longreach, Mt Isa and Townsville. The tour he undertook while in Queensland was extremely productive.

Winthrop C. Ray, Chief Staff Veterinarian, Brucellosis Epidemiologist with the United States Department of Agriculture, also visited Queensland and enabled staff to gain some insight into the operations of the U.S.D.A. and some of the problems it is experiencing with eradication.

Tuberculosis. Table 1 indicates the number of infected herds by Divisions and a State total. As can be seen, the number of infected herds has not altered to any degree for the past 3 years. While tuberculosis was successfully eradicated from 49 properties, this was nullified by the discovery of new and recently confirmed infections at meatworks.

T.B. INFECTED PROPERTIES

Division	31-3-78	31-3-79	31-3-80	31-3-81
Brisbane	1	1	6	1
Toowoomba	2	2	1	1
Roma	66	62	61	58
Maryborough	4	3	1	9
Rockhampton	55	54	46	52
Townsville	49	43	41	45
Cairns	14	19	18	20
Mt Isa	67	77	80	74
TOTAL	258	251	254	260

Although the number of infected herds remains static, activity within these herds has increased and it is hoped that more positive results will be achieved over the next 2 years. As can be seen from the table, the number of herds tested, the number of cattle tested and the number of reactors, all increased during the year.

A total of 1 350 (0.1%) carcasses was affected for the 9-month period to March 1981. This represents a 22.4% decrease in the number affected from a similar period in 1979–80. T.B. reactor condemnations are not included in the above figures.

TUBERCULIN TESTING RESULTS

	Herds tested		Cattle tested		No. of reactors	
	1979–80	1980–81	1979–80	1980–81	1979–80	1980–81
Brisbane	66	46	9 524	5 635	24	7
Toowoomba	43	9	8 659	1 627	14	1
Roma	129	176	68 903	83 618	120	409
Maryborough	37	1	5 592	321	2	1
Rockhampton	212	223	78 180	105 150	223	225
Townsville	263	317	125 098	125 879	260	269
Cairns	73	64	32 257	35 653	22	21
Mt Isa	394	457	343 739	362 479	1 362	1 756
STATE	1 217	1 293	671 952	720 362	2 027	2 689

Taxation concessions under Section 75C have resulted in a marked increase in activity, as the property must be on an approved programme for these concessions to apply. Such programmes are designed so that, if adhered to, eradication should be achieved.

Destocking, either partial or total, is now being used as an eradication tool. Some 36 properties are now acting under orders to destock where this is considered the most economical procedure. Where eradication is considered impossible using normal eradication procedures, total or partial destocking, spelling of pastures and restocking with clean stock is very effective. Unmusterable stock are destroyed in the paddock.

Older cattle often fail to react to the test in infected herds. With a view to minimizing this problem, partial orders to destock have been issued in some herds for cattle 6 years or older. This procedure has encouraged a number of graziers to remove these cattle from the herd and utilize the provisions of Section 36AAA of the Taxation Act. This, associated with increased testing intensity under an approved programme, greatly enhances eradication prospects.

As part of the tuberculosis eradication campaign, studies were undertaken into the possible causes of non-specific reactors to tuberculin in the caudal fold test. Reported isolations of mycobacteria other than *M. bovis* or *M. tuberculosis* from no visible lesion (NVL) reactor cattle may indicate a relationship between NVLs and other mycobacteria, or simply reflect contamination by extraneous, non-pathogenic mycobacteria.

A project is being conducted to establish the extent of contamination occurring in presently employed field necropsy techniques and to identify means of reducing it.

Twelve NVL cattle from a T.B. herd were divided into two groups of six animals each. One group was necropsied by a Veterinary Services officer using standard autopsy techniques in field conditions. The other group was transported to and necropsied at the Oonoonba Veterinary Laboratory. Aseptic conditions were rigidly maintained during laboratory autopsies. No abnormalities were observed in any of the cattle, and selected lymph nodes were processed according to routine culture techniques. Other mycobacteria were isolated from 46 (42.6%) of the lymph nodes from cattle necropsied in the field while no organisms were isolated from any of the 108 lymph nodes necropsied from cattle under laboratory conditions. Identification of the other mycobacteria isolated has yet to be completed, but they appear to be fast growing scotochromogenic rough isolates suggestive of Runyon Group II organisms. Efforts will now be directed towards developing field autopsy techniques which will allow collection of satisfactory samples from NVL reactors. This will involve laboratory staff in attempting to reproduce their results under field conditions, which will probably necessitate progressive modifications of technique until an acceptable result is obtained.

A trial was set up to determine the period of desensitization in cattle following the use of 0.3 mg bovine PPD tuberculin in the caudal fold test. The Standard Definitions and Rules state, with reference to HCSM tuberculin, that repeat tuberculin testing may be performed within 7 days of the first injection or 42 or more days after the last injection. This interval may not be applicable with 0.3 mg bovine PPD tuberculin, which is currently used in the TB eradication campaign.

A protocol drawn up by C.S.I.R.O. called for the selection and holding of 140 reactor cattle for a minimum of 126 days. This proved impossible because of management difficulties and drought. Only 55 cattle were available for the trial and they were divided into three groups of 18. These animals were injected intradermally into the caudal fold with 3 mg per mL bovine PPD tuberculin at Day 0, one group repeat injected at Day 7, and one group at Day 14 and the remaining animals at Day 42. The tests were read at 48 and 72 hours on the Day 0 test only. Animals were autopsied after reading the tests and lesions submitted for laboratory examination. Selected lymph nodes were cultured from animals without lesions.

Thirty-seven out of 54 animals were subjectively classed as positive at the test carried out on Day 0. Of the group which were retested at Day 7, one of 11 animals positive at the Day 0 test failed to react; of the group which were retested at Day 14 five out of 13 animals positive at Day 0 failed to react; and of the group which were retested at Day 42, eight out of 13 animals positive at Day 0 failed to react. Of the Day 7 group, the animal which failed to react was positive for T.B. histologically and yielded *Mycobacterium bovis* on culture. None of the five animals which failed to react from the Day 14 group had lesions at autopsy and all were negative for *M. bovis* on culture. Of the eight animals from the 42-day group which failed to react, one had lesions consistent with T.B. histologically but was negative for mycobacteria on culture and one was positive for T.B. both histologically and on culture.

Laboratory examination confirmed tuberculosis histologically and/or on culture in 3/18 of the Day 7 group 3/18 of the Day 14 group and in 5/18 of the Day 42 group. Of these 11 tuberculosis animals, 3 (detailed in the paragraph above) would have been missed at the retest.

Mycobacteria other than *M. tuberculosis* or *M. bovis* were isolated from a total of 25 animals. Of these, 10 gave a positive caudal fold reactions at both tests, seven at the Day 0 test only, three at the retest only, and five had negative caudal fold reactions at both tests.

Of the 55 animals used in the comparison of 48 hours versus 72 hours reading of the caudal fold test at Day 0, there was 84% (46/55) agreement, but 14% (5/37) of positive reactors at 72 hours were negative at 48 hours, including one with lesions. This suggests that reading the tuberculin test at 48 hours is unacceptable, although the test needs to be repeated.

The caudal fold retests at Days 7, 14 and 42 showed an increasing number of desensitized animals, three of which were confirmed as infected. This result strongly suggests that the period of desensitization following the use of 3 mg per mL bovine PPD tuberculin exceeds 42 days. The role of other mycobacteria in tuberculin sensitivity was not clarified by this trial, but preliminary results from an investigation into mycobacterial flora of NVL reactors suggests environmental contamination is a major source of other mycobacteria in field autopsies. The falling plane of nutrition imposed considerable stress on the animals during this trial and this may have contributed to the results obtained.

Rotterdam tuberculin was also trialled in an infected group of cattle from the far west. Initial results are encouraging and further work with this tuberculin is warranted. European work suggests that Rotterdam tuberculin is an extremely sensitive and specific tuberculin. Although results obtained in Australia suggest that the tuberculin is more sensitive, some doubt is expressed as to its specificity. Further trials in infected herds should help assess its specificity.

Ticks

Generally infestations tended to be light until after the summer rains. More graziers are heeding advice and seeking to develop integrated cattle tick control programmes involving the breeding and selection of tick resistant cattle, combined with effective use of acaricides only when necessary and pasture spelling where applicable. Field staff have continued to submit samples of ticks to the laboratory for acaricide resistance testing, when apparent failure to control ticks has been reported.

Testing results for 1980–81, as well as the progressive total since 1963, is set out below.

Resistance Type	Number (1980–81)	Progressive Total
Ulam	5	5
Mount Alford	25	323
Biarra	37	2 541
Mackay	–	152
Tully	–	3
Gracemere	–	18
Glastonbury	–	3
Ridgelands	1	1 321
Susceptible	5	1 931
TOTAL	73	6 297

With the gradual spread of the Biarra and Mt. Alford strains throughout the major tick-infested areas of Queensland, the usefulness of the organophosphorus compounds is diminishing. These strains may still be controlled by the amidine group of acaricides (chloromethiuron, amitraz and cymiazole) and the carbamate, promacyl and the developing synthetic pyrethroids.

In 1980, an amidine resistant strain of *B. microplus* (designated Ulam) was isolated by the Department of Primary Industries and C.S.I.R.O. from the Bajool area, south of Rockhampton. Resistance was shown, in laboratory and stall trials, to chloromethiuron (Dipofene), amitraz (Taktic) and cymiazole (Tifatol), as well as to organo-phosphates and DDT. This strain has been located on five Ulam district properties and movement controls have been applied to restrict its spread.

No other foci of resistance have since been detected. However, the emergence and spread of the Ulam strain could reduce the number of effective registered acaricides to promacyl (promicide), clenpyrin (Bimarit) and the new synthetic pyrethroid/OP mixture, Barricade S.

The presence of ticks on properties in those parts of the McKinlay, Richmond and Flinders Shires south of the Great Northern Railway gives cause for concern. However, it is hoped to commence a control programme in the ensuing year.

There has been a decrease in the number of quarantines in the tick-free area of southern Queensland. The number of properties presently under quarantine because of infestation with *Boophilus microplus* are as follows—

Shire	No.	Shire	No.
McKinlay	39	Crows Nest	17
Richmond	16	Rosalie	10
Flinders	23	Toowoomba City	4
Murweh	2	Jondaryan	1
Bungil	1	Cambooya	51
Taroom	14	Clifton	22
Nanango	27	Allora	8
Kingaroy	11	Glengallan	13
		Chinchilla	1
		TOTAL	260

The trend towards the acceptance of adapted *Bos indicus*-infused cattle in the tick areas of south-east Queensland continues. Because of the reduced availability of tick-susceptible cattle from the previously traditional Hereford breeding areas, bullock fatteners are being forced to buy crossbred stores and, having experienced the advantages of easy care cattle, are prepared to lower the non-acceptance barrier of earlier years. Added to this is the increase in the acceptance of cross-breeding by local breeders. Already there is evidence of a reduction in the use of chemicals for tick control but this has been coupled with relatively low tick numbers due to dry summers in recent years. However, there are several properties now running crossbred cattle where dipping is no longer practised.

In north Queensland, work is in progress to develop a satisfactory, simple method for selecting breeders for tick resistance in a commercial herd. In the north Queensland environment, May or June is the preferred time for assessing tick resistance to avoid the confounding effects of nutrition. Cattle need adequate exposure to ticks during the preceding 4 to 6 months. The tick resistance of cows needs to be assessed within lactation categories, because lactating cows carry many more ticks than non-lactating ones. Pregnancy status does not seem to have an effect. These trials are demonstrating that selection for tick resistance of breeders and bulls is possible in commercial herds. In addition, highly resistant cattle require few, if any, dippings with no detrimental effect on growth rate or fertility.

The owner of one of the trial herds gave a paper to the ANZAAS Conference on selection procedures in his herd. A demonstration on his property was well attended and followed by a lively question and answer session.

Research at 'Swan's Lagoon' with an unselected Droughtmaster herd indicates that regular 3-weekly dipping can increase production. In 2 of 4 years, more dipped cows were pregnant than undipped ones. Each year there was a consistent advantage in weaning weight to the dipped calves, ranging from 18 to 27 kg. However, such increases must be weighed against the extra cost of chemicals and labour to keep the cattle free of ticks. Despite the benefits due to regular dipping, the emphasis must continue to be on the selection of highly tick resistant cattle.

There was no significant response in liveweight to dipping in three trials conducted in the north Burnett. Tick counts were extremely low and the most useful information from these trials relates to tick burdens. It is possible that areas previously considered to be very ticky may be marginal when resistant cattle are used.

The dipping vat analysis service analysed 3 386 samples from vats. All 12 registered acaricides were represented as well as some samples of the no longer registered arsenic formulations. A few vats containing arsenic are still in use. Ethion is still being used consistently above 0.075%, the recommended strength—59.6% of ethion samples were more than 0.090% (20% overstrength) while a few samples were 0.22 to 0.27%. However, it is encouraging that the general incidence of samples more than 20% overstrength has reduced from 40% to 29%.

Tick fever

Field officers investigated 56 outbreaks of tick-fever due to *Babesia bovis*, 10 due to *Babesia bigemina* and 16 due to *Anaplasma marginale*.

There is a tendency for diagnosis of tick fever to be made on clinical grounds in the field, but it is essential that appropriate smears are forwarded to the laboratory for confirmation. If this is not done, the laboratory will not be aware of changing epidemiological patterns or possible vaccine failures. The following brief case histories illustrate this point—

A severe mortality due to *B. bigemina* occurred on a property in Widgee Shire. Twenty-five out of 240 Hereford breeder age cows died and five were sick. They had been introduced from Glenmorgan 14 weeks previously and had been vaccinated with *B. bovis* and *A. centrale* 12 weeks ago. Affected animals had severe jaundice, thick granular bile, enlarged spleen and heavy parasitaemias with *B. bigemina* in blood smears.

A severe vaccinal reaction occurred in one out of five 2-year-old Limousin bulls. The affected animal died 10 days after receiving bivalent vaccine. A 4% parasitaemia with *B. bovis* was detected in blood smears.

A case of apparent failure of *A. centrale* to provide effective protection against *A. marginale* was recorded. One out of 60 4-year-old Friesian cows was affected. The cows had been introduced from New South Wales 12 months previously at which time they were all given trivalent vaccine.

A 7.5-week-old Friesian heifer in Moreton Shire was severely affected by anaplasmosis. There was a 3.5% *A. marginale* parasitaemia and the calf had a haemaglobin level of 3.5g% at the time of diagnosis. It is extremely unusual for a calf as young as this to be severely affected and it is of interest that treatment with imizol 3 days previously did not control the infection.

Culture of *B. bovis*. Extensive studies on the transmission of tick fever parasites by the cattle tick have continued. These have concentrated on elucidating the significance of various stages of the life cycle of the parasite in the tick and on the effect of various physical factors on the transmissibility of the parasite. One long-term aim of this work is that, with sufficient knowledge, it may be possible to harvest parasites from tick colonies for use as vaccine which would be free from cattle red blood cells.

The successful adaption of *B. bovis* to an *in vitro* tissue culture system has been a long sought after goal, as has the development of a killed vaccine. Achievement of these goals would relieve our dependence on cattle for production of vaccine and provide a stable vaccine which would be much easier to handle than the present highly perishable material. The following reports show that some highly encouraging progress has been made in these areas.

A method for the continuous cultivation of *B. bovis in vitro* was recently reported from the U.S.A. We have successfully adapted the procedure with two Australian strains of *B. bovis*, one of which has now been continuously in culture for 57 days. Critical factors appear to be (1) a culture medium composed of RPMI 1640 plus 15 mM HEPES buffer plus 40% normal bovine serum at a pH of 7.0; (2) red blood cells used must be collected by defibrination, as anticoagulants (notably heparin) are detrimental to the parasites; (3) the settled layer of red blood cells must have overlying medium to a depth of 6.2 mm. This allows the parasites to create their own microaerophilous environment.

Fresh medium was replaced daily and the culture was diluted in normal red blood cells every 3 to 4 days in order to attain maximum parasitaemias. Cultures were started with parasitaemias as low as 0.1%, with peaks at 10 to 15% after 4 to 5 days. The table shows data for the strain maintained continuously for 57 days.

By using these culture conditions and procedures *B. bovis* may grow and multiply *in vitro* 'indefinitely'. Fifty-seven-day-old parasites appear normal morphologically and were infective when tested at 43 days.

K strain *B. bovis in vitro*

Days in culture	57
Number of subcultures	15
Cumulative dilution	7×10^{11}
Cumulative increase in number of parasites	1.2×10^{12}
Generation time (h)	22–24

Work has begun on the extraction of soluble antigens from *B. bovis* cultures to examine the possibility of producing a nonviable vaccine against *B. bovis*.

Metabolic products from these cultures have been shown to be antigenic and might prove to be useful in the development of a killed vaccine for *B. bovis*. The most promising culture component is the supernatant material which is readily obtainable. In a preliminary experiment, this supernatant was combined with the adjuvant, saponin, and used to vaccinate the animals in group 1. Groups 2 and 3 received either the present live tick fever vaccine or were left unvaccinated.

Upon challenge with a heterologous strain of *B. bovis* the unvaccinated animals reacted severely wheras both vaccinated groups were adequately protected, showing only mild temperature rises and low grade parasitaemias. While more experiments must be done to confirm these findings, it does look promising for the development of a killed *B. bovis* vaccine for the future.

Vaccination procedures. Field reports indicate that some producers vaccinate their cattle and administer low doses of 'Imizol' (new formulation—imidocarb diproprionate) simultaneously to prevent possible adverse reactions to the vaccine. The practice could be useful in protecting susceptible cattle moved into tick infested areas with extensive management procedures, but because of 'Imizol's' potential for sterilizing babesial infection, an excessive dose may prevent effective vaccination. Experiments were therefore planned to define satisfactory dose rates and timing of 'Imizol' treatment in relation to vaccination.

In the experiment completed, three groups of 10 susceptible cattle were inoculated subcutaneously with 10^7 *B. bovis* parasites ('K' vaccine strain); group 1 received 0.5 mL/100 kg bodyweight 'Imizol' (0.6 mg per kg imidocarb diprop.) on the same day, group 2, 7 days later, and group 3 was not given 'Imizol'. Infections were monitored by examination of blood smears and brain smears, and by measurement of specific antibody levels in serum from the cattle following initial infection and following homologous re-infection 35 days later. The results indicated that group 1 (simultaneous 'Imizol' treatment and vaccination) was not effectively immunized. Treatment with 'Imizol' 7 days after vaccination (group 2) caused some reduction in antibody response compared to that of group 3 but, for field use, would be much preferred to the procedure used for group 1. Further testing of different dose rates of 'Imizol' on day 7 is planned. A puzzling result in the present work was that antibody levels in group 1 and 2 were higher than in group 3 following homologous re-infection. A potentiating effect by Imizol + *B. bovis* (whether dead or alive) on antibody response to subsequent infection is possible.

Buffalo fly

Buffalo fly activity in all areas markedly decreased during the winter months and light to moderate infestations were reported in northern Queensland during the spring and early summer months.

Widespread rains during early 1981 resulted in medium to heavy infestations being reported, and in the south-eastern areas of the State infestations of 100 flies per side were common. Infestations were observed in areas north and west of Charleville such as Tambo, Augathella and Morven, while it is interesting to note that moderate infestations of cattle were seen on 'Orientos' in far south-west Queensland. Heavy infestations were seen in the Taroom Shire and light infestations were observed in the ranges north of Wallumbilla. The demand for advice on treatment remained high in southern Queensland.

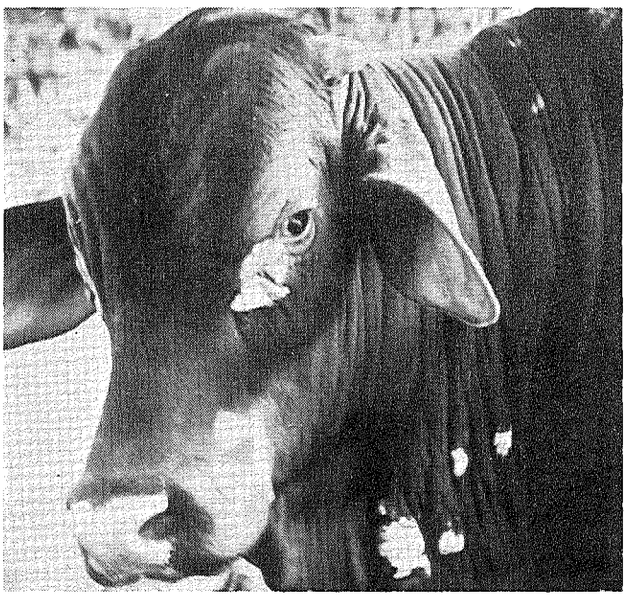
No further instances of resistance to fenvalerate occurred, and apart from the Kuttabul area where resistance to fenvalerate was detected last year, the three synthetic pyrethrins, namely, fenvalerate, permethrin and cypermethrin, are giving good control of buffalo fly. However, there is field evidence in some areas to suggest that the residual period afforded by these compounds is reduced to about 1 week during periods of high fly pressure.

A field trial was conducted on a commercial beef cattle property in the Tully area to evaluate Barricade (Cypermethrin) treated ear tags for the control of buffalo fly. The trial, which did not determine the breakpoint of the ear tags, was terminated after 158 days' duration. Breakpoint was defined as that point where fly numbers on treated animals rose to 10% of the fly numbers on control animals. During the 158 days of the trial, the treated cattle were afforded protection from buffalo fly. There was a noticeable difference in temperament between the control and treated groups. All cattle in the latter group were easier to handle and more relaxed.

At 'Swan's Lagoon', a study is examining the effect of buffalo fly control every 3 weeks on the performance of steers and bullocks. Treatment has tended to depress weight gains by the steers whereas there have been small responses of about 10 kg per annum by bullocks. In 1980, the carcasses of treated bullocks were 5 kg heavier than untreated ones (259 *v* 254 kg). In a preliminary analysis of the 1977–78 data, there was no significant relationship between fly burdens and the average daily gain of animals. While bullocks carried more flies than steers, so did red or dark coloured animals attract more than light coloured ones.

Stephanofilariasis

A filaroid parasite (*Stephanofilaria*) not previously recognized in Australia was detected by the Oonoonba Veterinary Laboratory. Adult worms, probably *S. stilesi*, have been recovered from ringworm like lesions on *Bos indicus* type cattle in northern Queensland. Active lesions were accompanied by a mild pruritis and were restricted to the head, neck, dewlap and sternum. The parasites can be seen in histological sections of lesions associated with an allergic dermatitis. A purebred *Bos. indicus* herd near Ingham, that has not been subjected to acaricide treatments for 2 years, had in excess of 80% of animals exhibiting lesions.



Skin lesions caused by Stephanofilaria, *an newly identified nematode-induced disease under study in the cattle industry in north Queensland.*

Stephanofilariasis of cattle is widespread throughout the world and has been reported from Indonesia (*S. dedoesi*), U.S.A., Canada, Hawaii and Russia (*S. stilesi*), Indian subcontinent (*S. assamensis*, *S. zaheeri*, *S. roni*, *S. andamani*), Indonesia and Malaysia (*S. kaeli*), Kenya (*S. dinniki*), Japan (*S. okinawaensis*) and from Nigeria, Denmark and Germany (*Stephanofilaria* spp.).

The horn fly *Haematobia irritans* has been shown to be the principal vector of *S. stilesi* in the U.S.A. and Russia. In northern Queensland it seems probable that the buffalo fly *H. irritans exigua* is the most likely vector. Changing methods of tick control could lead to an increased incidence of Stephanofilarial dermatitis.

Initially it is proposed to survey the distribution of this parasite, followed by investigation into vectors, epidemiology, treatment and control. Preliminary sampling at Bohle Abattoir has surved 152 head from 35 properties. *Stephanofilaria* have been detected in 10 animals from nine properties situated between Cooktown and Ayr.

Internal parasites

During the drought months of winter, spring and early summer, few outbreaks of internal parasitism were reported. However, wet conditions predisposed to outbreaks of haemonchosis of calves in south-east Queensland.

Interestingly mortalities due to infestations of *Haemonchus placei* and *Cooperia* sp. occurred during the drought in Santa Gertrudis heifers following introduction to the Nanango area from Quilpie. Similar mortalities occurred in Hereford weaners following their movement from Roma to the Gayndah area.

Cooperia punctata caused the death of seven out of 17 calves 4 to 10 weeks old in a calf-rearing unit at Upper Coomera.

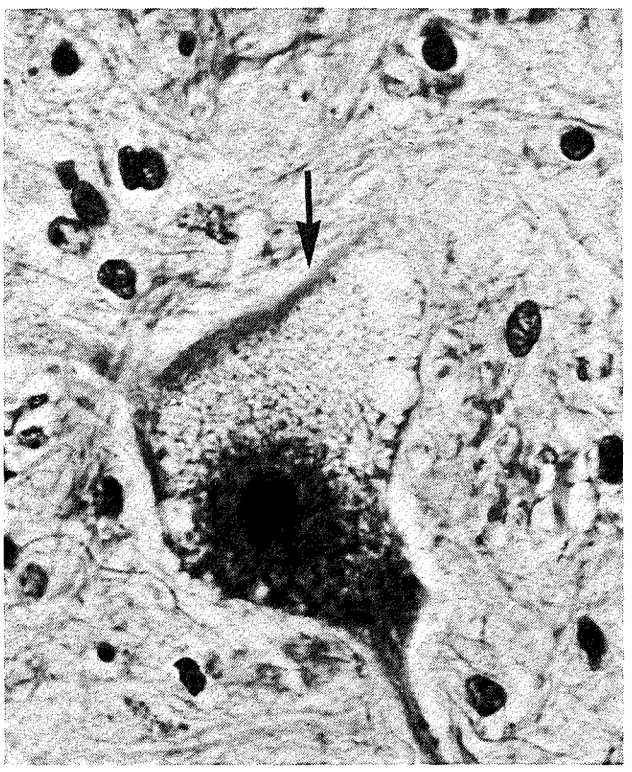
Coccidiosis also caused calf losses in a number of areas.

Large volumes of anthelmintics are sold every year and used without any certainty regarding the need for treatment. It is difficult in most situations to say whether treatment is or is not worth while, but the results of various trials do suggest that, if young cattle are to be finished on intensively grazed pasture and sold at a young age, anthelmintic treatment is warranted. If cattle are to be grown out to an older age, then treatment, in the absence of clinical disease, is probably not worth while. Treatment trials are presently in progress in a number of different environments.

Other diseases

Following upon confirmation of clinical cases of Pompe's disease (generalized glycogenosis), a total of 768 liver samples was collected by Slaughtering and Meat Inspection Branch officers at meatworks from Brahman bulls (¾ or better) for analysis for alpha-glucosidase activity. The results indicated that 32 (4.2%) of the bulls could be considered heterozygous and another 30 (3.9%) must be considered equivocal and suspected of being heterozygous.

Using these bulls as sires of breeders for the next few years, if they were a random sample, a loss of 0.04% to 0.16% of calves could be predicted. No dramatic change in gene frequency would be expected unless a particular heterozygous bull or family was to become popular for some reason. The results of the survey have been conveyed to the Australian Brahman Breeders' Association.



A neurone (arrowed) from the brain of a bovine affected by Pompe's Disease—generalized glycogenosis. The cytoplasm surrounding the dark staining nucleus has some large vacuoles and the remainder has a foamy appearance. This is due to the storage of glycogen in lysosomes in the cytoplasm.

Queensland is participating in the national mannosidosis accreditation scheme, the objective of which is to eradicate mannosidosis from Aberdeen Angus stud herds. Blood sampling is carried out by private veterinary practitioners and the laboratory testing is undertaken by the New South Wales Department of Agriculture at Glenfield Research Station.

Approximately 650 animals in 11 herds have been sampled with 47 animals (7.2%) returning results indicative of heterozygosis. Twenty-five of these reactors involve a Red Angus herd. If this herd is excluded, the heterozygote reactor rate is of the order of 3.4%.

As part of an ongoing study of causes of bovine abortion, all foetuses submitted to the Animal Research Institute are subjected to a detailed pathological examination. An unusual form of infectious abortion characterized by epi/endocarditis is emerging as a significant cause of loss. Abortions characterized by this change have been seen for several years and have now become the major group of undiagnozed abortions. These foetuses were between 3 and 8 months' gestation. Lesions demonstrated microscopically were epicarditis, endocarditis, interstitial myocarditis, hepatitis, interstitial pneumonia and placentitis. The cause of these inflammatory changes has not been demonstrated. *Mycoplasma* sp. was isolated from foetal membranes of one case but the isolate died out before it could be identified. The possibility of infection by a Sarcosporidial/Toxoplasma type organism is also being investigated.

Other infectious abortions from which a specific agent was not identified were those in which significant inflammatory changes were seen microscopically but no significant infectious agent demonstrated. The most interesting of these was a 7-month foetus from Ipswich. This foetus had extensive haemorrhage, malacia and inflammatory infiltration in the cerebral cortex. Specific agents considered to be responsible for abortions included *Escherichia coli, Enterobacter agglomerans, Klebsiella pneumoniae, Leptospira* and Akabane virus. A foetus of approximately 4½ months' gestation was aborted from an AIS cow from a property at Rockhampton. Autopsy of the foetus revealed erosive lesions of 1 to 2 cm diameter on the head and body and a swollen abdomen filled with blood-tinged fluid. Histology demonstrated the presence of large septate fungal hyphae on necrotic lesions of the lung, heart, abomasum and liver. A mycotic dermatitis was shown to be the cause of the necrotic skin lesions. Attempts at culturing the fungus were negative.

Numerous infertility investigations were carried out, especially in the dairying areas, and vibriosis was diagnosed as the cause of infertility in beef herds at Cairns, Taroom, Injune, Richmond and Glamorganvale. Vaccination, especially of bulls, has reduced the prevalence of abortions in herds infected with vibriosis.

An unusually high level of infection of bulls with *Trichomonas foetus* was recorded on a large property at Mt. Isa, where 20 out of 41 bulls were found to be infected.

Two unusual outbreaks of dermatophilosis occurred during the year. In one, *Dermatophilus congolensis* was isolated from multiple abscesses in a steer rejected for slaughter at a Brisbane metropolitan abattoir. The animal had subcutaneous abscesses in the brisket and rump region, abscesses in prescapular, superficial inguinal and precrural lymph nodes and an internal abscess in the omental fat around the abomasum. *D. congolensis* was isolated in pure culture from the precrural and superficial inguinal lymph nodes and from the internal abscess. Histologically the lesions in the brisket and superficial inguinal lymph nodes were club forming granulomas. The clubs contained a filamentous gram positive organism consistent with *Dermatophilus* sp. Inoculation of the isolate onto the scarified skin of a horse, calf, lamb and rabbit produced the typical exudative dermitiis normally associated with *Dermatophilus.*

The other severe *Dermatophilus congolensis* infection was diagnosed in a herd of Angus cattle at Palmwoods (Maroochy Shire) following spraying with an acaricide. Two very badly affected animals died and 12 others developed extensive lesions in a herd of 20. The first lesions appeared 2 days after spraying and developed into large scabs in 10 days, especially on the lower parts of the body. A subsequent spraying, which was required to control ticks, resulted in further severe cases. There was no unequivocal evidence to incriminate the particular acaricide involved and the outbreak probably related to prolonged wetting in susceptible cattle.

The relationship between heavy flood rains and melioidosis was again demonstrated in north Queensland when *Pseudomonas pseudomallei* was isolated from multiple lung abscesses in a dead Brahman weaner in Hinchinbrook shire.

Numerous outbreaks of mastitis in dairy herds were investigated. The majority of outbreaks were caused by *Staphylococcus aureus,* although *Streptococcus agalactiae, Streptococcus uberis* and *Streptococcus salivarius* were often implicated. Sporadic cases were caused by *Corynebacterium murium, Pseudomonas aeruginosa* (chronic unresponding mastitis), *Bacillus cereus, C. pyogenes, Corynebacterium bovis* and *Enterobacter aglomerans.*

The prevalence of blackleg was lower than usual but investigations confirmed the disease as the cause of light mortalities at Rathdowney, Tuchekoi, Jandowae, Yarraman and Goondiwindi. Non-vaccinated cattle were involved.

A variety of syndromes in cattle on the Darling Downs during the drought was ascribed to the feeding of peanut hay. In one case, 11 weaners died following access to peanut hay containing many peanuts. Signs included photosensitisation, salivation, dysentery and 'bottle jaw'. Aflatoxins B1, B2, G, and G2 were recovered from the peanuts. Eight out of 200 weaners agisted on a property at Wandoan died from what was histopathologically diagnosed as chronic aflatoxicosis, but no source was determined.

A group of steers in a feedlot at Warra exhibited persistent coughing and mucopurulent nasal discharge. *Pasteurella multocida* was recovered from a pulmonary abscess in one animal.

Seven steers in a mob of 200 died at Wyandra following signs of swelling of the abdomen, pain and anorexia. Diet consisted of mulga and *Eromophila longifolia.* Post mortem examination of an animal revealed the presence of two oxalate calculi, 2.0 cm in diameter in the urethra, ruptured urinary bladder and peritonitis. A bull at Roma died from the effects of a ruptured urinary bladder that followed blockage of the urethra by magnesium phosphate uroliths.

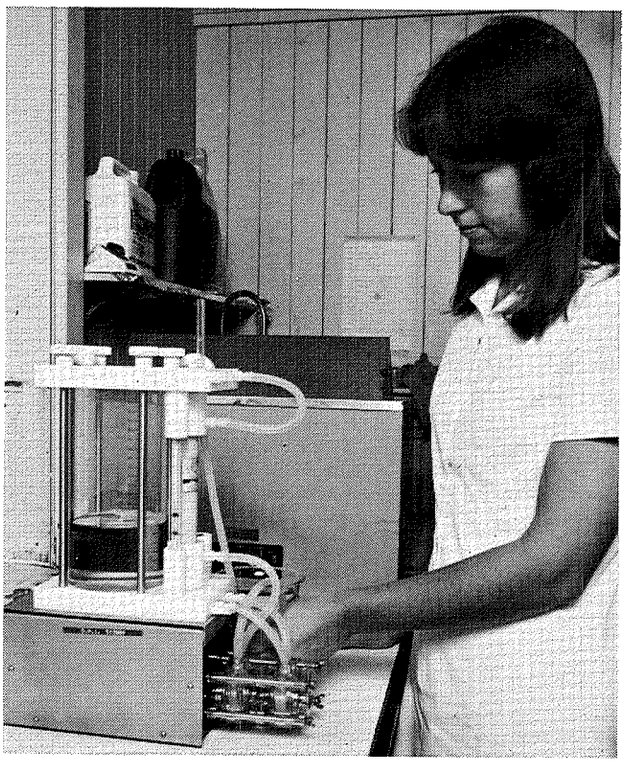
One hundred calves died from tetanus following castration on a property in the Cape York Peninsula.

A high prevalence rate of telangiectasis was recorded in cattle from a feedlot on the Downs. The condition has been detected at slaughter in 50% of animals from some pens.

Sporadic outbreaks of ephemeral fever were diagnosed throughout the eastern coastal areas during the winter and spring months of 1980. An outbreak on the Atherton Tableland and another in the Springsure area were serologically confirmed. However, they became more widespread following the general rainfalls of midsummer. Outbreaks involving cattle under 3 years of age were reported from Mt. Isa, McKinlay Shire, Hughenden, Atherton Tableland, Springsure-Rolleston area, Quilpie, Augathella, Charleville, Cape York Peninsula, eastern coastal districts and Wandoan. Another outbreak at Laidley was serologically confirmed. Generally young cattle which apparently had no previous contact with the causal virus were affected. Mortality rates reported were less than 1%.

Work has continued on enzootic bovine leucosis (EBL) throughout the year. A limited quantity of antigen for use in the agar gel immunodiffusion (AGID) test has been successfully prepared from EBL virus infected cell cultures by ultrafiltration. The Department has a commitment to the Australian Meat Research Commmittee to survey Queensland cattle herds for AGID antibody and this commitment will be given priority.

Infection has been established in sheep inoculated with EBL virus suspensions 12 months previously. Virus has been recovered from several of these animals and they are still positive to the AGID test, but they have remained clinically and haematologically normal.



This molecular sieving device is used by staff of Pathology Branch to selectively concentrate fractions of solutions of comparable molecular size. In this instance, it is being used to concentrate and purify the antigen used in the agar gel immunodiffusion test for enzootic bovine leukosis. The equipment was purchased with funds provided by the Australian Meat Research Committee.

Investigations revealed the presence of EBL in herds at Grantham, Boonah, Beaudesert, Beechmont, Numinbah, Mt. Whitestone and Kingaroy.

Infectious bovine rhinotracheitis (IBR) vaccine was imported from New Zealand for protective vaccination of introductions to a feedlot at Dalby, following a serious outbreak of IBR which occurred in this feedlot in 1979. A few cases of IBR followed the initial vaccination of the feedlot population, but these cases were probably vaccinated during the incubation stages of the disease. Apart from this, no cases of IBR have followed vaccination.

Cases of sporadic bovine encephalomyelitis (SBE) were diagnosed in southern Queensland. Six young Hereford steers in a feedlot at Bell displaying signs of fever, increased respiratory rate, nasal discharge and ataxia gave positive results to the CF test for *Chlamydia* sp. Also S.B.E. was confirmed following post mortem examination of a 6 months old calf at Morven.

A virus isolate from a sentinel herd animal at Utchee Creek was identified as CSIRO 154. The isolate was made following sero-conversion of the animal in the agar gel immunodiffusion (AGID) group test for bluetongue viruses. CSIRO 154 is serologically related to bluetongue virus serotype 6, although it can be clearly distinguished from it and probably represents a new serotype.

A limited survey on bloods collected in the summer of 1979–80 was undertaken by the Oonoonba Veterinary Laboratory for serum neutralizing (SN) antibodies to bluetongue (BT) 20, CSIRO 154 and CSIRO 156 (serotype 1) and AGID antibodies. A total of 770 bloods was collected, mainly from coastal shires throughout Queensland. The tests revealed that 46% of the sera were positive for the AGID test, 14.7% were positive for CSIRO 156, 12.6% were positive for CSIRO 154, but only four samples (all from north Queensland) were positive for BT20. A high level of positive reactors to CSIRO 154 and CSIRO 156 was detected in far northern shires, but there was also a relatively high proportion of reactors in south-east Queensland. The results show that:

a high proportion of AGID positives cannot be explained on the basis of the three recognized Australian BT serotypes;

there was no recent evidence of BT 20 activity in southern Queensland;

there was CSIRO 154 and CSIRO 156 activity in south-east Queensland in the summer of 1979–80.

These results have serious implications for the live cattle export trade should further importing countries require a 'bluetongue group' test as part of their test requirements.

Routine monitoring of sheep for bluetongue AGID antibodies has continued to reveal only a very low level of reactors. Selective blood testing of sheep from specific districts of Queensland is continuing.

Since 1973, a Murray Grey stud has had an increasing number of calves born with a congenital abnormality, namely distortion of the head bones and curvature of the spine. In 1979, 10 calves died from this condition. A genetic analysis identified an autosomal recessive gene as the probable cause of the condition and 10 cows were identified as carriers. The owner replaced the oldest carrier bull with one from another herd and a breeding programme was devised. As a result of this, only two affected calves were born in 1980. These were progeny of the two known carrier bulls mated with cows which had not had the opportunity to display their carrier status in the first year. With appropriate procedures, the abnormal gene should gradually be eliminated from the herd.

Reproduction

Reproduction and breeder management still command a large part of the time of staff. In northern Queensland, particular attention has been given to the problem of preventing mortalities among breeders. On extensive properties, one of the most important factors which affects profits is the number of breeders which reach the meat-works as opposed to dying in the bush. For many years, cattle owners in the north have accepted high breeder mortalities as inevitable and something which cannot be economically prevented. Timely weaning has, for many years, been put forward as a means of preventing breeder mortalities and increasing conception rates. This has not been accepted for a variety of reasons, one of which is the infrequency of musters and the unwillingness of producers to wean cattle when they are young. However, if calves are not weaned at one muster the chances of their being weaned in less than 4 or 5 months time are remote.

In the Peninsula region, the Beef Cattle Husbandry Branch has been advocating very early weaning and a few producers have now accepted this proposition and special emphasis is being given to it in extension programmes. The Cattlemen's Union in Mareeba has gone so far as providing funds for the publication of a leaflet on the subject titled 'Radical Weaning Lifts Profits'.

On the downs country of the north-west, a different approach has been taken. These properties are less extensive and more closely managed and the emphasis has been on trying to identify animals at risk so that they can be segregated for supplementary feeding, if necessary. This goes hand-in-hand with timely weaning. The Beef Cattle Husbandry officer has been involved with about 10 properties on which pregnancy status has been diagnosed and cattle segregated on this basis so that all the higher risk animals—high risk because of their expected time of calving—can be kept together in one small herd for special attention.

The co-operative work with James Cook University on testicular growth patterns in Zebu cross bulls was continued, and it is hoped to gain some information on relationship between testicular size and fertility.

Work on libido and serving capacity of Zebu cross bulls indicated that the libido test devised for Hereford bulls was quite unsuitable for Zebu crossbred bulls.

Nutrition

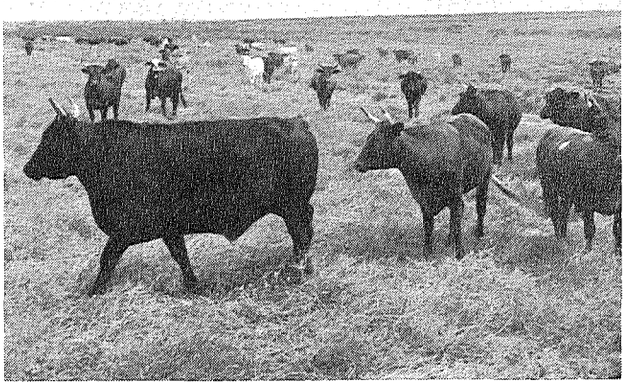
The most important factor which determines the level of performance of cattle is the nutritional plane. Producers are very conscious of this fact and have maintained a high level of interest in improving the nutritional status of their stock, either through pasture improvement, supplementation or full hand feeding.

Opportunity feedlotting of animals to maintain turn-off has continued at a reasonable level. Most feedlotting still takes place on the Darling Downs, but the drought saw several successful feedlots set up in the Mackay district and other areas of central Queensland.

Molasses feeding to ensure survival of stock during the dry season and in drought situations has been accepted widely. Last year it was reported that a number of producers was concerned at losses from urea toxicity, but the slight risk of such losses did not prevent widespread feeding of molasses fortified with 3 to 8% urea. In the Mackay district on one property, 1 100 weaners were fed for 3 to 5 months almost solely on molasses and urea, with very little paddock feed and no losses. Extensive feeding without loss in the Central Highlands was also reported.

For the first time, molasses was used extensively in southern inland areas to feed drought-stricken stock. The unknown factors in molasses feeding under these circumstances are the quantities and preparations of protein or nitrogen additives. Studies to determine these are under way.

There has been increased interest in the use of improved pastures: perennial stylos in north and central Queensland and irrigated ryegrass in the south. An attempt is being made to obtain data on which decisions can be based. However, even in the absence of data one company in north Queensland has proceeded with the sowing of 3 000 ha with Verano seed on a newly-acquired property.



Brahman-cross cattle grazing improved Stylosanthes *pastures on the Peninsula.*

Following the positive responses obtained in field observations, with the growth promotant, Ralgro, many thousands of fattening age stock have been implanted during the past growing season. It is reported that, in the Central Highlands alone, more than 100 000 implants have been carried out.

Pastures

Native pastures still remain the predominant source of forage for beef cattle in Queensland, most of the beef produced in the State is derived from them.

Despite this fact, native pastures have not been studied to a significant degree and little is known of the effect of various management practices on the productivity and long-term stability of the pastures. For this reason, a long-term burning-management trial has been started on 'Swan's Lagoon'. Other pasture trials are concerned with the low cost introduction of legumes into native pasture and the use of *Leucaena leucocephala.*

Fire is used widely as a management tool in native pastures to remove overburden, control regrowth, provide a green shoot and to aid in mustering. A study is under way at 'Swan's Lagoon' to study the effect of a number of burning strategies on pasture and animal performance.

Burns were carried out in January, June and December 1980 and June 1981. Studies of this nature are long-term studies and results to date are merely preliminary. Indications are that yield of pasture during the wet season is reduced by about 20% following a pre-wet season burn. However, animal liveweight performance over 2 years has not been affected by burning treatment. This is not surprising since quantity of feed is rarely limiting on native pasture in north Queensland, quality being the major limiting factor. Provision of a urea-salt-sulphur supplement during the dry season gave a significant improvement in animal performance on both burnt and unburnt areas. This response to nitrogen supplements on unburnt pasture during the dry season is in keeping with earlier studies on the station. However, the effect of supplements on performance on burnt country has not been studied before.

The perennial stylosanthes species, *S. hamata* cv. Verano and *S. scabra* cv. Seca, have been shown to grow and persist well in a range of environments in tropical Queensland, but there is a lack of information on their effect on animal performance. A study has been designed at 'Swan's Lagoon' to examine the effect of introducing these legumes into native pasture on the performance of grazing steers. In addition, the study will measure consumption of these plants by animals throughout the year as well as the spread and persistence of the legumes.

The legume seed was sown into lightly disced soil on burnt areas in January 1980 but establishment was poor. This was a function of poor quality seed, failure to control grass competition and a short wet season. Further seed was sown in 1981 wet season and a more satisfactory establishment obtained, but only as a result of special treatment. The seed, as purchased, was purported to be scarified but this was found not to be so. Grazing will commence in December 1981.

Observations are under way on four private properties at Mareeba, Georgetown and Cape York to examine the effect on animal liveweight performance of introducing perennial stylos into native pasture. The legumes have established well and animal data should be available during the coming year.

Townsville stylo has been affected quite seriously by anthracnose (*Collectotrichum gleosporoides*) in many parts of coastal Queensland and there has been a tendency to disregard it as a useful pasture plant. Some paddocks at 'Swan's Lagoon' have been studied since December 1965 to determine the long-term dynamics of Townsville stylo pastures. These pastures have provided an excellent area on which long-term data are available to assess the effect of the disease.

Growth of Townsville stylo during the 1981 wet season was vigorous and did not appear to be seriously affected by anthracnose. Several graziers in the area have reported their best crop of Townsville stylo for many years. This may be a function of the seasonal conditions or of the legume adapting to the disease. Fertilized areas in the trial are carrying little legume because of the very vigorous growth of annual grass.

Annual liveweight gains by animals do not appear to be affected by the presence of the disease. Highest performance is still recorded on fertilized Townsville stylo with unfertilized Townsville stylo and native pasture being similar. Mean annual change over the past 7 years has been: fertilized Townsville stylo 169 kg, unfertilized Townsville stylo 88 kg, and native pasture 99 kg at a stocking rate of a steer to 2.4 ha.

The shrub legume, *Leucaena leucocephala*, has been used extensively as a grazing plant in many tropical countries. Research in Queensland has demonstrated that it has potential as a supplement to native pasture in coastal, tropical areas. A grazing observation on a commercial property north of Rockhampton is examining the benefits of allowing animals grazing native pasture to have access to an area of leucaena pasture from June to November.

Studies in the coastal and inland Burnett Regions and the Texas area have demonstrated high levels of beef production and positive gross margins from irrigated, nitrogen-fertilized ryegrass. To broaden our knowledge, liveweight production and gross margins will be measured from a ryegrass pasture on a producer's property in the Brisbane Valley.

Alkali treatment of low quality roughage. Alkali treatment of low quality forages in many areas has been shown to improve intake and digestibility of the forage. To determine the advantage of treating native pasture at 'Swan's Lagoon', an alkali treated group has been included in a number of pen studies at the Station.

This metabolism experiment measured the effect of alkali treatment on intake and dry matter digestibility of native pasture hay by steers. Intake of untreated hay with urea-sulphur and alkali-treated hay with urea-sulphur was 57% and 168%, respectively, higher than that of untreated hay without supplement. Dry matter digestibility of the untreated hay was not improved by a urea-sulphur supplement (42 *v* 44%) but alkali treatment caused a marked increase in digestibility (53%). This combination of increased intake and digestibility of treated hay should result in greatly improved liveweight performance.

These results were verified in a pen study where an alkali-treated hay group was included. Intake of untreated hay with urea-sulphur was 41% higher than with no supplement while the intake of alkali-treated hay with urea-sulphur was 129% higher than the untreated controls. The control group lost 30 kg liveweight over 57 days while the alkali-treated group with urea-sulphur gained 15 kg. Further studies are planned to determine the potential of this method of treating hay in northern areas, especially in remote areas where alternative sources of hay are expensive.

Mineral supplements. Feeding of phosphorus supplements in the wet season has been advocated for some years in the phosphorus-deficient areas and this is reported as gaining acceptance in the Bowen and Peninsula districts.

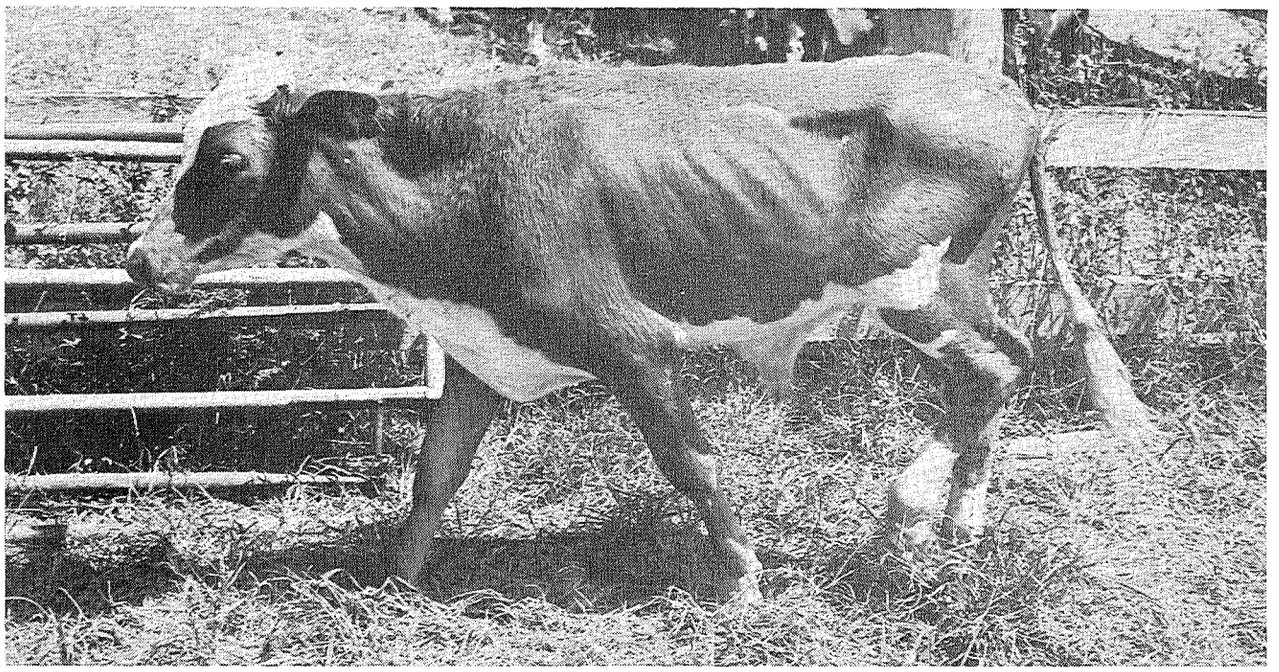
Investigations into the role of copper and cobalt in the nutrition of grazing animals have continued. Regular sampling of pastures over a wide area of coastal Queensland has been carried out to obtain a picture of cobalt status of the pastures. Despite low copper levels in animals in some areas, treatment has failed to produce a response.

The response to copper therapy of steers grazing improved brigalow-vine scrub country between weaning and 30 months of age has been studied at Wandoan. The copper was provided by injection or as copper-oxide needles. The latter were given as a drench and lodge in the reticulum. Three drafts of animals have now grazed the area and the study terminated in May 1981.

Serum (0.02 to 0.25 mg per 100 mL) and liver (4 to 8 p.p.m.) copper levels in unsupplemented animals were indicative of copper deficiency throughout. Although copper treatment raised these values to above normal levels, no liveweight response was obtained in any of the three drafts. During the summer periods steers have gained in excess of 1 kg per day, which suggested that no deficiency in the diet existed.

It is possible that an effect upon production would occur in a poor season. Analyses of pasture samples suggested that the low copper status of the steers was due to low copper content of the pastures. Molybdenum levels in Rhodes grass reached levels as high as 7 p.p.m. in summer which may have contributed to the low serum copper levels in steers, as Rhodes grass seemed to be selectively grazed at that time.

On Brigalow Research Station, the effect of copper treatment on reproductive performance of Hereford cows and growth rate of their progeny is being studied. The cattle are grazing improved brigalow country. No responses in liveweight performance have been obtained



A typical cobalt-deficient weaner in a grazing experiment being conducted north of Bundaberg. Cobalt deficiency is responsible for poor production in cattle in some coastal areas of Queensland.

in either cows or calves, although liver copper levels as low as 7 p.p.m. and serum copper levels as low as 0.03 mg per 100 mL were recorded in unsupplemented animals. Copper treatment raised liver levels to 90 to 150 p.p.m. and serum copper levels to 0.06 to 0.07 mg per 100 mL. Analyses of a limited number of pasture samples have indicated satisfactory copper levels in buffel, Rhodes and green panic grasses, but molybdenum level in green panic may be high enough to interfere with copper absorption.

A series of studies on the Queensland coast are examining the interaction of copper, cobalt and anthelmintic treatment on performance of young growing animals. Treatments are applied in a number of combinations. The studies are a follow-up to the successful responses to cobalt and anthelmintic treatment in the coastal foothills near Bundaberg. Animals in these areas have a history of poor performance.

Animals in the Torrens Creek area have a history of poor performance and mortalities are common. The effect of a calcium-phosphorus supplement on animal performance and incidence of bone disorders is being studied. A radioactive tracer technique has been used to identify animals consuming supplement and to determine levels of supplement consumed by individual animals. In July 1980, only six of 199 animals which were sampled were not consuming some lick. Intake within the group varied widely but the overall means for different categories of animal were: 7 g phosphorus and 10 g calcium for steers and 8 to 15 g phosphorus and 12 to 23 g calcium for cows. These are very satisfactory intakes and possibly account for the absence of deaths in the paddock during the period.

Nitrogen supplements. Over much of the native pasture areas of Queensland, low nitrogen level in the diet limits animal performance during part of the year. The current research programme into nitrogen supplementation is concentrating on determining combinations of urea and true protein which will give the optimum economic response.

A pen feeding study aimed at determining the effect of feeding commercially available protein meal with and without urea on intake of native pasture hay by steers was carried out. Feeding of a urea-sulphur supplement increased roughage intake by 41% over unsupplemented controls. When the supplement was a protein meal, intake was stimulated by 48%. With the combination of urea-sulphur and protein meal the increase in intake was 77%. The protein meal was a mixture of treated cottonseed meal, fish meal and meat meal (8 : 1: 1).

This study has demonstrated the potential of a dry lick composed of urea-sulphur and protein meal for cattle grazing native pastures during the dry season. A further study is planned to determine the conditions under which protein meal gives an additional response over urea-sulphur and the magnitude of the response. The study will investigate as well the contribution of the various components of the protein meal.

Mortality of breeders during the dry season is a serious problem in north Queensland and represents a significant financial loss to the beef industry. The survival feeding study was designed to assess the effect of various nitrogen supplements on the performance of pregnant breeders fed native pasture hay in pens. The supplements compared were lucerne chaff, urea-sulphur, and urea-sulphur plus protein meal (an 8 : 1 : 1 mixture of cottonseed meal, meat meal and fish meal).

The urea-sulphur supplement increased roughage intake by 48% over unsupplemented controls while the urea-sulphur plus protein meal supplement resulted in a 93% increase. Intake was increased by 59% when lucerne chaff was fed. Improvement in liveweight performance reflected these increases in feed intake. Calf birth weights were 46 to 52% heavier when nitrogen supplements were fed. Cows fed a urea-sulphur supplement maintained weight during the study, mirroring the results normally obtained in the field.

Work on survival feeding is continuing to assess the usefulness of mixtures of molasses and grain. A combination of the two may help overcome the problems associated with grain feeding and, in some circumstances, lead to cheaper rations. The combination may also be beneficial where cattle are on the point of death from starvation and rapid recovery is essential.

Experimental work, in co-operation with the Sugar Research Institute, to investigate the nutritive value of bagasse pellets has commenced. Results to date show the apparent digestibility of dry matter of bagasse pellets, with 4 to 10% molasses, was 40.8%. Preliminary *in vitro* analysis of alkali treated bagasse suggest that the *in vivo* apparent dry matter digestibility may be increased 25 to 30%.

A study on 'Swan's Lagoon', has examined the effect of dry season supplements and different weaning times on the survival, liveweight, body condition and fertility of Brahman cross cows grazing native pasture. Cows calved in November–December and calves were weaned at 5 months (April) or 8 months (July). Supplements compared were nil, a salt-urea-sulphur dry lick fed from July, and a grain-salt-urea-phosphorus-meatmeal-molasses mixture fed from when half the cows in a group reached poor body condition.

Cows in early-weaned groups were heavier and in better body condition throughout the year than late-weaned groups. Dry season supplementation from July reduced dry season weight loss of cows. However, there were no differences in conception rates of the various treatment groups. Overall this study has shown that, where mating is controlled, there is little advantage in weaning calves in April in place of normal July weaning. While feeding a supplement from July onwards will reduce weight loss during the dry season and cow mortality, there will not always be a response in pregnancy rates.

At Charleville, the effect of various supplements on the performance of steers and heifers running on mulga country is being examined. In the study with steers, combinations of cottonseed meal, urea, phosphorus, sulphur, and salt were compared. Feeding extended from December to August. Cottonseed meal and sulphur both produced significant responses in liveweight performance with little response from urea or phosphorus. At a subsequent weighing in November, supplemented groups had retained their weight advantage.

Based on these results, pregnant heifers were fed combinations of phosphorus, sulphur, cottonseed meal and salt, commencing in September 1980. Phosphorus was included because of the higher phosphorus requirements in pregnant and lactating heifers than in steers. Between September and April, animals fed a cottonseed meal supplement maintained weight while unsupplemented animals lost 32 kg. This response is of a similar order to that obtained with the steers. Sulphur alone gave little response in contrast to the marked response with steers. Phosphorus produced no improvement in liveweight change.

Growth stimulants. The growth promotant, zeranol, has been used widely in many countries of the world and has been shown to increase weight gain by 10 to 15% and feed conversion by 8%. Much of this work has been carried out in feedlots or in animals grazing high quality improved pastures or crops.

During the past year, a series of 24 observations has been conducted throughout Queensland to determine the responses to implantation under a range of grazing conditions. The situations studied ranged from improved tropical pastures on the wet coast at Innisfail to droughted crop at Bungunya. Most animals implanted were fattening age bullocks but calves were used in some studies. In all cases, positive liveweight responses were obtained. Implanted animals gained from 10 to 40% more weight during the 80 to 100 days following implantation than untreated controls. Carcass data were obtained in some studies and this showed increased carcass weight in implanted steers commensurate with their higher liveweight.

The studies have demonstrated that a zeranol implant will increase the gain of steers grazing pasture or crop in Queensland provided animals are gaining about 0.5 kg per day. However, to realize on this increased liveweight, it is important that animals are sold by an objective method, for example, carcass weight or liveweight.

The growth promotant, monensin, is under study at 'Swan's Lagoon'. Monensin acts by changing the fermentation patterns in the rumen and increasing energy availability. Studies are under way to devise slow-release capsules which can be deposited in the rumen and release the medicament over an extended period. When steers grazing native pasture were dosed with capsules (release rate 150 to 250 mg monensin a day), their liveweight change over the following 274 days was not significantly different from that of untreated controls. In a second study, steers grazing fertilized Townsville stylo were dosed with capsules designed to release 120 mg monensin a day. Over the following 124 days, performance of treated and untreated animals was identical.

These two studies would suggest that there is no advantage in dosing grazing animals with monensin at the dose rates used under these conditions in north Queensland. Lower dose rates may be studied in the future.

Genetic improvement and breed evaluation

Objective selection of cattle continues as a major activity in the Division's extension and research programmes. During the last 12 months, increased activity has been directed towards promoting the concept of breeding home-bred bulls. An extension programme in the Central Highlands, 'Breed your own bulls', has resulted in seven commercial herd owners deciding to accept the concept. Many commercial herds do use home-bred bulls but the technique used to select these bulls needs to be improved. Extension material has been developed that explains simplified techniques that can be used to ensure that all home-bred bulls used are above average.

Since most of the breed societies now have their pedigree records processed at Armidale under the umbrella of the National Beef Recording System (NBRS), there has been little promotion for enrolment in the NBRS 'basic unit'. This has occurred because it is expected that most breed societies will provide a pedigree-performance option that will be more attractive to stud breeders. However, a slowly increasing number of breeders is selecting on objective criteria, mainly growth rate, and doing their own calculations, with the guidance of branch officers.

The Sire Reference Scheme being run by the Angus and Poll Hereford Breed Societies in association with the NBRS continues to operate. However, there have been some problems particularly with the A.I. programmes and a survey was conducted to identify the specific problems so that corrective action could be taken for the future programme.

Stabilized ½ and ¾ Brahman and Sahiwal herds are being developed at 'Swan's Lagoon' Research Station to determine genotype differences and demonstrate response to selection. The programme also provides stock of known age and breeding for research programmes. For the No. 0 calves, birth-weight differences in different genotypes were recorded but are confounded by different dam age effects. For weaning weights the F_2½ and ¾ Brahman calves were heavier than the F_3½ and ¾ Brahman and F_2 and F_3½ and ¾ Sahiwals were heavier than their comparable Brahman genotypes. For the 1980 mating, overall conception rates were low at 51% and demonstrate the strong seasonal effects that can influence results. Conception rates for 1978 and 1979 were 78% and 72% respectively. Growth rates and carcass data are also being collected but insufficient data are available to draw any conclusions at this stage.

Murray Grey and Brahman x Murray Grey genotypes are being evaluated at Moura in a project designed to measure the effect of breed and age at first joining. In results to date, ½ Brahman–½ Murray Grey cows reared heavier weaners than Murray Grey cows. While differing selection pressures have influenced results, generally ½ Brahman ½ Murray Grey had higher growth rates followed by ¾ Brahman ¼ Murray Grey and Murray Greys. On reproductive performance, there was no difference between F_1½ and Brahman ½ Murray Grey and Murray Grey yearling heifers. However, Murray Greys tended to conceive earlier than the Brahman genotypes.

On another Moura property, European-Brahman crossbred bulls and Brahman bulls are being mated to ¾ Brahman breeders to compare the performance of Limousin, Charolais and Chianina infusions with high grade Brahman progeny. With two calf drops produced to date, there were no significant differences between sire breeds in conceptions. For the first calf drop branding weights (82 days) and weaning weights (209 days) were recorded for both sexes and a yearling weight (370 days) collected for steers only. Sire genotype effects were significant at branding only when the ¼ Chianina ¾ Brahman had the highest growth rate.

Belmont Red, Brahman and Santa Gertrudis genotype evaluation. In a trial at Charters Towers, Africander and high grade Brahman bulls are being mated to low grade Brahman cross cows. To date three calf drops have been produced and branding rates show significant yearly variation. Overall branding rates have tended to be higher with the Brahman-sired group but this could be influenced by paddock differences. Growth rates of progeny will have to be assessed over a number of years before any conclusions can be drawn, but initial observations indicate that the Brahman cross is superior to the Africander cross in the environment.

At Brigalow Research Station, a high grade Simmental herd is being developed as a representative of the large European breeds to assess performance traits in the central Queensland environment. The project is to run for a number of years and the various genotypes developed are being assessed.

For the 1980 calving season, birth weights averaged 32.5, 33.2, 34.3, 36.3 and 37.8 kg for Herefords, ¼ Simmental ¾ Hereford, ½ Simmental ½ Hereford, ¾ Simmental ¼ Hereford and ⅞ Simmental ⅛ Hereford respectively. These results are influenced by different group sizes and dam age effects. Within genotypes sire effects on birth weight were considerable.

For the No. 0 steer yearling progeny, average gain ranged from 0.45, 0.50, 0.53 and 0.55 for the Hereford, ¼ Simmental ¾ Hereford, ½ Simmental ½ Hereford and ¾ Simmental ¼ Hereford. Age corrected 480-day weights for the comparable groups were 248, 270, 290 and 302 kg. Growth increased with increasing Simmental content.

Also at Brigalow, a two-stage project is designed to compare the performance of Africander and Belmont Red genotypes with Hereford. In stage 1, Africander and Hereford bulls are being mated to Hereford cows to produce ½ Africander ½ Hereford and Hereford progeny. In stage 2, Belmont Red bulls will be mated to the ½ Africander ½ Hereford females to produce Belmont Red progeny that will be compared to contemporary Hereford females joined to Hereford bulls.

To date, three matings have taken place in stage 2 of the programme and results are influenced by year effects. During this period, the ½ Africander ½ Hereford had a 5% higher conception rate and a 10% increase in percentage of calves weaned. There has been a higher calf mortality rate among Hereford calves.

Progeny generated in this project are also used in a trial measuring the effects of ticks and worms. In the first draft of steers in this trial ½ Africander ½ Hereford steers were 16 kg heavier than Herefords as yearlings when the experiment started. At 39 months of age the crossbred steers had a liveweight advantage of 66 kg when stressed with worms and ticks. When the stress was reduced by regular drenching and dipping the advantage to the crossbreds was reduced to 42 kg a head. Comparable figures for the second draft No. 9 steers gave advantages to the ½ Africander ½ Hereford of 5 kg and 61 kg at 8 and 27 months of age when stressed. The advantage at 27 months was reduced to 51 kg when stress was reduced.

Of particular interest was a demonstration within the Africander-Hereford herd which demonstrates selection responses gained through using above and below-average bulls. Progeny from 14% above and 8% below-average bulls were compared. At birth calves from above-average bulls were 2 kg heavier. At 4 months of age, calves from above-average bulls were 11 kg heavier—an advantage of 8.9% over the below-average bulls.

At Toorak, the performance of different genotypes is being compared so that recommendations can be made concerning fattening operations on Mitchell grass downs country. The performance of steers is being assessed over a 2-year period commencing at weaning. The original intention was for half the draft to spend the first 12 months of the test in ticky forest country north of Toorak but agistment was not available.

The first draft compared the performance of ¾ Brahman X, ½ Brahman X, and Santa Gertrudis genotypes. For the period from January 1979 to May 1980, overall liveweight gains were similar for all genotypes when adjusted for differences in initial liveweight. The mean gain was 0.42 kg per head per day. At May 1980 liveweights adjusted for initial liveweight were 408, 402 and 398 kg for the ¾ Brahman X, ½ Brahman X and Santa Gertrudis.

The Africander and Brahman are being compared on a Banana district property. In this project, the performance of Herefords is being compared with Africander x Hereford and Brahman x Hereford genotypes. Results to date cover 1970–1980 and indicate relativities

for weaning weight of 100, 107 and 112 for the Hereford, ½ Africander ½ Hereford and ½ Brahman ½ Hereford respectively. On yearling weight, the relativities were 100, 111 and 120. These results are similar to previous Belmont work which shows the Africander cross to be intermediate in performance between the Brahman and British breed lines. For the first 2 years there has been very little difference in the fertility of the Africander and Brahman halfbred heifers.

Transport and marketing

During the past year, the saleyard curfew issue has been the subject of a lot of attention. Welfare as well as economic considerations have had to be taken into account.

The results from a series of trials carried out over the past 2 years have indicated quite clearly that a dry curfew period, when cattle are denied water, does not decrease the variation in dressing percentage, as claimed by many buyers. As a consequence of this work, it has now been accepted that a wet curfew with water available during presale and sale periods should be adopted whenever possible in association with liveweight selling.

Weight loss during marketing. Except under certain circumstances, losses in carcass weight are more important than those in liveweight. Loss of liveweight is most affected by losses in the contents of the alimentary tract (gut fill). Loss of carcass weight can result from changes in hydration status and tissue catabolism, with the loss increasing the longer that animals are without water and feed.

Two of the most critical factors influencing weight loss in cattle are the time between mustering and sale, and the provision of water before sale. Distance travelled and method of sale seem to be less important mainly because of the time factor. Unnecessary delays during marketing should be avoided and whenever possible cattle should have access to water. These recommendations apply whether cattle are sold at a saleyard or an abattoir.

The total journey time has a greater effect on carcass weight loss than the distance cattle are transported. The effects of distance and time were further examined in a trial with bullocks from near Mt Surprise. Between 4 and 11 days after mustering, groups of bullocks were held in yards at Cairns Meat Export Company's abattoir. During this time the mean carcass weight decreased from 290 to 285 kg, that is, almost 1 kg per day. An extra group of bullocks was sent to F.J. Walker's Maryborough and also dressed 285 kg when slaughtered 11 days after mustering. On a 'wet' curfew basis, the loss in liveweight during this time was about 2 kg per day, but travelling increased the rate to about 3 kg.

One of the criticisms of the saleyard system is that it prolongs the marketing process. Such criticism is valid if weight and grade cattle are delivered and slaughtered before saleyard animals. In two trials, when weight and grade cattle were slaughtered 2 days before saleyard animals, they had heavier carcasses. However, when both lots were slaughtered at the same time, carcass weight did not vary with method of sale.

Further research has demonstrated how essential it is to give animals access to water between arrival and slaughter at abattoirs. This practice can reduce losses in carcass weight due to dehydration. Western Queensland bullocks which were not watered after a 30 hour rail journey had a mean carcass weight of 319 kg. In contrast, bullocks given access to water until half an hour before slaughter averaged 331 kg.

Further investigations are planned to examine the effects of management, in particular rest at abattoirs, on carcass weight and meat quality.

Saleyard curfews. There are now 30 saleyards in the State with scales for liveweight selling and together they account for approximately 70% of the annual throughput for all saleyards. All cattle are sold in pens and weighed after sale.

The introduction of mandatory fasting ('dry' curfew) periods with liveweight selling meant that cattle had to be penned without feed and water for 10 to 12 hours before the commencement of the sale as well as during the sale. The aim was to reduce the variation in mean liveweight due to gut fill between sale lots with a similar carcass weight.

A series of trials was conducted to re-assess the need for a curfew and examine alternative procedures for liveweight selling. The trials were conducted in conjunction with the Queensland Meat Industry Organization and Marketing Authority.

In summary, the curfew fast did not significantly reduce the large difference in liveweight and dressing percentage between sale lots with a similar carcass weight. The differences resulted from the widely different fasting times while cattle were being transported to saleyards. Under the 'dry' curfew system, cattle also lost liveweight during the sale.

Under a 'wet' curfew system, cattle are penned with access to water, but not feed, for at least 12 hours before the start of the sale and during the sale. When cattle always had access to water at the saleyard, the variation in liveweight and dressing percentage was greatly reduced and these factors tended to remain stable during the sale period. There was no indication that liveweights were inflated by large amounts of water in the gut and all animals presumably had a similar hydration status.

For a 'wet' curfew and sale system to be effective, cattle must accept saleyard water. Studies at Cannon Hill, Bohle (Townsville) and Warwick saleyards indicated that water consumption tended to increase with length of fast, when cattle were not disturbed. As expected, local cattle drank only small amounts, but thirsty cattle usually drank without hesitation.

The various curfew procedures had little effect on carcass weight at the time of slaughter when cattle drank some time between sale weighing and slaughter.

Reducing the variation in dressing percentage between sale lots, as under a 'wet' curfew, should improve the accuracy of estimates by meat buyers. Buyers will have less need to adjust estimates for gut fill and hydration status of individual sale lots and during the sale to account for loss in gut fill. Time of weighing within the sale will be less important. Fewer mis-estimates of dressing percentage should mean that prices are determined more accurately. In turn, reporting of sale prices also will be more accurate. Any decrease in the variation with dressing percentage from saleyard to saleyard will improve the compatibility of liveweight price quotations.

Following discussions between QMIOMA, QDPI and the various sectors of industry it was agreed to adopt the 'wet' curfew and sale system for selling cattle by liveweight. Individual saleyard operators will decide whether or not to accept the decision. Selling under this system commenced recently at the Bohle saleyards and other major centres are expected to begin within the next few months.

Marketing cattle. This is an aspect of the beef industry that has generally tended to be neglected, particularly from the point of view of research. Beef Cattle Husbandry Branch officers have, in recent years, undertaken several studies in relation to marketing of cattle.

The comprehensiveness, comparability and accuracy of livestock agents' reports have often been questioned. A recent study at Cannon Hill saleyards showed that the reports issued by agents were reasonably accurate.

The Prices Justification Tribunal in 1978 suggested that marketing efficiency could be improved if some of the small volume saleyards were phased out. In a case study, the prices paid by one meatworks for third grade cows were examined at 47 saleyards over a 4-year period. A significant relationship between the size of the saleyard and price was found. A second case study examined the price paid by another meatworks at five centres over 5 weeks for all categories of stock. No relationship was found. It was concluded that while, on average, larger centres attracted higher prices than smaller centres, this influence may not occur between all centres nor at all times. There is evidence that some rationalization of the saleyard network is already occurring in the State.

The number of cattle in each sale lot may be another source of inefficiency at saleyards. A study of the prices paid by two different meatworks did not find a significant relationship between lot size and auction price. However, larger lots predominated and this may explain why significant relationships have been reported in other trials where most lots were small.

A number of groups has argued that an objective system of carcass classification would provide a more objective basis for trading than existing weight and grade methods. The prices of 125 lots of saleyard cattle were regressed against the four classification parameters (dentition, sex, weight and fat thickness) and also carcass weight and subjective grades. Classification explained less of the variation in price than the weight and grade method (44.0 *v* 61.0%).

An important finding was that saleyard auction prices were significantly higher than weight and grade prices at the point of slaughter. However, the reverse was marginally true when compared at the farm gate. It seems that part of the difference is due to a time lag between auction and weight and grade price formation.

The per unit costs of on-property inspection are increasing in areas where small lot sizes predominate. Even when on-farm inspection does not occur, premiums for larger lots existed and it was considered this was the result of lot identification costs during processing.

Extension

Again, as in the previous year, staff in most districts were preoccupied for a large part of the year in dealing with problems relating to drought and supplementary feeding. This applied particularly in the southern border areas. For several months, an officer ran a weekly 'drought bulletin' on the Toowoomba ABC morning programme. This was used primarily to discuss various aspects of managing droughted cattle and inputs emanated from all Downs officers. With the financial assistance of Dalgety Pty Ltd, work was started on the making of a drought film. All of the scenes were shot late in 1980 and the film is now being edited and scripted. The purpose of this film is not to depict the drought scene, but to emphasize that drought is a normal occurrence in Queensland and that certain management practices can be implemented in order to alleviate its effects.

Large numbers of cattle from southern Queensland were agisted in central Queensland and many owners had substantial losses on agistment. A survey of people who agisted cattle was undertaken to find out what were the main causes of losses and the principal difficulties encountered. The office in Dalby was set up as a contact point for buyers and sellers of fodder on a farm to farm basis.

Interest in electric fencing is still widespread and occupies part of the time of a number of officers. Field days on the Darling Downs on electric fencing have attracted a total of some 500 persons, and a 2-day session in the central west also attracted a large audience. Since the extension programme on electric fencing commenced some 3½ years ago, more than 20 000 energizers are estimated to have been sold in Queensland, and at a conservative estimate these would be electrifying 100 000 km of fencing. The rejuvenation of old fences or the erection of light electric fencing represents a saving of $800 per km by comparison with the cost of putting up a conventional fence. Many electric fences have been used in situations where the producers would otherwise have not, perhaps, put up any fencing at all. Nevertheless, the total saving in costs must be in the region of $40m for which the officers concerned can claim at least some of the credit.

It was mentioned in the last annual report that Beef Cattle Husbandry officers edited or played a major role in the editing of eight district newsletters. Two more have been added to the list, the Insufferabulletin put out from Mareeba and another new newsletter started from the Dalby office. The first issue of the Mareeba publication carried an article on botulism and the need to safeguard cattle by means of vaccination. Agents in the area reported a very substantial lift in sales following the publication of this newsletter which at least suggests that they are read and in some cases heeded.

During the beef slump Beef Cattle Husbandry Branch discontinued running regular 'beef schools'. To a large extent this was because of the cost entailed for producers to attend a full day or 2 days in one of the major centres. There has been a renewed interest in this type of activity, but with some changes. In the previous year, a series of seminars on genetics and breeding was held at Toowoomba. This year, a live-in workshop was held for producers at the Dalby Agricultural College. Twenty-two producers and five Beef Cattle Husbandry officers spent 2½ days discussing aspects of herd improvement and selection. There was a fairly high degree of technical input, but a substantial amount of time was devoted to discussion and to consideration of producers' objectives and priorities. Those who attended expressed a high degree of satisfaction with the conduct and outcome of the proceedings. It is intended to conduct at least one such workshop a year. The Dalby Agricultural College is ideal but is available only during school holidays and in some cases these do not coincide with suitable times for producer workshops.

A number of more conventional extension activities was held throughout the State, usually in association with producer organizations.

In Mackay, a cattle marketing and carcass quality symposium attracted an attendance of nearly 300 cattlemen. One of them subsequently purchased a butcher's shop as a direct result of the symposium, in order to try and ensure that there was at least one outlet in the area which might offer a consistent product. The question of marketing of beef featured prominently in many such functions and there has been a marked rise in interest by producers in the marketing of their beef. At a beef seminar in Gympie, attended by 150 people, the discussion was dominated by a consideration of beef as a retail product. Producers voiced very strong concern that beef was not being processed in the best possible manner.

A carcass classification seminar in Miles also covered other aspects of beef marketing. It was opened by the Minister and attracted a very large audience. Discussion was very lively and prolonged. Both the Gympie and Miles seminars were organized by Beef Cattle Husbandry Branch in association with both the Cattlemen's Union and the UGA. It was pleasing to be able to work simultaneously with both organizations for such functions.

In the Gympie district, a special effort was made to establish contact with small herd owners and for this purpose a field day was held at Bli Bli attended by about 130 owners of small beef herds.

A day each at Longreach and Winton combined a morning session of lectures and discussion and an afternoon of demonstration. One-day bookkeeping schools in the Barcaldine district were run by Economic Services Branch officers from Charleville at the request of the beef cattle adviser from Barcaldine.

A series of 'Gulf Field Days' was organized from Richmond. One-day sessions at five different centres attracted large gatherings of interested producers.

Last year, Departmental officers in Rockhampton were involved in a well attended day on 'Tartrus' stud. The exercise was repeated this year on 'Cardowan', attended by 450 producers and others. Staff have been associated with cattle management on both properties.

In association with the Tropical Grasslands Society, 68 producers from Mackay made a 3-day bus tour of the Atherton Tableland and coastal areas. Arrangements in the north were in the hands of the Beef Cattle Husbandry Officer.

The Beef Cattle Husbandry Officer in Gayndah was instrumental in forming a sub-branch of ASAP and organizing two well-attended meetings.

Numerous other small field days were conducted and covered a variety of topics. These activities all indicate a renewed willingness and ability on the part of producers to support such activities.

The major extension efforts by Veterinary Services Branch have been associated with various aspects of the brucellosis and tuberculosis eradication programme, a successful field day being held at Monkira in the Channel Country. Other extension thrusts revolved around tick and tick fever control, pesticide residues and disease control.

Field days bring the most up-to-date information to graziers. A group of producers at the 'Cardowan' (Sarina district) field day listen to a talk of beef production.

Sheep and goat industries

Rainfall in the southern half of the State was below normal and the drought conditions have continued. Some relief rain was received in late summer and early autumn but in most cases was insufficient to break the drought. Large numbers of sheep were moved from south Queensland; some were sold while others were taken to agistment in the more favoured areas in the north. Many producers did not join their breeding stock and many who did recorded poor lamb-marking percentages. In some of the worst-affected areas, this is the fourth successive year in which there have been no lambings. As a result the sheep population in Queensland has been further reduced by 15% to 10.4m.

Drought feeding of sheep has been widespread. Fodder, particularly good quality hay, was difficult to obtain and, in many cases, prices almost doubled during the year. A number of producers successfully fattened store lambs in feed lots. The feeding of edible trees has continued: in some districts producers have been felling trees for 2 consecutive years.

Normal seasonal conditions have prevailed in the central and north-west.

Wool receivals were below normal with consequent reduced offerings at Brisbane wool sales. The April 1981 sale was cancelled and wool on hand was sold by separation in Sydney. If this trend continues, it is probable that all Queensland wool will be sold by separation.

The wool market remained steady throughout the season. The market indicator has at all times been over the Australian Wool Corporation minimum floor reserve of 365¢ per kg clean, ranging from 392¢ to 427¢.

The main point of interest this season was the narrowing of the price differential between wool in the 20 to 24 micron range. Within this range, the price of 20 and 21 micron wool decreased, 23 and 24 micron wool increased, while the 22 micron category remained steady. The difference in price between the 20 and 24 micron categories at the end of the season was 69¢ clean, as opposed to 100¢ at the start of the season.

Extension

The comprehensive extension programme in operation in central and north-west Queensland was continued and expanded. In October and November 1980, a set of four management discs was distributed to all sheep producers in this region. These discs outlined proven practical techniques for implementation at shearing, joining, lambing and weaning to improve the productivity of the sheep flocks in the area. A number of field days was subsequently held on specific aspects of technology outlined on the discs and further activities are planned for the ensuing year. In addition, demonstration trials on co-operator properties commenced. An extension programme aimed at disseminating information obtained from research efforts at the Charleville Pastoral Laboratory was commenced. Relevant results are being collated into a manual acting as a basic reference document for producers in south-west Queensland. It will be published and distributed next year. As a prelude to this programme, a successful management school was conducted at Charleville during April 1981.

The Sheep and Wool Branch continued to mount exhibits at major Agricultural Shows held in the sheep districts of Queensland. Displays during the year highlighted recommendations for the control of external parasites and the alleviation of low lamb-marking percentages.

As part of the series, Wool Harvesting Notes, the Australian Wool Corporation in association with the Queensland Department of Primary Industries and the Departments of Agriculture in the other States published a comprehensive document describing the design of sheep yards, shearing sheds and sheep handlers. In addition, a shearing shed design service was developed and is available to producers wishing to erect new sheds or modify existing sheds.

The Department of Primary Industries, in association with the Ithaca Technical College and the Australian Wool Corporation, completed its programme of 2-day wool classing courses for professional classers. Three-quarters of all professional classers registered in Queensland have now successfully completed the requirements for up-grading from PI to PII Stencil. Six schools for owner-classers were also held during 1981. They were well patronized, with 50 to 65 producers as well as some professional classers attending each one. The schools will continue into 1982.

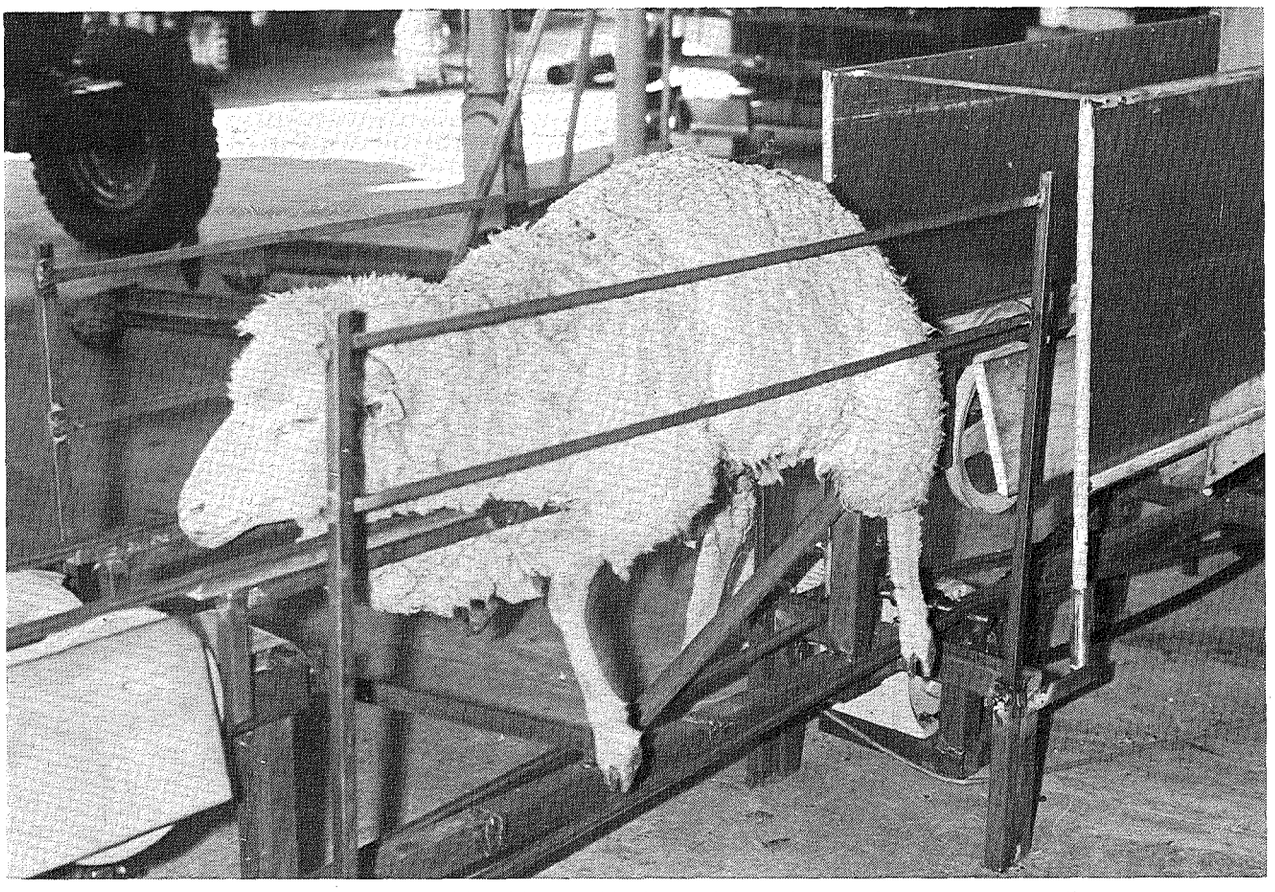
Overseas markets for Queensland sheep

In the continuing effort to develop an export market for sheep from central and north-western Queensland, a delegation representing the Queensland Department of Primary Industries and the Queensland Meat Industry Organization and Marketing Authority visited several countries in South-East Asia from 22 April to 8 May 1981.

The delegation visited several centres and held discussions with meat importers, processors and wholesalers who provided them with an insight into the meat processing and marketing systems. The three delegates from this Department were Mr. L. Laws, Deputy Director, Division of Animal Industry; Mr. A. Jurgensen, Marketing Officer; and Mr. G. Roberts, Sheep Husbandry Officer; while Mr. B. Collins and Mr. S. Melrose represented industry.

External parasites

Studies into the biology and control of blowfly strike and lice infestations of sheep continued during the year supported by funds from the Wool Research Trust Fund.



A 'maximum' exposure sheep conveyor providing ideal positioning and throughput for insecticide application.

The Air Mist Sheep Race was used successfully on eight properties to eradicate lice burdens from 22 000 sheep. This machine was also evaluated as a means of applying insecticides for protection against blowfly strike at the Ciba-Geigy insectory at Kemps Creek, New South Wales. The investigations demonstrated that the Air Mist Machine can provide protection against strike for a period of 9 weeks after treatment. This degree of protection is similar to that obtained by hand jetting, a procedure that is more labour intensive and uses more insecticide.

Studies designed to identify sheep that are susceptible or resistant to challenge from *Lucilia cuprina* larvae continued. Approximately 1 000 sheep have been screened to date. Results have shown that susceptible animals have an area of myiasis which is approximately three times that of resistant animals after both types of sheep have been subjected to standard larval challenge. Susceptible sheep do not acquire resistance after successive challenges. Studies have shown that intravenous infusions of antihistamines markedly reduce larval survival after a standard implant challenge: this finding highlights the degree to which anaphylactic type reactions may be associated with the spread of myiasis.

Attempts to immunize sheep with third instar somatic antigen extracted from the larvae of *L. cuprina* produced substantial antibody titres as measured by radioimmunoassay and/or immunodiffusion techniques but did not confer protection against subsequent implant challenge. *In vitro* sero-culture studies, however, showed that pooled sera from immunized sheep significantly reduced larval survival, growth and maturation. Work in this area is continuing.

Observations aimed at predicting blowfly activity began at three locations in Queensland. Drought conditions prevailed over most of the State and catches from fly trapping were low. However, fly densities along the shaded water courses at both 'Toorak' and Cunnamulla were found to be markedly higher than those 0.5 to 1 km away from such sites.

Work continued on the evaluation of the potential use of the Wiltshire Horn (WH) breed in crosses with the Merino (M) for the development of an easy-care wool producing sheep. The Wiltshire Horn sheds all its fleece and, in crosses with the Merino, the sheep produced shed wool from the head, neck, belly and breech regions. The degree of shedding increases with the proportion of Wiltshire Horn in the sheep. This shedding makes the sheep less susceptible to fly-strike.

Lifetime production from ½M½WH, ⅝M⅜WH and ¾M¼WH sheep continued to be recorded. When these data are complete, an economic assessment of the potential of Wiltshire Horn will be possible. During the current year, a 3-year assessment of the effect of time of shearing on production from the various crosses was commenced. Half the sheep will be shorn in August and the other half in February (when the sheep have usually been shorn) to determine whether, by an August shearing, it is possible to recover the wool that is normally shed in the paddock before a February shearing, but still retain the resistance to fly-strike achieved by shedding.

Internal parasites

A survey in south-east Queensland showed multi-resistant strains of *Haemonchus contortus* and *Trichostrongylus colubriformis* to be present in sheep and goats in this area. In these flocks, only a few narrow-spectrum anthelmintics can be relied upon to give effective control of helmenths. Trials conducted with the Merck, Sharp and Dohme Pty Ltd experimental anthelmintic MK533, however, indicated that this compound could be highly effective against both resistant species of helmenths.

The survey in the major sheep producing districts of Queensland investigating the resistance of strains of *H. contortus* to commonly used anthelmintics continued. Drought conditions depressed internal parasite burdens and it was difficult to find properties where sheep carried burdens sufficiently high to enable testing.

Trials investigating the effect of low to medium infestations of *H. contortus* on the productivity of pregnant and lactating ewes and weaner sheep commenced. Studies using artificially infected sheep progressed satisfactorily, but those involving natural burdens under field conditions were affected by the continued dry conditions.

Biological defleecing

Studies on biological defleecing continued supported by funds from the Wool Research Trust Fund. Previous investigations into biological methods of defleecing sheep have highlighted the benefits of using catagenic steroids and have delineated the defleecing potential of a range of corticosteroids to show that small changes in the molecular structure of the steroids elicit large differences in catagenic activity.

For example, the long-acting derivatives of triamcinolone and betamethasone were shown to have defleecing activity, whereas prednisolone was shown to have none. This work also indicated that defleecing activity of the corticosteroids is not related to anti-inflammatory potency. The principles established in this work will be used to develop a specific catagenic steroid which produces brush-end fibres. To this end experimental steroids will be obtained from two sources, namely, commercial manufacturers and the Organic Chemistry Department, University of Queensland.

Some important features of recent studies using steroids include the short time that wool growth is suppressed; the subsequent rebound in growth rate; the need for only one injection to induce shedding; the retention of the fleece on the sheep until sufficient wool has grown to afford protection against the environment following plucking.

Sheep breeding and wool production

Sheep and Wool Branch has initiated a number of programmes during the past 6 years which are designed to improve the productivity of Queensland sheep and, in particular, tropical Merinos. This work has attracted support from the Wool Research Trust Fund.

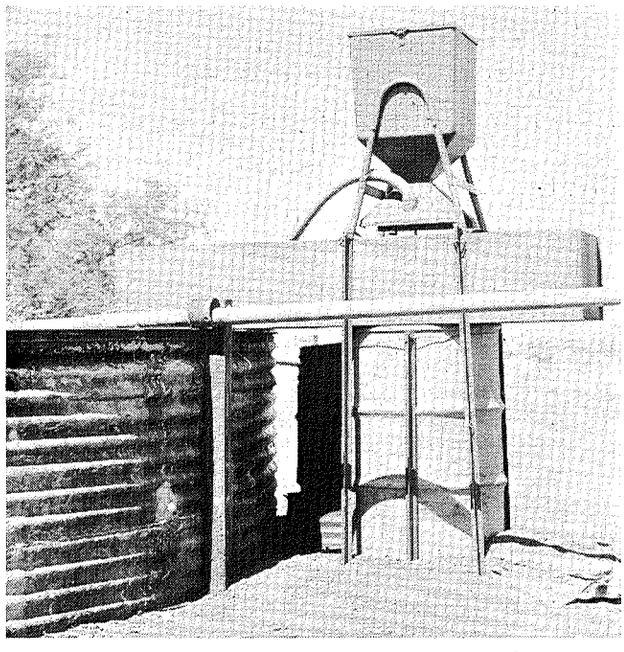
A nucleus of high-producing ewes and rams selected from 19 co-operating properties in north-western Queensland has been established on 'Toorak'. Of the male progeny, the highest producers are returned to the nucleus while the next tier is offered to the co-operating properties. Two hundred and fifty rams were so distributed during the past 12 months. The higher producing ewe progeny from the scheme are returned to the nucleus.

As an adjunct to the above Ram Breeding Scheme a Sire Evaluation Project is also located at 'Toorak'. High producing rams from studs in more southern regions of Australia are progeny tested at 'Toorak' and those siring animals with an enhanced wool and meat producing ability are introduced into the Ram Breeding Scheme. The Sire Evaluation Project has now developed to the stage that semen from selected rams has been offered to stud principals interested in breeding rams adapted to the harsh north Queensland environment.

Translocation studies have commenced at 'Croxdale', Charleville, 'Manningham', Longreach and 'Toorak' to quantify the impact of environmental factors on sheep production and, if possible, to determine the most suitable genetic material to use in these differing environments. The performance of ewes, rams and wethers from southern, central-western and northern Australia is being compared with that of locally-bred animals and appropriate physiological parameters are being monitored. Preliminary results only were available from these studies. They suggested that high-producing sheep introduced from favourable areas and their progeny bred in north Queensland performed better in the northern environment than locally-bred sheep when seasonal conditions were favourable, but that this superiority was not maintained under adverse seasonal conditions. These investigations are in their early stages and it is expected that they will yield much valuable information in the future.

Nutrition

The widespread drought conditions in 1980-81 stimulated innumerable enquiries from graziers concerning supplementary and total hand feeding of all classes of sheep. The information that has been obtained from experiments conducted by officers of Sheep and Wool Branch during the past few years was extensively utilized when responding to these enquiries. Urea supplementation of lactating ewes has been widely accepted in the industry. In south-west Queensland, mulga-fed sheep are now commonly supplemented with sulphur, phosphorus and in some instances, protein.



A urea dispenser discharging into a tank. Supplementing lactating ewes with urea in the drinking water increases lamb survival and productivity.

Interest in producing native pasture hay is increasing. Several field days have been conducted and a number of producers in the central and north west is now conserving hay as a hedge against drought and as a source of medium quality roughage to feed to weaner sheep during late winter.

Preliminary observations have indicated that spraying dry standing grass with a solution of sodium hydroxide stimulates intake of the grass by sheep. This technique is being further evaluated to determine how the treatment influences the nutritive value of the sprayed material.

Further results from the study of the nutritional factors limiting production of sheep grazing a mulga grassland pasture are now available. When seasonal conditions were good, the quality of the diets eaten by the experimental sheep was adequate to support a high level of production. After 4 to 6 months without effective rainfall, however, the nutritional value of the diets consumed deteriorated significantly. The first limiting nutrient appeared to be energy, followed by intestinally digestible protein and then a number of minerals including sulphur, magnesium, zinc and sodium.

An interesting observation was that the manganese concentrations in all of the diets consumed on this mulga grassland site were very high although the nutritional significance of this finding was not yet clear. The practical benefits that can be achieved by supplementing sheep with the nutrients indicated by the results of this study on mulga grassland pastures and those obtained from the study conducted on a Mitchell grass pasture are now being evaluated on 'Croxdale' Charleville.

Many of these nutritional research programmes were supported with funds from the Wool Research Trust Fund.

Stout oats, Corvette barley, and Dua triticale are recent additions to the list of crops that can be used for winter grazing. These crops were grazed by lambs at a range of stocking rates in order to measure their productivities at their respective 'optimum' stocking rates. The season was dry and grazing commenced unusually late, but results were interesting. Dua produced the least carcass gain at all stocking rates and at the most productive stocking rates Corvette produced about 40% more carcass than Dua, with Stout intermediate.

Reproduction

Owing to dry seasonal conditions, a large proportion of the central and southern Queensland ewe flock was not joined in 1980. This severely curtailed field investigations into reproductive problems.

An intensive study has clearly shown the penalty that a lamb suffers when its mother has only one functional teat. Over a range of dietary regimes, milk production of ewes with one teat was reduced by 5 to 20% with a corresponding reduction in lamb weight gain of 15 to 30%. This study further illustrated the importance of providing an adequate water supply for lambs reared in western Queensland during the early summer months. Ewes with two functional teats supplied approximately 65% of their lambs' fluid requirements in the form of milk, while the comparable figure for ewes with only one functional teat was 50%. In addition to milk, the lambs required between 400 and 800 mL of water per day.

From results obtained in the low-lambing investigations carried out over the last decade, a field diagnostic procedure has been developed which allows extension officers to determine accurately areas of reproductive wastage and to advise on remedial measures.

Diseases

Despite dry conditions, mortalities due to haemonchosis were reported as occurring in the Hughenden, Roma, Goondiwindi, Darling Downs and southern coastal districts. Infestations of *Trichostrongylus* spp were investigated on many properties on the Darling Downs.

Cysticercosis due to *C. tenuicollis* was diagnosed as the cause of severe anaemia, listlessness and weight loss in a mob of 120 Merino weaners, being fed on lawns around a station homestead. Twelve animals died suddenly over a period of 2 days. Post-mortem examination revealed large numbers of immature cysts floating free in an excess of blood-tinged peritoneal fluid. The liver was friable, surrounded by fibrin and had numerous haemorrhagic foci under the capsule. There were areas of consolidation in the lungs and immature cysts were visible under the visceral pleura.

Mycoplasma ovipneumoniae was considered the likely cause of a respiratory condition in a group of 200 Dorset cross hoggetts of which 150 were affected, with no mortality. Clinical signs included fever, nasal discharge, weight loss and anorexia. Lung changes involved a severe interstitial pneumonia with proliferation of bronchiolar epithelium, peribronchial lymphoid hyperplasia and large numbers of alveolar macrophages.

Salmonellosis was confirmed as the cause of deaths of lambs on a property at Roma.

Sheep with arthritis of the carpal joints in a Dorset flock at Thulimbah were serologically positive for *Erysipelothris rhusiopathiae.*

One hundred 4-month-old lambs of a mob of 1 100 died from gas gangrene about 72 hours following shearing.

Sera from rams at Dalby, Goondiwindi and St. Ruth returned positive results to the complement fixation for ovine brucellosis.

Severe polioencephalomalacia was diagnosed in a flock of sheep at Chinchilla.

Goats

The Angora goat industry continued to expand and to utilize much of the Sheep and Wool Branch's resources. One District Adviser has assumed responsibility for the Angora goat extension programme. In an attempt to rationalize the use of its limited resources, this Branch placed emphasis on group activities such as field days, seminars and meetings.

Work continued on studies designed to assist in the development of selection criteria which can be successfully used in the up-grading of feral goats.

The demand for goat meat for both the export and local trade increased. To the present, much of the meat supplied was obtained from feral animals. Concern was expressed as to how long feral goats would be able to supply requirements as current harvesting methods remove entire herds and the harvesting rate may be exceeding the natural reproductive rate. The importance of 'conditioning' captured feral goats before transport was demonstrated by severe losses due to stress and metabolic diseases in a herd of 500 goats transported from Bourke to Miriam Vale. Limited quantities of goat meat were produced under commercial conditions and it is expected that, in the near future, there will be an expansion in this type of enterprise.

Internal parasitism is one of the most serious problems of goats particularly in coastal areas. Infestations of *H. contortus* and *Trichostrongylus* spp. were investigated in the Maryborough, Monto, Brisbane, Ipswich, Gatton and Darling Downs regions. Lung worms (*Dictyocaulus* sp. and *Mucllerius* sp.) are regularly encountered in caprine lungs although pathogenic effects have been obvious in only one herd suffering from *Mucllerius capillaris* infection.

Mastitis in dairy goats due to *Staphylococus aureus* was often confirmed. *Mycoplasma mycoides* subsp. *mycoides* was isolated from milk samples from a 2-year-old Saanen doe with acute mastitis. The animal had a 'hard udder with watery, blood-tinged milk' and was clinically ill with temperature 41.5°C and complete anorexia. Penicillin treatment had not altered the course of the disease. C.S.I.R.O., Parkville, identified the organism as the small colony type which offers no threat to cattle.

Studies particularly on the isolation of a causitive virus continued on the recently described disease of goats in which there may be arthritis, encephalitis and/or pneumonia. These different pathological conditions are thought to be manifestations of the one disease.

Cultural examination of the tissues of five adult goats with chronic arthritis isolated a virus from the explant of affected synovial membranes. Early cytopathic effect commenced about 6 to 7 weeks after incubation and gradually extended over the monolayer. The ultrastructural morphology of the isolate was similar to that of a retrovirus. Inoculum was prepared from the cell cultures which had been passaged onto foetal synovial cells. The inoculum was injected into the carpus (3), trachea (2) or cerebrum (2) of seven goat kids. Control animals were inoculated with tissue culture fluid. Three of these recipient kids were from commercial farms, while seven deprived of colostrum had been reared at the Animal Research Institute. No clinical signs were seen except enlargement of the injected carpal joints.

Blood samples were collected for haematological, serological and virological testing. In the agar-gel immunodiffusion test (AGIDT) using antigen prepared from the tissue culture fluid of the affected synovial membrane explant, the two test goat kids examined seroconverted at about 10 weeks postinoculation, while the control goat kid examined remained negative. Further work is continuing to characterize the agent and to develop the AGIDT.

Pig industry

At March 1981, preliminary figures from the Australian Bureau of Statistics showed that Queensland pig numbers had fallen by 5% compared with the previous year's total. At an estimated 485 000 head, this is 10% below the peak population recorded in 1973.

Queensland production figures for the year ended March 1981 showed substantial increases on the previous year. At 859 000 head, slaughterings had risen by 11.7% while carcass meat production at 52 000 t increased by 9.2%. Production of bacon and ham, however, declined by 2.6%. With increases of 12.7% and 11.6% respectively Australian production in terms of pig slaughterings and pork produced showed a similar trend.

Following a dry winter period of low returns, first advance payments for baconer pigs rapidly reached a new peak at $1.55 per kg hot dressed weight by February 1981. The previous year's pattern was repeated shortly after as prices began to fall sharply. By the end of April, the first advance price had steadied on $1.25.

Dry weather reduced the winter cereal harvest and in some southern districts grain was hard to obtain. As a consequence, feed prices increased steadily. The tight feed situation existed until supplies of sorghum grain were obtainable in the new year.

In August 1980 the 'pig price-feed cost' ratio reached the lowest level for 12 years. It expresses the ratio between first advance payment plus bonus calculated at 6%, and ready mixed grower feed. The ratios during 1980–81 were—

April	7.49	July	6.30	October	7.43	January	7.43
May	6.77	August	6.24	November	7.81	February	7.70
June	6.42	September	6.44	December	7.38	March	7.66

As a reflection of the depressed state of the industry and difficulty in obtaining finance, the level of enquiry to Pig Section staff from aspiring producers was much lower than in the previous year. However, district officers were called upon to provide a wide range of advice on new construction or alterations to existing accommodation for producers already in the industry.

Producer meetings, discussion groups seminars and field days continued to be a significant means of contact with producers. Farm visits and contact by telephone or in the office were important means of day-to-day communication. Media items were prepared as necessary and advisory material was published on a wide variety of subjects. Pig Section officers maintained involvement in District Extension Committees as appropriate, but the emphasis was increasingly oriented towards Industry Extension Groups and three such groups are operational.

The Queensland Pork Producers' Organization continues to seek means of serving members efficiently. It is in a sound financial position and is well respected in industry circles at State and National levels. Successful producer meetings were jointly organized by district officers of Pig Section and branch members of the Organization at various country centres. The Organization has successfully represented the interests of producer members in discussions with Local Government Authorities on Shire by-laws. The Dial-a-Market report was expanded to include more detail on pig prices. A non-profit company wholesaling protein meals has been formed.

Pig Section staff judged 33 pig carcass competitions associated with Agricultural Societies throughout the State. A competition conducted at Biloela each year emphasizes growth rate as well as carcass traits.

The voluntary scheme of pig tattoo branding initiated by Pig Section was terminated on 30 June 1980 and holders of tattoo brands were advised of the requirement to register under the compulsory scheme. Amendments to the Brands Act made tattoo branding of all sale pigs over 30 kg liveweight compulsory from 1 January 1981. However, stud pigs sold for breeding and identified as required by the Australian Pig Breeders' Society were exempted. Owners with only one or two pigs were exempted from branding, and pigs bearing the previous owner's brand were exempted if resold within 7 days of purchase. Reference to the tattoo brands register would establish legal ownership of pig carcasses and would show their origin for disease control programmes.

Producers who had imported boars from Canada and New Zealand requested assistance in establishing artificial insemination programmes for rapid multiplication. They were instructed in all aspects of maintaining an artificial insemination programme. At present, each participant is assessing his own skills before embarking on a wider application.

Breeding

Performance testing of stud boars. A total of 439 boars, of which 230 were approved as herd sires, completed performance testing at the Rocklea test station. This was 10 more than in the previous year. Of these, 254 were Landrace from 10 herds and 185 Large Whites from nine herds. Fifty-seven percent of the boars tested had sires which were previously tested at Rocklea and 17% were the sons of imported sires. As shown in the following table, the average growth rate and food conversion ratios of both tested and approved boars were considerably better than in the previous year, and fat measurements were about the same. All these traits were superior in the approved boars.

	1980–81		1979–80	
Trait	Tested	Approved	Tested	Approved
Daily gain (kg)	0.92	0.95	0.87	0.91
Feed conversion ratio	2.63	2.49	2.72	2.55
Av. fat depth (mm)	23.0	22.2	22.6	21.6

An investment appraisal of central boar performance testing in Queensland was undertaken during the year. In the appraisal, the contribution of Queensland's boar performance testing scheme to the genetic improvement of the State's pigs was estimated from a model comprising three tiers: (i) the performance testing station; (ii) the stud herds; and (iii) the commercial herds. Improvement is disseminated from the station by the movement of sires between the tiers.

Monetary benefits to the pig industry and to the community as a whole were estimated using station herd book and survey records. Costs and returns were discounted to present-day values using real rates of interest in order to obtain the net present value of improvement from the testing programme. With a discount rate of 5%, the time taken for returns to exceed costs to the pig industry was 6 years, while that to the community was 10.5 years. Net present values of improvement over a 16-year evaluation period were $\$1.8 \times 10^6$ and $\$5.4 \times 10^5$ for the industry and community respectively even though gross returns were only 13% of those which would have been obtained, had all stud sires been drawn from the station and all commercial sires drawn from the studs.

Using the information recorded for 1 001 boars which passed through the Rocklea Boar Performance Test Station, estimates of genetic parameters for these boars were calculated. The 378 Large White boars represented 74 sires and 193 dams in nine herds and the 623 Landrace boars represented 107 sires and 317 dams in 10 herds. The most important traits had medium to high heritabilities: daily gain 64%, food conversion ratio 64% and P_2 fat 42%. Of all the measures of backfat, the P_2 is the most satisfactory having a reasonably high heritability combined with high correlation with fat measurements taken at other positions. The trait with most influence as a boar's test station score is food conversion ratio.

Additionally causes of variation in the performance of station tested boars were investigated. These were genetic, the environment of the farm of origin, and the maternal environment of the dam.

For accuracy in performance testing, the contribution to boar variation from genes should be maximum and from farm of origin and maternal environment a minimum. Average daily gain and food conversion ratio were very satisfactory from this point of view; 64% of the variation for each being due to genes, zero percentage due to farm environment and only 6% and 3% respectively being due to maternal environment. Average fat is less satisfactory having 14% of its variation derived from maternal environment. Total score, the criterion used to select or reject boars had a satisfactory large contribution from genes (51%) and low contributions from farm and maternal environments (0 and 6% respectively).

In the central boar performance testing programme, former owners have first option to repurchase approved boars at the completion of testing and non approved boars are sold for slaughter. During the year, a programme developed in the Moreton region which aims at placing some approved boars on local farms. This requires close liaison by Pig Section staff with the Boar Performance Test Station and appropriate breeders and district farmers.

On-farm performance testing. Pig Section officers assisted more than 40 producers in their own on-farm performance testing programmes by demonstrating techniques of objective selection of breeder replacements. This work is considerably facilitated by all district officers having access to ultrasonic fat measuring equipment. As co-operators acquired the necessary skills and equipment, they undertook testing independently and advisers were able to demonstrate the work to other interested producers. The programme continues to assist officers to combine other advisory and project work with visits related to performance testing.

Selection for efficient lean growth in a pig herd. In the previous selection experiment conducted at Hermitage Research Station with the control herd maintained at Biloela Station, selection was undertaken in the herd for 6 years using an economic index combining growth rate, food conversion efficiency and carcass leanness, measured in a performance test which permitted appetite variation between pigs to be expressed. Analysis of the results indicated that the index used was equivalent to selecting for the biologically more meaningful trait, lean tissue food conversion (LTFC) which is the ratio of food intake to lean tissue growth rate (LTGR). Values for LTFC averaged 8.2 on *ad lib.* feeding and 7.7 in restricted feeding. Compared with controls, selected pigs had an average LTFC which was 7.5% and 5.8% less on *ad lib.* and restricted feeding respectively.

The programme demonstrated, however, that minor appetite restriction from *ad lib.* levels of feeding caused no reduction in LTGR. Thus, in a performance testing regimen which placed low emphasis on food intake and high emphasis on LTGR, selection of those animals with the fastest liveweight gain would favour those with the highest LTGR and hence the lowest LTFC. This selection approach has been adopted in the new experiment being conducted at Hermitage Research Station. In the selection herd, all pigs commence performance testing at 25 kg liveweight. They are fed a fixed amount over a 12-week testing period thus eliminating appetite variation and at the end of the testing period those pigs with the greatest weight of lean assessed by liveweight and live fat measurements are selected as herd replacements. Selection on this basis has been conducted for approximately 2 years and will continue for five generations. During

the year, a further three batches of 24 boars and 24 gilts were performance tested. The average performances of all pigs tested and those selected as breeder replacements are given in the following table.

		Liveweight at end of test (kg)	P_2 fat (mm)	Estimated ham lean (kg)
Males	Tested	88.3	17.5	5.7
	Selected	91.7	14.6	6.2
Females	Tested	86.4	17.2	5.4
	Selected	88.8	16.2	5.8
Improvement of selected compared with tested		+2.9	−2.0	+0.4

While at present the selection herd is maintained at Hermitage and the control herd at Biloela Research station, both herds were originally established by splitting a foundation population formed by crossing the selected Hermitage herd with boars from outside herds. To establish the initial indentity of these two herds, a comparison is being done at the Pig Research Centre Wacol of progeny of the foundation members of the selected and control herds. The first two batches of this three-batch comparison show no difference between herds.

Teat number investigations. Observations are being made in the Hermitage herd on teat numbers in gilts before and after breeding. The objectives of the study are to establish the relationship between teat counts before breeding and the number of functional teats after farrowing; the heritability of teat number; the relationship between number of functional teats and number and proportion of piglets surviving to 3 weeks of age; and the decline in functional teats with successive parities.

Nutrition

Ready-mixed feed prices increased by an average of 1.5% per month prompting enquiries on the subjects of diet formulation, on farm feed storage and preparation. Least-cost diets were formulated on request for producers and feed compounders and in two districts, computer diets were published on a regular basis. Pig Section staff, in co-operation with Husbandry Research Branch, promulgated new specifications for pig diets. These appeared in a Farmnote and the computer matrix for least cost diets was modified accordingly.

Fibrous diets for weaner pigs. A number of on-farm trials investigated controlled feeding of fibrous weaner diets. Bran fortified, drug free, low energy diets tended to reduce the incidence, severity and duration of scours among weaning pigs. Provided conditions were good and feed restriction was not too severe, the practice appeared useful. It did not prevent scours under adverse conditions. Controlled experiments are envisaged in the future.

Evaluation of protein concentrates. Studies investigating the nutritive value of navy bean (*Phaseolus vulgaris*) using rats continued. Previous studies had shown that raw navy bean contains a potent relatively heat-stable growth inhibitor which has to be inactivated before navy beans can be fed to monogastric animals. Thorough autoclaving inactivated the toxin but more practical and commercially more acceptable procedures such as oven cooking, dry roasting (Roast-a-tron), microwave cooking, boiling and steam pelleting have been unsuccessful.

During the year, three rat growth assays were completed. The first one examined extrusion processing at various temperatures as a means of detoxification whereas the other two assays were done to determine optimum conditions of autoclaving. Because of its low oil content, navy bean could not be extruded on its own but successful extrusion of a 55.45 blend of navy bean and soybean was achieved and the navy bean growth inhibitor appeared to be inactivated by extrusion temperatures of 275°F and above. An experiment with pigs using extruder-processed navy bean is planned.

The dye binding technique to measure the nutritive quality of heat-processed beans as previously reported has been applied as a routine method. However, the varying behaviour of the dyestuff between navy beans and soybeans in the overcooked state continues to be investigated. A field trial conducted in north Queensland observed the effect of feeding lupins as 10% of the diet for all classes of pigs. Results in terms of growth rate and backfat deposition were comparable with controls and no ill effects were seen.

Lysine requirement of growing pigs. Growth performance and carcass quality of pigs reared from 20 to 80 kg liveweight on diets containing either 0.53, 0.69, 0.83 or 0.97% lysine and fed at either of two restricted feeding scales were examined. Feeding level had no effect on the pigs' response to dietary lysine, the efficiency food was utilized for growth, or carcass quality, but it did significantly affect growth rate.

The response to dietary lysine content varied according to the weight of the pig. In the period to 55 kg liveweight, growth rate and economy of food utilization improved linearly as dietary lysine increased. From 55 to 80 kg liveweight, pig performance was not significantly affected by dietary lysine although there was a tendency for the lowest lysine diet to give the worst performance. However, for the entire experimental period, the response to dietary lysine resembled that for the early growth period except that it was curvilinear with differences between the upper two lysine levels being small. Carcass leanness improved curvilinearly with increasing dietary lysine but differences between the upper three lysine levels were small.

Energy and lysine requirements of breeding sows. All of the breeding sows in the herd at the Pig Research Centre, Wacol, were involved in an experiment where they were allocated at first mating to a diet providing either 0.45, 0.58 or 0.70% lysine and the diets were fed during pregnancy at a level of either 1.5 or 2.0 kg. The same diet was fed during pregnancy and lactation although in the latter period the food was offered *ad lib.* Sows continued on their respective treatment regimens for at least three complete parities.

The data indicated that pregnancy feeding level and dietary lysine content independently influenced both sow and piglet productivity. The higher pregnancy feeding level enabled greater net weight gains to be achieved in both the first and second parities. Even though all sows had *ad lib.* access to food during lactation, actual consumption in this period varied inversely with the amount consumed during pregnancy and directly with dietary lysine content.

The number of pigs born and reared was not influenced by either pregnancy feeding level or dietary lysine content. Birth weight was positively correlated with pregnancy feeding level; subsequent piglet weight, however, tended to be influenced by the lysine content of the sow's diet. At this stage there are insufficient data available to assess whether the imposed treatments are affecting the breeding regularity of the sow. The trial is continuing.

Rough rice as a feed ingredient for grower-finisher pigs. Rough rice (grain in husk) when rolled was found to have dry matter, crude protein and energy digestibilities of 70.5, 75.5 and 72.3% respectively. The rice used in these studies had a digestible energy (D.E.) value of 2 995 kcal per kg. This compares to D.E. values for ground wheat, maize, barley and sorghum of 3 250, 3 430, 2 890 and 3 240 kcal per kg respectively.

The rice was found to be well tolerated by pigs both in terms of palatability and fibre content. The coarse, abrasive high silica content husk did not cause digestive problems but did lead to the production of a larger volume of faecal material than with other grains. The influence of this on effluent treatment and utilization may need further investigation.

The growth rates of pigs to bacon weight were satisfactory on diets in which rice was blended with any one of the other cereal grains, with a general decrease in rate of gain as rice inclusion level increased. Rough rice, therefore, can be a useful component of pig diets depending on the purchase price in relation to energy content and slightly increased overheads from slower growth.

Water quality for pigs. Drinking water for growing pigs containing up to 500 mg per L nitrate with 3 000 mg per L total dissolved ions was assessed during both the cool and warm periods of the year. Preliminary findings suggested that high levels of nitrate did not affect feed efficiency or rate of gain. No gross abnormality was seen on post mortem inspection of the stomach and duodenum. Further work is evaluating the effect of 0, 5, 15, and 50 mg per L nitrite in a trial recently commenced. Early observations suggest that there is no detrimental effect on growth rate.

Water containing high levels of nitrate is now being analysed for nitrite as well. It was recommended that theoretical nitrate tolerance level be raised from 50 to 100 mg per L. Further work may well indicate that pigs tolerate a much higher level. Field sampling in several districts using indicator strips should provide further information on the nitrate-nitrite question.

Reproduction

The reproductive performance of the sow herd, Pig Research Centre, Wacol, continued to be monitored by using vaginal biopsies as a method of pregnancy detection and by examining the reproductive tracts of sows culled for failing to breed.

Gilt management survey. Detailed records are being maintained by two co-operators. Preliminary observations from these and other properties suggest that failure to detect oestrus in first-litter sows and gilts is more common than expected. Confirmation was obtained from inspection of reproductive tracts at slaughter. Although boar contact appeared good, silent heats or behavioural anoestrus may have contributed to non-detection of oestrus. Producers are being encouraged to induce early puberty in gilts by exposure to mature boars following selection between 160 and 170 days of age. By 200 days of age, those failing to cycle are sent for slaughter as they are normally within factory bacon weight specifications. Those retained as herd replacements are mated at the second or third oestrus.

Heritability of litter size. Data from three herds on the Darling Downs comprising 440 sows are being recorded. The investigations are examining the size of litter from which performance tested herds replacements originate and the heritability of litter size.

Disease

Scouring of pigs, particularly young pigs, maintained its position as the number one health problem for producers. *Escherichia coli* was the commonest cause of the scouring. The disease was reported from all pig raising areas. Many strains were encountered that were resistant to a wide range of antibiotics. The most susceptible age group was from birth to weaning, although pigs up to 12 months of age were involved. The worst outbreak involved the deaths of 400 weaners on a property at Warwick.

There was an upsurge in the incidence of oedema disease and outbreaks occurred at Hattonvale, Dulacca, Ferny Grove, Eumundi (150 deaths), Caboolture, Purga, Dayboro, Rosewood, Roadvale and Donnybrook. Depression, ataxia, muscle tremors, limb paralysis and variable occurrence of diarrhoea were seen ante mortem. At necropsy oedema of the forehead, eyelids and stomach wall were observed together with excessive volume of watery intestinal contents and hyperaemia of the intestinal wall.

Salmonellosis outbreaks were reported from the Darling Downs, Burnett and Dayboro areas. *Salmonella* Gp B or C were isolated.

The isolation of *Haemophilus pleuro pneumoniae* confirmed a diagnosis of porcine pleuropneumonia in baconers and weaners in a piggery at Warra. The disease was peracute with death following severe respiratory disease. Marbling of lung due to severe necrotizing and haemorrhagic fibrinous pneumonia was the main post mortem finding. Only occasional outbreaks of this disease are reported. Numerous cases of metritis in sows were caused by *E. coli* and *Streptococcus* spp.

Extensive lesions in oropharyngeal, mesenteric, hepatic and bronchial lymph nodes were seen in baconers from a Bundaberg piggery at meat inspection after slaughter. Microscopically they were acute caseating granulomas and *Mycobacterium bovis* was isolated. The possible source of this infection was infected cattle tissue. A mycobacterium other than *M. bovis* was recovered from the submandibular lymph nodes of three feral pigs at Ingham.

Following the isolation of *Pseudomonas pseudomallei* from the abscesses of spleens of eight porker weight pigs and the condemnation of these carcasses at slaughter in the first half of 1980 the property of origin near Townsville was visited, a history of the herd obtained and samples collected. It appears that this outbreak and at least two similar ones were related to the consumption of cloudy drinking water contaminated with *Ps. pseudomallei.* The causal organism was isolated from one of the clay samples collected from the bank of the seepage pit used as a water source during the end of 1979.

Ps. pseudomallei was recovered from the tissues of a sow that died at Woodstock and from a feral pig slaughtered at the Bohle River Abattoir.

Outbreaks of swine dysentery were investigated in all pig raising districts of the Toowoomba Division and in the Burnett, Ipswich and Bundaberg areas.

Tetanus was confirmed as the cause of sporadic mortalities. Fourteen weaners at Gatton died following tail docking and teeth cutting.

Erysipelas was confirmed as the cause of mortalities at Oakey and Charleville and the cause of arthritis at Eidsvold. The prevalence of this disease has declined since the advent of vaccination.

Brucella suis was isolated from a further four piggeries during the year. Three of the four herds had extensive husbandry and there was contact with feral pigs. The potential of feral pigs as a reservoir and means of transmission of *Brucella suis* to domestic pigs is apparent. Fifty pigs from two of the herds were slaughtered and examined culturally and serologically. *Br. suis* was isolated from 28 of the pigs. The Rose Bengal test had a sensitivity of 85.7% and a low specificity of 50%. The tube agglutination test had a sensitivity of 68% and a specificity of 55%.

Six infected properties have been detected since January 1979. Five of these properties have either depopulated or are at present close to depopulation. At the request of the owner, it was agreed that the sixth property could pursue a two-herd programme in separate buildings. The original infected herd is being gradually reduced while a clean herd is being established in a close location. Assistance is being given by Veterinary Services Branch staff to operate this programme with serological testing and general supervision. As a result of these recent diagnoses, efforts have been intensified to identify and control the disease. Policy is now that all infected herds are quarantined. Quarantine will be lifted after a property has been destocked, cleaned and disinfected and spelled for a minimum of 2 months in an intensive unit and 3 months for other units.

Blood samples collected at meatworks from breeding animals in domestic herds are serologically tested. Epidemiological investigations are undertaken in herds with positive titres. To date, none of the samples collected has been positive to the serum agglutination test.

The serological survey of feral pigs is continuing as opportunities arise.

Leptospira pomona was incriminated as the cause of abortions, stillbirths and birth of weak piglets in many piggeries on the Darling Downs and in the Burnett area and the infection in baconers resulted in kidney condemnations at abattoirs. The eradication of infection using whole herd injection with streptomycin has been shown to be feasible. Following the isolation of *L. pomona* from condemned kidneys from an abattoir, weaned pigs experimentally infected at the Animal Research Institute were used to determine whether a long acting terramycin preparation could be used to eradicate *Leptospira* from pig herds. Treatment with a single injection of long acting terramycin of these pigs decreased urinary excretion but did not eliminate *Leptospira* from all pigs. The development of the experimental model of kidney infection and urinary excretion of *L. pomona* in pigs lends itself to further use in the study of the efficacy of vaccines to prevent infection and disease in pigs. A penicillin-streptomycin combination was used to eliminate *Leptospira* from pigs in one herd. The day following intramuscular injection, 135 of 241 sows and gilts in early pregnancy had a creamy mucoid discharge and aborted foetuses were subsequently observed. Abortion following the use of procaine penicillin has previously been reported.

A preliminary trial in which piglets were orally dosed with a culture of *Lacto bacillus* as soon as possible after birth to control scouring was undertaken in the field. The incidence of pre-weaning deaths was less in the treated groups compared with those which did not receive *Lacto bacillus.*

Outbreaks of mulberry heart disease occurred at Maclagan and Jimboomba.

Parvovirus infection continued as an important cause of abortion, stillbirths, foetal mummification and infertility. The virus appears to be widely distributed on the Darling Downs.

A small survey showed gastric ulceration to be uncommon in feral pigs. This may be because of their coarse, unmilled diet. Autopsy revealed the presence of gastric ulcers in domestic boars on a piggery at Clifton. The causes usually ascribed to gastric ulcers are stress, increased metabolic demand or vitamin A deficiency.

Platelet antibodies in the sow, incompatible with antigens inherited by the piglets from the boar, were the cause of death of two and thrombocytopenic purpura in other piglets in the fourth litter of a Landrace sow and a Large White boar. Immunization had occurred in previous pregnancies to another Large White boar. Eleven of the 13 piglets in the litter recovered and, at 4 months of age, they had normal platelet counts. Platelets from these piglets and the boar were agglutinated by the sow's serum. Although the sow also had antibodies to red cells from the boar and some of the piglets there was evidence that neonatal isoerythrolysis did not occur concurrently.

Management

Producers have become increasingly aware, because of lower profit margins, of the need to improve production efficiency. District officers of Pig Section have encouraged the adoption of record keeping as means of identifying weaknesses in management.

Piggery performance analysis. Thirty participants in all districts were initiated into the scheme during the year. Results were collated in each district by the adviser but calculations were largely carried out by the producer. Group results were tabulated quarterly together with a 12-month update and forwarded to each participant. In Toowoomba, a group discussion between participants was held on a regular basis. Most of the members also maintained Pig Breeder Assessment records. A computer programme was developed in north Queensland for calculation and tabulation of each participants and the group's results. Ultimately it is expected results from all districts will be handled in this manner. Changes which have been made on piggeries as a result of their participation include: improvement in sow feeding, use of least-cost diets, greater accuracy in feed mixing and weighing, selling of pigs at a heavier liveweight, improvement in pig density, improved farrowing environment, changes in mating and weaning pattern, changes in mating procedures, changes in breed of pigs used.

Pig breeder assessment. An increasing number of producers adopted this system of recording and those who previously participated continued to find the scheme useful in management decision making.

Pre-slaughter handling of pigs. The Pig Section collaborated with C.S.I.R.O. on a project funded by the Australian Pig Industry Research Committee. The project is aimed at determining the effect of pre-slaughter treatment of pigs on meat quality, meat yield and prevalence of pig deaths. The areas of pre-slaughter treatment being investigated are transport, holding, pre-slaughter handling, slaughter procedures and processing conditions.

Effluent management and piggery siting. Liaison was maintained with local government authorities and the Water Quality Council. Departmental staff continued to offer an advisory service in the formulation of by-laws to permit the successful operation of piggeries while maintaining suitable environmental considerations for the farming and urban population.

Regulation

Swill feeding. Veterinary Services Branch inspectors kept piggeries under regular and energetic surveillance during the year to ensure that pigs were fed and housed in conformity with Regulations 146 to 156 of the Stock Act. This work was necessary to prevent spread of exotic diseases which might penetrate our quarantine barriers.

Eight piggeries in Queensland were licensed under Regulation 147 of the Stock Regulations of 1935 to feed treated animal matter to swine. These are located at Maleny, Gordonvale, Tinana, Kuttabul, Warwick, Biggenden and Aitkenvale. Compliance with the regulations was satisfactory. However, there was one prosecution and two prosecutions are pending. Sixteen owners ceased feeding scraps following receipt of official warnings from inspectors. Surveillance of piggeries in the remote areas proved difficult, especially those on aboriginal reserves in the Cape York Peninsula.

Poultry industry

Egg industry

The patterns of reduced egg production surpluses and satisfactory profitability which have been apparent in the egg industry since the effective implementation of demand supply management were again evident in 1980–81. A seasonal quota reduction (8.5%) was again applied during the period July-August and January-February to more closely attune egg production with demand, and seasonal variations are to be continued as a permanent feature of the scheme.

Despite the overall effectiveness of hen quotas in reducing surplus production and maintaining profitability, two factors emerged during the year which tended to reduce effectiveness. These were a reduction in sales (3% in south Queensland) and an increase in egg production per quota hen. Of the various reasons advanced for the decline in sales, price increases and increased egg production from 'spent hens' sold for 'backyard' egg production appeared to be the most significant. The increase in production per quota hen appeared to be the result of producers becoming more adept at manipulating their flocks to maintain actual hen numbers very close to quota limits and improvements in genetics, nutrition and management. Because of these trends the seasonal quota reduction in 1981–82 will be increased to 15% in an attempt to restore the balance between supply and demand.

Producers were faced with substantial increases in costs of production during the year particularly in relation to feed and net pullet replacement cost. Layer feed prices in south Queensland (the major production area) increased by 13.8% from $174 to $198 per t and the price of point of lay pullets rose by 16.4% from $2.86 to $3.33 during the period under review. The cost of producing eggs in south Queensland rose by an estimated 8.5% during the period July 1980 to March 1981 (the date of the latest update of the south Queensland cost of production model).

Net return per dozen eggs to producers in south Queensland for the 8 months ended March 1981 was approximately 9.4% higher than for the same period in 1979–80.

During the year, agreement was reached with producer organizations in north and central Queensland for quota adjustments in those areas to achieve 95% self sufficiency in supplying local markets. This move will result in fewer south Queensland produced eggs being required to meet the shortfall in locally produced eggs in north and central Queensland. As egg production is not officially recorded in north Queensland and estimates of production and of market requirements are subject to considerable error, there is some danger that over supply problems may develop in the region.

Disposal of spent hens became more difficult during the year due to the reluctance of poultry abattoirs to accept large batches of spent hens for processing. This problem was exacerbated by the declining demand for hen meat and the application of seasonal quota reductions. Some producers who could not find a satisfactory market for their spent hens had to destroy and bury considerable numbers of these to comply with the seasonal quota reduction.

Poultry meat industry

During the year, there were significant changes in the proportional shares of the poultry meat market held by the larger intergrator companies. The smaller companies experienced some minor expansion.

The further products plant under construction at Capalaba will service all of Inghams Enterprises Australian requirements for smoked chicken, basted chicken and other novelty lines. When under full production, this plant will be able to process in excess of 100 000 chickens a week.

It is unlikely that the construction of new shedding of any quantity will occur in the near future. It appears that processors will exchange growers as production fluctuates from group to group. In addition, it is likely that density and batches will increase in accordance with provisions within the formula for determining growing fees. Approximately 33m birds were processed in Queensland during 1980–81 with 35m being the likely processing figure for 1981–82.

Further performance gains occurred during 1980–81 with the better strains weighing approximately 1.85 kg at 47 days on a feed conversion of 1.97 and mortality of 4.00%. These figures indicated that the same weight was being achieved 2½ days earlier in 1980–81 compared with 1979–80 and feed conversion improved substantially from 2.11 to 1.97. Average stocking density was approximately 15 birds per m^2 with average batch output approximately 4.7 batches per year. Stocking density and batch throughput varied between the growing groups.

As in the United States and Europe, the supply and price of red meat continued to be a dominant influence affecting the demand for poultry meat. Large stocks of frozen birds which built up during the early months of 1981 were gradually cleared and the trend to the fresh product continued. It is likely that the fresh product will cater for approximately 80% of the chicken market by the end of 1981–82. The clearing of the large stocks of frozen birds by sale throughout the State at discount prices created marketing problems for some local processors. With proximity to their markets and local knowledge, the local processors should be able to withstand this competition by more aggressive marketing of the fresh product.

Processors found it difficult to market spent commercial hens and it is anticipated that rendering will account for in excess of 80% of this market within 2 years. A preliminary analysis of a sample of poultry meal prepared from spent hens revealed that the meal contained more fat, cystine, methionine and isoleucine and less phosphorus, calcium, arginine, glycine and phenylalanine than a meat meal of similar protein content (67.0% on a D.M. basis). On the other hand, spent meat breeder hens were eagerly sought and replaced a percentage of the spent layer hen market. However, it was estimated that about 30% of spent meat breeders were being rendered for recycling as poultry meat meal by the major integrated organizations.

Disease

The mild, dry winter of 1980 and the mild autumn of 1981 resulted in relatively few disease problems during these times. The heat, rain and humidity in late summer appeared to contribute to a number of complex respiratory disease outbreaks. Coryza, chronic respiratory disease and the respiratory form of cholera were all seen. Complex respiratory disease problems which occurred on several farms in the Brisbane and North Coast areas were diagnosed as being the result of management and disease control deficiencies involving over reliance on chemotherapeutic measures for disease control. Poultry Section officers assisted the producers involved to develop more soundly based disease prevention and control programmes. Respiratory disease outbreaks associated with introduction of started pullets appeared to be on the increase.

Infectious laryngotracheitis (ILT) was diagnozed on a poultry fancier's property in the Brisbane area. Both poultry and pheasants were involved. All birds were vaccinated and movement restrictions were placed on the property in accordance with Section 13 of the Stock Act. As some of the birds had recently been exhibited at a show, the flocks of other exhibitors were examined and in those in which infection was diagnosed control vaccination was instituted.

The Show Association has taken action to ensure that only healthy birds are exhibited. A suspected ILT outbreak in a fancier's flock in north Queensland was treated by vaccination.

Infectious laryngotracheitis (ILT) was diagnosed on a poultry on the Darling Downs in which 50% of 1 650 pullets displayed signs of coughing. Egg production drops have continued to be a problem throughout the year in several areas of the State. The causes of many of these drops were not readily identifiable. Infection with infectious bronchitis virus was incriminated in a few instances. Serological examination for haemagglutinating adenovirus suggested that this virus was not associated with any of the cases investigated. Some production drops have occurred after introduction of started pullets to accommodate hen quota variations.

Infectious bursal disease was suspected as the cause of 2% mortality in a flock of 5 500 broiler chickens between 12 and 21 days of age.

Marek's disease was responsible for 5% losses in a flock of 4 000 pullets 18 to 21 weeks of age. The pullets had been vaccinated for Marek's disease at day-old. In another flock of layers, 10% losses occurred over a 3-month period to 40 weeks of age. The birds had been vaccinated at day-old. Investigations are continuing into the causes of these outbreaks in vaccinated flocks.

A syndrome featuring varying degrees of leg weakness, runting, anaemia and feathering abnormalities in 12-week-old chickens appeared in a number of layer and broiler flocks. In some cases mortality was up to 25% and up to 50% were runted. Post mortem examination revealed emaciation, atrophy of bursa (hypoplasia of bursa follicles) and thymus, pale bone-marrow, (hypoplasia-aplasia of both erythroid and myeloid series) watery blood and in one case chondrodystrorphy of long bones. Rations appeared to be adequate in

Ca and vitamin D levels. No significant bacterial pathogens were isolated from representative samples of each case. A Reovirus was isolated from liver-heart of only one bird of the many examined. Overseas evidence suggests that this syndrome may have an infectious cause. As there is no *in vitro* assay for the agent, Pathology Branch are currently undertaking transmission trials using Specific Pathogen Free chicks and a crude inoculum of liver-heart.

In a small non commercial flock of poultry, ducks, turkeys and geese there was 33% mortality in the duck flock. Affected ducks showed emaciation, ataxia, diarrhoea and in some cases a subcutaneous tumour mass located in the thymic region. Histological examination of duck tissues demonstrated diffuse infiltration and proliferation of uniformly sized lymphoreticular cells with vesicular nuclei in the thymus and liver. Reticuloendotheliosis (REV) virus was isolated from the thymic neoplasm and in addition antibody against REV was detected in the sera of two ducks and two turkeys. All poultry in the flock were in close contact. Virological examination was undertaken at C.S.I.R.O., at Parkville.

A project to classify avian adenoviruses and study their importance as a cause of disease and production loss in broiler chickens continued at the Animal Research Institute with funds provided by the Australian Chicken Meat Research Committee. A collection of 175 adenovirus has now been established from examination of diseased birds and by culturing rectal swabs obtained from normal broiler chickens just before slaughter. One hundred and ten adenoviruses have been serotyped and types found were: type I (42), type II (7), type III (3), type IV (1), type V (5), type VIII (39). Thirteen adenoviruses could not be typed. Pathogenicity trials were conducted to determine the interaction of infectious bursal disease virus (IBD) and 5 type I adenoviruses. No consistent differences in clinical signs, post mortem lesions or weight gains were demonstrated between groups exposed to IBD alone and those exposed to IBD and adenovirus.

An avirulent Newcastle disease virus (NDV) was isolated from the trachea of a started pullet with visceral leucosis. The survey for Newcastle disease virus antibodies in broiler breeders, layer breeders and caged layers which commenced last year was completed during the year. Flocks on 70 commercial properties were tested for haemagglutination inhibition (HI) antibodies to NDV. All the breeder farms in Queensland and approximately one-third of commercial layers in south-east Queensland were tested. A flock was regarded as positive if a serum with a HI titre of 11/8 or greater was detected. Only 26% of the flocks tested were positive. Eighty-five percent of positive sera showed a titre of 1/16 or less indicating exposure to the lentogenic strain of the virus.

Following the recovery in the United Kingdom in 1978 of a haemagglutinating adenovirus from poultry in a flock experiencing depressed egg production and the recovery in 1980 of a similar virus from commercial fowls in a flock in N.S.W. in which there was an egg drop syndrome, haemagglutination inhibition (HI) antigen (killed virus) was provided by N.S.W. to the Animal Research Institute for a serological survey for this virus. Sera collected in the NDV survey were examined with the haemagglutinating adenovirus HI antigen. Two broiler breeder farms of the same franchise had positive flocks. In these flocks more than 50% of birds had a HI titre of 1/20 or greater. It was revealed that an egg drop syndrome had occurred in these flocks. Further monitoring of these two farms revealed that flocks became serologically positive at approximately 30 weeks of age. This virus is basically egg transmitted. This seroconversion at 30 weeks is believed to be a result of reactivation of latent virus as the birds reached full sexual maturity and not indicative of lateral spread.

Whole flock or partial flock testing with the rapid whole blood slide agglutination test (RWBSAT) continued to be the mainstay of testing in the pullorum disease control programme. Poultry Section staff blood tested 22 226 birds on 31 properties. There were 88 790 birds in these flocks. Monitoring of pullorum testing done by licensed private testers was carried out by checks of testing procedures and by check testing of spent breeders, and microbiological examination of fluff samples and dead-in-shell embryos. Because of difficulties associated with collection and testing of blood samples collected at abattoirs check testing of spent breeders will be discontinued. It is anticipated that, in future years, rapid whole blood slide agglutination testing will be gradually replaced by microbiological monitoring of young chickens. *Salmonella litchfield* was isolated from a fine reactor in a flock of north Queensland.

Salmonella GpC was isolated as the cause of a 6% mortality in a group of 2-week-old chickens from Mt. Larcom. The clinical syndrome was represented by uneven growth, dehydration and death. Gross pathological changes included a severe enteritis.

An outbreak of acute cholera occurred in a flock of 2 000 breeder Japanese quail at Pittsworth. The cholera combined with local flooding resulted in a 50% mortality. The strain of *Pasteurella multocida* isolated was resistant to sulpha drugs and oxytetracycline.

Myoplasma spp. were recovered from growers at Helidon which exhibited swollen faces and sneezing. Seventy-five percent of the flock (2 000) was affected, but the birds recovered following medication with Tylan.

Botulism was responsible for the deaths of 10 birds in a small Townsville flock and mortalities in ducks and fowls at Gin Gin.

Escherichia coli infection occurred in a flock of 8 000 6-week-old broilers following an attack of coccidiosis. The infection was treated successfully with Furasol.

A flock of 10 000 2-day-old broiler chickens at Bracewell had a high incidence (4%) of yolk sac infection.

The project to characterize Australian isolates of *Haemophilus* sp. continued at the Animal Research Institute supported by funds from the Australian Chicken Meat Research Committee and the Poultry Research Advisory Committee. The ultimate aim is to provide a basis for the development of effective vaccines against infectious coryza of fowls. Basic characterization tests were completed on all 62 isolates in the collection.

The isolates form two broad groups. Group 1 consists of 21 isolates that are catalase positive and grow in air while Group 2 consists of 37 isolates that are catalase negative and require CO_2 for growth on solid media. Three isolates are highly unusual and will not fit into either of these groups. The 59 isolates tested were all dependent upon the presence of NADH (V Factor) but none required the presence of haemin (X Factor). Four different media were examined in tests to determine the most suitable solid medium to support the growth of this organism. A TMA medium developed by Rimler in 1976 proved to be the most suitable. Antigens for use in serological tests have been prepared from the imported prototype strains and Australian strains and antisera to the prototype strains have been produced in rabbits.

A further 18 isolates were tested in five experiments to check their pathogenicity. Results were consistent with literature reports in that there is a negative correlation between positive catalase reaction and ability to cause disease, namely, swelling of the infraorbital sinuses often accompanied by a serous ocular and nasal discharge. These signs were present in birds 24 to 48 h post inoculation and in uninoculated contact birds within 72 to 96 h. The majority of both catalase positive and negative isolates has been demonstrated (by reisolation techniques) to reproduce in inoculated birds and transmit to in contact birds kept in the same isolator, whereas only catalase negative isolates will produce disease. Four catalase positive isolates deviated from these trends and were subjected to further testing. In duplicate pathogenicity trials, these isolates did not produce disease (as expected). However, re-isolation from sinuses of inoculated or in contact birds was not afforded. This suggests that these isolates were not replicating appreciably in inoculated birds and consequently were not transmitting.

Coccidiosis was consistently diagnosed throughout the year. During June 1980 in south-east Queensland, outbreaks occurred in a number of flocks totalling 60 000 broilers 3 to 4 weeks of age. The flocks were on medicated feed (Avitec). Amprolium was used with little success. Sulphaquinoxaline eventually arrested the disease. An unusual outbreak was reported in a flock of 5 000 5-week-old pullets housed in rearing cages. Contaminated feed troughs were implicated. Caecal coccidiosis caused losses in replacement pullets on several farms. Outbreaks occurred in a 10 000-bird flock at Moggill and in a 4 000-bird flock at Capalaba. Response to sulphaquinoxaline treatment was slow. Another outbreak occurred at Greenmount in a flock of 1 000 4-week-old pullets due to flooding of the shed, mortality exceeded 30%. Amprolium was of little value and there was a slow response to sulphaquinoxaline. Seven percent losses occurred in a flock of 2 400 7-week-old pullets at Dululu. There was a poor response to water medication due to highly mineralized bore water.

A large number of inquiries was received about the control of stickfast flea (*Echidnophaga gallinacea*) in household flocks during the year. The main areas involved were Toowoomba, Gatton, central Queensland and Brisbane.

Numerous enquiries were received from non commercial producers about control methods for lice. A severe lice infestation led to a drop in egg production affecting 6 500 birds at Rochedale.

Several cases were examined where round worms were found in pullet eggs from caged birds. Reports of occurrence of round worms in eggs appeared to be on the increase. The reason for this was not clear but it may be the result of producers paying too little attention to round worm control in floor-reared pullets destined for laying cages on the assumption that caging will eliminate the worm problem.

Application of faulty restriction programmes based on feed quality and time of access restriction to a batch of 3 000 egg-strain pullets in the Caboolture area resulted in an uneven, underweight flock. Average body weight at 17 weeks was 0.9 kg compared with the target weight of 1.16 kg. Another flock of 2 800 backward pullets reared on a faulty restriction programme were still not laying at 28 weeks of age.

A low incidence (0.5%) of cage layer fatigue was reported in a flock of 15 000 birds. This was associated with a marked increase in weak shelled eggs (up to 30%). The condition was found to be due to inclusion of excess calcium in a farm-mixed, owner-formulated feed.

Vitamin A deficiency was seen in a flock at Townsville and riboflavin deficiency was seen in chickens on farms at Cairns and Boonah. Vitamin K problems occurred in a number of flocks and additional losses of 1 to 2% have been attributed to this cause.

One incident of fatty liver and kidney syndrome was reported in 3-week-old pullets. Treatment with biotin was effective.

With financial support from the Poultry Research Advisory Committee, Biochemistry Branch staff continued investigations into the problems of fatty liver syndrome in laying hens. Investigations over the past year centred on those factors influencing the production and accumulation of fat within avian liver, particularly dietary factors such as grain type and energy. A trial using hens selected for either high or low liver fat was completed. Cereal *per se* did not significantly influence liver lipid levels. The greatest differences in liver lipogenic enzyme levels and plasma enzyme, lipid and hormone levels existed between the lines of birds; dietary cereal and energy levels had a minor influence only. This trial is being repeated so that insulin and thyroid hormone levels may be monitored more closely. Future studies at present being initiated aim to measure the nature and integrity of liver reticulin in relation to fatty liver syndrome as well as metabolic relationships using isolated liver cells *in vitro*.

Nutrition

Based on information from our own laboratories and from some other Australian laboratories, the publication on feedstuff composition data is being reviewed and it is anticipated that a new edition will be published early in the 1981–82 year. Concurrently the computer feedstuff data matrix is being updated so that the new data can be used for feed formulation in the field. There is demand for a revised edition of the publication throughout Australia.

There has been a reduction in the demand for feed formulation services (including least cost formulations) from individual producers due to the move away from farm-mixed feed to commercial feed. It was suggested that the reasons for this included: physical burden to producers of increasing average age, sounder financial situation, availability of nutritional advice from feed supply firms, competitive price for suitable commercial feeds, periodic unavailability of some feedstuffs to producers. However, requests have been sought increasingly by companies for assistance from Poultry Section staff in relation to feedstuff composition data, feeding practice and nutrient specification recommendations as well as feed formulation.

Feed companies and feedstuff suppliers use the least-cost service mainly with the view to comparing relative prices of the various ingredients on the market. The service has been used also to examine potential values for new feedstuffs coming onto the market, for example, cottonseed meal and whole poultry meal. A south-east Queensland layer least-cost feed formulation is produced each month to monitor changes in feed costs relative to feedstuffs costs and availability on the market.

Some new nutrient specifications for high and low energy diets for summer and winter have been recommended.

Suggested practical vitamin-mineral premix formulae have been revised and discussions have been held with representatives from the premix companies to achieve a more uniform approach to vitamin and mineral premix formulation. Recommendations which have been developed for vitamin-mineral premix formulation and usage are aimed at reducing the storage time of premixes under adverse conditions on farms.

Controlled feeding of layer stock. This long-term research programme conducted at the Poultry Section, Animal Husbandry Research Farm, Rocklea, and supported by an extension programme in the field continued during the year. While the programme has demonstrated that controlling intake of the replacement pullet and laying hen by controlling fat deposition improves the efficiency of egg production, not all replacement pullets in the industry are controlled-fed.

The extension programme continued to identify some problem areas requiring further investigational research. The two areas currently being investigated are the influence of grower diet nutrient density on age at sexual maturity and laying performance; and the response to lysine level in the layer diet of *ad lib.* and controlled fed pullets and layers. Unpredictable delays on maturity have severely disrupted replacement programmes in the field. The experiments have demonstrated that the quality of starter and grower diets, the diets fed to pullets before they come into lay, can have an effect on the age of sexual maturity of even full-fed birds and have an even more marked effect on controlled-reared birds.

The intake of controlled-reared birds was dictated more by diet bulk than calorie requirement and this was clearly reflected in age at maturity. The delays were not followed by compensatory improvements in egg production. The experiments have also shown that maximum benefit will also only be obtained from controlled feeding if the birds, once in lay, are fed diets adequate in nutrients. It has been indicated that strains of layers in Queensland require higher lysine intakes for both most economic and maximum egg mass yields than overseas results would suggest and controlled-fed birds are more responsive to lysine intake and more efficient in utilizing consumed lysine than *ad lib.* raised birds.

Prediction of voluntary food consumption. If the feed consumption of laying flocks could be predicted continually over the production cycle, diets could be appropriately manipulated to minimize both excessive and inadequate intakes of essential nutrients.

An investigation was begun this year to develop models for the prediction of the voluntary food consumption of laying hens for discrete periods over the laying year. The variables under investigation are strain of birds (2 strains), energy density of the diet (3 levels) and time of commencement of lay (summer and winter). The characters against which changes in feed consumption are measured are: bodyweight, dietary energy concentration, egg production, ambient temperature and relative humidity.

Feed ingredient evaluation. Research during the year continued on the evaluation of traditional ingredients and on the nutritional potential of new products.

In the project evaluating the available energy and amino acid composition of cereal grains, 32 wheat samples and 12 triticale samples were examined. The samples were from crops grown in Agriculture Branch's regional variety trials. Significant differences were found between the metabolizable energy contents of wheat varieties (range of means 3 358 to 3 677 kcal per kg D.M.) and, in contrast to the barley work in 1979–80, the location where the wheats were grown was also significant in its effect (range of means 3 491 to 3 643 kcal per kg D.M.). The average metabolizable energy content of the triticales was lower than that of the wheats. The two varieties of triticale had a similar value (approximately 3 390 kcal per kg D.M.) but location had a marked effect on metabolizable energy (range of means 3 231 to 3 631 kcal per kg D.M.).

Sufficient *Amaranthus edulis* grain was produced during the year for production experiments to be conducted with broilers and laying hens in the future.

Experiments on waste activated sludge (W.A.S.), the by-product from treatment of abattoir effluent, showed that the product is of little value as a protein concentrate as such due to poor amino acid availability and low available energy. It displayed, however, no toxic properties and no evidence of detrimental effects on performance at low levels of replacement for meat meal.

The possibility, therefore, exists for waste activated sludge to be included at a low proportion (less than 20%) of the offal charged to rendering cookers if the material becomes a significant environmental pollutant. W.A.S. prepared by either using ferric chloride or polyelectrolyte as the conditioning agent was investigated. Chick bioassay for metabolizable energy gave values of 1 240 kcal per kg and 1 020 kcal per kg for the polyelectrolyte and ferric chloride W.A.S. samples, respectively.

Investigations to evaluate bentonites mined in Queensland as means of reducing 'wet droppings' problems in layers showed that although *in vitro* they bound from approximately 500 to 800% of their own weight of water *in vivo* they had only a limited effect in alleviating the problem by increasing the bulk of dry matter voided. The bentonites acted as simple diluents in the excreta and had lost their water binding properties after passage through the gut even when 'protected' by a layer of fat.

Breeding

Selection for efficiency of production in layers. A previous experiment at the Poultry Section, Animal Husbandry Research Farm, Rocklea, showed that by selecting to reduce liver fat in layers, a marked improvement in efficiency of production resulted. Chickens were selected on the basis of their dam's liver fat at slaughter. This would be an impractical method of selection in the field. This project indicated that more practical parameters could be used in the commercial situation. Thus a selection programme has commenced in which rate of production and rate of growth after first egg are being used to select for improved efficiency of production in layers. After only one generation of selection, an improvement in efficiency of production has been found in two lines selected using different measures of growth rate. In these two lines feed efficiencies of 2.39 kg and 2.37 kg of feed per dozen eggs laid were found, compared with 2.44 kg for an unselected control line and 2.61 kg for a line selected solely on rate of production.

Selection for efficiency of production in broiler breeders. An attempt is being made to develop a selection programme which will reduce obesity in broiler breeders and so improve their efficiency of production without reducing growth rate to broiler age. After one generation of selection, a line selected for high 6-week bodyweight and low growth rate after first egg had a 6-week bodyweight of 0.99 kg and 40-week bodyweight of 4.38 kg. The corresponding figures for a line selected solely for 6-week bodyweight were 0.97 kg and 4.46 kg respectively, while those for an unselected control line were 0.93 kg and 4.33 kg respectively.

Fatty liver haemorrhagic syndrome. Lysis of the liver reticulum has been defined in work previously carried out at the Animal Research Institute as the primary lesion of fatty liver haemorrhagic syndrome. A total of 774 livers has been sampled and examined histopathologically to determine the presence or absence of reticulolysis

and so allow the estimation of the heritability of the condition. The incidence of reticulolysis was 11.9% and these birds were produced by 37.3% of the sires used and 24.1% of the dams used. The estimation of the heritability of reticulolysis is currently being carried out.

Selection for high specific gravity of eggs in an Australorp flock. An Australorp flock (S) was selected for high egg specific gravity for five generations. An unselected control flock (C) was maintained concurrently. The realized heritability of response in the S line was $0.28 + 0.05$. In the final generation, a comparison with the C line during a 50-week laying period indicated the following significant ($p < 0.05$) direct and correlated responses in the S line: (i) an increase in average egg specific gravity (C 1.085, S 1.091); (ii) a decrease in the percentage of eggs laid with soft shells (C 6.3%, S 2.9%); (iii) a decrease in average egg weight (C 55.3 g, S 53.2 g); (iv) a decrease in average hen weight (C 2.51 kg, S 2.24 kg); (v) a decrease in food intake per bird per week (C 721 g, S 664 g); and (vi) a decrease in food eaten per kilogram of egg produced (C 3.96 kg, S 3.73 kg).

There was no change in the total number of eggs laid or in the albumen quality of either fresh or stored eggs.

Egg quality

Shell quality investigation. This investigation which commenced in 1979–80 continued. Egg shell defects identified by candling samples of 250 freshly laid eggs from a number of flocks on the Darling Downs were recorded for each farm. The results were used to determine the incidence of the defect on each farm and, if the incidence was abnormally high, its possible cause. In discussion group meetings, producers compared their flock results to more clearly understand the significance of their results compared with those from other farms in the group. One example of the type of problem identified involved a trailer used for egg transport on a farm. Candling showed that 5.2% of eggs were being cracked during transport. This was reduced to 1.9% by the simple means of placing a foam base beneath the eggs on the trailer top. On-farm investigations into shell quality defects have also begun in the Brisbane region.

Egg quality surveys. Egg quality surveys were conducted in central Queensland and north Queensland during the year. In February 1981, a survey of egg quality at the retail level was carried out in central Queensland. Samples of eggs were taken in 43 retail outlets in Rockhampton, Gladstone, Yeppoon, Biloela, Mt. Morgan, Moura, Blackwater and Emerald. The results of the survey indicated that considerable quality deterioration was occurring along the marketing chain. Storage and display conditions for eggs in retail stores appeared to be the most significant factors contributing to quality loss. The Central Queensland Egg Marketing Board has appointed a quality control officer whose duties include liaison with retailers to achieve improvement in conditions under which eggs are stored and displayed at the retail level.

In March 1981, an egg quality survey was conducted in north Queensland. This survey was aimed at assessing the quality of eggs at farm, wholesale and retail levels in order to identify quality problems. Eggs were sampled from 23 farms, eight wholesalers and 45 retail stores (including nine supermarkets). The farms sampled were in the area from Proserpine to Mossman and retail stores sampled were in Townsville and Cairns. Each farm sampled was supplied with a report detailing any quality problems and suggesting measures which could be taken to overcome the problems. The survey identified similar problems to those which have been found in south and central Queensland. The important role of the retail store as a focus of quality loss was highlighted and other factors peculiar to the north Queensland situation were identified. The survey has had the effect of raising the awareness of north Queensland producers of the egg quality problems which exist and has achieved considerable commitment from producers in the area to take action to improve the situation. A pleasing feature of this survey was the co-operation from producers in providing funds for purchase of egg samples and offers of other assistance to officers who conducted the survey.

Animal behaviour

Studies on behaviour of meat chickens under commercial conditions. Poultry Section staff continued studies on the behaviour of meat chickens on commercial farms with financial support from the Australian Chicken Meat Research Committee.

The behaviour of chicks during the important first days of brooding was investigated. Many different management procedures are followed at this time and the aim of the studies is to investigate the effects of these different procedures on the behaviour of the chicks. Investigations have been confined to those aspects of behaviour considered to influence performance. Large behavioural differences have been found, for instance, in the number of chicks drinking during the first hours after placement. Within sheds the numbers observed to use the drinkers of the same design during one minute periods varied from 0 to 14. Between sheds, estimates of the proportion of the total flock drinking varied by a factor of eight between the two ends of the observed range. Individual chicks and individual drinkers have been observed in an attempt to determine which of the many variable factors relating to chicks (for example, speed and direction of movement, head position) and to drinker (for example, height, shape, proximity to feed) are important in determining whether or not chicks drink.

These studies have been conducted by two different methods. One involved direct observations by a person present in the shed, aided by tape recorder, 35 mm and super 8 cameras. The other involved filming with time lapse video equipment which allows recording of the chicks' behaviour throughout entire 24-hour periods. This latter method has not been used previously for this type of study and innovative methodology is being perfected by the officers involved, particularly with respect to direct computerized storage and analysis of data.

Bloodtesting breeders is still the basis for pullorum disease control in Queensland poultry flocks. Poultry Section staff who are responsible for implementing the provisions of the Pullorum Disease Regulations monitor pullorum testing done by licensed private testers by checking testing procedures and taking samples of dead and culled chickens for microbiological examination.

Animal welfare. Concern with the scientific and legislative aspects of poultry welfare, both in Australia and overseas, continued to be an area of involvement for poultry officers. Much important research is being conducted in this contentious field and it is vital that the Department keeps abreast of developments in this field. An officer from the Poultry Section was involved in an educational role for producers and professional societies in Queensland and interstate, and also was a member of the Standing Committee on Poultry Welfare of the Australian Branch of the World's Poultry Science Association.

Regulation

Poultry Section field staff, who are also inspectors under the Poultry Industry Act, were involved in the following activities during the year.

Inspections were made of 17 hatcheries to determine their eligibility for re-registration in 1981. Re-registration followed a satisfactory inspection report.

In the pullorum control programme, Poultry Section staff 'bloodtested' 22 226 birds on 31 properties. There were 88 770 birds in these flocks, 18 flocks were subject to sample testing, while 13 flocks were completely tested. A total of seven people are now registered as pullorum testers having met the prescribed requirements by examination and practice.

Six licensed sexers were operating during the year. One chicken sexer elected to cancel his licence. Returns of chickens sexed by the sexers for the year ended 30 November 1980, showed that 3 482 165 chickens were sexed compared with 4 001 355 in the previous year. This downturn in sexing reflected the variation in quota cuts and increased sales in Queensland of New South Wales day-old pullet chickens.

Twenty-nine licensed egg pulping premises operated during the year. Only one of these was licensed to pasteurize egg pulp. Routine inspections of all premises showed that most were being satisfactorily maintained. A few owners were required to make minor improvements to bring their premises up to the required standard.

The degree of compliance with the requirements of the Egg Marking and Grading Regulations, as indicated by the number of breaches reported, was satisfactory. A number of smaller producers was warned regarding breaches of the Regulations. However, there has been a marked reduction in the number of producers attempting to evade the Regulations.

Poultry Advisory Board

Two meetings of the Board were held in the 1980–81 year. In future, the Board will meet twice each year instead of three or four meetings as in the past. If the need arises special meetings will be held.

At the July meeting, the Board considered and supported the Poultry Industry Fund Budget for 1980–81. The Board recommended to the Minister that precepts levied on the industry for 1980–81 should total $107,848 (Egg Marketing Boards, $63,244; Licensed Poultry Slaughter houses, $37,584; Holders of hen quotas in non Board areas $7,020). Other significant items considered by the Board at its meetings included: relocation of the Poultry Section, Animal Husbandry Research Farm; guidelines for poultry farming in Queensland; pullorum testing policy; layer random sample testing; poultry technology training at the Queensland Agricultural College; poultry farm management recording studies; egg marking and grading regulations; representation of north Queensland producers on the Poultry Advisory Board; and poultry welfare—Code of Practice.

Extension

The development of the pullet management recording study is nearing completion and it is anticipated that it will be available to producers rearing their own pullets in July 1981. At producer request, the programme was altered to provide one set of results at the end of the rearing period for each batch of birds recorded up to 18 weeks. This better suits producer needs and is more practical for the collection of data. The programme aims at providing: more effective monitoring of the physical and financial performance of the pullet-rearing enterprise; a comparison of farm performance with the average for the recorded group; a means of identifying those areas where performance is below average and an opportunity to improve performance and profit in these areas; data to identify problems requiring research and for extension.

Queensland has agreed to participate in a joint layer management recording study with the New South Wales Department of Agriculture. New South Wales commenced the study in 1970. An officer of Poultry Section, Brisbane, is to act as the Co-ordinator of the Queensland segment. After discussion with the Queensland egg producer groups, the Co-ordinator reports that up to 10 producers will form the study in 1981. Comparative analysis of flock physical and financial performance data enables participants to identify weaknesses in their farming operations and to apply corrective measures where necessary.

The poultry industry group set up in 1978 to plan and review progress of the poultry extension programme in the East Moreton Region underwent some changes in function. The objectives of the group were changed to improve the effectiveness of the group in identifying extension and research needs and deciding priorities, and to give more emphasis to the groups co-ordinating and communication functions.

Producer discussion groups continued to be important vehicles for extension in the Darling Downs, near north Coast, central Queensland and far north Queensland areas. These groups are providing an effective means of involving producers in identification of industry problems requiring extension and/or research and are helpful in evaluating the Departmental effort in these undertakings. Major emphasis was given to extension programmes in the areas of egg shell damage; effect of nutrient intake on layer performance; energy use in brooding broilers; hot-weather management of broilers; physical and financial performance recording for decision-making on egg farms; programming of replacements for seasonal hen quota adjustments.

Newsletters continued to play an important part as communication media for extension information. The monthly newsletter 'Birdwise' circulated to producers on the Darling Downs will also be distributed to producers in the Brisbane region. Responsibility for its production will be shared by Brisbane and Toowoomba staff. 'Quill', previously circulated to producers in the Brisbane region was discontinued. 'Featherfront' was produced quarterly in Townsville for distribution to producers in far north Queensland. 'For Your Information' was distributed on an irregular basis to broiler growers in the Brisbane area.

Heat stress seminar. This seminar held in October was jointly planned and conducted by the Poultry Section, the Queensland Chicken Growers' Association and the Queensland Chicken Meat Council. The seminar, which included displays of equipment, updated producers' knowledge of equipment and management practices which can reduce the adverse effects of high temperatures on broiler performance. One hundred and thirty people attended.

The poultry industry field day, planned and conducted jointly by the Egg Marketing Board Suppliers' Organization, World's Poultry Science Association and the Poultry Section was held at the Queensland Agricultural College in April 1981. More than 40 exhibitors who service the poultry industry exhibited displays of their equipment, products or services. Many new developments were demonstrated. More than 400 people attended.

Horses

The horse industry is quite a significant one in Queensland, where they are still used extensively in the pastoral industries. The breeding of thoroughbreds and standard breeds is sustained by buoyant racing and trotting industries, while breed societies and horse sports associations are still enjoying great popularity, although prices for these animals have eased somewhat. Numerous enquiries are received from the public concerning their feeding, husbandry and health.

Group C Salmonella caused diarrhoea in horses at Samford and Group E caused the death of a mare at Gatton.

Also *Salmonella anatum, Salmonella hvittingfos* and *Salmonella muenchen* caused scouring in horses at Kuranda. Salmonellosis was incriminated as the cause of deaths at Warwick, Tamborine and Aspley.

Equine infectious anaemia (EIA) was diagnosed in four horses at Kilcoy and others at Surat and Wamuran. All animals had been introduced from known EIA enzootic areas.

An outbreak of strangles in the central and western areas of the Rockhampton Division occurred following the movement of a mob of horses from Ipswich. The mob was offered for sale in Emerald, Winton and Charters Towers. Other horses contacted en route became infected and ultimately property horses contracted the disease. One property at Emerald reported 40 horses affected out of 60 in the group. Outbreaks of strangles were also reported from the Mundubbera area, Townsville and Hughenden and the disease was confirmed in a group of 11 horses that had been rejected from export to Japan.

A 5-year-old stock horse mare with ascending paralysis had haemorrhage in the grey matter and lingula of the cerebellum and meningoencephalitis. *Klebsiellia pneumoniae* was isolated from the cerebrospinal fluid and organisms consistent with *Klebsiella* were seen in the brain lesion. Colitis-X was diagnosed as the cause of death of a 7-year-old mare and a 9-month-old colt both from the one property. The animals were paddocked together and they died suddenly 12 days apart. The aetiology of this highly fatal condition is unknown.

Toxicoinfectious botulism was diagnosed on clinical signs in four thoroughbred foals ranging in age from 21 to 90 days of age. Clinical signs included flaccid paralysis, laboured respiration, elevated heart rate, poor pupillary reflex and tongue paralysis. In the early stage of the condition, the foals could stand when assisted. In a few minutes they would begin to tremble in the forelegs and would eventually collapse. Gross pathological changes at autopsy included ulceration of the stomach mucosa at the margo plicatus, distended bladder

(glucosuria was present in one foal) and pulmonary oedema. A necrotic lesion was present on the tongue of three foals, lung abscesses were present in one and hypopyon in another. *Clostridium botulinium* type B was isolated from the tongue lesion and retropharyngeal lymph node of one foal and organisms consistent with *Clostridia* sp. were demonstrated in a stomach ulcer of another.

Bacteria isolated from cases of infertility of thoroughbred mares on the Darling Downs included *Enterobacter agglomerans, Pseudomonas aeruginosa, Proteus* sp., *Streptococcus zooepidemicus, E. coli, Staphylococcus aureus, Exterobacter cloacae, Streptococcus uberis* and *Klebsiella pneumoniae.*

Streptococcus zooepidemicus was isolated from eight mares with metritis at Dalby.

Causes of abortions in the Brisbane and Toowoomba Divisions were ascribed to: *Acinetobacter levofti* 1, *Actinobacillus calcoacetius* 1, *Actinobacillus equuli* 2, *Enterobacter agglomerans* 2, *E. coli* 2, *Enterobacter cloacae* 1, *Klebsiella pneumoniae* 1, *Leptospira pomona* 1, *Pseudomonas aeruginosa* 1, *Streptococcus* spp. 6, non-infectious causes 9, no diagnosis 8.

Titres to *L. pomona* were returned from horses with periodic opthalmia in the Bulloo shire, Townsville, Yuleba, Roma, Kingaroy, Georgetown and from a horse with jaundice at Wyandra.

Two horses at Taroom with a history of fistulous withers showed positive titres to *Brucella abortus.*

Microsporum gypseum caused ring worm lesions in horses at Canungra and Toowoomba and *Trichophyton equinum* was responsible for an outbreak at Rathdowney.

Habronemiasis was reported in horses at Oakey and Warwick and in many animals in the Mt. Isa area. Trombiculid mites caused scattered areas of alopecia in standard-bred trotters at Oakey.

Veterinary public health

Meat inspection

The 1980 slaughtering season was a relatively short one with all works on reduced kills in the last quarter of 1980. A combination of depressed overseas markets, high prices, cattle shortage and a fair amount of industrial trouble at some works all contributed. The 1981 season did not start in the north until about Easter time, some 4 to 6 weeks later than usual. Two export works did not reopen this year. After the cattle season, one northern works killed horses for export for human consumption in Europe and Japan.

The usual effects of severe drought have been apparent: slaughter of poor stock, scarcity of 'quality meat', and the extended closure of abattoirs. This drought has seen an upsurge in the numbers of lot fed cattle accompanied by an unprecedented demand for identification branding. During the year, an industry decision was made to use the terminology 'grain fed' on brands, not lot fed. The system of identifying cattle as such has been reviewed with industry and modified. A purple tail tag system of identification has been developed to replace the cumbersome statutory declaration system. Branding of grain-fed cattle for trade and consumer identification continues to be a success story.

Standing Committee on Agriculture and the Australian Agricultural Council considered the Kelly Report in August 1980. A top-level working party was set up to consider the feasibility and costs of the proposed Australian Meat Inspection Service and to compare these with the present system. At the Standing Committee on Agriculture-Australian Agricultural Council meeting in February 1981, it was decided that only two options would be further considered and a decision taken in August 1981: either the Commonwealth will take over all inspection in export works or States which are willing will take over all inspection. A high level working group is currently gathering information for consideration. In addition, States are undertaking working party investigations into meat inspection fees and a uniform basis for fee scheduling.

Re-inspection fees for interstate meat were reduced by half during the year for meat on which fees had already been paid in the State of origin. It is planned to do away with these fees altogether next year.

A most significant feature of the year has been the development of consultation with industry and industry organizations and their direct involvement in decision-making in those activities which affect them directly. Examples of topics dealt with in this way have been standards for lamb, branding of grain fed beef and meat identification. A close working relationship has developed with the Queensland Meat Industry Organization and Marketing Authority on a number of matters, national carcass classification activities and grading being foremost among them. The Chief Inspector of Slaughterhouses, in association with the Secretary, Queensland Meat Industry Organization and Marketing Authority, undertook a study tour of the meat industry in New Zealand.

Slaughtering facilities

Bundaberg Abattoir has increased production and general standards at this works are good with continuing good relationships with management. Ipswich Regional Abattoir has shown an increase in the total number of stock slaughtered, considered to be in excess of capacity for the premises and for the number of inspectors engaged thereat. Considerable progress has been made with the construction of the new small stock slaughter floor. The Townsville Public Abattoir has regained normal production levels after an all time low in December. A small trial consignment of live lambs was slaughtered: this obviously was not a financial success and the operation did not continue.

Structural and general standards have been improved at several non-export abattoirs including those at Kingaroy and Tolga. The Tansey Abattoir remains closed. Improvements are necessary at Gladstone and Gavial Creek.

The Cairns Regional Meat Area came into operation on 1 May. The Sunshine Coast Regional Meat Area comes into effect on the 30 September 1981. The replacement Class 2 slaughterhouse at Landsborough began operating in early March. An inspector spent 2 days demonstrating procedures to slaughtermen and management. The premises is of high class and was officially opened by the Honourable the Minister at a function held on 9 May. No progress has been achieved with the Caboolture slaughterhouse to date.

The freeing up of meat movement between declared areas has enabled northern markets to be supplied with Queensland meat during periods of low or nil production instead of using interstate meat.

An important new development is in the slaughtering of deer. This is now permitted in slaughterhouses or abattoirs, as deer are now 'stock' within the meaning of the Meat Industry Act and Regulations. This is on a very small scale at present, but will certainly increase. The service is watching this development closely and one officer has submitted an excellent report. One operator slaughtered 40 Angora-cross goats for human consumption in the Cairns area. They were not skinned but dehaired by machine (head on) quite successfully.

Poultry slaughterhouses. During the year, the industry experienced changes from one of economic buoyancy in the early part of the year to a downturn in production at the end of the year. One processor, holding large stocks of frozen birds in store, in the face of heavy southern introductions and consumer preference for chilled poultry, reduced kill from approximately 8 000 birds an hour to 4 000 an hour. Two Class 3 slaughterhouses in the Brisbane Division have been reduced to producing only in holiday periods.

On the other hand, the expansion programme at one plant is estimated to cost $400 000. This company intends to develop the processing of prescribed meats containing poultry meats as its main ingredient and to further develop and expand their present smoked chicken trade. Also a new Class 2 poultry slaughterhouse at Nerang has been re-built with a semi-automatic chain system being installed. A new chain system has been installed at a Forest Glen Class 2 slaughterhouse. Plans have been approved for a new Class 1 poultry slaughterhouse to be established at Glasshouse which will replace existing premises at Bald Knob. Considerable improvement in processing standards has been achieved at premises at Aspley.

Three of the four major processors in the Brisbane area are now utilizing electronic weighing systems. A feature of this system is its ability to weigh each individual carcass passing over an on-line sensor and drop it off at a predetermined point for further processing. The system can also convey and drop carcasses off in boning rooms for breaking up into smaller portions.

Growth in the market of pieces, chilled on polystyrene trays and frozen in take away bags, has occurred during the year. The trend reflects society's changed eating habits which now require conveniently packed portions for ease of preparation.

Regular weight gain tests were carried out during the year at premises using spin chilling equipment. Two tests at different premises produced results over the legal limit of 8% but subsequent tests proved satisfactory.

Water sampling has been carried out at licensed premises which use water other than town supply. The necessity for treating water was shown in the unsatisfactory results of specimens taken at the source, compared to results shown from samples taken from treated water.

In the interests of uniformity, particularly in the case of small processors who converted their processing operations from manual to semi-automatic, all poultry processors with mechanized chain systems in the Brisbane and near Brisbane area have been placed under the responsibility of two specialist officers who previously controlled the three major processors in the Brisbane area. Thus more frequent inspection is being provided at plants whose increased throughput warrants such.

While two of the three poultry slaughterhouses within the Cairns district do not comply fully to the required structural standard, they do comply to a satisfactory standard. The third plant has many structural repairs and renovations to be carried out. The economical operation of poultry slaughterhouses in north Queensland seems in doubt due to the availability and price of frozen chickens from southern producers.

Butchers' shops and smallgoods establishments

Butchers' shops generally throughout the State were maintained at a high standard. Rapid growth areas, particularly the Gold Coast, Sunshine Coast, outer Brisbane suburbs and provincial towns have led to the building of many new shopping centres incorporating one or more butcher's shops in addition to the main chain store butcher's shop. Night shopping and competition from shopping centres have had an effect on the nearby butchers, some of whom have closed.

The new retail meat market complex at Mount Gravatt was opened in October. Only three of the 12 shops have been occupied and it appears that the concept has not been the success anticipated by the developer.

Notable changes in marketing trends have been the increase in the number of Class 3 butcher's shops; the hotel and restaurant trade being supplied extensively by the local trade section of meatworks firms; an acceptance by the butcher and the public of vacuum-packaged meat; keen interest in electrical stimulation and grain-fed beef identification; a fall off in the number of butchers selling bulk carcasses; and a change in pre-wrap meat sales combined with personal sales in shops previously selling only over the counter.

Very few butchers have taken the opportunity to sell products other than meat.

Class 2 licensees have shown confidence in the industry by upgrading their premises. One operator has installed a stainless steel smokehouse which can be programmed to automatic time sequences of time delay start, smoking, cooking and showering.

To assist butchers and developers with new butcher's shop construction, a booklet entitled 'A simple guide to Class 1 butcher's shop requirements' and a leaflet on air conditioning were prepared. The 'Interpretation of Regulations and Approved Materials' document was redrafted to clarify certain points and to cater for regulation changes.

Vacuum packaging of meat is being used for small portions of meat in some butchers' shops, that is, retail cuts as well as primals. Although this adds to the cost of the meat, the butchers claim it is profitable because it increases the shelf life of the meat, and allows the use of staff for this procedure during quiet trading periods.

Pet food. Pet food activity has increased throughout the State due to the high cost of meat from butchers' shops and the increased demand from greyhound owners. Pet food shops have mushroomed with many old butchers' shops converting to pet food outlets.

A cooked chicken loaf is being prepared from poultry pieces. Identification is by dyeing of the surface of the product and labelling on the container.

Approaches have been made to allow sales of frozen raw pet food in the grocery section of chain stores, wrapped and sealed in flexible film. Written submissions are expected.

To illustrate the point made about the dramatic increase in the number of pet food shops, in 1979 there were 16 pet food shops registered in Brisbane. Currently there are 68 with a total of 133 registered throughout the State.

Meat market activities. The value of re-inspection of meat introduced from other States and meat that has travelled some distance intrastate can best be demonstrated by illustrating the variety of problems encountered.

Microbiology of mechanically-deboned meat. This problem came to our attention through the detection of an abnormality in frozen products from Victoria. As a result, a survey in collaboration with processors, A.R.I. and C.S.I.R.O. was instituted into local production. Confidentiality was agreed on between all parties concerned. The bacteriological results indicated heavy contamination. Similar results were obtained in a Victorian survey. Despite collaborative investigation, no solution to the problem has been found to date. Queensland processors have agreed to use the product in house for heat-treated products only while a solution to the problem is sought.

Contamination from aluminium filings. Approximately 70% of a Victorian consignment of 80 bodies of beef were contaminated with aluminium filings from the action of the 'S' hooks rubbing against the face of the aluminium hanging rails. This occurred despite the capping of the rails with what appeared to be stainless steel.

Contamination from fibre glass. Sixty-five quarters in a load of 70 bodies of beef from Victoria were condemned for fibre glass contamination when the ceiling of the trailer collapsed en route. The contaminants from the wall linings ranged from fragments of fibre glass panelling, loose filaments of fibre glass, fragments of insulation and waxed resin. They were either embedded into the tissues or lying on the surface. A fine grit, either resin or fibre glass covered the affected meat.

Hook marks. Despite the marked progress over the years by recommending to southern suppliers and transporters of carcass meats to discontinue the predominant use of metal hanging gear and its replacement with synthetic ropes and thus eliminating hook marks and associated disfigurement from trimming, one Victorian supplier who persisted with metal gear had in-transit contamination comprising hook marks (33%), rail dust (6%), and fallen to floor (10%), among 3 600 lamb carcasses in a 5-week period.

Load out of 'hot' meat. Beef loaded 'hot' from a New South Wales abattoir resulted in condemnation from bone taint and bacterial spoilage. In the case of beef from a Victorian abattoir which took 5 h to load in the middle of a heat wave, extensive trimming was necessary to remove surface spoilage.

The above specific examples, outside of the usual findings, have been cited to indicate one of the many roles played in the interest of public health.

Introductions to the two Gold Coast meat markets have increased. One Gold Coast meat market licensee, a retail butcher with a property in north Queensland, slaughters at the Townsville abattoir and transports the meat direct to the Gold Coast.

Large numbers of southern lamb carcasses continue to find a ready market in the Brisbane area. The spring lamb season saw September introductions reach the figure of 49 747 the highest for that month for the last 5 years. The regular practice by the supermarket chains of offering lamb specials no doubt tends to maintain continuity of supply.

The steady increase in hamburger fast food take-away stores has meant increased introductions of beef patties from the south.

Disease recording

Disease control activities continue in 38 meatworks throughout the State. These duties include collection and preparation of tuberculosis-like lesions, and general pathological conditions, blood sample collection for tuberculosis testing, recording of slaughterings and condemnations plus various trials relating to specific diseases and conditions.

The new colour code format for the return of quarterly slaughterings and condemnations has been accepted well and is providing statistical information to various organizations and instrumentalities.

Statistical information on liver condemnations is kept at meatworks staffed solely by State inspectors. Commonwealth inspectors continue to refuse to record information of this type. Suggestions have come from senior meatworks personnel that condemnation due to hydatid infestation is increasing, resulting in a higher economic loss. More detailed information will be sought on this problem in the near future.

Blood samples are being collected at the major pig slaughtering establishments and some abattoirs from adult breeding stock under the swine brucellosis survey. Blood samples continue to be collected from wild pigs when available.

State inspection staff continue to play an important role in the collection of fat samples for the pesticide residue survey. Two hundred and ten samples a week are collected from nine works in the State. Sample collection has a bias to particular shires in specific regions of the State.

A total of 768 liver samples was collected by Slaughtering and Meat Inspection Branch officers at meatworks from Brahman bulls (¾ or better) for analysis for alphaglucosidase activity. The results indicated that 32 (4.2%) of the bulls could be considered heterozygous and another 30 (3.9%) must be considered equivocal and suspected of being heterozygous.

A sheep orbivirus survey was commenced at four works in specific regions of the State. Blood samples are being collected at the rate of approximately 70 samples a week from identified properties or regions.

Meat quality

Grading and classification. Efforts are continuing to trial and evaluate voluntary objective carcass classification in Queensland. At present, weight, fat depth, sex and age are the suggested criteria for beef carcasses. Colour charts are being tested to evaluate fat colour and meat colour, which are considered to be important by many retailers. Classification trials continue at Kilcoy and Bundaberg abattoirs.

Nationally, carcass classification is widely demanded by producers and retailers tend to see value in it for them, but processors are lukewarm to negative about it. The food division of the Australian Retailers' Association has decided to solidly support the introduction of voluntary manual classification of beef, sheep and pigs for use in their supermarket outlets.

Pig carcass classification is becoming more widely used. The introscope, to measure backfat thickness in pigs, is being used at J.C. Huttons (Oxley), Swickers (Kingaroy), South Burnett (Murgon) and the MRA (Cannon Hill). In addition, Queensland Bacon (Murarrie) and Capricorn Meats (Rockhampton) have taken action to train operators with an intention to introduce the introscope routinely in the near future. K.R. Darling Downs have indicated that they may also introduce the introscope at their works at Willowburn and Doboy. If this happens, most of Queensland's pig production will be covered. In collaboration with the Queensland Meat Industry Organization and Marketing Authority, updated slide-tape presentation on the introscope and its value to the industry is being produced.

Slaughtering and Meat Inspection Branch staff measuring muscle pH, an important parameter in meat research.

Identification. A submission was made to the Queensland Meat Industry Organization and Marketing Authority on colour identification of meat, recommending the use of red for young beef or lamb, orange for electrically-stimulated or tenderstretched beef or sheep meat, purple for grain-fed beef and green for hoggets. Suggestions were also made in this submission about some alterations to the design of our current roller brands to bring about simplicity, neatness of application and national uniformity. Decisions have now been made and are to be put into effect as soon as possible.

Grain-fed beef. Public acceptance of grain-fed beef is increasing, and the purple brand is being publicized by the trade and is being looked for by discriminating shoppers. A new system of identifying grain-fed cattle sold through saleyards en route to meatworks has been implemented. It involves the use of serially-numbered purple tail tags which are applied to the cattle when they leave the feed lot. The tags are supplied by the Queensland Meat Industry Organization and Marketing Authority on receipt of a statutory declaration by the feed lot owner, which states that the tags will be used on cattle from his feed lot only, and that the cattle have been grain fed to the agreed standard. Records are kept by the Authority of which numbers are issued to which person. The system appears to be working well. It is envisaged that, in the future, all feed lot cattle, even those on direct consignment, will be identified in this way for eligibility for branding at the meatworks.

Electrical stimulation. This process is becoming more accepted. One works uses high voltage stimulation routinely, and another is about to begin. The use of low voltage (rectal probe) stimulation is becoming more general. Many smaller establishments now use this method. It is estimated from the Townsville region that 83% of all cattle carcasses for the local market are stimulated.

Official policy is that only cattle with six permanent teeth or fewer (that is, less than 3½ years old) be branded. However, at one abattoir, branding of eight-tooth steers is taking place on a trial basis, pending the results of C.S.I.R.O. trials on the effectiveness of stimulation on carcasses of this age. The Department continues to collaborate closely with personnel of the C.S.I.R.O. Meat Research Laboratory, Cannon Hill, in various aspects of the process. It supports this type of technology, and is aware that it will probably be used in the future on sheep carcasses, as it is in New Zealand.

Lamb classification and branding. During this year, a working party, including Authority and abattoir representatives, investigated the definition and branding of lamb carcasses. Discussions and investigations were conducted at abattoirs and saleyards, with management, producers, wholesalers and the A.M.L.C.

It was recommended that a lamb have no permanent teeth erupted, and hoggets have not more than two, and that mouthing on the slaughter floor be the method of classifying as lamb or hogget for branding purposes. It was also recommended that the red colour still be used for roller branding and that the Queensland brand be slightly modified to make it basically similar to the New South Wales lamb brand. Neatness and legibility of the brand were considered vital, as is interstate uniformity in respect to definition of lamb.

Carcass classification

Mr. W.R. Ramsay continues to represent the Department on the National Carcass Classification Supervisory Committee (NCCSC). Official national policy has crystalized recently on two points. Firstly, subsidized trials should be restricted in future to those where the data are used commercially. Secondly, it has been made clear that the phase of voluntary adoption is being entered upon and NCCSC has been asked to draw up codes of practice.

An important national workshop was held in Perth in August 1980. This was attended by a wide cross section of influentials from all sectors. Opinions from the various sectors expressed there have been subsequently confirmed as organizations publish their views.

In summary, producers largely favour adoption. There are some groups who favour a 'wait and see' policy on the trials. Processors do not favour adoption. They describe it as an extra cost, of no use to them and an incomplete product description. Where studied, retailers tend to favour adoption. During the year, the supermarkets' association declared themselves in favour.

Extension and liaison activities

Officers of Slaughtering and Meat Inspection Branch have taken every opportunity to provide extension talks and material to interested parties. The Assistant Director, Mr. Ramsay, spoke to the Tropical Grassland Society, Mackay. This was a hard-hitting talk which pointed out that quality aspects, for example, tenderness and flavour, cannot be ignored by the industry if it is to prosper, especially now that technology such as electrical stimulation and tenderstretch is available to improve these aspects.

The Meat Quality Officer, Mr. J.M. Beames, spoke on pig classification at a pork producers' seminar, held at the Queensland Agricultural College, by the Queensland Pork Producers' Association. He also delivered a talk on meat quality and branding to students of the Queensland Institute of Technology.

Many officers have shown films to various community groups. These have been very well received. The films are about butchering and cooking meat, and are excellent. Technical talks have been given to industry groups, the Food School and the Queensland Institute of Technology and Queensland Agricultural College students. Also, in co-operation with the Australian Meat and Livestock Corporation, films on hygiene and preparation of meat were shown in Townsville.

A shop inspector at Roma made a display and a slide series suitable for showing to producer groups. Other inspectors prepared a tape and slide presentation on electrical stunning for use by officers and abattoir managements and a leaflet on air-conditioning in butchers' shops.

Show activities. At the R.N.A.'s Brisbane Exhibition, bone-out carcass competitions were held for beef and superpork carcasses. The Meat Information booth was again manned by inspectors, and was well patronized. Due to economy measures in the Department, the supply of handout material was limited, and it was felt that it would have been advantageous if more of this had been available. Inspectors have been active in assisting with country shows and in judging carcass competitions.

Investigations

An officer noted, in a line of feed lot cattle, that many had injection abscesses in the rump from vitamin injections, and pointed out that the injections should have been given in the neck. Some aluminium particles from overhead rails which were stated to have been approved for use in Victoria, were found on some carcasses, and necessitated heavy trimming of these carcasses.

A pig backfat trial was prompted by a pig producer's complaint that his ultrasonic backfat measurement on live pigs on his farm was considerably less than the routine works introscope measurement. This trial showed that, measurements on the dead pig with either instrument were, on the average, 2 mm greater than those on the live pig.

Investigation of the microbiology of mechanically deboned meat began following detection of contamination at re-inspection. Collaborative work with Pathology Branch and industry has shown that this product shows variable but at times heavy contamination (total bacterial count, *E. coli*, Salmonellae). Studies to date have failed to show how this can be prevented. Two publications have been prepared to make the industry aware of the problem. The approach is to develop a code of practice with industry to allow this cheap product to be used with safety in smallgoods production.

Reports have been received from meat industry representatives that there is an increase in the incidence of condemnation due to hydatid infestation. In Queensland, at present, there is no overall disease recording scheme which accurately records the incidence of hydatids in slaughter stock. Slaughtering and Meat Inspection Branch officers in Mackay and Roma have been making primary producers more aware of the risk and importance of hydatids by showing a series of colour slides and follow up discussion. Further work would appear to be needed on a State-wide basis to truly assess the problem which is becoming an increasing burden to the meat industry.

Following recent research into erysipielas arthritis in pigs, the New South Wales meat inspection service suggested that routine incision of the lymph node in the axilla is necessary to detect this condition. Inspection of that node necessitates some mutilation of the carcass to expose it. Research indicates that examination of a much more superficial node (Lg costae primae axillaris) in only suspected cases may be more effective and cause no mutilation. Two inspectors at different places are investigating the problem further.

There has been an increase in the scope and complexity of inspection problems in vacuum packaged meat during the year. This is associated with increased use of the technique by the trade and some belief there that it solves all preservation problems. Some very large amounts have been involved. It is anticipated that this trend will continue.

There has been pressure for change in merchandizing and handling practices during the year, 'open' butchers' shops in supermarkets, freezing frozen raw pet food from prohibited animals for sale in supermarkets packed in flexible film and sealed, and seeking approval for use of wooden pallets in meat delivery vehicles. Industry consultation and submissions were sought on these where appropriate.

A working party is investigating animal welfare at abattoirs. It includes one representative each from the Poultry Section, Beef Cattle Husbandry, Sheep and Wool, and Slaughtering and Meat Inspection Branches.

Poisonings and mycotoxicoses

Poisonous plants, chemicals and mycotoxins continued to be significant causes of sickness and deaths in all classes of livestock and diagnostic and research work was actively maintained throughout the year. There was an increasing awareness of the potential problem of mycotoxins which may be produced by a wide range of moulds growing on animal feeds spoiled during storage or by adverse seasonal conditions during the growing period or during harvesting.

The Poisonous Plants Committee, with representatives from the Departments of Primary Industries and Health, University of Queensland, C.S.I.R.O. and the former Government Botanist continued to review stock losses from poisonous plants and research programmes investigating plant toxicoses.

Poisonous plants

Losses in stock. The prolonged dry conditions and the movement of cattle to agistment predisposed to the majority of the outbreaks of plant poisoning that were investigated.

Nitrate poisoning killed three of 60 AIS cows grazing tetraploid ryegrass regrowth in the Gatton area. Depression, abdominal pain and recumbency preceded death by 2 to 3 h. At autopsy, the blood failed to clot and was very dark. Haemorrhages were seen in the heart and alimentary tract. A level of 5.0 to 10.5% KNO_3 was measured in the ryegrass. In another case, four dairy cows in poor condition and with calves at foot, died after being fed sorghum hay. The hay contained the equivalent of 6.4% potassium nitrate.

One hundred out of 300 young steers on a property near Ingham died following access to lantana. The cattle had no experience of grazing lantana previously. Mortalities also occurred at Ripley, Toogoolawah and Nanango.

More than 41 cattle died on two properties at Mundubbera following access to Hoya vine (*Hoya australis*) in scrub country. Drought conditions predisposed.

Three mortalities and sickness in 18 of a mob of 60 steers occurred following travel from Roma saleyards to Cunnamulla. On arrival, the cattle were released into a paddock in which wild tobacco (*Nicotiana* sp.) was growing. In western Queensland, wild tobacco was a common cause of poisoning in cattle walking sparsely grassed stock routes.

Green cestrum (*Cestrum parqui*) caused the death of a cow at Mulgildie and mortalities at Dayboro, Forest Hill, Karrabin, Oxley, Bribie Island and Mt Pleasant. At Mt Pleasant two of four Friesian calves died suddenly and at autopsy had haemorrhages of the myocardium and pericardium and centrilobular hepatic necrosis.

Ingestion of bracken fern (*Pteridium esculentum*) was responsible for mortalities in calves at Buaraba (5), Peachester (5), Palmwoods (3), Woodford and Dayboro (2). Some of the cases involved newly introduced stock. Clinical signs described were salivation, dyspnoea, blood stained mucoid nasal discharge, haemorrhages on the mucous membranes and tenesmus. Haematological examination revealed a neutopeonia, thrombacytopoenia and anaemia indicative of bracken fern poisoning.

Lomandra longifolia poisoning was thought to be the cause of ataxia and urinary incontinence in three 6-year-old Hereford-cross steers at Kingaroy. The plant, a relative of *Xanthorrhoea* spp. (grass trees), had been heavily grazed in the winter of 1979 and to a lesser extent in 1980. Cases were reported in late 1979. Wallerian degeneration was seen in the cervical cord of one animal.

Xanthium pungens (fruits) poisoning was involved in the deaths of five of 50 yearling Braford steers at Clermont and of four of 300 yearling Shorthorn heifers at Longreach.

Trema aspera (poison peach) poisoning killed two of three Freisian heifers at Forest Hill. Two were found dead and one dying in sternal recumbency. Severe generalized centrilobular liver necrosis was seen and *T. aspera* found in the rumen contents. SGOT was 975 IU/l and GT 34.8 IU/l. Poison peach was also diagnosed as the cause of deaths of three cattle at Greenbank.

Three mortalities in cattle at Bryden were ascribed to ingestion of white cedar (*Melia azedarach*).

Drought conditions at Augathella, Roma, Surat and Bollon predisposed outbreaks of *Pimelea* sp. poisoning.

Ellangowan (*Myoporum deserti*) was diagnosed as having killed a bull at Acland. This plant is well known as a cause of mortalities in hungry cattle and sheep on stock routes. However, it also frequently causes mortalities in hungry paddocked sheep and cattle.

Black pigweed *Trianthema portulacastrum* killed 10 drought affected cattle in the Gayndah area.

Two yearlings died, and another became sick following access to blue heliotrope *Heliotropium amplexicaule* in the north Burnett area. This plant contains pyrolizidine ackaloids.

Oxalate poisoning caused the death of approximately 250 out of a flock of 800 Merino weaners. Clinical signs were consistent with hypocalcaemia. The animals were held for 2 days in yards then placed on pasture containing a pigweed. Large numbers of oxalate crystals were present in kidney tubules and rumen contents contained 3.8% oxalic acid on a dry matter basis. Four sheep of a group of 24 died after having been held overnight in a yard of which the ground was overgrown with black pigweed (*Trianthema portulacastrum*).

Humpyback was diagnosed on clinical signs and typical spinal cord lesions in a mob of 1 100 sheep in south-west Queensland. Affected animals showed hindlimb inco-ordination when mustered. Humpyback was also suspected in sheep in a flock at Hughenden.

Manihot esculenta (cassava) was diagnosed as the cause of death of a goat at Toowoomba. This plant is reputed to cause prussic acid poisoning. *Cheilanthes tenuifolia* (rock-lip fern) caused mortalities of goats at Bundaberg. Green cestrum (*Cestrum parqui*) killed a goat at Wondai. A goat at Townsville developed jaundice following access to lantana.

An Angora-cross doe died suddenly after eating the leaves and green pods of *Phaseolus lunatus* (Lima bean). Clinical signs included tachycardia, increased respiratory rate, spasmodic muscle contractions, lateral recumbency, opisthotonus, moderate bloat and eventual death. A marked cyanosis of mucous membranes was evident at autopsy. The ruminal contents were positive for the presence of HCN along with samples of the plant.

Helichrysum ramosissimum was diagnosed as the cause of 26 mortalities in horses and sickness in five others on a property in the Bulloo Shire. Sickness and deaths in horses and cattle due to this cause have never been documented. Signs included dragging of hind toes, depression and apparent blindness. Histopathological examination revealed moderate nephrosis, petechial haemorrhages in the epicardium and mild centrolobular fatty changes in the liver.

Oxalate poisoning resulted in the death of two horses grazing a pure stand of actively growing *Setaria* sp. Clinical signs of depression, oedema of the head, neck and ventral abdomen were suggestive of impaired renal function. White deposits were noted in the cortex at autopsy. Histologically, there was severe tubular necrosis associated with numerous deposits of oxalate crystals. Clinical biochemistry results were serum Ca 8.9, Mg 5.9 mg per 100 mL and creatinine of 14.0 mg per 100 mL.

Chronic pyrrolizidine alkaloidosis resulted in the death of 10 horses on a property in the Arcadia Valley. The animals began dying 3 to 4 months after being introduced from north-western N.S.W. Histological changes in the liver were periportal fibrosis, megalocytosis, bile duct proliferation and bilary retention. *Crotalaria juncea* and *C. incana* may have been involved.

Very dry seasonal conditions predisposed to mortalities in horses on several properties in the Kidston area due to walkabout disease.

Three horses at Roma and another three at Taroom died within the 2 days following the ingestion of hay containing a large amount of *Lepidirum bonariense* (Argentine peppercress). Feeding tests carried out at the Animal Research Institute were negative.

A syndrome corresponding to Mexican poppy-salt toxicity was seen in a commercial broiler flock. Five percent losses were experienced in a flock of 4 000 2-week-old broilers. Affected chickens exhibited subcutaneous oedema (including anasarca), ascites and hydropericardium. Some birds examined showed focal liver haemorrhages. Examination of the feed did not reveal any positively identifiable seeds but some fragments were thought to be those of *Argemone ochroleuca* (Mexican poppy).

Jute, *Corchorus olitorius*, seed was found in the ration of 5-day-old layer replacement chickens dying on a property near Charters Towers. Of a total of 600 birds, more than 40 died before the ration was changed and the problem ceased. Chickens exhibited clinical signs of depression before dying. There were no specific post mortem signs.

Research. *Melia azedarach* (white cedar) occurs all around the world and has been responsible for numerous animal poisonings. Pigs are the species most often affected. The fruit appears to be the most toxic part of the plant. During the year, chemical investigations concentrated on this part of the plant. Tests with laboratory animals showed that two distinct kinds of toxin were present. One was fast acting: the animals dosed died within an hour. The other was slow acting and took several days to kill. In the case of the fast-acting

toxin, the clinical symptoms shown in laboratory animals and pigs were similar. An interesting feature was that the fast-acting toxin was found in only a small proportion of fruit samples examined. This supports field evidence which indicates that only some white cedar trees are toxic. This fast-acting toxin has been isolated in pure form and its structure is being investigated at the Australian National University, Canberra.

Wedelia asperrima (sunflower daisy) has caused toxicoses in sheep in north-west Queensland, particularly after summer rains. The toxin, wedeloside, has been isolated and its structure determined. The compound has shown antitumour activity in small scale tests and a large quantity of pure wedeloside has been purified and sent for anti-tumour testing by the American anticancer foundation in Wisconsin, U.S.A. Four other new toxins from *Wedelia asperrima* were isolated and purified. The structures of these are closely related to that of wedeloside.

Wedelia biflora grows widely in south-eastern Queensland where it is often planted in sand dunes to prevent erosion. The toxin in this plant has been isolated and purified. Its structure is similar to that of actractyloside found in *Atractylis gummifera* (Compositae).

Sawfly larvae (*Lophyrotoma interrupta*) have caused extensive poisonings of cattle in the Maranoa and St. George districts as well as isolated mortalities in many other areas. The isolation of the toxin, lophyrotomin, and preliminary work on its structure was published in 1977. A large quantity of pure toxin was sent to Cambridge University, England, for completion of work on the chemical structure. The possibility of developing an antagonist for the toxin to treat field cases was investigated. Lophyrotomin is a peptide and acts as a liver toxin. Its action appears similar to that of the peptidic toxins in Amanita species mushrooms. Consequently, initial experiments with laboratory animals used sodium hemisuccinate silybin which has been used successfully as an antidote for the acute hepatotoxicity of Amanita poisoning.

Trema aspera (poison peach) occurs throughout eastern Queensland. Isolation of a toxin from this plant was first reported in 1968 but structural work has proven difficult. It is anticipated that the latest techniques available in Cambridge University will clarify the structure.

Amaranthus edulis was examined because it was suspected of causing liver lesions in chickens. Two apparently biologically active steroids were isolated from the seeds. The Australian National University, Canberra, has determined the structures of these two steroids but their biological action has not been confirmed.

The toxin of *Verbesina encelioides* (wild sunflower) was isolated and sent to The Australian National University, Canberra, where it was identified as galegine (3-methyl-2-butenyl guanidine), a known toxin previously isolated from *Galega officinalis*. This plant, known as goat's rue has been responsible for stock losses in the Middle East and North America.

Feeding trials with Crofton weed (*Eupatoriun adenophorum*) continued in horses with a view to establishing a management regime to avoid toxicity while using affected country. The flowering plant causes extensive pulmonary fibrosis.

Jute seed (*Corchorus olitorius*) was found to be toxic to pigs causing, anorexia, vomiting and diarrhoea. In order to assess an acceptable level of jute seed contamination of grain crops, a trial in which three levels (0.05, 0.1, or 0.5%) of jute seed in a cereal grain based diet were offered to growing pigs was undertaken. Preliminary results indicated that pigs receiving the 0.5% diet showed a marked reduction in feed intake and liveweight. The jute seed was removed after a fortnight to prevent deaths from starvation. A less marked decrease in feed intake was noted in the other two groups.

Chemical poisonings and drug overdosing

Lead poisoning was the major source of intoxication supported by laboratory analysis. Samples were submitted from 303 properties of which 34 supported a diagnosis of lead intoxication. Sources of lead included car batteries, linoleum and flaking paint. The mortalities involved in excess of 80 mostly young cattle.

Twenty-two outbreaks of arsenic poisoning involving an equal number of dairy and beef properties occurred. Approximately 70 mortalities were reported. At Eidsvold and Raglan, weaner cattle died in dip yards which had been used 15 years earlier for the disposal of arsenical dip contents.

Six cows died at Barmoya following the ingestion of 1080-treated grain. The treated grain had been laid for feral pigs but it had not been totally consumed before the reintroduction of the cattle to the paddock.

Fifty-two cattle died on a property near Charleville after having drunk water from a trough serviced by a faulty urea dispenser. A dairy farmer at Laidley lost two cows and four calves. Another cow showed loss of milk and coldness to the touch but it subsequently recovered. Autopsy of two calves demonstrated severe ruminal oedema and ruminitis; one also had haemolytic anaemia. A search of the paddock revealed a bag of wettable sulphur that had been dumped by the farmer and some of this had been eaten.

Endosulphan poisoning was confirmed in four 10-week-old Jersey calves at Lowood. Death in all four was rapid. Some convulsed before death. Congestion of tissues and petechiation in several organs including brain were noted. Endosulphan leaked from a drum onto grass adjoining the calf pen. Rumen contents of the calves were strongly positive for Endosulphan.

Since the introduction of the amidine based acaracides the prevalence of organic phosphorus poisoning has markedly decreased. The only case of poisoning during the year came from Maryborough where one calf died following dipping in bromophos ethyl (Nexagan).

Urea poisoning was responsible for the deaths of 30 sheep on a property at Roma. A softly compressed supplement block had been supplied to the sheep. On three other properties in the Roma area and on one property in the Charleville district, mortalities due to urea poisoning occurred through malfunctioning dispensers.

Autopsy revealed that the intestinal contents of a goat which died at Mt Tyson contained 5% by volume of fuel distillate.

Seventeen 10-week-old pigs with severely inflamed skins due to mange were sprayed with diazinon. Two days later, shivering and salivation was seen in live pigs, three were moribund and two dead. The pigs with most severe skin lesions were most severely affected presumably due to enhanced absorption of diazinon.

Water deprivation predisposing to salt toxicity was diagnosed on the basis of clinical signs and histopathology in four pig herds. Clinical signs included convulsions, tremors and paddling. Polio encephalomalacia and eosinophilic meningoencephalitis were seen on histopathology.

Jaundice and toxic hepatitis typical of copper poisoning were found at post mortem of a 3 to 4-month-old pig. Liver copper of 2 273 p.p.m. and kidney level of 733 p.p.m. were present. A home-mixed ration with added copper sulphate calculated to give 250 p.p.m. copper was being fed. An obvious protein deficiency in the grain-based ration probably helped precipitate the problem.

Salt poisoning killed 11 of 15 guinea fowl chicks at Gayndah through incorrectly mixed rations.

A 30% drop in production over 3 weeks corresponding to a change of diet was evidenced in a flock of commercial layers near Toowoomba. The ration was mis-formulated at 4 kg per tonne (0.051%) furazolidone instead of 4 lb per tonne which gives a recommended 0.02%.

Mycotoxins

A variety of syndromes in cattle on the Darling Downs during the drought was ascribed to the feeding of peanut hay. However, only one was confirmed as aflatoxicosis. In this outbreak, 12 of 90 calves fed peanut hay died on a property near Inglewood. Jaundice, photosensitization, diarrhoea, anorexia and depression were seen before death. Haemorrhage and characteristic liver damage were seen at autopsy. Total aflatoxin levels up to 2.2 mg per kg were detected in peanut hay samples with most concentrated in the nut-in-shell fraction. Eight of 200 weaners agisted on a property at Wandoan died from what was histopathologically diagnosed as chronic aflatoxicosis. No source of the aflatoxin was found.

Aflatoxicosis was also diagnosed in two small herds of free range pigs. Vomiting, abortion, anorexia and death occurred in sows and sudden deaths in young animals. Trash which contained approximately 30% nuts resulting from peanut harvesting was fed in both cases. Total aflatoxin levels in feed averaged 30 mg per kg in both cases. Toxic hepatitis typical of aflatoxin poisoning was seen on histopathology in one of the cases.

A trial was conducted to determine the feeding value of maize infected with the fungus *Diplodia maydis*. This is an important pathogen of maize grown in south-east Queensland but its possible effects on poultry have not been determined.

Diets containing up to 60% infected maize were fed to broiler chickens from day-old to 3 weeks of age. No symptoms of toxicity were observed and no effects on liveweight gain, feed consumption or feed conversion efficiency were found.

Following surveys of peanuts and maize grain in previous years, a survey of mycotoxins in Queensland barley was commenced. Supporting funds were provided by the Queensland Barley Growers' Co-operative Association. Samples representing the 1979 crop are being analysed for aflatoxins B1, B2, G1 and G2, zearalenone, T-2 toxin, ochratoxin A and sterigmatocystin.

Laboratory services

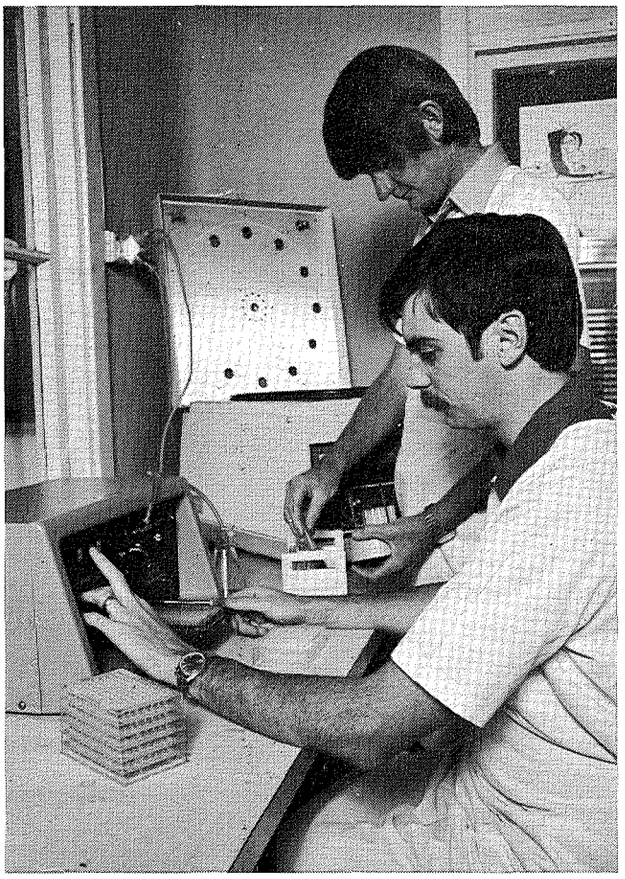
Specimens examined

The Division's laboratories in Brisbane and Townsville continued to examine a large number of specimens to support the diagnostic, regulatory, product control, extension and research work not only for Departmental officers but also for private veterinarians and industry staff who all service the livestock industries and the consumer public. While most of the laboratories in Brisbane and the Oonoonba Veterinary Laboratory, Townsville, are of recent construction and well appointed, the main Pathology Branch laboratory at the Animal

Research Institute is scattered in several very old buildings. These facilities make it difficult to maintain high quality work with an increasing number of specimens for examination. The Animal Research Institute, Oonoonba Veterinary Laboratory, Rockhampton Veterinary Laboratories and the Charleville Pastoral Laboratory continued to examine a large number of specimens from the brucellosis and tuberculosis eradication programmes.

A total of 9 425 batches of specimens, excluding those connected with the brucellosis and tuberculosis eradication programmes, was processed by Pathology Branch. Of these 7 612 were handled at the Animal Research Institute and 1 813 at the Oonoonba Veterinary Laboratory in Townsville. Examination of these batches involved 136 163 serological tests, 9 138 microbiological tests, 3 422 haematological tests, 8 046 parasitological tests, 1 245 protozoological tests, 3 248 histopathological tests and 106 botanical examinations. These procedures totalled 161 368 individual laboratory examinations.

Where previously laboratory tests associated with the export of livestock were done in the various discipline sections of Pathology Branch, during the year a new section was established to handle all the tests and to streamline procedures. This was necessary because of growth in the export trade and an increase in the range and complexity of laboratory tests required by importing countries. Since inception, the section has tested 25 243 animals of which 24 557 were cattle, for export mainly to south-east Asian and south Pacific countries. A total of 69 296 individual tests was carried out and charges for these tests totalled $45,654.



Two technical staff of the Export Serology Section of Pathology Branch have been kept busy performing 69 296 individual tests on sera from 25 243 animals in the 12 months since the inception of the section in May 1980.

As an integral part of the diagnostic services of the Animal Research Institute the Toxicology Section of Biochemistry Branch examined 1 420 samples representing 795 cases of suspected poisoning. Toxicologically significant results leading to positive diagnostic findings were obtained in 118 cases (15%). Analytes determined included arsenic, lead, strychnine, pesticides, mycotoxins and nitrates. Arsenic and lead were again the predominant sources of animal poisoning.

One hundred and twenty-three samples of export peanuts were analysed for aflatoxins B1, B2, G1 and G2, on behalf of the Queensland Peanut Marketing Board. Clearance certificates (aflatoxins < 10 μg per kg) were issued for the large majority of these samples. Twenty-two samples of stockfeeds were analysed for aflatoxins and ochratoxins as part of the regulatory programme of Standards Branch of the Department.

In the pesticide monitoring programme, Toxicology Section performed 16 000 analyses on 8 000 fat samples mainly from cattle. In addition, several other types of samples were screened for insecticides either as an aid to diagnosis or to assist marketing of a product by ensuring that regulatory residue levels were met. These samples included 52 toxicological samples, 20 samples of bagasse, 60 eggs, tissues from eight hens, 24 poultry feeds, nine poultry faecal samples, and 200 miscellaneous samples from the banana industry, various field branches of the Department and the Northern Territory Department of Primary Production.

Clinical Biochemistry Section of Biochemistry Branch performed more than 10 000 analyses for a wide range of blood and tissue components. Of these 4 097 were for diagnostic service work. Nutritional Biochemistry Section received a total of 2 111 samples on which a total of 6 110 analyses was performed. Although the bulk of the samples was related to the research programmes of the Department, considerable assistance was also given in the diagnosis of nutritional disorders across all species throughout the year. The section also co-operated with medical staff of the Royal Children's Hospital, Brisbane, following a specific request from them for assistance with their studies in human nutrition.

In the past 12 months, although the use of acaricides is decreasing, the dip analysis service analysed 3 370 samples—more than for any of the last 7 years. Of these analyses 47.5% were for Taktic. Ethion continued to be the chemical used consistently above the recommended strength of 0.075%. Approximately 60% of ethion analyses were above 0.090%. A few samples were as high as 0.27%. In comparison, Tifatol samples were low and 42% of samples analysed were less than 0.024% (recommended strength 0.030%). This factor could be important in loss of control.

During the year, the radioisotope facility at the Animal Research Institute undertook counting and advisory services for the Wool Biology Laboratory, Husbandry Research, Plant Pathology, Beef Cattle Husbandry and Agricultural Chemistry Branches, and the Charleville Pastoral Laboratory. The University of Queensland Veterinary School also took advantage of these specialist facilities. Isotopes counted were tritium, carbon-14, phosphorus-32, phosphorus-33, cobalt-57, iodine-125 and sulphur-35 in a total of 5 230 samples. A series of leaflets was prepared and duplicated as advisory literature for users on the safe use of radioisotopes.

To assist in Sheep and Wool Branch's extension programme the Wool Biology Laboratory undertook measurements for yield, clean fleece weight and fibre diameter on 6 121 wool samples from studs and flocks undertaking breeding programmes and on 366 wool samples from wether competitions. To assist mohair producers, the Laboratory examined 191 mohair samples for quality, yield, fibre diameter, medullation and pigmentation. As part of the Branch's active research programme 3 909 skin or wool samples from sheep in various projects were examined for a number of parameters.

Method development

Work continued during the year in developing or adapting methods to improve the efficiency and accuracy of diagnostic and biological analytical tests.

The final ancillary equipment parts were received for the Spectra Physics 8 000 B high pressure liquid chromatograph. After some months spent in specification testing and column selection, the unit became operational providing a sophisticated separating and identifying tool for research and development programmes. Chemical derivatization of mycotoxins and other organic compounds of interest provided a useful method for improving overall sensitivity in the ultra violet and fluorescence modes.

Work progressed in developing more effective methods for the detection and estimation of fluoracetate (1080), warfarin and blood cholinesterase activity.

An enzymatic assay for 'available cyanide' in linamarin (a cyanogenic glycoside) was developed and used to analyse 28 samples of cassava flour for Agricultural Chemistry Branch.

A common problem in the diagnostic clinical biochemistry has been the receipt of samples which are haemolysed to varying degrees. This haemolysis can significantly affect the measurement of biochemical parameters. Recent work involved estimating the effect of haemoglobin by measuring the degree of interference or the contribution to a particular biochemical result. Consequently a more realistic result can now be given for all measured biochemical parameters.

Methodologies related to the availability of amino acids were investigated with preliminary studies aimed at the determination of lysine in plasma. A method dependent on the enzymatic decarboxylation of lysine to cadavarine and the subsequent analysis of this volatile product was evaluated as the first step in this programme. A more modern and more versatile Amino Acid Analyser would greatly enhance the scope of diagnostic and research work on the levels and availability of amino acids in feedstuffs and animal tissues.

Atomic Absorption Spectrometry (AAS) remained an essential technique in trace element analyses. Three varian AAS units were maintained, namely, AAS-2, AAS-5 and an AA175 fitted with the CRA-90 carbon rod atomizer. These three instruments were used to perform more than 22 000 analyses from 8 300 samples during the past

12 months. Elements analysed were arsenic, cadmium, calcium, chromium, cobalt, copper, lead, iron, magnesium, manganese, mercury, molybdenum, selenium, sodium and zinc. For the analysis of molybdenum in animal tissue and cobalt in plant samples major modifications of the CRA-90 and development of new instrumental operating techniques were necessary. Modifications included additional ramp heating controls, an optical device to improve precision of sample application and provision of variable atmospheres for the carbon rod furnace.

Vaccine production

A total of 764 562 doses of tick fever vaccines was supplied by the Tick Fever Research Centre of which 486 113 doses contained both *Babesia bovis* and *Anaplasma centrale*. The demand for anaplasmosis vaccine has remained at this high level of 64% which is somewhat surprising in view of the fact that fewer than 20% of all tick fever outbreaks have been due to this infection since 1974.

Since early 1981, all vaccine was supplied in coolite eskys which replaced the previous packaging method consisting of cardboard cartons filled with loose polystyrene beads. The main advantage of the eskys was their superior insulation properties but also they were more robust and easier to use than the old materials. The vaccine container was changed also as some batches of the polyvinylchloride (PVC) bags were shown to be toxic to the vaccine organisms and there were also problems of availability. The new polypropylene packs of high quality plastic were more readily available, being used by commercial firms for other types of vaccines. Further, they are more versatile and can be used with either a single shot or repeater syringe.

Evaluation of a heating procedure for the bovine serum component of the vaccine diluent was mentioned in last year's report. The aim was to inactivate any contaminating viruses which would not be removed by the filtration process. The parasite viability testing procedures have now been completed and show no harmful effect due to the heating process. Thus a further step in improving vaccine quality has been accomplished.

Miscellaneous

The Quantitative Microbiology Section of Pathology Branch actively continued with research projects on: abattoir hygiene and *Campylobacter* in commercially processed poultry; investigations into the microbiological quality of mechanically deboned meat and the disinfection of meat workers' protective gloves; the evaluation of a number of disinfectants and egg washing compounds; examinations of stockfeeds for *Salmonella*; and the examination of water samples.

The role of meat inspectors' knives in the transfer of *Salmonella* to meat and offal was examined. Significant numbers of salmonellae were found on the knives of viscera inspectors and it seemed that many of these organisms could be transferred to the edible offal. The knives of meat inspectors having no contact with the viscera did not seem to play a major role in the contamination of the carcass with *Salmonella*.

Campylobacter jejuni/coli was found on 94% of the poultry carcasses examined. Numbers were as high as 10^5 per carcass. In view of the importance of *Campylobacter* enteritis in man, it seems that the relationships between animal and human compylobacters and their incidence in other animal products should be investigated further.

Investigations into the microbiological quality of mechanically deboned meat and the disinfection of meat workers' gloves were done at the suggestion of the Slaughtering and Meat Inspection Branch. Mechanically deboned meat was found to have a high incidence of *Salmonella* contamination, suggesting that it should be used only as an ingredient in products undergoing treatments known to kill salmonellae. Methods presently employed in the cleaning and disinfection of meat workers' gloves were found to be unsatisfactory. More satisfactory methods will be investigated in the future.

Biochemistry Branch, in collaboration with Sheep and Wool Branch, began preliminary investigations on the transfer efficiency of depilatory agents to the skin of sheep. Initial experiments involved the study of the behaviour of aerosol droplets generated by several pneumatic generators in conjunction with an electrostatic induction unit. A thorough literature review to assess future possibilities is being carried out.

Eight samples of tainted meat provided by Slaughtering and Meat Inspection Branch officers following complaints by customers and/or butchers were examined by Biochemistry Branch in an endeavour to identify the taint. In one case, the source of the taint was identified as a plastics additive leached by water from a new plastic hose used to fill a brine tank. The presence of tainting in other samples was confirmed by tasting. However, the analytical difficulties involved have to date prevented positive identification of chemicals causing the taint. This investigation is continuing.

Preliminary work has been undertaken on the measurement of carboxyesterase activity in blowfly as an indicator of the degree of resistance to various insecticides. It is considered that this enzyme could be involved in the detoxification mechanism. Initial results suggested that a malathion-resistant strain kept at the Animal Research Institute had elevated levels of this enzyme compared with a susceptible strain.

Major activities completed in the Animal Research Institute Library included the weeding of the book collection. The rationalization of serial holdings led to the cancellation of 35 subscriptions as prescribed by Departmental financial constraints. At the end of the year, the collection consisted of 2 392 catalogued books and 1 872 indexed pamphlets, with 357 current serial subscriptions. The binding programme was accelerated considerably due to a special allocation of funds for this purpose, and a total of 652 volumes was bound.

The library committee paid particular attention to accommodation problems associated with the protracted delay in the building of the new library. Deterioration of material in the collection continued at a disturbing rate. Steps were initiated to weatherproof the library building, and to provide an extra 25 bays of shelving.

Computer-based information retrieval continued to play a significant role in the reference service, with 31 literature searches being done for Institute officers. Publications lent to institute staff totalled 2 225, and to other Departmental officers 1 221. A substantial rise in the number of requests for material not held in the library has created a total of 827 inter-library loans to the Animal Research Institute while 414 items have been lent to other libraries.

A Department of Primary Industries district tick extension officer counts the ticks on a Hereford steer in a joint D.P.I.—C.S.I.R.O. tick control trial in southern Queensland.

Division of Plant Industry

QUEENSLAND'S rural industries encompass wide environmental diversity from tropical to temperate and from humid to arid conditions for plant production. This diversity is reflected in the plant species used commercially. For many of these, particularly in the tropical regions, production problems are unique and related research has its major affinities with that in the developing countries of the world.

The objectives of the Division of Plant Industry are to improve and stabilize the productivity of the agricultural, pastoral and horticultural industries of Queensland and to conserve its soil and plant resources for the benefit of the entire community. This requires broad ranging programmes of research and extension which extend from improving the native pastures of the arid regions to ensuring superior quality of wholesome fruit and vegetables on the consumer's table.

The Division's functions are developed by two major production Branches: Agriculture Branch, which is responsible for research and extension for native and sown pastures, field crops and heavy vegetables; and Horticulture Branch, which undertakes research and extension in the fruit, vegetable and ornamental plants industries. Specialist services are provided by Agricultural Chemistry, Botany, Entomology and Plant Pathology Branches.

The Director of Horticulture administers Plant Quarantine in Queensland as an agent for the Commonwealth. Divisional officers are also involved in the administration of regulations concerned with crop production and beekeeping.

Four special research units established within the Division carry out research for particular industries.

At 'Brian Pastures' Pasture Research Station, Gayndah, research is aimed at improving beef production through the development of improved nutrition and husbandry practices. The Australian Meat and Live-stock Corporation contributes an agreed sum each year with staff salaries and running costs being met by the State Government.

Toowoomba is the site of the Queensland Wheat Research Institute where an integrated programme of research into the many production problems of the wheat industry is conducted. The Australian Wheat Research Council and the Queensland Wheat Industry Research Committee are responsible for financing most of the activities with the State Government making a major contribution to staff salaries and operating expenses.

Staff at the Charleville Pastoral Laboratory are involved in studies on the management, productivity and maintenance of the semi-arid rangelands of the south-west. Evaluation of new pasture species forms part of the programme. Grants from the Wool Research Trust Funds meet most maintenance costs, while the State Government is responsible for most staff salaries.

Tobacco experimental work is centred at the Southedge Tobacco Research Station, Mareeba, with a small field station at Beerwah. The emphasis in research is on plant breeding, crop protection and management. These centres are financed very largely by the Tobacco Industry Trust Account with some salaries again being met from State funds.

Genetic improvement of plants by breeding and selection for yield, product quality and resistance to pests and diseases continues to be a most effective avenue for productivity advance. Major progress was achieved during the year in the fruit and vegetable arena. Three new cold-tolerant stringless French bean cultivars for winter and spring production in south Queensland which are under release offer substantial yield advances over commercial cultivars, and the processing pea industry will soon benefit from cultivar improvement in that crop.

Superior varieties of summer cabbage and litchi have also been identified, while release of an interim tomato cultivar with resistance to a devastating new race of Fusarium wilt is imminent. Tissue culture has produced virus-free strawberry, sweet potato and garlic stocks for industry, and has provided a procedure for rapid cloning of outstanding pineapple lines.

The plant disease spectrum is continually changing with the emergence of new diseases and the occurrence of new disease races with increased virulence. This necessitates identification of pathogens, studies of their epidemiology and the development of control strategies, including the breeding of disease resistant plant varieties.

Ergot diseases on buffel grass and guinea grass, white root rot of apples and a needle netamode in rice were detected for the first time. New races of sunflower rust and Fusarium wilt of tomatoes and increasing severity of stem rot of soybean and yellow spot of wheat have necessitated urgent action by pathologists and plant breeders.

Release of new *Stylosanthes* cultivars which offer substantial increases in beef cattle productivity from low-cost overseeding of natural pastures has coincided with a resurgence of interest in property development within the grazing industry of central and northern Queensland. The increasing range of adapted plants for pasture improvement throughout the State is gradually leading to viable improved pasture technology.

Pasture legumes that can withstand high grazing pressures and poorly drained conditions along the coast and others which are adapted to the low fertility sandy and solodic soils of southern inland Queensland are also emerging from the Division's research programmes. A major effort is now directed at selecting new pasture legumes for the heavy, cracking clay soils of sub-humid and semi-arid Queensland.

Agriculture Branch

Agriculture Branch seeks to improve the productivity and stability of field crop, forage crop and pasture production in the State through its research and extension programmes.

Plant breeding programmes are seeking superior local adaptation and disease resistance in wheat, barley, sorghum, maize, sunflower, soybeans, peanuts, tobacco and cotton.

Plant selection programmes are also seeking varietal improvement in forage oats, linseed, safflower, rice, navy and mung beans, potatoes, sweet potatoes and onions. Exploratory studies are assessing the potential for new crops such as chickpea, lupins, cassava, guar and pigeon peas.

Soil fertility and weed problems are also diverse and Branch research and extension encompass tillage practice, plant nutrition, fertilizer technology, crop and pasture rotation systems and weed control. Irrigation developments require specialized servicing.

The pasture research programme seeks principles to guide the balanced use of the natural grazing lands with emphasis on the mulga, Mitchell grass, blue grass and bunch spear grass communities.

Improvement of animal production from natural grassland is pursued through legume selection and introduction to extensive grazing lands in the better watered eastern section 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 more basic studies undertaken by C.S.I.R.O. and the Universities.

The Branch maintains a widely deployed extension staff skilled in promoting the application of crop and pasture technology to commercial enterprises. This demanding activity has to blend productivity and farm profitability with conservation of natural resources. The extension service maintains effective liaison with all agricultural industries and, in this way, identifies problems to ensure a proper orientation for research activities.

Agronomy research

Wheat

In 1980, 60% of the Queensland wheat area was planted to three varieties, Oxley, Cook and Banks, which were released from the Departmental breeding programme. Cook is now the leading variety occupying 40% of the wheat area while Oxley, at 13% of the total, is declining because of its susceptibility to stem rust. Availability of seed limited the area planted with Banks to 7%.

Derivatives of Oxley and Cook with the *Agropyron elongatum* gene *Sr26* have been developed. One of the Cook-based lines is being advanced to the regional variety evaluation trials, but the Oxley-based lines have been shown to suffer from low water absorption of the flour. A further backcross to Oxley has been made in an attempt to raise the water absorption characteristic at least to the level of Oxley.

Rising nitrogen costs have increased the appeal of chickpeas as a winter grain legume crop.

Difficulty has been experienced in obtaining backcross derivations of Gatcher with adequate test weight where Kite has been used as a parent to inject resistance to stem rust, shorter straw and absence of awns. A third backcross has been made and selections taken for evaluation.

Backcross derivatives of Gala are being developed with a view to the release of a variety with good resistance to crown rot. Lines homozygous for resistance to stem rust and resistant to crown rot have been selected for further testing.

Thirty-three trials in the regional variety testing programme were successfully harvested in 1980. In the early maturing series, the highest yielding line was DKJH4 an experimental line from the DeKalb Shand Seed Co. Banks was the highest yielding commercial variety. Where the nematode, *Pratylenchus thornei* existed, Cook outyielded Banks. The nematicide Temik* was tested in this series and Banks treated with the nematicide outyielded untreated Banks in all regions except the Maranoa. The nematicide not only controlled the nematodes but also *Petrobia* mites, *Petrobia lateus*, which were observed on the trials.

In the mid season series Oxley, QT4144, QT7761 and QT7765 gave similar yields. In seasons when stem rust is a problem, it is probable that the susceptible variety Oxley will yield less than the three resistant test lines.

In baking tests, the loaf volumes of all varieties, and particularly QT4144, QT7761 and QT7765, were inexplicably low at three central Queensland sites. For this reason, a decision on release of one of these lines has been deferred to permit further testing.

Barley

Adverse climatic conditions in the 1980 season resulted in the abandonment of several trial sites in the barley variety testing programme. In this dry season, which produced low yields, the advanced selection BUS*ZEP 166 gave somewhat disappointing results. Nevertheless, this selection has now been tested in 37 trials over the last five seasons and has an average yield advantage of 17% above the commercial malting barley variety, Clipper.

Micro-malting tests have indicated that BUS*ZEP 166 has suitable malting quality and commercial scale maltings are being carried out in 1981 as a final test. In anticipation of the results of these tests, seed increases to commercial quantities are being undertaken in 1981.

The interstate trial series is continuing and Queensland selections have been among the highest yielding entries when grown in Queensland and the northern part of New South Wales. However, they have not been outstanding in trials at sites in the southern areas of Australia.

*Registered trade name.

In the barley physiology programme, work has concentrated on quantifying the photoperiodic and vernalization requirements of barley varieties. These data are now being applied to develop models from which to predict flowering dates for the varieties for any planting date.

Oats

One site of the new interstate oat testing programme was planted at Hermitage Research Station in 1980. The trial experienced a very dry season and produced an average yield of 1 527 kg ha^{-1} from the 25 lines entered.

In general, the earliest flowering varieties produced the highest yields because of the dry season. Rust was absent so susceptible lines such as Swan, West and many of the Western Australian entries were able to do very well.

Eleven trials were planted throughout Australia and the Hermitage results corresponded very well with those obtained in other States. This may not apply, however, in years when rust is a problem.

During the year, 377 oats lines were introduced from the U.S.A. These lines are being screened for yeilding ability and resistance to rust.

Sorghum

The sorghum breeding programme has continued to be productive and four lines with resistance to surgarcane mosaic virus were released in 1980. QL19 is a breeding line based on KS4 with field resistance to the disease derived from the line Q7539. QL20 to QL22 have resistance derived from the Krish gene. QL20 is very similar to the male parent of Texas 610 but with resistance to head smut as well as sugarcane mosaic virus. QL21 is a virus resistant version of KS4 which is the female parent of a number of commercial hybrids. QL22 is a breeding line with resistance to sorghum downy mildew as well as to the virus.

Sorghum downy mildew is a disease which does not occur in Australia. It does, however, occur in many other countries including the U.S.A. where a new strain of the disease has affected all but a few lines. One of the few resistant lines is QL3, an earlier release from the Department's programme. QL22, released in 1980, is closely related, but agronomically much superior, to QL3.

The sorghum midge resistance breeding programme has progressed to an advanced stage with the production of female lines bearing the resistance. For the production of sorghum hybrids, it is necessary for both parents to have the resistance. Seventy-six hybrids based on Departmental male and female lines are under test and early indications are that a few are promising.

In Queensland, the area planted to triticale has increased in recent years. This is a well-grown crop of Groquik, a dual purpose variety.

It is believed that, in the next 10 to 15 years, hybrids without a reasonable level of midge resistance will meet a restricted market. For this reason, work on the breeding populations QP28 and QP1R is being scaled down and four new breeding populations QP3R-MR, QP4B-MR, QP5R-MR and QP6R-MR are being developed.

The commercial acceptance of midge resistance will depend largely on crop management. Resistance does not imply immunity and resistant hybrids will have to be correctly managed to obtain the full benefit. This aspect is currently being examined.

Sorghum yields in central Queensland are generally much lower than in southern Queensland and a major physiology programme has been commenced to understand the constraints to sorghum production and their alleviation through genotypic selection and cultural practices.

The International Crops Research Institute for the Semi Arid Tropics, situated near Hyderabad in southern India, has a major role in improving sorghum production in areas with similar environments to that of central Queensland. As a prelude to the new programme, a Departmental agronomist spent 6 months at this Institute in 1980 studying the progress made there and participating in work on quantifying variation in leaf extension rates in response to temperature and water stress in sorghum hybrids.

Maize

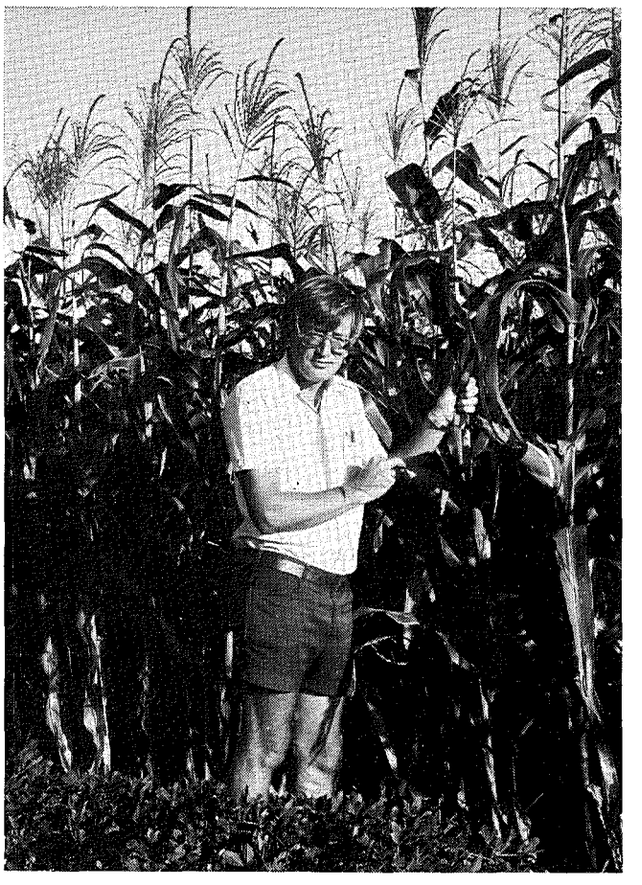
A new hybrid maize bred at Kairi Research Station has been released as QK657A. In 3 years of testing, the new hybrid, which shows improved resistance to head smut and lodging, has given 13% more yield than the best existing commercial hybrids, QK690 and QK694. Seed of the new hybrid will be available for commercial plantings in the 1981–82 season.

The regional variety testing programme continued though dry weather prevented trials being planted on the Darling Downs. In north Queensland, the Departmental QK hybrids were supreme, occupying the first six places in respect of yield. At Gatton Research Station where commercial hybrids only were tested, Sergeant, XL81 and MH699 gave the best yields. At Kingaroy, a number of experimental hybrids gave good yields though not significantly better than Sergeant.

In co-operative work with Plant Pathology Branch, genetic resistances to the viral diseases, sugarcane mosaic virus and wallaby ear, have been identified in elite mid maturity and sweet corn inbreds. Resistances to these diseases, which cause serious losses, were previously available only in inbreds with late maturity or with serious agronomic deficiencies.

Java downy mildew was discovered in the Northern Territory 2 years ago. There is a possibility that this disease could migrate to Queensland despite stringent precautions to prevent this occurring. Steps are being taken to determine sources of resistance to the disease and 30 hybrids have been sent to the Northern Territory for resistance evaluation.

In trials on the Atherton Tableland, it has been shown that 50 000 plants ha^{-1} are the best population at which to grow the recently released hybrids QK690 and QK694.



Maize and peanuts are major crops on the Atherton Tableland. Recent market movements have resulted in increased interest in maize.

Soybeans

Although no new varieties were released during the past year, four high-yielding soybean lines, identified in strain trials, were tested for the first time in the regional variety testing programme. Three of these lines were from the cross Davis x Bragg and the fourth from the cross Hinn x Semmes. All four lines performed very well and their average yields were the four highest in south-east Queensland. Consideration for release will follow a further year's testing.

In the recurrent selection programme, 4 000 F_2 seeds were planted in 1980 and about 800 selections were made for testing as S_2 lines. About 40 of the highest yielding will be intermated to produce the next generation of this population.

Seventeen trials were planted in the regional variety testing series and all were successfully harvested. Reflecting the very dry season, yields at all rain-grown sites were low. At several irrigated sites water was short and yields lower than normal. At Inglewood, St George and Emerald, water was abundant and high mean yields obtained. The season clearly demonstrated the ability of soybeans to yield well, even under very hot conditions, if water is applied at the right time.

Phytophthora disease became very widespread during the 1980–81 season being identified in the West Moreton, South Burnett and St George districts as well as on the Darling Downs. A relatively small number of growers suffered severe losses but the presence of the disease in many fields suggests potential danger in future years.

A disease nursery was established at Hermitage Research Station to test the field tolerance of soybean cultivars to *Phytophthora megasperma*. HS1115, a line being tested in the regional variety testing series, possesses a major gene resistance to the current strain of the disease. Two commercial varieties Davis and Hill have good field tolerance while others such as Bragg, Forrest and Dickie have lesser, but useful, levels of tolerance. Several selections from the cross Davis x Bragg have high levels of tolerance.

Varieties such as Wills, Flegler, Fitzroy and Semstar do not have sufficient tolerance to the disease and they will have to be replaced by tolerant or resistant varieties. The ideal situation would be varieties with an effective major gene in a highly field tolerant background but this objective may be difficult to achieve.

Sunflowers

Fifteen trials were conducted in the 1979–80 regional variety testing programme, eight in southern Queensland and seven in central Queensland. Sunking, Hysun 31, Cargill 205, Sungold, Hysun 21, Hysun 30, Sunbred 707 and Sunace constituted the superior group.

Five experiments have been carried out in the phytotron in Canberra and sufficient information has been gained of the photoperiod x temperature responses to allow of their practical application.

In conjunction with the phytotron studies, monthly field plantings of most of the commercial sunflower varieties have been carried out in Toowoomba over a 12-month period.

The recorded plant-growth data have been used to classify the varieties into maturity groups and plant development models are being constructed to allow the prediction of time to various growth stages, particularly flowering, from any known planting date.

Peanuts

In a programme to re-select higher yielding lines within the Virginia Bunch variety, the original 255 lines have been reduced by testing to 16. These 16 lines, with pod and kernel yield not significantly different from that of Virginia Bunch across locations, have higher percentages of the large VK1 grade kernels.

In a similar programme with the Red Spanish variety, the original 187 selected lines have been reduced to 12. These lines were selected for pod and kernel yield and quality bonus.

Seven Spanish lines from a backcrossing programme were compared with their parents Red and White Spanish and three other Spanish lines in trials in north and south Queensland. Three of the lines from the cross were 8 to 10% superior to Red Spanish for kernel yield in south Queensland. Further testing will be undertaken before considering release.

In a programme to investigate peanut plant populations and inter-row spacings on the Atherton Tableland, preliminary results from one trial show a trend for yields to increase with plant population up to 130 000 plants ha^{-1} and then decline. There is also a trend for 50 cm inter-row spacings to give higher yields than 75 or 100 cm inter-row spacings.

Tobacco

The tobacco industry in north Queensland has followed a system of monoculture reverting to natural grass leys between tobacco crops. The duration of these grass leys depends on land availability but most farms would have a tobacco land use pattern of 2 : 4 or 2 : 6.

Studies commenced in 1972–73 have evaluated cropping sequences recommended for tobacco land involving tobacco followed by at least 2 years of an undisturbed grass ley. This work has shown that sloping land required for tobacco should not be used for summer row crops because of severe soil erosion problems. Where tobacco followed 3 years of a grass-legume ley, the tobacco crop had good development and colour and no maturity problems.

The tobacco cultivar ZZ100 developed by Departmental staff in north Queensland and registered for north Queensland districts was readily accepted by growers and accounted for approximately 30% of plantings in the Mareeba-Dimbulah district in 1980–81. This cultivar performed well and leaf quality was better than that of other registered varieties.

Almost all of Queensland's tobacco crop is now solid-set irrigated, further reducing labour needs and growings costs.

ZZ100 cures well under difficult growing conditions and has the ability for leaf to 'hold' on the plant thus making harvesting time less critical. However, leaf brittleness caused some problems and the closer spacing of leaves on the plant made harvesting of the lower leaves a little more tedious than with other cultivars. The disease, potato virus-Y (PVY) can cause serious damage to ZZ100 but fortunately no significant PVY damage occurred during 1980–81.

Following the release of the chemical 'Ridomil' in 1978–79 the disease blue mould has ceased to be a threat to the tobacco industry. However, because blue mould resistance may develop to this chemical, breeding for resistance to blue mould has continued.

The low incidence of the APT2 strain of blue mould has hampered attempts to select for tolerance to this disease. Seedling APT2 screening results are to be compared with the results of mature plant field screening and, if results are comparable, seedling screening will be used in future. In addition to screening for resistance to blue mould, screening for bacterial wilt resistance with mild PVY reaction is continuing as an important part of the plant breeding programme.

Research at the Southedge Tobacco Research Station near Mareeba has also evaluated tobacco grown during the winter compared with more conventional later plantings of the crop. Winter-grown tobacco would have the advantage of requiring less water, and soil-borne diseases and insect pests would create fewer problems. Studies during the past few years have been directed towards an understanding of factors which affect early flowering and leaf number, and the effects of modifying cultural practices on the performance of winter crops.

It has been shown that smaller sized seedlings at transplanting and post-planting water stress are both beneficial to the overall productivity of winter tobacco. Preliminary studies on plant spacing also indicate a marked increase in productivity where plant populations per hectare are increased. Plant spacing studies are being continued towards formulating recommendations for growers in the management of winter grown crops.

Cotton

Small plot cultivar trials conducted in collaboration with the C.S.I.R.O. Cotton Research Unit, Narrabri, have identified Coker 310 as a promising cultivar for Queensland. Coker 310 gives similar yields to Deltapine 61 but has higher fibre strength. This variety is being tested in commercial size plots in the 1980–81 season.

In the 1978–79 season, the high gossypol line HGQ25 produced high yields and good levels of insect resistance. In the 1979–80 season, however, yields and insect resistance were only average. This variation may be due to insect migration between plots and this aspect will be investigated.

Time of planting x cultivar trials on the Darling Downs have shown that early October plantings frequently encounter cold, wet soil conditions and severe attacks from thrips. Early November plantings are optimum for high lint yields. These trials have also shown that earlier maturing cultivars are better adapted to the Darling Downs.

Rice

Testing of rice introductions from overseas is now progressing more rapidly as seed is increased to levels which permit larger scale testing. Lines received from the International Rice Research Institute (I.R.R.I.) in the Philippines and the New South Wales breeding programme (Yanco) are, in general, not promising due to excessive lodging.

I.R.R.I. lines produce only fair yields and whole-grain millouts tend to be low. One exception is the line 78A14 which shows a good yield potential and reasonable millouts. This line, however, was selectively grazed by ducks last season.

A line from Colombia, 76A25, has given good yields in the two trials in which it has been entered. It will be further tested and samples will be evaluated in milling and cooking tests by the rice mill.

Three varieties from the U.S.A. have also shown promise. Lebonnet and Bonnet 73 produce yields similar to that of Starbonnet but the yield of Labelle is rather lower. Labelle, however, is extremely early maturing and it could have a place in the rice industry as a means of spreading the harvest period.

Navy beans

Three variety trials were planted in 1980. The trials at Hermitage Research Station and Kingaroy experienced very dry conditions and produced low mean yields of 605 and 550 kg ha^{-1} respectively. The trial at Inglewood was irrigated but wet weather delayed harvest for a few weeks causing seed deterioration which reduced the mean yield to 1436 kg ha^{-1}.

The commercial varieties Actolac, Gallaroy and Actosan gave above average yields but Kerman was below average. Two test lines, M2 and 3GA, gave the best yields. M2 is fairly late in maturity and responds well to good moisture conditions. 3GA is derived from a single plant selection, with three genes for rust resistance, from the Actosan variety.

In the trial at Kingaroy, all lines were better than the variety Kerman in respect of hard seededness and water absorption.

Strain trials were conducted to test 36 small-seeded and 15 large-seeded lines. Fifteen small-seeded lines with resistance to rust or peanut mottle virus were advanced to the variety testing programme next season. Among the large-seeded lines, the highest yields were obtained from a red-seeded variety, Rufus, and a black-seeded line, Puebla 152. The best yielding white-seeded line, ML47, unfortunately had a high percentage of hard seeds.

The Burdekin is a major producer of navy bean seed.

Lupins are an alternative winter grain legume well adapted to lighter, acid soils.

Safflower

The study of the longevity of the disease *Alternaria carthami* on safflower stubble has been completed. The disease survived for periods up to 2½ years.

Tests on progeny from a diallel cross among eight varieties indicate that an increase in tolerance to *Alternaria carthami* above that demonstrated by the original parents can be achieved. Further evaluation is required.

Harvesting trials have shown that concave clearance has little effect on subsequent germination of safflower. Drum speed, however, had a considerable effect and germination was reduced by 10% when the drum speed was increased from 750 m per minute to 1 450 m per minute.

Lupins

A new interstate variety testing programme was commenced in 1980 and trials were planted at two sites in Queensland. The variety Illyarrie, recently released in Western Australia, gave the highest yield and appears to be a satisfactory replacement for Unicrop.

Alkaloid levels in lupin seed have been a source of concern for the last 3 years since pigs declined a ration based on lupin meal. Co-operative work with Agricultural Chemistry Branch and the Animal Research Institute has shown that normal alkaloid levels in *Lupinus albus* cultivars are much higher than in *Lupinus angustifolius* cultivars. It has also been established that, if lupin meal is restricted to 10 to 15% of the ration, no problems arise in feeding to livestock.

Chickpeas

The chickpea variety, Tyson, released by C.S.I.R.O. was found to consist of two distinct strains, one of which is very inefficient in assimilating iron. A selection programme was undertaken and a pure sample of the iron-efficient strain has been obtained. Seed is now being increased for release to replace the mixed variety presently available to commerce.

A new variety, Opal, has been released by New South Wales and is under test in Queensland. It is a large white-seeded variety which yielded poorly at Biloela but very well at Bongeen.

Phytophthora megasperma var. *sojae*, which was found at Hermitage and Cambooya in 1979, has been identified as the same strain that attacks lucerne. The chickpea collection is being screened for resistance to the disease and, though the commercial variety Tyson is quite susceptible, other lines are showing useful tolerance.

Guar

The condition with symptoms similar to phosphorus deficiency, reported last year has received further attention. A virus was isolated from affected plants and a trial to determine any virus-nutritional interaction failed to produce any conclusive evidence of a virus effect on dry matter yields of guar. Guar grown on unsterilized soil from the Emerald area responded significantly to applications of phosphorus and sulphur.

A number of trials has been commenced at Biloela and Emerald to determine the effects of waterlogging, soil sterilization and zinc application.

Selections with apparent resistance to the virus-nutrient disorder were made in 1980 and these are being evaluated at Emerald.

Pigeon peas

A pigeon pea testing programme was commenced to assess lines from the University of Queensland's breeding programme.

Earlier introductions of pigeon peas were tall, late maturing and, because of sensitivity to frost, unsuited to all but frost-free coastal areas.

Lines produced by the University programme are dwarf and early maturing. Yields of lines sensitive to photoperiod ranged up to 1 500 kg ha^{-1} at Hermitage Research Station, up to 1 800 kg ha^{-1} at Kingaroy and up to 2 600 kg ha^{-1} at Walkamin Research Station. Other early maturing lines insensitive to photoperiod are currently under test and show promise.

Cassava

In a study of planting methods, the use of growth hormones, the length of the planting set and the angle at which the set was planted had no effect on the yield or number of cassava roots produced.

The programme to study the regional adaptation of cassava has made significant progress. Under rain-grown conditions at South Johnstone, the maximum yield recorded to date is 97.6 t ha^{-1} wet tubers from a harvest taken 20 months after planting in April 1979.

At Southedge, near Mareeba, both rain-grown and irrigated trials are being conducted. To date, maximum yields of wet tubers have again been harvested at 20 months after planting in April–May 1979 and amounted to 53.4 and 109.7 t ha^{-1} from rain-grown and irrigated trials respectively.

At Coolum, on the Sunshine Coast, under rain-grown conditions, the best yield obtained to date has been 90.8 t ha^{-1} wet tubers from a harvest made 20 months after planting in August 1979.

Although the field work in the programme is not completed, it appears that the period from October to December is best for planting cassava in southern Queensland. This allows the plants to establish, then build up stem and leaves when crop growth rates are highest in the December to February period.

From September to January, photosynthate partitioning is more towards stem and leaf production than to storage in the tubers. During January, changes in partitioning occur and, thereafter, more of the photosynthate is stored in the tubers while less goes to producing stems and leaves. In the period April to June most of the photosynthate is stored in the tubers and little goes to stem and leaf production. The plant is semi-dormant to dormant in July–August.

There would appear to be advantage in harvesting after two seasons' growth during July–August as the tuber yield is double that of one season's growth and the tuber dry weight percentage is at a maximum.

Tea

In April 1972, a trial was laid down to compare plant densities and time to maturity in tea. The effects of plant density have been negligible over the first 9 years of the trial in which plant densities ranged from 13 600 to 81 600 plants ha^{-1}. Tea brought into plucking 18 months after planting has an advantage over tea brought into plucking 4½ years after planting which is a common period in the traditional tea-producing countries.

The early plucked tea produced more crop in the first 6 to 7 years of the plantation and, thereafter, production from the two practices has been more or less equal. Early plucking reduces the capital cost of the plantation and generates an improved cash flow and more profit.

Weed control

A study on the effect of weeds on rice yields has shown that yield reductions are negligible in summer crops but significant in winter crops.

The herbicides trifluralin and E.P.T.C. are unsuitable for use in rice as they significantly reduce yields. In most cases, correctly timed applications of propanil at a rate of 3.5 L ha^{-1} in conjunction with good water management will control weeds adequately. Naphthalene acetic acid used as a seed dressing protectant failed to give protection against the phytotoxicity of a number of herbicides.

Red rice, however, is a major weed problem in rice as the presence of red rice can result in penalties or even rejection at the rice mill.

Molinate at 16 kg a.i. ha^{-1} gave good control of red rice with only a small reduction in population of white rice. This herbicide, however, did not effectively control red rice under flooded conditions.

Alachlor, which severely affects the germination of white rice, performed extremely well in controlling red rice when used in a pre-sowing flood fallow. It did not adversely affect white rice planted after a flood fallow of 1 or 2 months. Alachlor, however, did not control red rice well under non-flooded fallow conditions.

Experimental and commercial experience has shown that damage to wheat can occur when herbicides registered for use on wheat are applied according to current label recommendations. Most of the research on wheat tolerance to these herbicides was carried out on varieties no longer grown and a research programme is in hand to test the tolerance of the current commercial varieties. After 2 years of testing, there is some concern with the use of 2,4-D either alone or in combination with dicamba or Tordon 50-D* at the early one-to-three-tiller stage of wheat. At the same stage of plant growth, MCPA either alone at 4 014 mL product ha^{-1}, or in combination with dicamba also causes concern. At the three-to-nine-tiller growth stage, the only treatment to reduce the yield of wheat significantly was 2,4-D amine at 2 200 mL product ha^{-1}.

In a study of the biology of the weed wandering Jew (*Commelina benghalensis*), it has been shown that the weed produces four types of seed, large and small aerial seeds and large and small underground seeds with normal germination of 20, 0, 90 and 34% respectively. Clipping the seed coat resulted in nearly 100% germination in all seed types. The optimum depths for emergence were in the range 0 to 50 mm. The optimum temperature for germination is 25°C for both types of aerial seeds but the large aerial seed can germinate over a wider range of temperatures than the small aerial seeds.

The efficacy of controlled droplet applicators applying spray volumes of 20 and 40 L ha^{-1} was compared with standard hydraulic nozzles applying a spray volume of 200 L ha^{-1}. It was shown that the recommended rate of post-emergence herbicides should not be reduced when using controlled droplet application. The efficacy of the herbicides, however, was maintained when the spray volume was reduced from 200 to 20 L ha^{-1}. There was no increase in crop phytotoxicity associated with lowering the volume of spray liquid.

The use of atrazine for weed control in maize and sorghum has restricted flexibility of land use in the West Moreton because of the phytotoxic effects of residues to some succeeding crops. Experimental work has shown that a mixture of Dual* at 2 L ha^{-1} and flowable atrazine at 2.5 L ha^{-1} gave good control of weeds in maize and reduced atrazine residue levels. The same mixture can be used in sorghum if the sorghum seed is treated with 'Seed Safener CGA 43089*' before planting. It was also shown that sorghum was tolerant to dicamba at 2.8 L ha^{-1} at the three to four and eight leaves plant growth stages.

Cultural techniques and soil surface management

In 1978, a project was commenced near Biloela to compare the effects of stubble retention and tillage on water entry and storage, soil nutrient status, crop establishment and crop productivity in grain sorghum. In the 1979–80 season, grain yield was 17% higher in the minimum tillage treatment (1 962 kg ha^{-1}) than in the conventional cultivation (1 650 kg ha^{-1}) and blade plough (1 684 kg ha^{-1}) treatments where stubble was retained. Significant yield reductions occurred when stubble was removed from conventional cultivation (1 402 kg ha^{-1}) and minimum tillage (1 547 kg ha^{-1}) treatments, whereas no reduction occurred in the blade plough treatment (1 682 kg ha^{-1}).

Good establishment was obtained in all treatments in contrast to the previous season when plant establishment under minimum tillage was poor. No significant differences in soil nitrate N were recorded over the fallow period. There were also no marked differences in soil moisture accumulation recorded during the fallow period nor were any soil moisture differences apparent at ear initiation or at anthesis.

At four sites on the Darling Downs, successive increments of wheat, barley and sorghum stubble increased the level of soil water in the 0 to 15 cm seedbed. Even the lowest levels of stubble applied as a mulch—1 000 kg ha^{-1} wheat, 750 kg ha^{-1} barley and 1 500 ka ha^{-1} sorghum—increased the level of soil water in the seedbed compared with the level in a bare fallow seedbed. The seedbed moisture levels under the higher levels of stubble resulted in improved emergence of wheat, barley, sorghum and maize sown after prolonged drying, thus demonstrating that stubble mulching can be used to extend sowing time. For example, during May–June 1980 on a Mywybilla clay, 5 000 kg ha^{-1} of oven-dry sorghum stubble extended wheat sowing time from 18 to 28 days. Low levels of stubble, however, rarely increased emergence over that from bare fallow.

Deep sowing with a narrow rigid tine and presswheel also extended sowing time. The use of water injection at 60 mL m^{-1} of row also extended sowing time but not to the same extent as stubble mulching and deep sowing.

All three practices, stubble mulching, deep sowing and water injection, improved emergence at low moisture levels but had no consistent effect at high soil moisture levels. Effects were also masked when rain fell after sowing, but reduction in emergence due to all three practices commonly occurred. The level of emergence was, however, satisfactory in all treatments.

The prolonged sowing periods which appear possible using these surface treatments and sowing techniques should permit larger areas to be sown on a single planting rain or alternatively the same area to be sown with a lower investment in sowing equipment and labour.

Research on the Darling Downs is also studying the effect of stubble retention on the growth of subsequent crops. Preliminary results have shown that retention of crop residues depressed plant growth and that the extent of the depression is related to the nitrogen levels in the soil.

Studies on the reliability of summer cropping on the Western Downs, initially on brigalow-belah soils to the north and west of Goondiwindi, were commenced. Weed problems under continuous winter cropping and the financial need to diversify have stimulated interest in grain sorghum cropping. Soil moisture is being monitored at several sites to assess its effect on sorghum establishment, growth and yield.

Winter cereal production on the fallow management plots of the long-term trial on Hermitage Research Station completed the eleventh year. The main barley yield differences were due to the nitrogen treatments. Wheat failed to show a significant response to any treatment.

In the final crop of the similar stubble mulching trial at Allora, the stubble-retained, zero-tilled treatment produced the highest grain yield reflecting superior levels of stored moisture in the profile.

A survey of peanut crops in the South Burnett was conducted as part of the programme to develop an understanding of the role of soil physical factors in determining peanut crop performance. Yields of the surveyed crops ranged from 700 to 3 600 kg ha^{-1} with rainfall being the main factor influencing yields. Variations of 20% in yield where rainfall amount and pattern were similar indicates that factors affecting soil moisture use efficiency require investigation.

Harvesting efficiency was also significant. The difference between machine and hand-harvest yields averaged 220 kg ha^{-1}—an average loss of 8% but this figure reached 20% on some farms.

Organic carbon level in the top 20 cm of soil was correlated both to the levels of acid and bicarbonate extractable phosphorus and to the replaceable potassium in the soil. Surprisingly, age of cultivation

*Registered trade name.

and organic carbon level were not correlated, suggesting that organic carbon may have stabilized in the range of 1.3% to 2.0% compared with a virgin soil range of 3.0 to 5.0% for ages of cultivation ranging from 15 to 80 years. Yields were not related to organic carbon.

At most sites, root distortion was observed. Of the nine sites not exhibiting this distortion, six had been subsoiled in 1979, whereas of 19 which did exhibit root distortion only two had been subsoiled in 1979 and six in the previous year 1978. This distortion could be associated with development of a compact layer in the soil profile and this was visually identified at 12 sites. These layers were 15 cm to 30 cm below the surface whereas the root distortions were observed at 5 cm to 15 cm below the surface.

Summer crop nutrition

In a study at Brigalow Research Station, poor grain yields in sunflower were related to low leaf tissue concentrations of phosphorus. This occurred despite broadcast application of 140 kg phosphorus ha^{-1} and band application of 20 kg ha^{-1}. Obviously, most of the applied phosphorus was not available to the plant and phosphorus fertilizers may require to be placed more deeply than standard practice.

In central Queensland, ammonium-free phosphorus fertilizer placed with sunflower seed depressed germination and hypocotyl elongation. The effect from superphosphate (9.2% P) was greater than from equivalent phosphorus rates applied as double superphosphate (19.2% P). The effect of the fertilizers was greatest in sandy soils and least in clay soil.

These fertilizers could reduce the availability of water to the germinating seed and their detrimental effects would be least in soil of high water availability or during periods of wet weather and greatest under rapidly drying conditions in lighter soils.

In the initial phase of a study of phosphorus and nitrogen nutrition of summer cereal crops in the South Burnett, a significant interaction between the two plant nutrients was found. This interaction has been more fully studied and the results indicate a major yield benefit from diammonium phosphate over comparable rates of phosphorus and nitrogen applied as superphosphate and urea.

The advantage of diammonium phosphate was also reflected in plant analytical data where the uptake of both phosphorus and nitrogen was greater than any other treatment. This was particularly so with phosphorus which reflects the effect of the ammonium ion on the enhancement of phosphate availability in the rhizosphere. This increased phosphorus availability, caused by slower precipitation of $H_2PO_4^-$, enables root proliferation to occur enabling increased moisture and nutrient uptake to proceed.

The soil phosphorus test calibration study has continued in the South Burnett. Equilibrium phosphorus concentration (E.P.C.) derived from phosphorus sorption curves is a good predictor of grain yield response ($r^2 = 0.83$) and the amount of phosphorus sorbed at an E.P.C. of 0.2 p.p.m. is highly correlated with phosphorus required for 90% maximum grain yield ($r^2 = 0.89$). Additional work showed that a 0.005N calcium chloride extraction is strongly correlated with E.P.C. on the same soils ($r^2 = 0.79$). This determination requires only one measurement whereas E.P.C. requires at least four.

The study of empty pods or 'pops' in Virginia Bunch peanuts in north Queensland was continued at five sites. Yield responses to applied calcium were obtained at two sites one of which suffered a severe infestation of *Sclerotium rolfsii* and the other very dry conditions. These two sites had the lowest levels of native soil calcium and the improvement in the kernel-shell ratio from applied calcium was highly significant.

A potato fertilizer study on the Atherton Tableland indicated that soil nitrogen levels and prospective crop growth is significant when making decisions on nitrogen application rates if yields are to be maximized. Where soil nitrogen was low and the crop grew well over a long season, yield responses occurred up to 200 kg ha^{-1} applied nitrogen. Where soil nitrogen was high and the crop had a short season due to early defoliation by leafspot, maximum yields were obtained with less than 120 kg ha^{-1} applied nitrogen. In this case, large yield reductions occurred with high rates of applied nitrogen. With high soil nitrogen and a long growing season, yield responses occurred up to 160 kg ha^{-1} applied nitrogen. Some reduction in yield resulted from higher rates under these conditions.

Winter crop nutrition

During the past decade, an extensive research programme has been conducted using ^{15}N-labelled fertilizer to trace the distribution of nitrogen fertilizer within the soil system and its loss following application to soil. Little applied nitrogen is likely to be lost during the May to November winter cropping period. When conditions do favour loss, deep placement may reduce the extent of loss and also protect the applied nitrogen from the influence of soil drying.

Nitrogen fertilizer applied during the summer fallow, however, is exposed to higher rainfall and higher temperatures which favour soil nitrogen losses. Retention of early applied nitrogen is important as grain growers are offered financial incentives to apply nitrogen for winter crops several months before planting winter cereals. In reduced tillage systems, the possibility of application of nitrogen during an early tillage operation is also attractive. It is also agronomically sound to have fertilizer move below the topsoil before planting in order to avoid reduced unavailability through drying out of the topsoil.

In an experiment on a Mywybilla black earth, urea, ammonium sulphate and calcium nitrate labelled with ^{15}N were applied at the rate of 100 kg ha^{-1} N to *in situ* soil cores confined in open ended 11 cm diameter plastic tubes to a depth of 60 cm. Irrigation simulated 'average' and 'wet' conditions.

Considerable loss of the labelled nitrogen occurred from the soil cores. In the urea form, 24% of the nitrogen was lost from the 'average' cores compared with 58% from the 'wet' cores in the 8-week period from mid February to mid April. In the ammonium sulphate form, the losses were 22% and 49% respectively for the 'average' and 'wet' conditions while for calcium nitrate they were 30% and 65% respectively.

In the relatively dry summer season which occurred, however, there was no detectable loss of field-applied anhydrous ammonia which was quantitatively recovered to a depth of 20 cm.

Pasture research

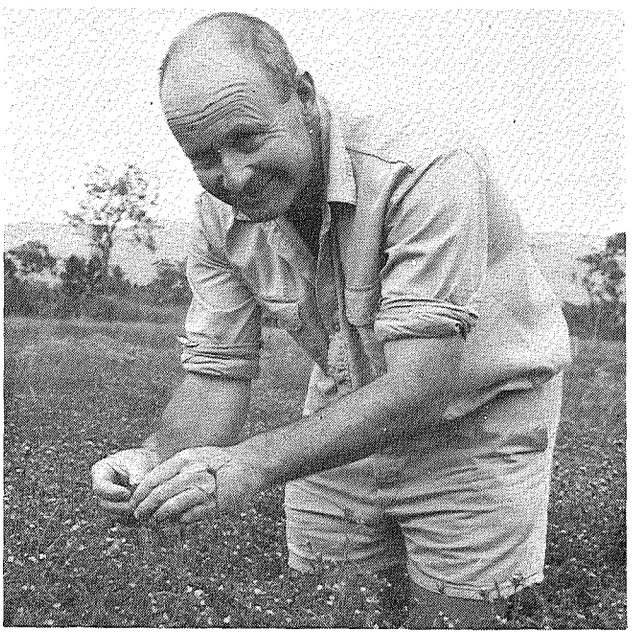
Seed production

With the work on seed production of Callide Rhodes grass (*Chloris gayana*) nearing completion and the studies of Narok setaria (*Setaria sphacelata* var. *sericea*) also finishing, efforts from Gympie have been directed to other potentially useful plants. Areas of Oxley fine stem stylo (*Stylosanthes guianensis* var. *intermedia*), Bargoo jointvetch (*Aeschynomene falcata*) and Hatch creeping bluegrass (*Bothriochloa insculpta*) are being established on commercial properties for pilot studies. The detail in which these crops will be monitored will depend on the ease with which adequate seed crops can be produced under the initial commercial management.

As well, two experiments with *Setaria porphyrantha*, released by Queensland Herbage Plant Liaison Committee during 1980, have examined the pattern of crop development and the response to fertilizer nitrogen. The crops were well synchronized and developed quickly with sharp peaks of yield (3 to 11 days) followed by rapid decline caused by shedding of ripe seed.

Surviving basal tillers had high fertility (50 to 60%). Aerial tillers developed from elevated nodes so that several seed flushes occurred depending on rainfall patterns. In the area used, the optimum fertilizer nitrogen rate was 50 to 100 kg N ha^{-1} $crop^{-1}$. Yield increases came from increases in inflorescence size and more particularly density. Consequently, for greatest effect, nitrogen should be applied as soon as possible after the clearing cut. Potential yields were 400 to 600 kg pure seed ha^{-1} $crop^{-1}$ with actual commercial yields of 150 to 300 kg ha^{-1} $crop^{-1}$ being attainable with up to three crops possible per year.

The major problem emerging for this species is post harvest dormancy with very low immediate germination being obtained.



Pasture seed production research in north Queensland is based at Walkamin Research Station. Dr J. M. Hopkinson is leading this research programme.

In north Queensland, the Walkamin group was able to produce almost 1 t of seed for experimental use. This covered 40 different lines of grasses and legumes. The largest amounts were 300 and 80 kg respectively of the recently released *Stylosanthes* cultivars Fitzroy and Graham, 30 kg each of 11 advanced lines of *S. scabra* and smaller amounts of 11 lines of *S. guianensis*.

Seed logging of Seca shrubby stylo (*S. scabra*) showed the standing seed reached a peak in early July in the commercial crop used, with about 400 kg ha^{-1} present. This peak did not fall appreciably until mid August. New production ceased about early August. Total accountable production reached some 620 kg ha^{-1}

Studies on the relationships between laboratory germination record, seed sample history and field performance of seed samples have continued with a large number of seed lots of Gatton panic (*Panicum maximum*) and Basilisk signal grass (*Brachiaria decumbens*) being used. Seed of very good or very bad laboratory record generally emerged predictably well or badly in the field, but intermediate laboratory assessed lots often behaved unpredictably in the field. Seed of Gatton panic, for example, in the 30 to 40% germination range, gave 4 to 36% field emergence. Reasons for this have not yet been found.

High rainfall tropical pasture

While the suite of plants available for pasture development is good, especially on the wet tropical coast, the search for other lines which will fill specific niches continues. On the Mackay coast, the need is greatest for more persistent legumes. Cool season productive species and species for low lying wet areas are required in all wet tropical areas. At Mackay, some 50 new legumes have been grown in nurseries over recent years with *Aeschynomene americana* accessions continuing to regenerate and spread under heavy grazing. *Alysicarpus rugosus, Desmodium heterophyllum* and *Centrosema pubescens* accessions CPI 55703, 55704 and 55711 are also persisting well for up to 3 years under heavy grazing.

Two *Centrosema pubescens* accessions (CPI 76000 and 75997) and a *Desmodium scorpiurus* (CPI 81344) have also shown some promise at South Johnstone, while at Utchee Creek several lines of *Calopogonium caeruleum* have given consistently high yields and persistence under intermittent grazing. Belalto centro has also performed well. One line of *C. caeruleum* (CPI 28107) however, has proved extremely unpalatable under long term grazing, with animal performance declining as its dominance of the sward increased.

The new *Macroptilium atropurpureum* lines bred by Dr. E. M. Hutton have shown no outstanding material superior to cv. Siratro. At both South Johnstone and Mackay, lines 2 and 3 were among the highest yielding types but these were not significantly better than Siratro; at South Johnstone, Belalto centro, mainly due to winter performance, outyielded all *Macroptilium* lines.

A number of legumes has been planted in large unreplicated plots under heavy grazing on the Mackay coast. Those showing some promise of production and persistence include *Vigna parkeri* (CQ 1374), *Cassia rotundifolia* (CPI 34721), *Alysicarpus rugosus* (CPI 52357), Bargoo jointvetch and *Aeschynomene americana* (CPI 56282), while at South Johnstone three hybrid centro lines (*C. brasilianum* x *C. virginianum*) have shown no superiority to Belalto centro. Also at South Johnstone, *Setaria sphacelata* var. *splendida* has outyielded common guinea grass and a *splendida* x *sericea* hybrid but has been less compatible with legumes.

On the red volcanic soils at East Palmerston, Belalto centro has proved relatively easy to indroduce into *Brachiaria decumbens* swards with direct sod seeding after slashing and burning. It has given cheap and effective stands that were only marginally lower in Belalto content than those resulting following pre-cultivation with discs and a rotary hoe. In the Mackay district, monitoring of Siratro soil seed reserves has shown much lower levels in commercially grazed paddocks (0 to 30 seeds m^{-2}) compared with the continuously grazed paddocks at the Tedlands grazing trial. Here, after 9 years at 2.5 steers ha^{-1}, there were still 120 seeds m^{-2}. Once depleted, build-up of seed reserves is slow even under lenient stocking.

In the Tedlands trial, now in its ninth year, selected plots are still being grazed. Siratro has continued to increase at the lighter stocking rate, while under the heavy fertilizer regime the area has experienced, the native legumes, particularly *Aeschynomene indica* and *Alysicarpus vaginalis*, have increased in density at 2.5 and 2.0 steers ha^{-1}. These have enabled liveweight performance to be maintained until frosts occur, after which liveweight gain falls away rapidly.

In the two production system grazing studies at Utchee Creek and King Ranch's Tully River Station, the best treatments have maintained stocking rates of 3.7 beast ha^{-1} while, at Utchee Creek, the 40 ha production unit of one-quarter N-fertilized signal grass and three-quarters Belalto centro-common guinea grass has maintained from 100 to 150 head since September 1978. In the Utchee Creek trial on basaltic rainforest soils, only the old centro-common guinea grass system without any N-fertilized grass is showing signs of collapse with high weed invasion and a reduced stocking capacity (2.47 beast ha^{-1}). This lower rate may still be too high.

The use of a linear programming model to examine manipulation of pasture type and land class, on two soil types and three types of cattle, shows that optimum management strategy is very sensitive to changes in beef prices, proportion of different land classes and stocking rate. It is hoped in time to be able to devise from this model the most resilient development, use and management strategies for differing classes of country on the wet tropical coast.

Seca and Verano stylos sown in uncleared grassland at Georgetown without cultivation.

Dry tropics pasture

While the effort in the north Queensland dry tropics is shifting to an examination of the effects of recently released cultivars on pasture development and animal performance, the search for better plants is continuing, especially for adapted grasses. In this work, some 50 grasses, 52 legumes and 28 browse shrubs were sown at eight sites across the northern dry tropics in 1980. *Brachiaria, Hyparrhenia* and *Urochloa* spp. in the grasses, *Stylosanthes* and at one site *Rhynchosia* spp. in the legumes, and *Cajanus cajan, Tephrosia elegans* and *Acacia angustissima* in the browse shrubs, provided the most promising lines in the first season.

Also, on the heavier soils in the Burdekin area, 57 legumes have been planted at a range of sites in an attempt to find some that will perform on this presently under-utilized soil type. Initially, accessions of *Atylosia* sp., *Desmodium dichotomum, Indigofera schimperi, Rhynchosia senaariensis, Stylosanthes sympodialis* and *Vigna trilobata*, plus a few commercial lines including cv. Verano and cv. Archer, have shown some persistence and production.

On other soils in this area, a range of *Stylosanthes* planted several years ago has shown Seca and Fitzroy shrubby stylos as the outstanding accessions. Initial discing markedly improved establishment as did superphosphate application. Spread from the plots has been minimal.

Sulphur has proved to be a major nutrient limiting *Stylosanthes* performance in the dry tropics. On a red earth at Kalinga, 20 kg ha^{-1} S gave maximum responses in the second year after application, but by the third year 40 kg ha^{-1} S were required. Gypsum and fine elemental sulphur were equivalent but coarser-grained elemental sulphur was less effective. At Morecombe Station, Mt. Garnet, on a red and yellow earth/duplex intergrade, P and S were the most important elements although omission of Zn reduced its concentration in the forage.

Again at Morecombe, Duchess rock phosphate, while giving a linear response of legume to increasing rates, was inferior to 'Super King' at equivalent rates of P over 2 years.

On the red basaltic soil at Meadowbank, south of Mt. Garnet, the supplementation of native pasture with sown pastures of *Stylosanthes* spp. and with common salt and sulphur resulted in a gain of 12 kg more for heifers between June and September compared with native pasture alone, and 52 kg more than native pasture plus mineral supplement. For most of this period the animals grazing native pasture without supplement had access to short green grass at very low grazing pressures, while the other groups had mainly tall rank native pasture material to graze after May. The sown pasture is now highly sulphur deficient.

Work has proceeded in the development of early maturing, non shattering lines of *Macrotyloma uniflorum* for evaluation as dry season forage in the dry tropics with single seed descent of some 2 000 F_2 lines being grown this year. These have derived from crosses between crop types that are soft seeded, and non-shattering wild types. Seed is also being bulked-up of a number of lines of different levels of hardseededness to enable seed digestibility studies to be carried out by University of Queensland.

On the red basaltic soil at Meadowbank, *Macrotyloma axillare* cv. Archer has continued to provide excellent dry season gains. It would appear that it is not well grazed during the growing season and animals did not perform as well on it as on native pasture early in the dry season. Later in the dry season animal growth responded well to Archer grazing.

Of the browse shrubs under test, *Acacia angustissima* (CPI 40175) continues to show promise at Walkamin.

Heifers grazing native pasture and Graham stylo at 'Meadowbank', Mt. Garnet. The stylo was sown 5 years previously with a spinner broadcaster after a burn.

Pasture studies—central Queensland

Within Area III of the Brigalow Development Scheme, the survey of the state of disturbance of the original vegetation shows that some 33% of the developed area carries severe woody regrowth problems, mainly brigalow (*Acacia harpophylla*), yellowwood (*Terminalia oblongata*) and currant bush (*Carissa ovata*). Only 54% of the developed area carries improved grass species and 46% carried native species of a range of genera.

A range of chemicals is being screened for woody regrowth control in nine trials on eight species of timber. Trichlorpyr is proving initially as effective as 2,4,5-T on all species and can be used in the same way but is three times as expensive to use as 2,4,5-T. Hexazinone is also effective against most species but is expensive and special application techniques will be required before it can be used on a commercial scale.

The Symonds blade plough is also under investigation as a machine to control brigalow and other species. Control increased with depth of ploughing. At 20 cm, 84% kill of brigalow was achieved and 82% of all woody species. In non-gilgaied soils, a single ploughing to 20 cm late summer at this stage is giving acceptable control of most species. This implement does not invert the sod but removes small stumps from the soil.

Despite the second successive dry summer, the stylos continue to be outstanding in the regional legume evaluations on contrasting clay, duplex and red earths at three centres. While there was a P fertilizer response, the *Stylosanthes scabra* lines still made a substantial contribution to the total dry matter in the absence of applied P. On the solodic duplex soils, a dramatic increase in *S. scabra* populations has occured. Only on the clay soils under the low rainfall conditions did the stylos perform poorly. Of the other legumes *Atylosia scarabaeoides* has been the most consistent performer over all sites.

On the red earths and duplexes Siratro and *Macrotyloma axillare* have also been among the best of the other legumes but much inferior to the stylos.

Within the *Macroptilium atropurpureum* strain evaluation, all lines have been infected by the rust *Uromyces appendiculatus* and, while most remain superior in stand and yield to cv. Siratro at the site north of Rockhampton, no line can be regarded as outstanding.

A substantial collection of *Alysicarpus* accessions was grown at Biloela for classification purposes during the year. The opportunity was also taken to assess their potential performance in the area. *A. vaginalis, A. rugosus, A. longifolius, A. monilifer* and *A. nummularifolius* all provided interesting ascendent to semi-erect, vigorous free-seeding lines.

Pasture studies—'Brian Pastures' and Isis

While the availability of leucaena (*Leucaena leucocephala*) as a supplement to breeder cows at 'Brian Pastures' is showing some liveweight benefit relative to native pasture supplemented with urea-molasses or fine stem stylo (*Stylosanthes guianensis* var. *intermedia*), there have been no treatment differences over the last 3 years in the mean calving percentages (74%) in each case. On the other hand, leucaena supplementation of growing animals grazing native pasture, both weaners and yearlings, is preventing the normal winter-spring liveweight loss experienced on straight native pasture. Over the dry 1980 winter, both classes of animals recorded gains of 17 kg $head^{-1}$ with the leucaena supplementation.

On the 110 ha intensive system, which runs some 60 head of weaner steers on a sequential grazing of green panic (*Panicum maximum* var. *trichoglume*), native pastures and crop residues, a dry winter and spring in 1979 left the animals somewhat short of target weights at the conclusion of finishing in a feed lot in August 1980. The final mean liveweight was only 418 kg $head^{-1}$ compared with 430 kg $head^{-1}$ in the previous 3 years. The decreasing performance as the green panic pastures age was again recorded and can be related to falling dietary nitrogen. In a small plot study on these ageing pastures, first year green panic yields were greater than those of fifth year pastures with 250 kg ha^{-1} N applied. There was also an increasing response to sulphur as the pasture aged.

The effect of pasture type, green panic or native pasture, on diet and animal performance is being assessed on intact and fistulated animals. Average daily gain was higher with cotton-seed meal supplement to either pasture in autumn and winter and higher on green panic than on native pasture. The animals were able to select a diet higher in nitrogen and sulphur than pasture leaf or stem, and daily gain of the intact unsupplemented animals was correlated ($r^2 = 0.94$) with dietary nitrogen on a dry matter basis.

Using data from the long-term grazing trials at 'Brian Pastures' it has been possible to develop a simple weather-derived predictor (growth index per head) which accounts for the effects of soil water supply, temperature, solar radiation and stocking rate on animal production. This has been used to predict seasonal liveweight change in cattle on three pastures, native, sown green panic and grass-legume at 'Brian Pastures'. The model so derived accounted for 80% of the variation in seasonal liveweight change on green panic and grass-legume pasture but was less accurate on native pasture.

Lucerne studies

The assessment of aphid resistance in lucerne cultivars has continued at Biloela, Toowoomba and Gatton, with a range of useful cultivars being isolated. Of these, Pioneer 581, DeKalb 185 and Matador have shown superior persistence under irrigation. CUF 101 has continued to perform well under irrigation. Under rain-grown conditions, severe drought has removed most lines within about 2 years.

The effects of cutting frequency on these aphid resistant lucernes under irrigation is also being investigated over a range of dormancy classes. The stands have been evenly established and will be cut at 3-, 4-, 5-, 6-, 7- and 8-week intervals and at a physiologically optimum stage. As well, an attempt is being made to define more fully the adaptation of lucernes to high soil temperature and high moisture conditions.

Waterlogging damage at high temperature occurs most readily not only immediately after cutting but again shortly before the next cutting is due, and appears to be associated with high levels of non structural carbohydrates in the roots at the time. Attempts to test all cultivars used at an even root carbohydrate level suggest that there are no differences in cultivar susceptibility to damage when even carbohydrate levels are achieved.

Annual medic studies

Despite a run of dry winters, the annual medic cultivars being grown at Warwick, Gayndah and Roma in a co-ordinated series continue to persist and produce. Robinson snail medic (*M. scutellata*) and Jemalong barrel (*M. truncatula*) remain the outstanding lines. When irrigated, cumulative medic dry matter yield for the 1980 season was around 7 000 kg ha^{-1} at both Warwick and Gayndah. Under rain-grown conditions comparable yields ranged from 4 500 kg ha^{-1} on the best soil at Warwick to around 1 000 kg ha^{-1} at Gayndah and Roma. Snail medic was the highest yielder on the basaltic and brigalow soils and Jemalong on the poorer sandstone and poplar box (*Eucalyptus populnea*) soils. The medics increased the yield of associated grass to at least the same extent as the 100 kg ha^{-1} rate of applied nitrogen.

In West Moreton region a range of winter annual legumes, mainly *Medicago* spp., is also being assessed under both irrigated and rain-grown conditions to take advantage of unseasonal winter rains. Although establishment was reasonable, prolonged dry weather again resulted in little growth. Despite some damage from blue-green lucerne aphids, Sanza barrel medic, snail medic and gamma medic (*M. rugosa*) have given the highest yields.

Temperate species studies

As well as lucerne and the annual medics, there is considerable scope and need for a range of winter-growing forages in southern Queensland. There is sufficient rainfall in some winters to warrant attention in this area and this work also has application to irrigated situations. The various cultivars of white clover (*Trifolium repens*) and ryegrasses (*Lolium* spp.) are the main ones utilized. Midmar, a South African-bred ryegrass of the 'Italian' type, has been under study for some years at Gatton and Dayboro, where it has been equal, if not superior, to the best of standard commercial lines. It has superior rust resistance but still shows some rust effects late in spring.

In 1980, plantings of ryegrasses at Gatton before late March showed reduced establishment. A late February planting at 30 kg ha^{-1} gave only two-thirds of the 223 plants m^{-2} recorded from a late March planting while a mid March planting virtually failed (11 plants m^{-2}) following an early March heat wave. Wimmera ryegrass (*L. rigidum*) performed best from the earlier plantings.

Sub tropical species evaluation

In southern Queensland, in trials to assess the bred lines of *Macroptilium atropurpureum* are in progress at two sites in the Gympie district and at two sites in West Moreton. At Gympie, Malawi glycine (*Neonotonia wightii*) was also planted but has died out, while cv. Siratro is equivalent or superior to all other *Macroptilium* lines. In West Moreton, however, despite very low yields, several lines outyielded cv. Siratro, which in turn outyielded Seca shrubby stylo (*Stylosanthes scabra*) and several other *Stylosanthes* accessions.

For the establishment of Siratro into native grass swards, rotary hoeing gave superior establishment (4.6 plants m^{-2}) compared with 1.9 for sod seeding, 1.4 from ripping and 0.8 for no treatment or simply burning the pasture before planting. Over the 3 years the trial has been in progress, spring plantings have given the most consistent results.

In the search for better legumes for the brigalow lands and Darling Downs, some 250 legume accessions representing 35 genera and 90 species have now been planted at Wandoan and Millmerran on a brigalow and a deep sandy soil at each centre. Below-average rainfall in both years has subjected the collection to very rigorous testing. The genera with the greatest numbers of surviving accessions are *Rhynchosia, Macroptilium, Vigna, Clitoria, Lablab* and *Neonotonia.* Accessions of *Acacia, Alysicarpus, Desmanthus, Galactia, Macrotyloma* and *Teramnus* have also survived.

Semi-arid species evaluation

While most work at the Charleville Pastoral Laboratory is related to the management of the native pastures of the mulga (*Acacia aneura*) and Mitchell grass (*Astrebla* spp.) zones, some effort is also devoted to isolation of introduced plants which may have a role for revegetation and reclamation of degenerate areas.

In the nursery at Charleville two legumes, *Otoptera burchellii* and *Lysiloma watsonii,* show good frost tolerance but are shy seeders, while the local native *Cassia sturtii*, following selection in Israel and reintroduction, is showing higher palatability than local unselected material.

In 1976, a grazing study with a number of introduced grasses was planted. The native mulga Mitchell grass (*Thyridolepis mitchelliana*) and several buffel grasses (*Cenchrus ciliaris*) including cv. Biloela are outstanding. Efforts to improve the establishment reliability in the low phosphate red earths of the mulga zone by pelleting buffel grass seed with phosphorus are showing considerable promise. The soluble orthophosphates at 1 to 2 mg P $fascicle^{-1}$ are most effective.

Management studies in semi-arid pastures

The current run of dry years has eliminated Queensland bluegrass (*Dichanthium sericeum*) from the various long-term monitoring sites on Mitchell grass country in south-western Queensland. These summer drought years have also removed feathertop (*Aristida latifolia*) from the more southerly sites but not from the more northerly sites, where better summer rains have been recorded.

A recent recording of the long term vegetation transect at Tobermory in the Grey Range suggests that some old mulga trees are dying without much seedling mulga recruitment over the recent dry years. On the other hand turpentine (*Eremophila sturtii*) seedlings have increased. This supports local contention that this inedible hardy plant is becoming a problem on sandplain country in the area.

A series of grazing management trials, two on Mitchell grass country (Burenda and Biddenham) and one on mulga country (Arabella), are in progress. The dry seasons have resulted in reduced stocking rates and at Arabella it was not possible to restock the 80% utilization treatment. At Burenda, under the dry conditions, 30% potential utilization of feed on offer appears to be the optimum stocking rate. This is set in April each year and seems likely to give the highest wool yield without adversely affecting the stock or pasture condition. At Arabella only the 20% utilization sheep did not lose weight last year.

At Biddenham, the dry season defeated attempts to modify the pasture and encourage more herbage growth. This year herbage growth and hence sheep performance were highest in the untreated control paddock. Despite the dry season lambing percentages and lamb weights at marking on the control plots were 90% and 13.3 kg $head^{-1}$ compared with only 40% and 7.4 kg $head^{-1}$ in 1979.

Agricultural extension

Farmers, primary producer organizations and government instrumentalities at local, State and Federal level require technical information and managerial advice on field crop and pasture production, soil, machinery and farm management. Agribusiness firms and their representatives, hobby, week-end and part-time farmers and backyard gardeners are also making increasing demands for assistance. The extension service exists to meet those needs.

The extension officer's role is to link industry with developing technology and to temper this with consideration and concern for the stability or improvement of soil, water and plant resources. Extension officers undertake specific projects emphasizing new problems or techniques, they engage in dissemination of information, and they require frequent technical training to keep abreast of technical developments.

An increasing proportion of their activities requires integration with officers of other disciplines. This is reflected in joint extension projects with officers of Soil Conservation, Beef Cattle Husbandry, Entomology and Plant Pathology Branches.

The trend of recent years towards more farmer group activities has continued. Farm visits have had to be curtailed but group activities are more relevant to discuss issues such as farm management, crop sequences, pest management. Discussion groups, workshops, farm walks, producer schools are more effective to address production restraints as farming becomes more sophisticated.

Pasture development has accelerated in all districts but has been hampered by scarce and expensive seed supplies. Buffel grass seed is scarce as the result of ergot infestations and a seed caterpillar. These pests are relatively new to Queensland and have had a significant effect on seed yields.

While the scarcity of seed of recently released pasture species such as Fitzroy stylo is understandable, the scarcity of seed of well-established pasture species such as Siratro is perturbing. Pasture seed producers have not regained confidence in the industry since the demand for pasture seed virtually ceased during the beef slump of the 1970s.

Extension officers are encouraging both previous and new growers to enter the pasture seed industry but their efforts have met with mixed success.

The demand for pasture development advice is associated with increasing demand for advice on timber and timber regrowth control. Extension activities have provided graziers with up-to-date technology on these issues.

Recommendations on the appropriate crop varieties to plant in each district have been continued. This service covers wheat, oats, barley, grain sorghum, maize and soybeans and assists grain growers to choose top performing varieties or hybrids.

The extension programme to control insect pests of stored grain was again directed at on-farm sites of infestation. This on-going programme will continue as farm hygiene to control these insect pests is essential if the State's grain industry is to meet market requirements.

An increasing range of field crops is being grown in most districts of the State as farmers diversify and as crops become more adapted to Queensland conditions. Lupins are now an established crop at Maryborough; guar has been grown at Inglewood, Biloela and Emerald; soybeans at Gympie; winter peanuts have been grown near Tully; and tea is being grown at Topaz on the Atherton Tableland. This diversification has placed considerable demands on extension staff who have required considerable inservice training.

Grain farmers, in particular, have demanded advice on farm machinery management, modification and selection. This demand has arisen because farm machinery costs have risen markedly and threaten the profitability of many farm enterprises. A farm machinery extension officer has been appointed to Dalby to train extension officers in aspects of farm machinery management to boost their ability to service these demands.

Other inservice training activities included a workshop to review pasture development in the brigalow lands, a grain legume insect control workshop at Kingaroy and a stored grains workshop at Toowoomba.

Most extension programmes are planned and implemented on a district or regional basis.

North Queensland

The legumes Seca and Verano stylo are the basis of the extension effort in the dry tropics beef production areas of north Queensland. Animal performance on native pastures oversown with these legumes is being monitored at Mareeba, Georgetown and Laura.

The demonstration sites are attracting considerable attention among graziers and have been used for a number of extension activities.

The adaptation of these legumes continues to impress. There has been good seedling regeneration at the Mareeba site after a severe fire in October 1980. This has impressed district graziers as periodic fires are normal in this environment.

Legume spread, particularly by the grazing animal, is continuing but the rate of spread and its impact on establishment strategies still has to be further defined.

On the wet tropical coast, the Utchee Creek, East Palmerston and Tully grazing systems demonstrations were continued. These sites are demonstrating the complex grazing systems developed for this environment at the South Johnstone Research Station. These demonstrations are accelerating the adoption on commercial properties of this technology. Fertilizer use by graziers has increased significantly and weed control in sown pastures has been more rigorous.

Farther south at Ayr and Bowen, the utilization and management of *Bothriochloa pertusa* are being studied. This valuable grass species has become naturalized in large areas of the Bowen Shire.

Fitzroy, Seca and Verano stylos show considerable promise and the location of an extension officer at Bowen will accelerate definition of their role in beef production systems. These species also exhibit adaptation to the higher rainfall areas around Proserpine and their performance is being assessed in native pasture areas where tea tree (*Melaleuca* spp.) regrowth is a major production restraint.

In the dairying areas of the Atherton Tableland, co-operative work with officers of Dairy Field Services Branch is boosting dairy production. This extension project is directed at developing appropriate feed year systems. The major thrust in the past year has been in nitrogen fertilizer application on permanent pasture, the use of temperate species in winter, maize silage and the regeneration of degraded sown pasture areas.

This programme is having a significant impact. Despite declining numbers of dairy farmers, milk intake at the Malanda factory is rising. Fertilizer sales and the area sown to temperate species have increased markedly.

Extension activities directed at the $25m tobacco industry at Mareeba-Dimbulah emphasized crop hygiene to reduce disease and pest incidence. Significant improvement in crop hygiene in seedbeds and in on-farm storages was achieved but the impact on stalk destruction was disappointing. Only 30% of tobacco farmers effectively destroyed crop residues. This aspect will receive added attention in 1981.

The rice industry in the Burdekin and at Mareeba is now well established and yields of the order of 5 t ha^{-1} are consistently produced. Weed control and herbicide application are issues which have required considerable extension effort. Weeds and lower yields interfere with crop management and development of suitable rotations for rice farms is of high priority.

The peanut industry in north Queensland is consolidating previous expansion. Extension activities emphasized the need to match crop size with soil, machinery and labour resources. These activities stressed the profitability of high yielding, appropriately managed crops compared to lower yielding crops on larger areas.

The construction of well-designed on-farm storage and drying facilities to minimize disease and insect infestations also received attention with pleasing results.

The increased profitability of maize encouraged growers to increase the area sown to this crop. Weed control and herbicide usage occupied much of the extension inputs into this field. Fertilizer usage is also increasing as maize growers strive to attain higher yields.

Extension officers in the Burdekin have been heavily involved in the establishment of a soybean industry. This crop appeals as a rotation crop with rice and a stockfeed market exists in north Queensland. Extension activities have emphasized varietal selection, planting time and rates, herbicide usage and irrigation strategies.

Capricornia

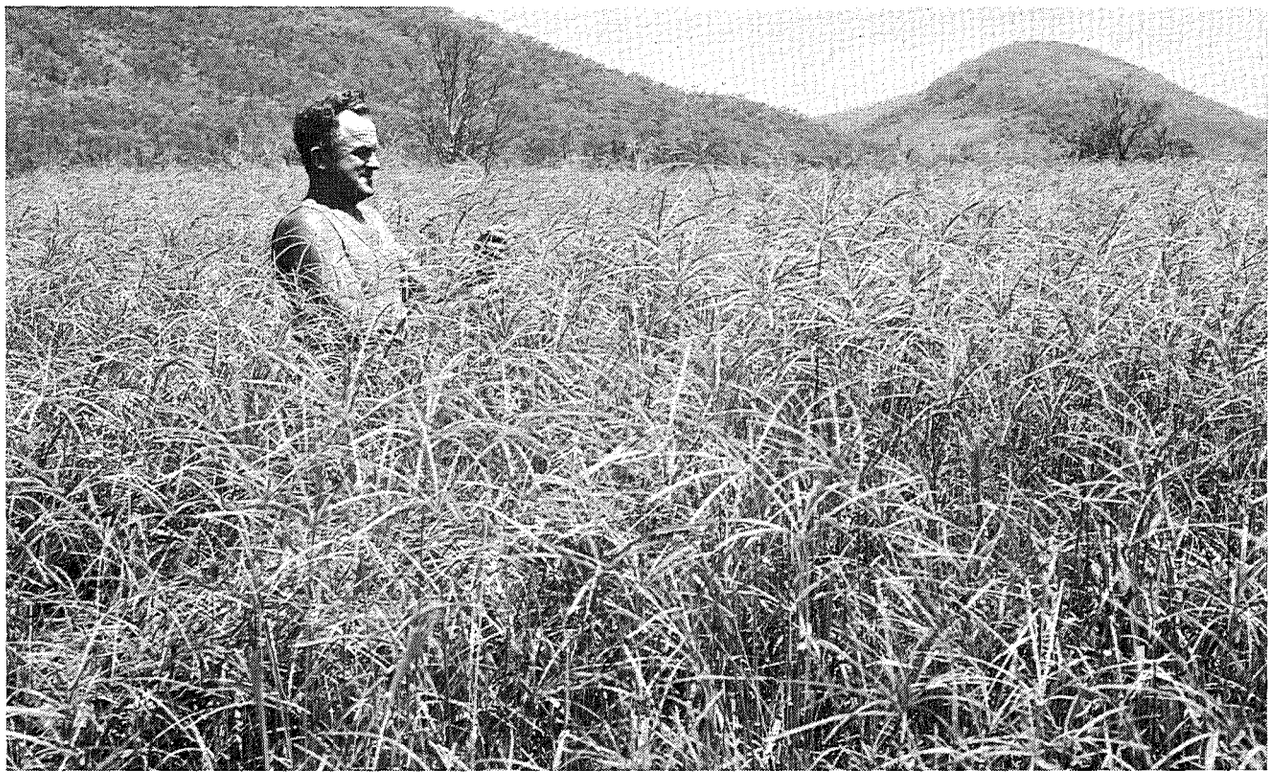
The area under crop continues to expand with the main expansion being in the Moura, Rolleston, Dingo, Barmount, Clermont, Nebo and Dysart districts.

A record 240 000 ha of grain sorghum was planted in 1980–81 and is expected to yield more than 400 000 t of grain. There was a drop in the area planted to sunflowers from 110 000 ha in 1979–80 to 95 000 ha in 1980–81. This decrease resulted mainly from market pressures but extension activities directed at stabilizing soils and minimizing soil erosion also contributed. Sunflowers provide little protection to the soil surface.

In a co-operative project with Soil Conservation Branch officers, extension activities to promote conservation cropping have been intensified in this soil erosion prone region. The use of crops which provide more surface cover is being studied, appropriate farm machinery modifications developed and the effect of reduced tillage and alternative methods of weed control monitored.

Summer crops have traditionally been difficult to establish in Capricornia region and plant populations of commercial crops have been unsatisfactory. This problem has been addressed in both the Central Highlands and the Dawson Callide and significant advances made. A successful seminar was held at Moura in September 1980 and a pamphlet for wider distribution released.

Creeping blue grass, an ideal grass for waterways, is also a promising grass species for the heavy clay soils in southern and central Queensland.



Well-managed, high-yielding seed crops have assured the future of Callide Rhodes grass.

Weed control has become a major production restraint in the Dawson-Callide and the Emerald irrigation area. It is emerging in the other grain growing districts of the region. Particular attention has been given to weed control in grain sorghum and sunflowers. Herbicide usage has increased as a result of grower meetings, field days and demonstrations.

The 1980–81 cotton crop in the region consisted of 10 700 ha of irrigated cotton and 720 ha of dryland cotton. The crop will produce an estimated 43 000 bales of cotton. Pest control and irrigation strategies were the crop husbandry issues which received emphasis from extension officers. The use of independent cotton scouts by growers has increased and this has assisted materially in better insect control programmes.

Weeds remain a problem in all cotton areas despite continued extension effort and these activities are to be reviewed.

Extension activities directed towards the beef industry emphasized control of timber regrowth and monitoring the performance of promising pasture species including Seca, Verano, Graham and Fitzroy stylos, leucaena, Hatch creeping blue grass and Indian blue grass. Grazier interest in pasture demonstrations and trials is at an all-time high and considerable commercial plantings have been made.

Seed of these species is scarce and expensive and pasture seed production has been encouraged. These efforts were successful and Fitzroy stylo seed crops have established at 12 sites in the region.

Some 1 200 ha of the browse shrub *Luecaena leucocephala* have been established on commercial properties in the region and these areas will boost beef production on those properties.

Burnett and South Burnett

Grain cropping continues to expand at Monto, Mundubbera, Gayndah and Kingaroy. Extension activities in these districts were directed at improving crop husbandry and land management with emphasis on insect, disease and weed control.

The insect control activities were particularly pertinent as a major outbreak of sorghum midge and heliothis occurred in all grain sorghum districts. Crop monitoring, appropriate insecticide usage and attention to application methods enabled grain growers to minimize crop damage particularly in late planted crops.

A major extension programme was directed at the substitution of atrazine for other herbicides in weed control in grain sorghum crops at Gayndah and Monto. Atrazine usage was increased significantly and it effectively controlled weeds. Atrazine also appeals as it overcomes herbicide spray drift to adjacent crops which are susceptible to the alternative phenoxy herbicides.

The Kingaroy-based officers emphasized the controlled droplet application of pesticides. Some 15 farmers purchased appropriate spray rigs principally for peanut foliar disease control. Some difficulties were experienced in their use as the use of this sophisticated equipment requires considerable managerial skills. The development of these skills will be addressed in future extension programmes.

Extension efforts to improve disease control stressed the need to monitor disease incidence and the use of appropriate fungicides.

Another project at Kingaroy was directed at appropriate fertilizer use. The use of fertilizers in crop production has been widely accepted but use of nitrogenous and phosphatic fertilizers is frequently more appropriate and economic than the use of factory-mixed fertilizers. Fertilizer prices change frequently and economic information is updated and distributed regularly.

At Bundaberg, an extension project to assist tobacco growers convert to bulk curing barns has resulted in 70% of the crop being cured in bulk units.

Landholders in the coastal Burnett are diversifying into a range of crops. Information on crop adaptation and production restraints is scarce and a series of demonstrations were established at Maryborough. These demonstrations on crops such as lupins, soybeans, sunflowers, barley, wheat and triticale were well received.

In the beef areas, extension activities to promote Oxley fine-stem stylo have again been restricted by scarce seed supplies. Several seed areas were planted with mixed success. Some areas did not establish because of drought while others are heavily infested with weeds. Other areas established well and should supply seed in 1981–82.

The coastal Burnett has considerable potential for pasture seed production. Most pasture seed producers left the industry in the beef slump of the 1970s but recent high prices and supply shortages have attracted new producers. Extension officers are actively supporting these ventures and making a significant technical contribution.

A major extension project was commenced during the year to demonstrate pasture species with potential in the beef areas of the Burnett. Demonstrations have been established from Miriam Vale to the South Burnett. The species being demonstrated leucaena (both seeds and plants) and Fitzroy, Seca and fine stem stylo.

The leucaena plantings have met with mixed success; an 8 ha site at Biggenden, for example, failed because of grasshopper attack.

Moreton and Near North Coast

In the dairying areas, further attention has been given to winter and spring forage systems. Irrigated, fertilized high density ryegrass is the established winter and spring forage on dairy farms but attempts are being made to reduce costly fertilizer inputs by studying the performance of ryegrass-clover mixtures. Results to date have been only partially successful.

Land management projects were pursued in a number of districts. The involvement in rehabilitation of Tin Can Bay Army base was continued. A pilot area which has been rehabilitated will be opened for an army bivouac in the near future and species regeneration assessed subsequently.

In the Lockyer Valley, the promotion of useful tree species such as leucaena, and sown pastures to stabilize land slip areas continued. Several Government Departments are involved with the community and individuals to rehabilitate the degraded grazing lands in the

Lockyer. These activities will require additional technical information and the integration of Government, community and landholder activities to be successful.

Drought reduced interest in lantana control particularly in the Brisbane Valley but studies in association with the Lands Department indicated that misting with the herbicides dichlorprop and glyphosate was not as reliable as spraying with dichlorprop.

In the Kalbar area, the problem of soil compaction and clodding on intensively farmed soils is being studied. Application of the soil conditioner, gypsum, offers some improvement but the use of alternative crops such as lucerne and soybeans and perhaps pigeon pea is promising.

Co-operative activities with the Victorian Department of Agriculture have resulted in a considerable reduction in damage at delivery of low quality Victorian certified seed potatoes.

Grain cropping continues to expand in the region. Maize growing is now well established at Gympie and Beaudesert and soybeans, grain sorghum and barley are significant crops in the West Moreton.

A project to study soybean production in pasture sward situations was initiated. The concept of direct seeding soybeans into a pasture sward and using herbicides for weed control was developed by the New South Wales Department of Agriculture at Grafton. Preliminary results are sufficiently promising to continue the project which promises to increase the area under crop in the Moreton region significantly. Land presently considered too steep for cropping could be growing soybeans if the technical problems can be overcome.

Darling Downs and Near South-west

The number of enquiries received by officers continued at a high level although agribusiness companies are handling an increasing number of enquiries. This trend requires close co-operation with staff of the companies and reflects the increasing complexity and sophistication of modern farming.

The demand for information and advice on farm machinery management increased. This demand has resulted from the increased cost of machinery and its impact on farm profitability. The newly appointed farm machinery extension officer has commenced a programme to improve the farm machinery management skills of extension officers in the southern grain belt, and to collate relevant machinery information. He will also address specific on-farm machinery management problems where possible.

A joint conservation tillage programme with Soil Conservation Branch officers was intensified. Activities have emphasized mulching of crop stubbles, reduced tillage and machinery modifications for crop establishment. The activities have been more prevalent in the Dalby, Pittsworth and Miles districts where a number of farm walks, field days and discussion group meetings were conducted. A demonstration farm has been established at Jandowae.

Farm management extension activities were also intensified. Some 19 farmers from the Darling Downs and Western Downs attended a 'Farming for Profit' live-in workshop at the Dalby Agricultural College in September. This workshop was a co-operative activity with officers of Economic Services, Beef Cattle Husbandry and Sheep and Wool Branches.

The farm management discussion group at Norwin continued to consider management of their cropping enterprises and a number of avenues for increased profitability were highlighted. A similar group has been established at Dalby.

Crop husbandry extension activities have been directed at weed control, fertilizer usage and irrigation strategies. Many of these activities, particularly those directed at the 1980 winter crops, were thwarted by drought.

A commercially viable cropping system has been developed for use in areas infested with the perennial Russian knapweed (*Centaurea repens*). The system requires the growing of winter grain crops, and two applications of the herbicide dicamba during the summer fallow.

A highly successful field day, attended by more than 80 producers, was held near Warwick in July. Topics discussed were herbicide selection and application in winter crop production. At Dalby, emphasis was directed at herbicide application and time of application, wild oats control and control of African boxthorn (*Lycium ferocissiumm*).

African boxthorn control was also emphasized in the Crows Nest and Rosalie Shires and seven areas demonstrating the effectiveness of hexazinone were established.

The programme to eradicate grassy sorghum weeds from the St. George irrigation area has again made significant progress. This programme co-ordinates the efforts of farmers, the Queensland Water Resources Commission and the Department. Drains, channels and farms have been kept free of these weeds during the year.

In the Jondaryan and Cambooya Shires, control of Johnson grass (*Sorghum halepense*) and other grassy sorghum weeds has slowed. These species are useful grazing plants and contribute significantly to the feed programmes on mixed grain and livestock farms in the Shire. These farms are usually at the top of catchments and are a ready source of infestation for the grain farms further down the catchment where more rigorous attempts have been made to eradicate or control the weed.

A recent innovation in fodder conservation has been the 'Stackhand' bale. Lucerne hay is being conserved for lot feeding on the Darling Downs.

Nevertheless, significant progress has been made and the roadside slashing campaign has maintained momentum. Co-operation from the Jondaryan and Cambooya Shire Councils has been high.

Extension activities aimed at boosting productivity through appropriate fertilizer use were conducted at St. George, Miles, Warwick and Toowoomba. Much of the cropping land in the Tara Shire requires phosphatic fertilizer. Responses to applied fertilizer were excellent despite the dry year and farmer interest is high.

On the other hand, winter cereal response to nitrogenous fertilizers in the demonstrations at Warwick was limited by the dry season. Farmer use of nitrogenous fertilizers on these eroded soils has not been great and the experience during 1980 will further delay its widespread adoption.

A demonstration of alternative winter crops was established at Inglewood. Rapeseed, lupins and safflower were grown and rapeseed shows promise although crop management needs to be further defined.

At St. George and Goondiwindi, extension activities directed at irrigators emphasized insect control in cotton, herbicide usage and irrigation strategies. Water supplies at St. George were critical until December and planting was staggered to utilize better the meagre irrigation supplies. Insect control was good and crops are expected to yield about 5.5 bales ha^{-1}.

Extension efforts to promote summer cropping on the western Downs and Maranoa were reduced due to the drought. However, where adequate summer rain was received, grain sorghum and sunflower crops reflected the improved crop husbandry. Hybrid selection, planting rates, weed and insect control were more appropriate.

In the dairying areas, considerable progress was achieved in the use of nitrogen-fertilized, irrigated high density ryegrass. Dairy production was also boosted by a programme to apply sulphur aerially to the basaltic uplands on the eastern Darling Downs.

In the granite and traprock around Stanthorpe, Texas and Inglewood, extension effort is being directed at oversowing winter legumes into native pastures and the assessment of pasture strategies to encourage *Danthonia* spp. for winter forage in native pastures.

In the more western areas, extension activities in pasture productivity were greatly affected by drought. Only a small area of annual medics (*Medicago* spp.) was sown. However, areas were established at Condamine to demonstrate control of limebush by hexazinone and at Tara to demonstrate pasture establishment methods.

Horticulture Branch

HORTICULTURAL products make up a very important part of our daily diet. As well as their significant nutritional contribution, they make food flavoursome, interesting and enjoyable. The horticultural industries in Queensland produce a wide range of fruit and vegetable products for both fresh and processing markets as well as an ever increasing range of quality cut flowers and potted ornamental plants.

The work of the Horticulture Branch is directed towards the development of the productivity of these industries in the State while conserving our natural resources. Its activities include extension, regulatory and research services in major producing areas. As most fruit and vegetables are perishable, emphasis is also given to maintaining quality during the marketing chain from the farm to the consumer.

Research investigation aimed at solving specific industry problems and developing production opportunities is a major Branch function. Field research stations at Applethorpe, Redlands, Nambour, Bowen and Cairns are the main centres for this work and field trials are conducted on properties of co-operating growers in many districts. Post-harvest and processing research is carried out at the Sandy Trout Food Preservation Research Laboratory, Hamilton.

Extension services are provided in all producing districts and these are in strong demand. Producers are provided with a wide range of technical information as well as receiving encouragement to adopt sound farm management and conservation practices. Services have recently been expanded to include the post-harvest and marketing areas with a view to reducing wastage and improving the quality of fruit and vegetables reaching the consumer.

Regulatory duties are also undertaken by the Branch. It plays a major role in administering the Diseases in Plants Act, which is aimed at limiting the spread of pests and diseases of plants within the State and preventing their entry from other States.

As an agent of the Commonwealth, it also administers, within the State, the Commonwealth Quarantine Act (Plants) designed to prevent the entry into Australia of any pests or diseases of plants or weeds which might constitute a hazard to primary production. As well as inspections of passengers and cargo entering the country, increasing emphasis is being given to monitoring and surveillance of the northern areas of the State to prevent the spread of serious pests and diseases from neighbouring countries.

Research

The major aim of the research programme of the Branch is to improve the quality, range, and availability of fruit, vegetables and ornamentals to the consumer, while minimizing production and distribution costs; and to make the production of these commodities more efficient, more reliable and less labour intensive.

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 and extension of some existing crops to new areas.

Alternative tomato production system

A considerable percentage of Queensland's tomato production is during the winter and spring months when the industry is the major supplier to southern markets. During this period, cool temperatures frequently result in poor fruit set followed by excessively vegetative plants. Luxury supplies of available nitrogen aggravate this problem. Unwanted rainfall can also result in over-vegetativeness during the growing phase, and fruit rots during the fruit maturation stage.

To minimize the effects of these problems, a tomato production system is being developed where the plants are grown on raised beds covered with plastic mulch, and irrigation is applied via a trickle irrigation line laid on the soil surface underneath the mulch. Because the application of water and nitrogen can be regulated, a high degree of control over the production of vegetative and reproductive plant material can be obtained. The plastic mulch also minimizes the development of plant and fruit diseases.

The system is proving most effective and following successful trials, one grower is planting 80 hectares of tomatoes by this method this year. A higher degree of mechanization of operations is possible than with present trellised production methods, and the system should ultimately prove suitable for mechanical harvesting. Research is now refining the equipment used to prepare and shape the beds, apply fertilizers and other chemicals, and lay the plastic mulch and trickle irrigation lines. It is also aiming at developing field monitoring techniques to allow systematic grower decisions on when to apply water and nitrogen through the trickle system for most effective control of growth and fruit yield.

A new system developed for the production of tomatoes uses raised beds, plastic mulch and trickle irrigation.

This production system is also proving most effective for growing rockmelons and largely overcomes the problem of fruit rots which has plagued the industry in the past.

Container-grown seedlings are proving most effective for field establishment of both tomatoes and rockmelons for this method of production.

Vegetable breeding and introductions

The programme to develop improved vegetable cultivars for use in the Queensland industry is continuing. Large numbers of vegetable cultivars considered to have potential for Queensland were imported from overseas, tested for adaptability, improved disease resistance, yield and quality characteristics and the most promising varieties distributed to major producing areas throughout the State for local evaluation. In addition, breeding programmes have proceeded in tomatoes, French beans, capsicums, cucurbits and sweet corn.

The tomato breeding programme at Bowen is concentrating on the development of a tomato cultivar similar to Flora-Dade but also having resistance to the new strain of Fusarium wilt recently identified in that area. Resistance to the new race has been found in lines of *Lycopersicon pimpinellifolium* and a breeding programme to incorporate this resistance into a commercial cultivar is in progress.

This breeding programme is expected to take a minimum of 5 years to produce the desired cultivar. Resistance to the new Fusarium race has also been found in some advanced breeding lines from the United States. This resistance does not hold up under heavy inoculum pressure in pot screening tests but has proved adequate in field studies on Fusarium Race 3 wilt affected soils. In an attempt to produce an interim cultivar for commercial production at Bowen, selections are being made from this field-resistant material.

In addition, a range of F_1 hybrids between the field-resistant lines and present commercial cultivars has been made and these are presently being evaluated. Despite the higher cost of obtaining F_1 hybrid seed, such a cultivar might prove useful as an interim variety. The Bowen fresh market tomato breeding programme also aims at developing a cultivar with a larger fruit size than Flora-Dade, and also having a more concentrated fruit maturation period.

The breeding programme to develop improved tomato cultivars for trellised production in south-east Queensland continues. Particular emphasis is being given to the development of varieties with improved resistance to bacterial wilt, Verticillium wilt and Fusarium wilt. F_1 hybrids produced from crosses between Scorpio, the bacterial wilt resistant cultivar released last year, and other cultivars having Verticillium and Fusarium Race 1 wilt resistance, possess resistance to all three diseases, and look promising for commercial production.

Selections from a cross between our major commercial variety Flora-Dade and an older variety Floradel are at an advanced stage of development and look particularly promising for trellised production. New initiatives in the breeding programme are using as parents compact, determinate lines from California which possess high fruit yield and quality and a short harvesting period. The aim is to develop determinate cultivars suitable for trellised production, which will allow reduced trellised heights and fewer picks with a subsequent saving in costs, but without a reduction in fruit yield.

The programme to develop a cultivar with bacterial canker resistance is continuing and several sources of tolerance and resistance to this disease have been identified.

Breeding work in capsicums is especially directed towards the development of a cultivar with similar fruit shape to the present major commercial cultivar Northern Bell, but also having resistance to bacterial spot, plus increased resistance to potato virus Y and tobacco mosaic virus, and an improved ability to set fruit under the range of environmental conditions experienced in Queensland production. Continued selection in segregating progenies derived from Yolo Y and PI 322719 has produced plants highly resistant to both diseases.

After several cycles of backcrossing to commercial Bell cultivars and further selection, a cultivar having the required attributes should be available for release. An advanced line derived from a cross between Yolo Y and Hungarian Yellow has similar fruit set, fruit shape, fruit colour, and bacterial spot tolerance to the latter cultivar, but also possesses potato virus Y resistance. This line is currently being evaluated throughout Queensland as a potato virus Y replacement for Hungarian Yellow. Seed of the present major capsicum cultivar Northern Bell is not now being produced by overseas seed companies and a replacement was urgently required for the Queensland industry. The plant introduction programme has identified an Israeli cultivar Maor as a suitable replacement, and this will be marketed to Queensland growers under the name Market Grant Y.

Cultivar introduction and evaluation trials continued throughout the year to find superior Brassica cultivars for the Queensland industry with a total of 104 new Brassica cultivars being imported. The cultivar Rampo, recommended as a replacement for Olympic in summer cabbage production in south-east Queensland, performed well during the past season. A collection of Chinese cabbage cultivars has been assembled and preliminary evaluation trials have been conducted to assess the potential of this crop for expanded production in Australia.

Container-grown transplants are now widely used for the establishment of tomato crops in Queensland.

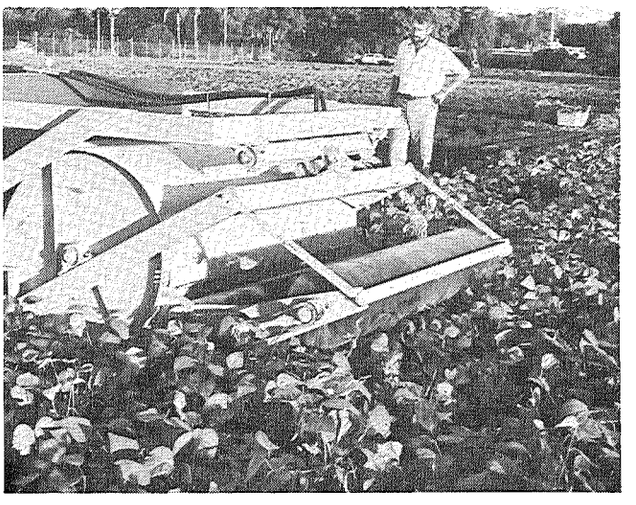
The breeding programme aimed at producing a cold tolerant stringless French bean cultivar for the Queensland winter bean industry centered on Gympie is at an advanced stage and three cultivars will shortly be released to industry. The three cultivars presently designated as CT 12, CT 15, and CT 57 have dramatically out-performed the present winter cultivar Redlands Greenleaf C in both yield and pod quality in winter trials conducted at Redlands Horticultural Research Station and on growers' properties in the Gympie district. The cultivars also show high potential for spring production in south-east Queensland. Seed dropping tests are being conducted on lines in the French bean improvement programme with the aim of incorporating resistance to mechanical damage into new cultivars.

The first stage of a major investigation aimed at identifying improved processing pea cultivars for the Queensland industry was completed during the year. Yields obtained in processing pea crops in Queensland are generally low compared with those obtained in southern States, and this is believed to be very significantly due to the lack of adaptability of present cultivars to our environmental conditions.

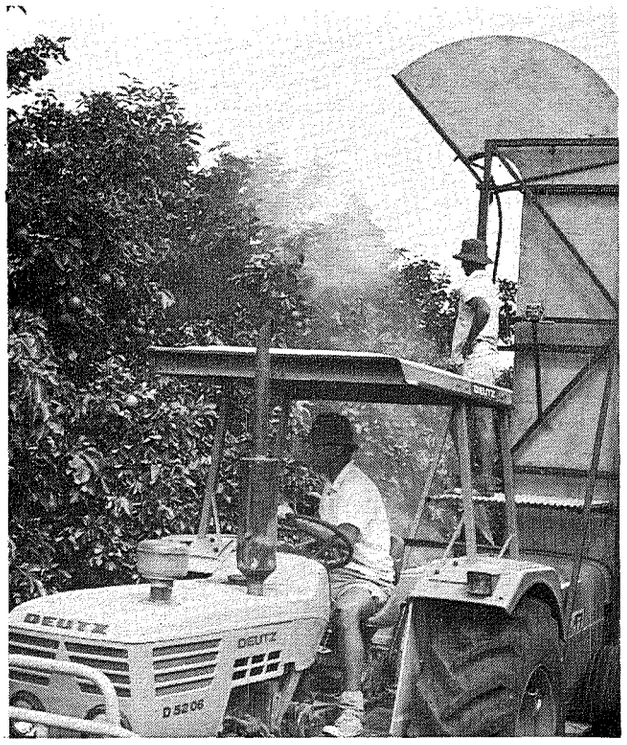
The programme involved 22 new cultivars which were each planted on six planting dates from 2 June to 6 August 1980. Each cultivar at each planting date was harvested a number of times to allow yield comparisons at a standard maturity index. A number of very promising cultivars was identified including Spring, Scout, Princess, Tristar and Trifect. Large-scale grower plantings have been planned for the 1981 season and these are being conducted in conjunction with commercial vegetable processing companies.

Citrus research

Exocortis viroid is proving effective in dwarfing Navel orange trees on Troyer citrange rootstock. Trees inoculated with a mild strain of the viroid are smaller than uninoculated trees but have produced as much fruit in their first crop. This makes the inoculated trees more efficient per unit area of ground covered. These studies will need to continue for many years to determine the long-term effects of inoculation with the viroid.



A new mechanical harvester for fresh market beans will reduce labour costs.



A 'Towermister' air blast sprayer allows good all-over coverage of citrus trees.

A survey which included chemical analysis of trunk wood appears to have confirmed the presence in Queensland of citrus blight. This disorder, which has not been previously reported in Australia, causes considerable tree losses in other parts of the world. The disease has not been transmitted artificially and it has no proven cause. Sweet orange trees on rough lemon rootstock are most susceptible to the disorder. Further studies on the distribution of the disorder in Queensland are continuing.

The use of ethephon for thinning Imperial and Murcott mandarins is proving successful in further trials and in commercial production situations in the Central Burnett. The use of this technique to reduce crop load in the 'on' year where biennial bearing is being experienced, has been very successful and has resulted in a more regular bearing pattern.

The 'Tower-mister' consisting of a low profile air-blast sprayer to which is attached an air tower to divert some of the air blast and spray down onto the tops of trees is performing very satisfactorily, and has resulted in improved spray coverage and more effective pest and disease control.

Glyphosate has been shown to be the most effective herbicide for eradicating perennial weeds under the skirts of close planted mature citrus.

Subtropical and tropical tree fruits

Research projects in south-east Queensland continue to evaluate the potential of kiwi fruit, avocados, litchis and mangoes for drier, cooler areas inland from the south-east Queensland coast; and of guavas, custard apples, litchis and persimmons for the more poorly drained soils of the wetter coastal districts. Numerous industry evaluation and development trials have been established with these crops on growers' properties throughout southern Queensland. In addition, the potential of a wide range of lesser known fruit crops including rambutan, pulasan, sapodilla and durian is being investigated.

The South Burnett district shows considerable promise for the production of a number of subtropical fruit species. However, water supplies are often saline and salt-tolerant rootstocks and scions will be required for industry development. Two lines of West Indian avocado seedlings have been found to tolerate strongly saline irrigation water and these could prove useful rootstocks for avocado production in this area.

Research trials with custard apples have shown that defoliation of Pinks Mammoth trees with Ethrel (R) at bud-break greatly increases the number of fruit-bearing laterals and fruit buds produced. In 3½-year-old trees the treatment resulted in a tenfold increase in harvested fruit. The cultivar introduction and improvement programme continues and 34 selections are currently being evaluated to find higher performing varieties for commercial production.

Kiwi fruit continues to show promise as a new commercial crop for elevated areas inland from the southern Queensland coast. Trial plantings in the South Burnett, Mary Valley, Blackall Range and Mt. Tamborine are under study. A technique has been developed for the recovery of rootstocks from better performing vines and these are presently being cloned. This procedure will allow for the development of highly uniform plantings of the higher performing stock-scion combinations.

Investigations are continuing in search of cultivars and management techniques which will allow reliable commercial production of litchi in Queensland. Irregular bearing and low yields have been a major problem for development of a litchi industry. The litchi cultivar No Mai T'sz produced a good crop of high quality fruit for the second year in a row in southern Queensland and shows high potential for regular cropping in this region.

A management system based on strategic application of fertilizer and water, which prevents excessive flushing at flowering and fruit set, has resulted in high fruit yield. The method will again be evaluated this year. Cincturing has also proved effective in promoting yield in this crop, but the application of various growth retardants has not been effective in this regard.

The programme to develop management systems and improved cultivars to overcome the problem of the relatively low yields obtained in the Queensland macadamia industry continues. Studies have revealed that floral initiation takes place in macadamias in southern Queensland in mid May and this knowledge will allow the development of management techniques to increase yield. The use of boron sprays at flowering and later applications of growth substances have increased nut set and nut retention and this has resulted in significant increases in nut yield.

A technique for the recovery of rootstocks from high performance field trees has been developed, and this method will allow the production of highly uniform orchards of outstanding stock-scion combinations. An additional four new cultivars from Hawaii were released from quarantine during the year and these have been incorporated into evaluation trials.

Selection and multiplication of high performance pineapple clones for the Queensland industry has been intensified in recent years. Multiplication of previously released improved clones continues throughout the industry. A breeding programme is in progress and the possibility of incorporating resistance to Phytophthora root rot into commercial cultivars is being investigated. The programme also seeks to develop improved fresh market types.

In nutrition, survey work has determined and confirmed leaf nutrient levels associated with good yields for avocado, custard apple and macadamia. The timing for tissue sampling has been established. A promising lead has developed from a positive correlation found between papaw tissue potassium levels, plant growth and incidence of rain on the one hand, and the occurrence of dieback in the crop. This has lead to a new approach to the study of this disorder.

A large collection of mango cultivars is now available in Queensland and importation of the most promising new cultivars from overseas continues. These new cultivars are being evaluated for their potential as commercial cultivars in northern, central and southern Queensland. A particular aim of the programme is to expand the production and marketing season for mangoes in Australia.

The guava crop development programme has developed systems for high crop yields.

A planting of virus-tested deciduous fruit trees at the Granite Belt Horticultural Research Station developed new lines which will supply propagation material for industry.

A number of cultivars with earlier or later maturity patterns than Kensington has previously been released to industry but commercial crops are not yet bearing in any quantity. A number of new cultivars now fruiting has potential for expanding the production season. These include Edward, Irwin, Tommy Atkins, Florigon, Nam Dok Mai and Fascell.

It has long been known that *Arabica* coffee will produce well in northern Queensland. However, the high costs associated with manual harvesting of the crop have prevented the development of a commercial industry. The advent of mechanical harvesting in overseas countries has changed this situation and two experienced growers from overseas have now established properties on the Atherton Tableland. It is expected that 100 hectares will be planted by the end of 1981.

The research programme is presently concentrating on the introduction and evaluation of high yielding *Arabica* coffee lines. The programme is aimed at improving productivity as well as providing a gene pool for coffee disease resistance.

Banana research

Maturity bronzing continues to be a major problem with the production of bananas in Queensland. Cutting the bunches before the completion of finger filling will minimize the incidence of the disorder but this results in considerable reductions in fruit yield. The incidence of the disorder has been strongly associated with high rainfall and humidity during bunch development, and the disorder is worse in poorly drained plantations.

Studies on the effects of water stress at various stages of development of the banana plant have now revealed that a high incidence of bronzing occurs when the plants are stressed just before and just after bunch emergence. Plants stressed 6 weeks or later after bunch emergence showed a relatively low incidence of the disorder. It appears that the heavy incidence of matuity bronzing in the field in summer is related to water stress during the dry spring period 100 to 130 days earlier. The commercial implications of this new lead in the maturity bronzing problem will be closely investigated.

Nutrient leaching models to define the rate of nutrient movement in tropical soils under high rainfall conditions are being developed to assist in defining optimum fertilizer practices for bananas in north Queensland. It has been established that 50% of rainfall actually runs down the pseudostem of the plant after collection by the leaves. This finding has important implications in the rate and positioning of fertilizer applications. Applications of lime and dolomite continue to produce yield increases in trials with bananas in north Queensland soils and growers have widely adopted the practice of using these materials in banana production. The application of various silicate materials to the soil has not increased banana yields.

Deciduous fruits

The breeding and plant introduction programme in apples, plums, peaches and nectarines has continued and several new 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 cultivars.

Small quantities of the early maturing apple variety R7T41 bred at Granite Belt Horticultural Research Station will appear on the market this coming season and market reception will be closely monitored. The original apple breeding population of 10 260 has now been reduced to approximately 900, and the most promising of these are being evaluated under commercial spacings in the field.

The plum breeding programme continues and an additional 15 500 crosses were made this year. A wide range of selections of both earlier and later maturing types has been made, and the most promising ones are being evaluated under commercial conditions.

The peach selection N1T6 again performed well this year with good colour and firm flesh. It is an early to midseason cultivar. The introduction programme in these deciduous fruits has been intensified in recent years with cultivars being obtained from overseas and interstate.

Test blocks of low-chilling peach and nectarine cultivars have now been established at numerous potential production sites throughout the State. The cultivars Flordasun peach and Sunred nectarine released earlier in the programme have obtained good commercial acceptance on Brisbane and local markets. Flordasun ripens in north Queensland in October and at Stanthorpe in November. Many new low-chilling cultivars have again been distributed this year for this Statewide evaluation programme.

The rootstock MM106 continues to prove the most suitable stock for close planted apples in the Granite Belt. Northern Spy is also performing well as a rootstock for close planted Delicious apples. The rootstocks M7 and M3428 have this season shown promise as semi-dwarfing rootstocks for Delicious and Granny Smith scions.

The programme to make available virus-tested budwood of pome fruit, stone fruit and grapes to industry is proceeding with further plantings of mother trees and vines at Granite Belt Horticultural Research Station. Budwood of additional virus-tested clones is being obtained from the Fruit Variety Foundation for further field plantings. This programme should result in a substantial improvement in industry productivity as virus-infected trees are gradually replaced with clean material.

A fertilizer trial with Granny Smith and Delicious apples, now in its eighth year, has shown a significant increase in tree girth with increased nitrogen applications. Increased fruit yield has been recorded in Delicious trees with increased nitrogen applications, and this is primarily due to increased fruit size rather than fruit number. No yield or tree growth responses have been obtained with phosphate applications. The programme aims at developing leaf analysis diagnostic information to allow fertilizer recommendations to be tailored to tree nutrient status.

Techniques have been developed for the propagation of stone fruit from hardwood and softwood cuttings, and further refinements to the methods are now being made. The best hardwood cutting procedure is to take the cuttings in mid June, treat them with IBA and give a bottom heat treatment of 18°C until root initiation has commenced.

Research to assist the developing wine industry in the Granite Belt has continued with cultivar assessment trials, laboratory production of wine from these trials, and advice to producers on wine-making technology. The search for suitable white wine grape cultivars continues with a large number of clones under evaluation. These include Chenin Blanc, Colombard, Chardonnay, Crouchen, Emerald Riesling, Riesling, Traminer and Trebbiano.

Ornamentals

A solution containing 500 p.p.m. citric acid, 500 p.p.m. sodium dichloro isocyanurate and 2% sugar was found to increase the vase life of roses from 5 to 13 days in recent studies. A survey of gladioli production has attempted to relate agronomic practices to the incidence of Fusarium, Stromatinia and other diseases which are major problems in this crop. The results are complex and require further detailed analysis, but it appears that a relationship exists between the use of animal manures and a high incidence of Fusarium in the crop.

Tissue culture research

This programme conducted at the Redlands Horticultural Research Station has now produced virus-free plants of seven strawberry cultivars, four sweet potato cultivars and one garlic cultivar. The Queensland strawberry industry is based on virus-free plants from this programme, and virus-free sweet potato material has also been released to industry.

A system of rapid multiplication of pineapples has been developed and field trials are currently evaluating this material for genetic off-types. No off-types have been observed in plants and fruit harvested to date. It is planned to have 1 000 plants of clone 13 ready for planting in spring 1981 to evaluate this propagation method on a large scale. The successful introduction of tissue culture propagation of pineapples would allow new clones and selections to be introduced into the industry much faster than at present.

Tissue culture techniques for the propagation of papaw and passionfruit are still in the developmental stages with many difficulties being experienced. A study of the potential of using somo-cloning (reproduction of plants from single cell isolates of callus tissue) as a plant breeding technique to produce new cultivars is being investigated for a number of horticultural crops.

Packaging, handling and post-harvest

The use of models to predict the failure of fruit and vegetable materials under stress has been expanded from studies on bruising of apples to a consideration of effects on numerous other crops including pears, strawberries, papaw and potato. The models are being developed in conjunction with engineers at the University of Queensland. The ability to predict tissue failure from stress factors will enable a systematic evaluation of the effects of different handling, transport and packaging systems on fruit and vegetable quality, and allow systems to be designed to minimize stress and produce damage during post-harvest operations. The models also have application to the texture and eating characteristics of the fruit and vegetable products.

Considerable inputs have been provided into the development of a modern packing shed for a grower in the Redlands district. The shed features comprehensive integration of bulk handling, ripening facilities, cooling facilities, palletization, vibra-packing, sorting, carton filling, washing and drying.

Investigation of a kernel splitting problem being experienced during the processing of macadamias has shown that the damage was caused when the nuts were dropped 8 m onto a steel plate. Drops only 2 m were sufficient to cause nut splitting. The equipment is being modified to overcome the problem.

Departmental staff are co-operating with the Committee of Direction of Fruit Marketing and the Australian United Fresh Fruit and Vegetable Growers' Association in developing package designs for package rationalization. The concept is related to the use of pallets for transporting produce and packages are being designed to fit a standard pallet with a number of sizes of package to suit all types of produce.

Packaging studies aim at developing efficient systems for marketing a wide range of fruit and vegetable crops.

Package designs are such as to allow integration of all types of packages on a single pallet, provided a whole layer of each package type can be established. The system is based on the principle of forced-air cooling of produce. The development of the rationalized series of packages is proceeding with the 18-litre package being widely accepted. Other packages are being tested and developed for specific commodities. Forced-air cooling and ripening of fruit with these packages has given excellent control and uniformity of ripening has been achieved.

The use of refrigeration to maintain favourable temperatures for fruit and vegetables during the transport and marketing operation is now widely accepted and utilized. Research continues to study the design of cool-rooms, refrigerated containers, and carton design as they affect the cost and effectiveness of these operations.

Studies on the patterns of air movement in refrigerated containers are almost complete and this knowledge is now available to offer advice on problems which occur in the operation, testing and design of refrigerated containers and vehicles. Quantitative data on the relationship between pressure differences across cartons, carton ventilation, type of produce and cooling rate have been determined for nine particular carton-ventilation-crop combinations.

The technique of forced-air cooling has been adapted to the ripening of bananas, and has proved very successful. Ripeners have been able to achieve close control of fruit temperature during ripening and this results in better and more uniform quality fruit having a better shelf life.

A programme conducted jointly with C.S.I.R.O. Division of Food Research and the New South Wales Department of Agriculture has led to the development of a punnet pack with an overwrap of PVC shrink film for the marketing of litchis. The pack maintains the fruit in excellent condition and has been well received by agents and retailers.

Cool-room trials have shown that pineapples show chilling injury when stored at 21°C or below, and that the symptoms are similar to the blackheart disorder which occurs in the field. Clones having the least susceptibility to the development of chilling injury symptoms have been selected and have been planted in the field to observe agronomic performance and the development of blackheart in the field.

Extension

Seasonal conditions

Dry conditions continued from the previous year and all horticultural areas of the State received below-average rain during winter, spring and early summer. There was a heavy demand on irrigation resources, and many growers exhausted their surface storages; planting of annual crops was restricted and some crops were abandoned. Absence of recharging rain, together with the heavy drain on underground reserves, resulted in water quality problems, particularly in the Lockyer and Fassifern Valleys and the Bundaberg area.

Winter temperatures were mild and frosts were limited to the most frost-prone areas. No winter westerly winds were recorded in southern horticultural areas. Abnormally hot, dry conditions in late spring and early summer had an adverse effect on horticultural crops throughout the whole State. Strong winds associated with cyclone 'Cliff' in February damaged many crops in south-eastern areas.

The drought was broken in midsummer by heavy rains in the wet tropics, and by scattered but beneficial rains in other horticultural areas. Flood rains in the Tully, Kennedy and Murray Upper areas of north Queensland damaged banana crops, and future production will be affected.

The drought-breaking rains replenished most surface water storages. However, there was virtually no run-off in the catchment area of the Waruma Dam which is holding less than 20% of capacity. Unless this situation is relieved by winter rain, there will be severe restrictions on irrigation of crops along the Burnett River. The rains were not sufficient to recharge groundwater supplies; unless there is significant winter rain there will be water shortages and salting problems in producing areas such as Bowen, where production relies on irrigation from underground sources.

Extension activities

The demand for technical information from horticultural field staff has continued to escalate. Many enquiries are coming in from new growers, hobby farmers and home gardeners, as well as from speculators and potential land buyers. Planned extension activities involving genuine commercial producers achieved some notable successes; but the pressure of non-commercial enquiries continued to detract from the time available for extension designed to induce improvements in the industries.

Considerable use was made of locally-produced technical papers as well as articles published in various farming journals and newspapers. These publications are used as a means of extension communication, or to reduce the time spent by field officers in servicing specific enquiries.

The following comments relate to the more important extension projects being undertaken in the various horticultural regions.

In a survey, **Granite Belt** growers defined marketing problems as being more limiting than those associated with crop culture. For this reason, considerable extension effort is being directed towards reducing the costs of packaging and marketing. Although growers have shown interest in the use of returnable crates (particularly the 36 L size), agents are continuing to resist its adoption.

Farm water storage capacity in the Granite Belt was increased by approximately 35% during the year, and there is considerable expansion in the use of trickle irrigation. Four hundred growers attended a Departmental field day at which seven companies demonstrated a wide range of trickle irrigation equipment.

Promotion of high density tree crop plantings is continuing, and most apple growers have now adopted this method to their advantage. However, some stone fruit growers who have changed to close planting are not gaining the full benefits, as they are tending to retain management systems which were appropriate to the wider spacings.

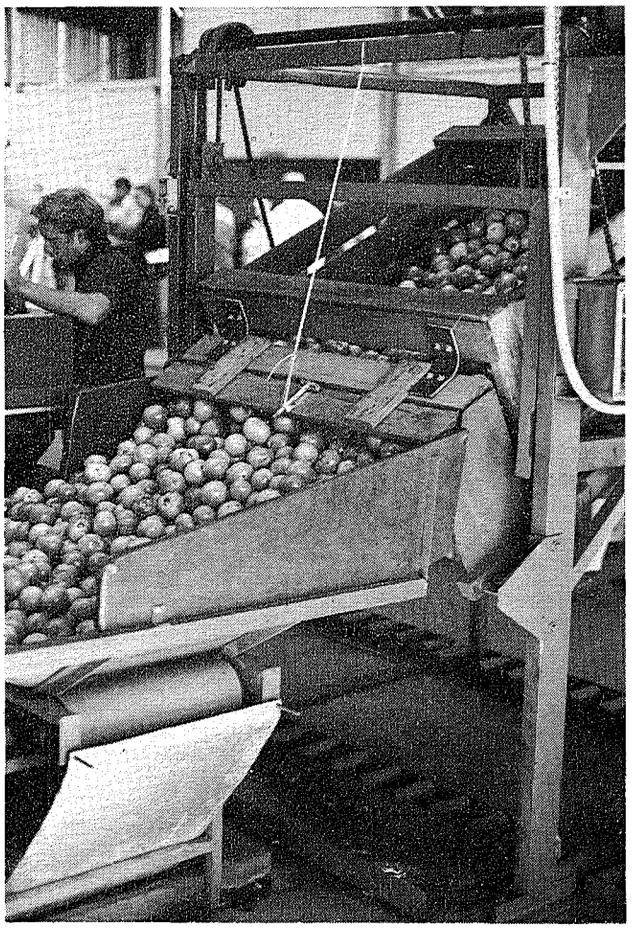
Compilation of the reference book of colour photographs of deciduous fruit varieties is continuing, and colour prints of the major plum and apricot varieties were published in *Queensland Agricultural Journal.*

Plant protection continued as a major field of extension activity. Advisory spray notices were given to apple growers at the green tip, blossoming and calyx stages, and three black spot warnings were issued. Eleven press releases and three newsletter articles were also devoted to plant protection. Codling moth control measures were demonstrated to members of the Deciduous Sectional Group Committee, and general plant protection matters were discussed. Demonstration spray plots are planned for the forthcoming year.

Other extension activities included a Wine Laboratory Workshop, two field days to demonstrate the effectiveness of Cytolin (R) in producing ideally shaped Delicious apples, and the evaluation and demonstration on growers' properties of mechanical summer pruning of deciduous fruit trees. Two issues of the Granite Belt Horticultural Digest were distributed during the year.

In the **South Moreton Region**, farm visits and routine enquiries have occupied about 90% of extension officers' time, and a considerable amount of information has been disseminated in the form of printed handouts. Field days were arranged for the benefit of gladioli, avocado and lettuce growers, while numerous small informal group discussions and farm walks were conducted to deal with a wide range of topics.

Changes in farm practices promoted by extension activities include a significant trend by tomato and lettuce growers to plant container-grown seedlings, and the adoption by Lockyer Valley grape growers of trickle irrigation and modified T-trellises. The demand for broccoli from the Lockyer and Fassifern Valleys has necessitated increased plantings. This demand is the direct result of improvements in quality since growers adopted precooling as a regular part of preparing produce for market.



A mechanical tipping device feeds tomatoes onto the grading line.

Use of zinc sprays, mulching and under-tree sprinklers has increased custard apple yields significantly. Some marketing agents have been endeavouring to attract new and inexperienced growers to supply the recently opened flower market at Rocklea by the prospect of lucrative returns for minimal input. Flower production is a highly specialized activity requiring appreciable capital and expertise, and it has been necessary to initiate an extension project to counter the misleading statements which have been made.

In the **North Moreton Region**, the Horticultural Industry Committee, comprising officers of all Branches in the Region involved in horticulture, continued to function as the central body responsible for the planning and co-ordination of the activities of extension officers. Almost half of the time of extension staff has been taken up with advisory and other on-demand commitments, in part due to a heavy influx of land buyers seeking advice on potential land use. After other commitments, only 5 to 10% of extension officers' time has been available for planned extension programmes, but steps are being taken to increase this percentage.

To provide appropriate and reliable information to the growers, considerable effort has been directed towards the preparation and updating of a wide range of well-researched technical pamphlets.

Development programmes are designed to adapt and upgrade information to a level where it can be applied with confidence by the growers. As the development programmes are largely conducted in association with growers and grower groups, adoption of recommendations follows rapidly after completion of the programmes.

These programmes include: improvements in equipment for spray application to strawberries; improvements in techniques and management of equipment in commercial pest control situations; guidelines for management of nutrition by crop logging–adopted by some leading growers; similar guidelines for scheduled irrigation–initial adoption on a trial basis; improvements in the nematode control techniques used by ginger growers–reduced crop variability and increased production; demonstration plots on a range of annual crops in the Gympie area resulted in confirmation of the use of some varieties and adoption of other more suitable ones; assistance to propagators of *Duboisia* resulted in adoption of bottom heating at the critical temperature of 27°C; extension of the Chinchilla rockmelon and watermelon production season from December–January to December–April.

Other development projects have included production of the North Moreton Irrigation Manual which has been adopted as a guide by extension officers, Water Resources Commission and commercial irrigation firms. Gympie officers facilitated the establishment of a collection and processing outlet for locally grown common mangoes.

The new flower market at Rocklea provides an additional outlet for cut flowers.

Group work with the Australian Macadamia Society saw the processors adopt payment for quality, effectively directing the attention of growers to practices to improve nut quality.

Extension work in Gympie led to the establishment of 20 new on-farm precooling units during the year, as well as a large central facility owned by the Gympie Fruit Growers' Association for precooling and onward forwarding of local produce.

In the **Burnett Region**, locally produced crop summaries and leaflets on specific aspects of crop production have been issued to provide growers with written information on the main horticultural crops. Latest developments and likely seasonal problems were highlighted in the Burnett Horticultural Bulletin which was published twice during the year. The Queensland Citrus Bulletin is prepared twice each year in the Gayndah office and, along with the annual Citrus Spray Programme booklet, is distributed to all commercial citrus growers in Queensland.

Development and testing of improved citrus spraying machinery continued. The tower-mister showed the most promise, providing more than 95% tree coverage using only 50% of conventional spray application rates. However, only two growers have purchased the equipment so far. It appears that others are awaiting evaluation of the new controlled droplet application sprayers which, it is expected, will use even lower application rates.

The complex interaction of pests, parasites, predators and pesticides was explained at a field day designed to promote adoption of integrated pest management. A handbook on the subject was distributed at the field day and a similar article was published in the Queensland Citrus Bulletin. Indications are that growers are very impressed with the benefits to be obtained by application of integrated pest management techniques.

After 2 years of extension effort, about 12 citrus growers in the Central Burnett used ethephon in the form of Ethrel (R) very successfully this year to thin newly-set Imperial mandarin crops.

As the result of an extension programme, about 30% of the rockmelon area at Bundaberg was planted with container-grown seedlings, using either bitumen or black plastic mulch. Post-harvest treatment of rockmelons with fungicides was also promoted to prevent fruit breakdown in the market and retail outlets. Three growers used in-line flooding to apply the treatment, while eight bulk dipped their fruit. All reported reductions in fruit losses, but those who used complete in-line washing and flooding received premium prices because of improved appearance as well as reduced breakdown.

Promotion of post-harvest cooling of produce has continued, and six new grower-owned rooms were built and equipped for fast cooling during the year. More significantly, three Bundaberg district transport companies with refrigerated trucks have built large centralized cool-rooms for forced air cooling. These developments will ensure the high quality of produce marketed from the district.

Suitable methods of land management for tree and plantation crops have been determined for sloping land in the Childers-Gin Gin area, previously declared to be an area of erosion hazard when planted to sugar-cane. Technical assistance has been provided to these tree crop growers. The main limitation is water availability, as subdivisions have tended to separate potential water storage sites from the soils suitable for cropping.

In **Central Queensland**, considerable effort was devoted to preparing and updating pamphlets designed to service the needs of growers in the region. Timely farming information was also broadcast in the agricultural segments of local radio programmes; and home gardeners were serviced through regular newspaper columns.

New strains of papaws developed at the Maroochy Horticultural Research Station have improved yield, fruit quality and handling characteristics.

Extension programmes were conducted to encourage papaw growers to precool their produce and palletize their consignments. The benefits and techniques of post-harvest dipping of rockmelons were demonstrated, and most growers immediately adopted the procedure. Other extension activities included promotion of precooling of fruit and vegetables, and topworking of mango trees to better varieties.

In the **Dry Tropics**, close co-operation was maintained with fruit and vegetable growers, and considerable technical support was given to grower initiatives. Successful extension activity was directed towards the use of container-grown tomato seedlings, and, in particular, adoption of the 'Speedling' method. This system is now being used almost universally, and reductions in transplanting losses and improvements in crop uniformity have resulted. A visit to the eastern capital city markets enabled a field officer to identify a rockmelon maturity problem and to recommend appropriate remedial action.

A private pest and disease monitoring service is now being employed on a contract basis by some Bowen vegetable growers. This service is proving highly beneficial.

In the **Wet Tropics**, clients and field staff have derived great benefit from locally prepared written extension material. However, further effort is now required to update some of these publications to meet the demands of the expanding horticultural industries.

By invitation, 25 of the less experienced banana growers attended a workshop to gain a basic understanding of the principles of banana culture. This type of information is not readily available to such growers from those already established.

A current project, aimed at developing and extending integrated pest and disease control methods, has been adopted successfully for the control of banana scab moth and weevil borer. Effective communication has been maintained with the industry through the Banana Industry Liaison Group. This Group has influenced the content of research and extension programmes of relevant Branches of the Department.

It appears that wide publicity of field days has tended to encourage a number of unsuitable growers to undertake papaw production. Future extension will be directed towards more responsible growers who will be encouraged to adopt improved cultural practices, and develop their own breeding lines with emphasis on resistance to ripe fruit rots.

Emphasis by extension staff on the adoption of recommended cultural practices for production of litchis has paid dividends. Future extension will concentrate on improving the shelf life and market presentation.

There is a heavy demand for planting material of and technical information on exotic tropical tree fruits such as rambutan, sapodilla, durian and carambola. Although the potential of such crops has not been fully assessed in terms of market acceptance, yield and profitability, it was necessary because of the considerable interest to conduct two propagation field days to dispense planting material and cultural information.

Atherton Tableland avocado growers have put their industry on a sound footing by adopting mounding and drainage recommendations. As a result, the heavy rains in January caused only relatively few tree losses. Fertilizer applications based on the results of leaf tissue analyses have ensured optimum fruiting; approximately two-thirds of Tableland avocado production is pre-cooled and refrigerated before marketing. Integrated pest and disease control schedules have improved yields and marketability of the fruit, but further extension is required as some growers still apply excessive quantities of pesticides.

Extension in the Cape York-Torres Strait area has improved public awareness of the objectives and value of plant quarantine. Future efforts could well be supported by meaningful advice contained in locally produced films which would relate better to the largely unsophisticated population.

Officers at the **Sandy Trout Food Preservation Research Laboratory** have continued to maintain close liaison with fruit and vegetable processors throughout the State, although most demand for technical assistance has been received from the smaller processors who are unable to employ their own technical staff. In particular, assistance was provided to apple processors, eight mango processors and several companies interested in processing guavas.

There has been increased liaison with the wine industry and winemakers have been visited regularly. Fifteen winemakers attended a laboratory workshop designed to improve their ability to control quality. Wine judging continues to be an important contribution made by the Laboratory to the wine industry.

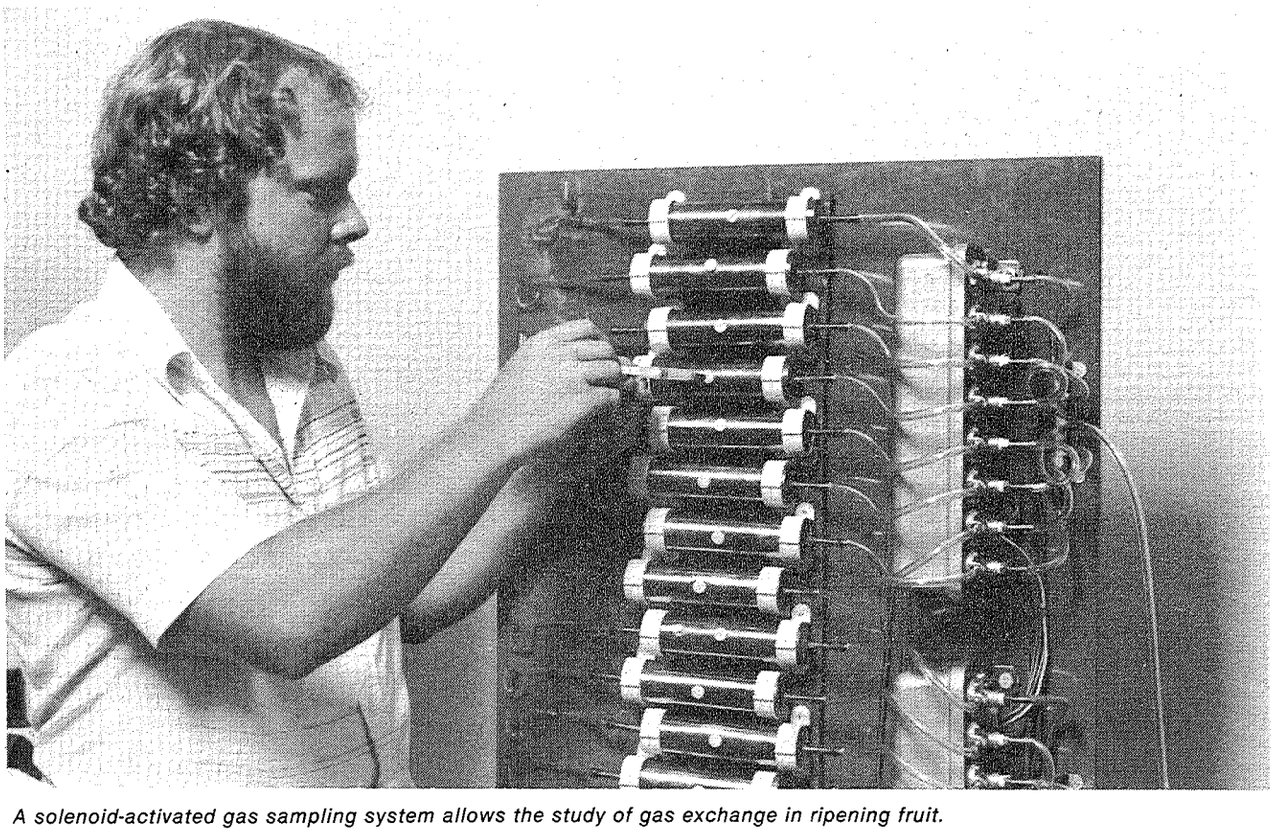
The demand is increasing for information on techniques of precooling produce, as more and more growers and grower groups are adopting the system. A seminar run in conjunction with the firm supplying most of the precooling equipment resulted in a considerable improvement in the type of equipment installed in new cool rooms. Banana ripeners are aware of the benefits of forced-air ripening of bananas, and some ripening rooms in Brisbane, Sydney and Melbourne have been converted to the system. Conversion designs appropriate to the Sydney ripening rooms were provided by the Laboratory, and proved satisfactory in tests. However, further adoption of the system depends on development of a more suitable banana package.

Post-harvest extension activities have now been assigned to the recently expanded Market Extension Service.

Servicing activities

Market Extension Service

Early in 1981, this service was expanded by the appointment of two officers of the Branch to carry out a programme of development and extension in all aspects of post-harvest handling, distribution and marketing of Queensland-produced fruit and vegetables. Some programmes will be developed in co-operation with field extension officers. Others will be related to the development of technology in the wholesale markets of the eastern capital cities.



A solenoid-activated gas sampling system allows the study of gas exchange in ripening fruit.

A current programme involves an evaluation of plastic returnable crates and the rationalization of packages for marketing a range of horticultural commodities. This work will provide an opportunity to promote, where appropriate, unitized handling of consignments into and out of the markets.

Extension to promote the use of forced-air cooling of produce before marketing has resulted in construction of numerous on-farm cool rooms and many central cooling installations. Promotion of appropriate precooling practices will continue, and further work will be directed towards improving techniques employed by refrigerated and non-refrigerated fruit and vegetable transport operators.

Trials will continue to elucidate the specific requirements for forced-air cooling of a wide range of produce marketed in rationalized packages and returnable crates.

Citrus Budwood and Seed Distribution Scheme

During 1980, Queensland nurserymen and orchardists were supplied with 139 510 citrus buds (6% increase over 1979) and 136 kg of citrus seed (26% increase over 1979). The increase in seed sales was due mainly to a greater demand for rough lemon and sweet orange seed. The supply of standard Joppa orange and Emperor mandarin budwood improved, but there were shortages of exocortis virus-free Navel and Joppa orange buds.

A further 72 budwood mother trees were planted in one mother block; the orchard containing the other mother block was sold, but the new owner has indicated that he is prepared to continue development of the block. Propagation of new mother trees is continuing in the Gayndah propagating house, the erection of which was financed by the Citrus Budwood Scheme. This work is also providing valuable information concerning the container propagation of citrus.

Strawberry Runner Approval Scheme

The objective of this scheme is to provide virus-free, high quality, true-to-type planting material to the strawberry industry. Currently the scheme is supplied by a single contract grower located at Crows Nest. While the single supplier benefits from the economy of large-scale production, the risks of supplying the scheme from a single farm are recognized. However, efforts to recruit suitable growers in other localities have so far been unsuccessful.

In the 1981 season, 806 400 Redlands Crimson and 370 400 Earlisweet runners were supplied to 241 growers—a slight reduction on 1980 figures, and very slightly less than the demand. In spite of the very difficult weather conditions which occurred during the establishment period in March, no serious problems were reported. This situation resulted from an extension effort to promote optimum management techniques during the establishment phase.

For the past two seasons, the scheme has been operated by the Strawberry Sub-committee of the Other Fruits Sectional Group Committee of the Committee of Direction of Fruit Marketing, with Departmental officers functioning in an advisory capacity. A recent review has shown that the scheme has operated satisfactorily under the present arrangements.

Bean Seed Scheme

There was a considerable reduction in plantings of registered bean seed crops in both the Burdekin and Callide-Dawson areas. Burdekin registered plantings declined from 462 ha in 1979 to 291 ha in 1980 which produced 402 t of clean seed. Callide-Dawson plantings declined from 210 ha in 1980 to 42 ha in 1981. Reductions in plantings are probably the result of competition from lower priced seed being imported from the United States. The predicted expansion in Callide-Dawson plantings did not occur, partly because growers now recognize the risks of producing registered seed in a non-quarantine area.

Regulatory

Plant quarantine

The objective of the Plant Quarantine Service is to minimize the risk to our agricultural industries of introducing into the country any serious pest or disease of plants or plant products or any serious weed pest. Administration of the service in this State is carried out by the Branch on behalf of the Commonwealth.

The work involves the supervision of all cargo, goods and passengers entering the country from overseas. The supervision and treatment of living plants and seeds is another important and specialized aspect of the work.

The transport of cargo in containers continues to expand. Arrangements have been made to have full quarantine services available at the new port complex when it becomes operational. There is a growing emphasis on interstate container movement by rail and quarantine services have been established at a new southside complex specializing in these operations.

The demand for quarantine services at the International airport continues to increase. As well as an increase in the number of passengers, there has been a considerable increase in air cargo. Some of the items now being imported in increasing amounts include fresh fruit and vegetables and cut flowers. As these products are perishable and the risk associated with their import is high, quarantine surveillance must be particularly efficient.

The importation of plants has continued at a high level and facilities for growing plants in quarantine are operating at near full capacity. The installation of trickle irrigation and mist propagation equipment has improved the efficiency of this work.

Surveillance of the area at Gordonvale, where an outbreak of the Giant African Snail was detected in 1977, has continued. No further specimens have been detected and proposals have been made to have the outbreak declared to be officially eradicated.

Full-time Plant Quarantine surveillance has now been operating in the Torres Strait area for over a year. This region is of great concern from a quarantine viewpoint because of its close proximity to other countries where serious pests and diseases not found in Australia are known to exist. The pest monitoring programme in the area is now well established and is being supplemented with a pest and disease survey. This will facilitate the early identification of any new organism that moves into the area and early recognition is always most important if eradication is to be attempted.

A national campaign to improve quarantine awareness in the community was carried out during the year. The programme involved personality Mr. Harry Butler and is considered to have been a great success. A campaign has also been undertaken on a State level to inform potential travellers of the dangers that can be associated with the illegal importation of plants. Displays have been mounted at the Royal National Association and some major agricultural field days and talks have been given to community and school groups in the Cape York area.

The following table gives details of passenger movement, containers, timber and plant imports that were supervised by Plant Quarantine officers during the year.

	1979–80	1980–81
Total number of passengers by sea and air	191 334	205 388
Containers from overseas	31 843	36 497
Timber in cubic metres	57 447	70 721
Consignments of plants released from quarantine	370	363

Exotic pests and diseases are regularly found during inspections of imported goods and this highlights the continuing need for an effective Quarantine Service.

Treatment of plants for interstate movement

Consignments of plants to or through New South Wales continued at a high level, with a marked increase in the latter half of the year. The number of registered export nurseries in Queensland rose to 11 Group A and 108 Group B, and this resulted in a considerable saving of time by the supervising officers. However, an appreciable amount of time was still devoted to supervising treatment of plants by nurseries not yet registered in the export categories. As the year closed, the Board of Tick Control in New South Wales decided to relax the restrictions on the movement of plants into that State. This very welcome decision eliminates the need for registration of export nurseries and will result in a considerable saving in field officers' time.

Banana Industry Protection Board

During 1980–81, the Board maintained the drive to have neglected areas of bananas eradicated, and the campaign has met with considerable success. However, the lack of responsibility by some growers requires pressure from inspectional staff to obtain co-operation.

The number of banana growers in the State increased by 20% to 1 356 and the total area under crop has increased from 3 650 ha to 3 960 ha.

In the Southern Banana Quarantine Area, bunchy top disease continues to be a serious problem, with a total of 1 192 infected plants being found on 227 properties. This is equivalent to one diseased plant per 1.6 ha of commercial plantings. However, this figure is somewhat inflated as the numbers of infected plants on both commercial and residential holdings have been combined.

The campaign to eradicate bunchy top in the Brisbane Metropolitan area has continued, its success being indicated by the reduced number of infected plants located. Although a large section of the Metropolitan area has been covered, completion of the project is still some years away.

The levy payable by growers on Queensland produced bananas was not raised during the year. This fund is used to offset the cost of field inspections.

The Board visited the Caboolture banana growing area during the year and met representative groups of growers. The aim of these visits is to publicize the Board's functions, and to make growers more aware of their responsibility to control pests and diseases of bananas.

Agricultural Chemistry Branch

THE work of the Agricultural Chemistry Branch can be considered in the categories of research, regulatory and supporting analytical services for research and extension. With its city and country laboratories, the Branch provides chemical services and specialist advice in a diverse range of activities which includes analytical chemistry, soil science, pesticide science, cereal chemistry, plant chemistry and land evaluation.

Research

Pesticide chemistry

Field trials must be carried out to establish levels of pesticide residues which will result from a particular application schedule. Tomatoes dipped in a 425 mg L^{-1} dimethoate solution for post-harvest fruit fly control were found to contain dimethoate residues at less than the maximum residue limit (MRL) of 1 mg kg^{-1}. Litchis treated with a 500 mg L^{-1} benomyl dip for post-harvest fungal control were found to contain benomyl residues of 0.5 to 1.4 mg kg^{-1} in the flesh and 10 to 26 mg kg^{-1} in the skin.

Experiments on the persistence of azinphos methyl on apples were continued. Measurements of the concentration of surface deposits on the apples were carried out over 6 weeks and the azinphos methyl half-life was found to be 13 days. This compared favourably with the value found (16 days) in the previous season. There was no significant difference in the rates of loss from apples in different positions of sunlight exposure.

The project to study the stability of pyrethroid insecticides on stored wheat has been completed. The four pyrethroids permethrin, phenothrin, fenvalerate, and deltamethrin were applied to wheat which was stored for 52 weeks at 25°C or 35°C at either 12% or 15% moisture. Half-lives (in weeks) for the pyrethroids at 25°C, 12% moisture and at 35°C, 15% moisture were—permethrin (252, 44); phenothrin (72, 29); fenvalerate (210, 74) and deltamethrin (114, 35).

Eight drainage water samples from irrigated cotton at Emerald were analysed for pesticide residues (chlorinated hydrocarbon insecticides and diuron and trifluralin herbicides). No residues were detected.

The study on stability of dithiocarbamate fungicide formulations has been completed. A total of 23 samples was tested according to the official CIPAC procedure, and only one, a zineb, failed to meet the specification. The samples tested included maneb, mancozeb, and zineb.

Bees are important primary pollinators of crops and, because of their susceptibility to poisoning by insecticides, should be kept from freshly sprayed areas. A method has been developed for field-testing potential repellent compounds for this purpose.

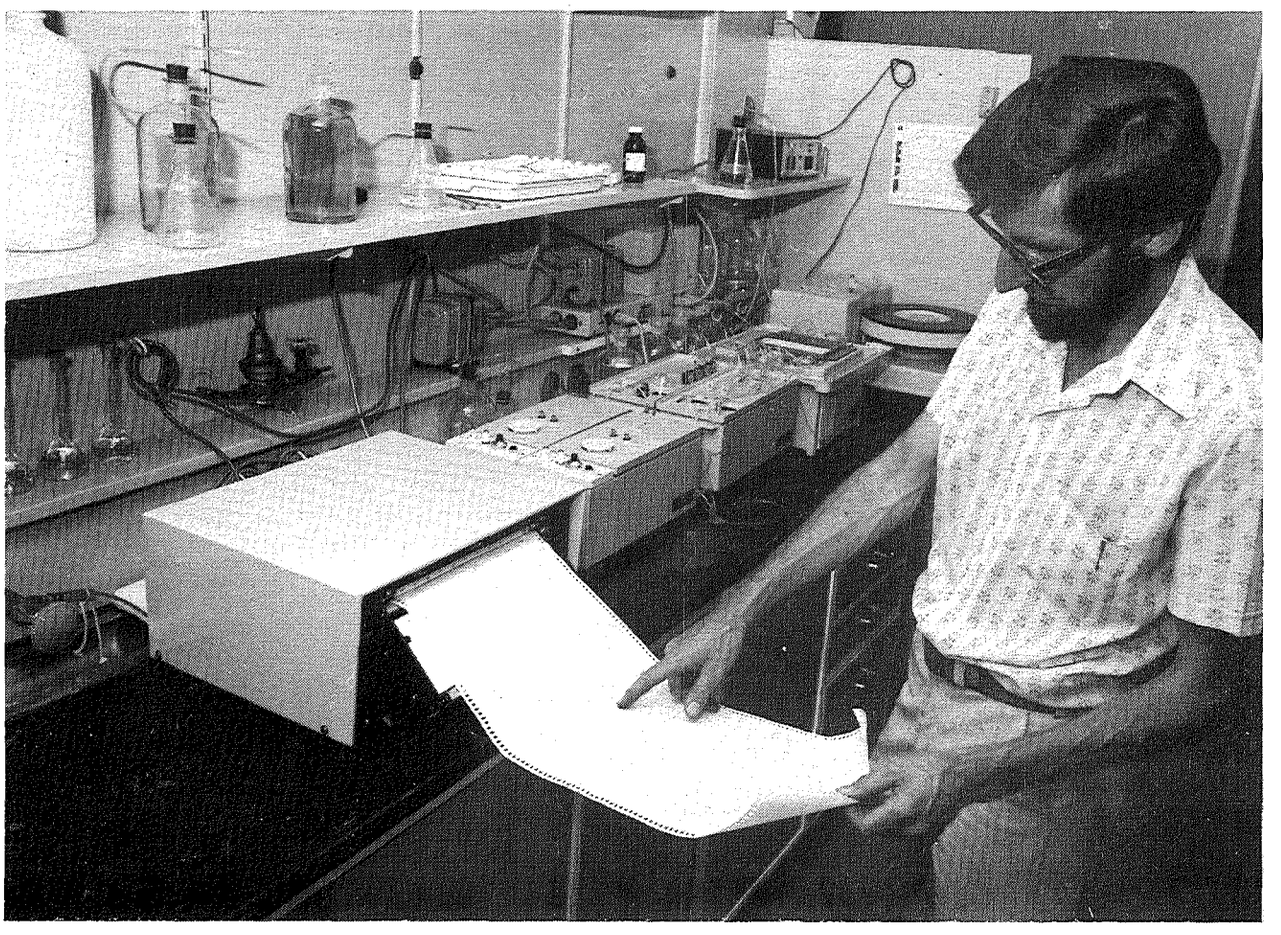
On the basis of a theory proposed to explain their behavioural activity, 30 compounds have been synthesised or purchased. These compounds have structural relationships to a naturally occurring bee pheromone. Repellency indices have been assigned to 11 of these compounds and all 11 have some activity as repellents. A glasshouse testing method, intermediate between the laboratory test and a full-scale field test, has also been developed.

Plant chemistry

As part of an evaluation of a new variety of malting barley, carbohydrate analysis was carried out on 24 samples of wort. Wort is the sweet liquid which results from the hot-water treatment of malt. When treated with hops and fermented with yeast, beer is produced. The sugars of interest included glucose, sucrose, maltose and maltotriose. The wort solutions derived from the new variety had a similar carbohydrate composition to that of the standard variety, Clipper.

The laboratory supports the cotton breeding programme aimed at developing lines resistant to *Heliothis* spp. One hundred and four lines selected for bioassay were analysed for gossypol. Some of these lines from the previous season's 'elite' lines showed the highest level of terpenoid aldehydes recorded for Queensland cotton (2.65% of dry matter) in this breeding programme.

In collaboration with Pathology Branch, a number of compounds was screened for efficacy of 'wildfire' control in tobacco. In particular, the copper-based treatments for tobacco were investigated with a view to registration with the Technical Committee on Agricultural Chemicals. The copper levels in dry tobacco leaf ranged from 26 to 478 micrograms per gram. The degree of disease control has still to be related to treatment and level of residual copper.



Soil chemist Dr. J. Standley, examines results obtained from an Auto Analyser at the Bioloela Research Station. The equipment was purchased from Oil Seeds Research Funds for studies of nitrogen and phosphorus in soils.

Cereal chemistry

The cereal chemistry section stationed at the Queensland Wheat Research Institute has the responsibility for quality assessment within the Department's wheat and barley breeding programmes and also conducts research in quality methodology.

In the wheat programme, 12 crossbreds were evaluated in the regional trial series, the final stage of testing. The results suggested that eight of these had acceptable quality and these will again be evaluated during the 1981 season.

The programme to develop a malting barley variety as a replacement for Clipper received a setback with the finding that the most promising crossbred, Bus/Zep 166, exhibited wort filtration problems when the malt was produced using optimum conditions for Clipper. Subsequent research established that wort filtration performance equal to that of Clipper could be achieved through slight modification of the malting procedure. It is intended to conduct commercial malting tests on samples of this crossbred from the 1981 season.

Research on the use of near-infrared reflectance spectrophotometry for measuring quality characteristics of wheat was continued during the year. The advantage of this method is that analysis requires less than 1 min per sample. The use of techniques for calibration recommended by the manufacturer of the instrument led to constant bias in the prediction of wheat protein content. Alternative methods for calibration were studied and a strategy was formulated to develop calibration equations with minimum bias. The section is co-operating with C.S.I.R.O. Division of Tropical Pastures to evaluate a method for measuring nutritional quality of pastures.

Crop nutrition and soil fertility

Phosphorus deficiency continues to be the area of greatest nutritional concern and is the subject of considerable research in co-operation with Agriculture Branch.

In the South Burnett, nine superphosphate rate trials with soybeans have been established to field-test phosphorus rate predictions based on newly developed phosphorus sorption and calcium chloride-extraction soil tests.

On the Atherton Tableland, field calibration studies are under way to relate soil phosphorus tests to superphosphate requirements of *Desmodium* pastures. Here also, a long term trial has commenced to compare superphosphate with Duchess rock phosphorus as a phosphorus fertilizer for legume-based pastures.

In Biloela and Emerald, current and residual effects of superphosphate on sorghum and sunflowers are being investigated.

Studies on rice grown on the black 'Baratta' soils of the lower Burdekin have shown that soil phosphorus levels required for optimum growth are low (5 p.p.m. P) by other crop standards. However, since these soils are severe fixers of fertilizer phosphorus, residual responses are small and, although phosphorus requirement is low, applications must be made annually.

One particular area of concern is the effect that spatial distribution of fertilizer phosphorus in soil has on its utilization by the crop. This is being investigated in glasshouse studies using radioactive phosphorus fertilizer.

Other nutritional work involves investigations of potassium, calcium, sulphur and cobalt deficiencies.

Sixteen field trials have been completed on soybeans in the South Burnett in a programme designed to relate potassium soil tests to potassium fertilizer response.

Calcium nutrition studies on low fertility granitic sand and yellow earth soils of the Atherton Tableland are aimed at defining soil calcium levels below which gypsum is needed to prevent 'pops' in Virginia Bunch peanuts. Results to date show that gypsum produces only marginal improvement even on soils of apparently low calcium status. A glasshouse trial is under way to relate peanut growth to alternative chemical measures of soil calcium.

Sulphur studies on rice in the Burdekin and on pastures of south-east Queensland have revealed no significant incidence of sulphur deficiency in these areas.

A cobalt analytical survey of pastures in Queensland, carried out in co-operation with Beef Cattle Husbandry Branch, has detected areas in which pasture cobalt levels are low enough to induce cobalt deficiency in stock.

Soil fertility decline with cultivation of cracking clay soils has been studied at the Queensland Wheat Research Institute. Rate of decrease of soil organic matter varied between soil types but was characterized by an initial fast reaction for the first few years, followed by a slow, long-term reaction. Decrease in organic matter was associated with an increase in soil bulk density and a reduction in wheat yield.

Soil physics

Soil water

Irrigation efficiency studies continue in the Emerald irrigation area. Techniques employing modern electronic equipment for run-off measurements are being developed.

A large part of Queensland agriculture is based on cracking clay soils. The physical processes in swelling and shrinkage of these soils have only recently been understood. Work on clay soils at Emerald has provided a mathematical description of shrinkage as soil dries. This will simplify consideration of bulk density changes with water content on all cracking clay soils.

Soil management

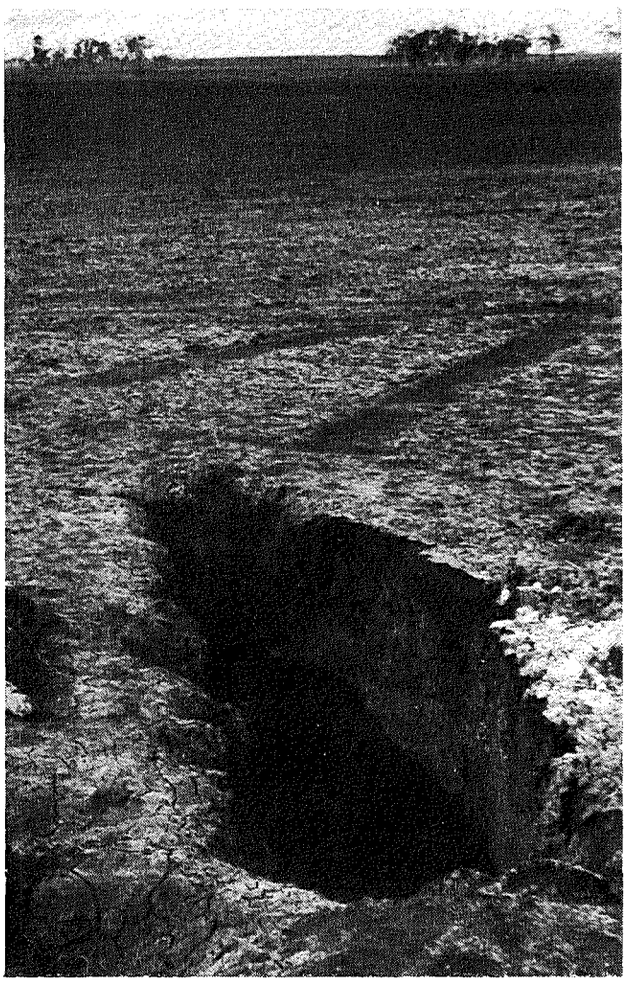
A co-operative peanut yield survey at Kingaroy suggested that the predominant factor affecting yield was rainfall, but there is potential to improve peanut yield. A co-operative field trial on a low yield paddock at Wooroolin aims at examining the effects of bulk density and soil water availability on yield.

In a co-operative trial on a tomato soil at Bowen, the effect of gypsum, molasses, lime and sand has been examined. The treatment giving most change in physical properties was topdressing with 10 cm sand. Tomato yield did not respond to any treatments.

The effect of gypsum, deep ripping, weed control methods and previous crops on the clod problem in mechanically harvested potatoes was examined in a co-operative project at Gatton Research Station. Clods were reduced where gypsum was applied or where weeds were controlled by chemicals rather than by hilling. An unusual result was that gypsum reduced yield of potatoes.

The use of fertilizer by-product gypsum as an amendment to improve physical conditions of certain soil types has increased, especially on the Darling Downs.

As part of a co-operative project between Queensland Wheat Research Institute and the Dalby Agricultural College, long-term demonstration areas with different stubble handling and tillage systems have been set up at the College. In a separate project, the effect of gypsum on physical properties of a range of soils is being studied to develop a test for gypsum responsiveness.



An area of badly salted land on the Darling Downs. Evaporation from a shallow, saline water table has concentrated salts on the soil surface, preventing plant growth. The demonstration pit in the foreground was dug to illustrate soil profile changes and depth to the water table.

There is often concern that harmful changes in valuable agricultural soils may occur over a period of time. Projects to monitor changes in soil properties over several years are under way on some irrigation farms at Emerald and on Brigalow Research Station.

Land degradation—salinity

In the lower Burdekin Valley, dryland seepage salting occurs at the lower slope interface with the alluvial soils. Past research has led to a basic understanding of the salting processes. This is being extended to map and identify suspected seep areas based on the land form and land use factors associated with the salting. Landsat imagery techniques are being used. Monitoring of the identified areas together with a drained area is continuing to determine trends and factors associated with changes in salting.

Underground drainage of shallow basaltic cracking clays in the Emerald Irrigation Area which are affected by high water tables has been successful in restoring cotton yields. The deeper, more salinized tertiary basaltic cracking clays have soil structural problems resulting in very poor crop establishment. Various amelioration and management approaches are being investigated.

Research at two dryland salting occurrences on the Darling Downs near Oakey and Dalby has continued. Deeper piezometers have been inserted, and this technique has allowed an estimate of the extent of aquifers contributing to the high water tables in the salted area. Drainage and soil amelioration programmes are being designed, based on the recharge characteristics of the aquifers and the quantity and quality of the water which must be removed to lower the underground water to a level safe for crop production.

An extensive field sampling of irrigation waters and irrigated soils has been completed in the Lockyer Valley. This sampling is designed to study the effects of water quality, soil type, and crop management on the accumulation of salt in the soils. This research will allow the formulation of more quantitative guidelines for selection of waters for irrigation.

Processes operating in dryland salting near Biloela on soils derived from the saline 'Rannes Beds' formation are being investigated at one site. The study will monitor changes, identify source waters contributing to the salting and plan appropriate managements for these saline groundwaters. Some work on the salinity of the underground water supply in the Callide Valley has given useful information on recharge areas and areas where saline water is entering the alluvial aquifers.

Land resource assessment

The 1:100 000 soil survey of 190 000 ha of the lands of the South Burnett (Kingaroy, Wondai, Murgon and Nanango Shires) will include 1:25 000 surveys of 10 reference areas representative of the major soil landscapes. It will provide a soils inventory for soil conservationists, agronomists and agricultural extension officers in design and implementation of their programs. Thirty-six representative soil profiles have been sampled for laboratory analyses. The Chelmsford reference area of 1 200 ha has been mapped at 1:25 000. A 30-ha area acquired by the Department has been mapped in detail at 1:2 500.

The 1:50 000 soil survey of 61 000 ha of the Lockyer Valley alluvia will provide a soils inventory for research into problems including the use of saline waters, soil compaction, calcium-magnesium balance and soil amelioration with gypsum. To date, 9 000 ha have been mapped. A 1:5 000 soil survey has been made of the Gatton Research Station.

The Beach Protection Authority was provided with a report on the soils of the North Mulgrave Coast, north of Cairns. A 1:50 000 soils map of the 2 300 ha is in preparation.

A soil survey of the Bowen district will provide a 1:100 000 survey of 85 000 ha in potentially arable lands with four reference areas of approximately 1 500 ha each being mapped at 1:25 000. A 1:250 000 survey of 75 000 ha of grazing lands will also be done. The legend-making phase is in progress.

A 1:5 000 soil survey of the catchment study area on Brigalow Research Station will give detailed data on the soils of the catchments for research purposes. The field work is complete.

A 1:100 000 soil survey of 17 000 ha of the Crooked - Piggy Piggy - Yambocully Creeks area near Goondiwindi is to provide information on the suitability of the soils for irrigation development. The field work is complete and an interim report has been prepared.

A 1:100 000 soil survey of 10 000 ha of the Sunshine Coast, Bribie Island to Teewah is to give the Beach Protection Authority an inventory of soils to be used in their management of beach areas. The field work is complete and representative profiles have been analysed in the laboratory.

Evaluation and planning of State projects

A 1:25 000 soil survey of 15 000 ha of the right bank of the Nogoa River in the Emerald Irrigation Area provides a soil inventory for the subdivision of irrigation farms by the Queensland Water Resources Commission. A soils map has been printed, representative profiles have been analysed in the laboratory and a report is in preparation.

A 1:100 000 soil survey of 200 000 ha of the southern area of the Lower Burdekin Valley includes 1:25 000 surveys of four reference areas representative of major soil landscapes. This survey completes the 1:100 000 soils inventory, with associated 1:25 000 reference area mapping, of 370 000 ha of the Lower Burdekin Valley for planning irrigation and pastoral development and management. Field survey is complete and representative profiles are being analysed in the laboratory.

Method development

A method based on high performance liquid chromatography (HPLC) has been developed for the quantitative determination of MCPA and dicamba in herbicide formulations. Subsequently it has been found that the Collaborative International Pesticides Analytical Council (CIPAC) has adopted a very similar procedure. The procedure has advantages over existing methods, where methylation and extraction steps are required. Related compounds such as 2,4-D, 2,4,5-T and mecoprop may also be determined by HPLC. This method will be used for future analyses.

Analysts were involved in international collaborative method testing with CIPAC. The samples analysed were maneb in maneb-fentin formulations and propineb in propineb formulations.

A second edition of 'Methods for Analysis of Pesticide Residues and Dip solutions' has been compiled. This is a working manual of analytical methods for the pesticides residue laboratory.

Molybdenum is an important trace element, deficiency of which in many crops may be limiting to growth. A method has been developed to determine trace levels of molybdenum using Inductively Coupled Plasma Emission Spectroscopy (ICPES). The method is being tested on reference materials and routine plant samples.

A method for determination of lead by ICPES in plant material has also been developed. This method is used mainly in experimental work. Lead is a difficult element to determine by more conventional chemical techniques.

Manganese and zinc are components of certain stock foods. A comparison of different methods of analysis for these elements was made. It was found that Kjeldahl digestion of samples, followed by Atomic Absorption Spectroscopy (AAS), provided a quick and accurate method of analysis for these elements.

Considerable work has been done on the theoretical aspects of analytical method development: (1) a scheme has been devised which will enable the development of an analytical method to be carried out systematically; (2) optimization strategies for multiparameter laboratory instruments have been investigated with a view to most efficient use of such instruments. A modification of the Simplex method has been very useful and is now used routinely in method development.

Further work on sampling of bagged fertilizers was carried out. Accurate sampling of fertilizers is essential for regulatory purposes.

Chromium oxide is used as a marker in animal feeding experiments since it passes through the animal completely unchanged. Further work on field sampling, sub-sampling and laboratory grinding of samples in preparation for estimation of chromium by ICPES was carried out.

Further work on the determination of the important element calcium in stock foods was carried out.

In the area of soil chemical analysis, research is in progress to establish a suitable method for measuring cation exchange capacity in acidic tropical soils with variable surface charge characteristics. Such soils are thought to be widespread in Queensland. There has also been a collaborative study with C.S.I.R.O., University of Queensland and other organizations to evaluate current soil methods used to assess exchangeable cations and cation exchange capacity.

New Auto Analyser systems for the purpose of increasing soil analytical accuracy and output have been installed and are operating in regional laboratories at Toowoomba and Biloela. Methods for assessing specific soluble salts in saline soils of Queensland have been defined and tested.

Regulatory

The Branch provides the analytical service for officers of the Standards Branch who administer the Agricultural Standards Act and the Agricultural Chemicals Distribution Control Act. The number of samples analysed for this purpose were—

Pesticide formulations	207
Veterinary medicine formulations	27
Fertilisers and limes	82
Stock feeds	365
Pesticide residues	64

The pesticide residue analyses relate to complaints under the ACDC Act over the incorrect distribution of pesticide by air craft.

Also, 121 export grain samples were analysed for the Australian Wheat Board for protein content, upon which the export price is based. Thirty-seven stone-fruit samples were tested for fungicide residue. The testing of fumigation chambers for certification has been continued.

General chemistry and services

Analytical services provided by the Branch are widely used by the Divisions of Plant Industry and Land Untilisation, and to a lesser extent by other Divisions within the Department of Primary Industries as well as by other State Departments (Local Government, Main Roads, Aboriginal and Islanders Advancement, Works). Almost all of the plant analyses and 67% of the soil analyses undertaken derived from research projects or surveys. Most of the remaining soil and water samples were associated with extension activities of the Department for the purposes of providing advice to primary producers on fertilizer requirements, plant nutrition problems and the suitability of waters and soils for irrigation.

Other analyses and specialist expertise were also provided to assist with soil physical problems, soil classifications, use of agricultural chemicals and identification of damage from them. General advice in areas of soil fertility and plant nutrition, including identification of deficiency and toxicity symptoms, was also given.

Samples analysed at the Indooroopilly laboratory were—

Type	No. Samples	No. Analyses
Plants		
For elemental analysis	17 052	52 525
Oilseeds for oil content	2 410	2 410
Oilseeds for fatty acids	146	584
Tobacco for alkaloids etc.	565	2 260
TOTAL	20 173	57 779
Waters	3 177	19 062
Miscellaneous pesticides	60	60
Miscellaneous stock foods and fertilizers	10	10
Other samples	18	18
Soils		
From research projects	7 176	58 254
From soil surveys	3 532	
For extension purposes	5 150	32 975

The numbers of plant samples for elemental analysis, of oil seeds for oil determination and of waters for water analysis have all increased over the last year.

The number of soil samples received for analysis increased significantly, as did the number of determinations provided on individual samples. This probably reflects a growing awareness by extension and research officers of the need to appreciate more fully the overall fertility of soil with which they are concerned.

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 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

Lucerne. The Hunter River replacement programme is a co-operative project with Entomology Branch and C.S.I.R.O. Division of Tropical Crops and Pastures. It has now reached the stage where 150 elite genotypes are being progeny tested under field conditions for resistance to anthracnose, Phytophthora root rot and aphids to select parents of a new synthetic cultivar. These genotypes are the parents of a bulked line 'APC cycle 3' which is being evaluated at several sites in southern Queensland.

Maize. Breeding lines and hybrid cultivars were screened for resistance to sugarcane mosaic virus (SCMV-Jg) and wallaby ear disease. Nineteen of 29 hybrids, including most of those currently recommended in Queensland, had adequate resistance to sugarcane mosaic virus. Wallaby ear symptoms on 19 hybrids were relatively mild.

Cereal chlorotic mottle virus (CCMV) was again very common in maize at Lawes, all plants in some highly susceptible lines being affected. Hybrids with one susceptible and one resistant parent were resistant and most commercial hybrids had moderate to good resistance. Wheat, barley and triticale were susceptible when grown in summer.

Further studies on the vectors and host range of maize sterile stunt virus (MSSV) have shown that barley, wheat and triticale are susceptible. The delphacid leafhopper *Sogatella longifurcifera* which colonizes *Echinochloa colona* and feeds on maize was shown to be an efficient vector of the virus.

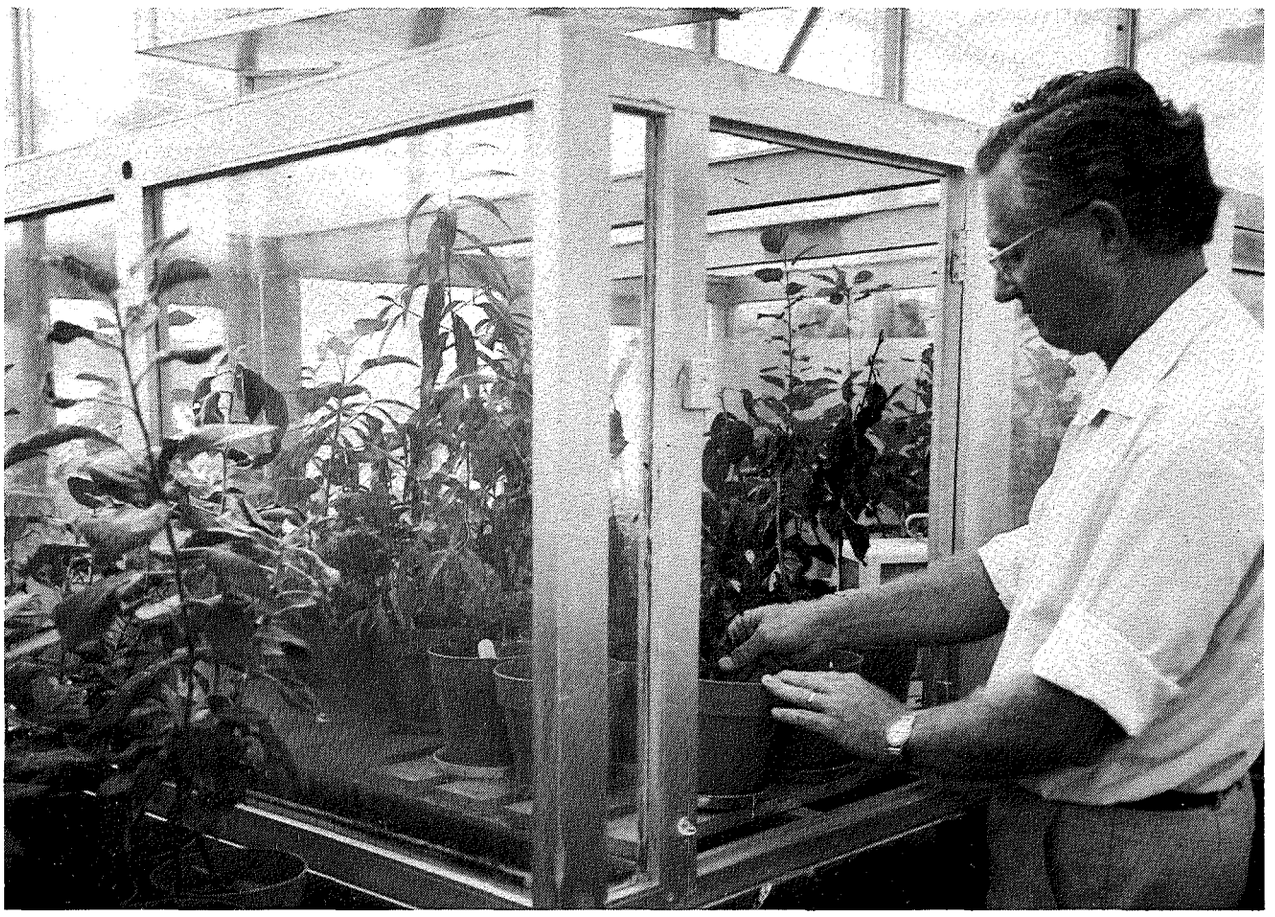
Peanuts. With routine monitoring of aflatoxin levels in peanut consignments delivered to the Peanut Marketing Board, peanuts with higher levels of aflatoxin are being kept for planting. As this has led to poor germination the effects of fungicide seed treatments on germination have been investigated.

Laboratory and field tests were made to compare the standard captan plus quintozene dust seed treatment with flowable formulations of other fungicides and fungicide mixtures. Seed treatments were compared at two sites and plantings were made under different weather conditions using two cultivars and two depths of planting. A flowable formulation of dicloran plus captan was as effective as the standard dust treatment and caused much less discomfort to the applicators.

Pumpkins and marrows. In a joint project with Horticulture Branch to develop pumpkins and marrows resistant to watermelon mosaic virus (WMV-1 and WMV-2), Queensland Blue and Butternut pumpkins were crossed with *Cucurbita ecuadorensis*. Backcross progeny have been screened for resistance to WMV at the Redlands Horticultural and Gatton Research Stations.

Safflower. Leaf blight (*Alternaria carthami*) is an important disease limiting the expansion of the safflower industry. Screening of safflower lines for resistance to this disease was continued, using lines recently obtained from the C.S.I.R.O. Breeding Programme. Several appear to be more resistant than cv. Gila.

A plastic-covered shelter at the Hermitage Research Station is used to exclude rain in a study of the effect of moisture stress on lodging of sorghum.



A plant pathologist uses a controlled environment cabinet in the new glasshouse at Applethorpe to study root diseases of deciduous fruit trees.

Leaf blight is a seed-borne disease and it is difficult to procure disease-free seed. Sprays of captafol and mancozeb applied three times during flowering reduced infection but it is doubtful if the level of control is sufficient to warrant commercial use.

Sorghum. A breeding programme carried out in conjunction with Agriculture Branch to incorporate resistance to sugarcane mosaic virus (SCMV-Jg) into sorghum has been completed with the release of four more lines (QL19-QL22). This programme has resulted in the release of 16 lines. These are now being used in most breeding programmes in Australia and seven hybrid cultivars resistant to SCMV were available commercially in the 1980–81 season. The lines have also been supplied to plant breeders in other countries.

Sets of 10 differential sorghum lines for SCMV strains were distributed for testing in eight countries. The resistance derived from Krish sorghum appears to have been effective against all but two overseas strains of SCMV.

Soybean. Phytophthora stem rot (*Phytophthora megasperma* f. sp. *glycinea*) continued to spread through the soybean growing areas of southern Queensland. It has not been reported from the Central Highlands or north Queensland. In most districts where the disease occurred, there was at least one field where the crop was a complete loss. Cultivars which sustained heavy losses included Semstar, Fitzroy, Flegler, P24, Bragg and Wills. Davis showed acceptable field resistance.

Fifty-four isolates of *P. megasperma* f. sp. *glycinea* from soil and diseased plants were typed to determine the races present in Queensland. Twenty-two were Race 1 and two were Race 15.

The disease reaction of soybean cultivars to hypocotyl inoculation with *P. megasperma* f. sp. *glycinea* Race 1 was studied. None of the commercial soybean cultivars grown in Queensland was found to contain a major (race specific) resistance gene. Some breeding lines were immune to Race 1.

In a field trial at Hermitage, metalaxyl seed dressing reduced post-emergence losses of Ross, a susceptible cultivar, for at least 28 days after sowing.

Sunflower. Before 1980 all collections of sunflower rust (*Puccinia helianthi*) from Queensland were typed as Race group 1. In 1980 there was evidence of a change in the race population as some hybrid cultivars were severely affected for the first time.

Nine cultivars were observed for their reactions to the two races of rust. No pustules were found on line R 266 and few were found on Hysun 30. Both lines were very sensitive to rust at the cellular level but the fungus did not complete its life cycle.

Tobacco. Metalaxyl continues to control blue mould (*Peronospora hyoscyami*) so well that the disease was not reported from any commercial planting. The L.D. 50 of the pathogen has been determined and will be monitored each season to determine whether there has been any change in resistance of the pathogen such as has been reported from overseas.

Wheat. Studies on the long fallow disorder of wheat on the Darling Downs have shown that the condition can be corrected by treatment of the soil with fumigants and non volatile nematicide-insecticides.

The following observations have been made: (1) roots of wheat crops that exhibit zinc and phosphorus deficiencies when grown first after a long bare fallow are not as well provided with vesicular-arbuscular mycorrhizas as roots of wheat grown after short or no fallow; and (2) second wheat crops that grow poorly in the crop sequence sorghum–sorghum–sorghum–long fallow–wheat–wheat–wheat are heavily infested with the root lesion nematode *Pratylenchus thornei*. Barley grew well where wheat failed and some wheat cultivars were more affected by long fallow disorder than others.

In field trials on the Darling Downs cv. Gala showed the best resistance to crown rot (*Gibberella zeae*) while Cook, Timgalen, 2338-9, 2421-4 and Puseas ranged from moderately to highly susceptible and Banks, 7605 and the triticale cv. Satu were very susceptible. These results are used for disease control recommendations and by breeders when considering the release of new cultivars.

Studies in 1979 and 1980 on advanced generations from the cross Puseas x Gala have provided some evidence that there are lines with resistance intermediate between those of the two parents. This is a further indication that resistance must be controlled by more than one gene.

Fifty samples of wheat from the Darling Downs, the Western Downs and the Lower Division were collected and their sub-crown internodes rated for severity to common root rot (*Cochliobolus sativus*). Although disease was generally less severe in 1979 than in 1978, it was present in all areas with highest incidence in the south-west and western Downs. Studies indicated that cvv. Timgalen, Shortim and Songlen are highly susceptible; Kite and four breeding lines have useful field resistance; and Cook, Banks, Gatcher and Oxley are intermediate in reaction.

As more growers practise stubble mulching, yellow spot (*Pyrenophora tritici-repentis*) has increased in importance. Most hard-grained cultivars currently grown were shown to be extremely susceptible with yield losses around 50% under conditions favouring disease development. Valuable sources of resistance to yellow spot

were found in field tests with 150 cultivars and breeding lines. These included most of the cultivars currently grown in Australia, lines frequently used as parents in Australian breeding programmes and some overseas cultivars reported to be resistant.

Pastures

Stylosanthes. Anthracnose (*Colletotrichum gloeosporioides*) is a serious disease of seed crops in north Queensland. Field trials have shown that benomyl sprays applied four times at fortnightly intervals from the first appearance of anthracnose followed by monthly sprays while the weather remains showery gives good control and increases seed yield.

Horticultural crops

Avocado. Post-harvest rots, mainly anthracnose (*Colletotrichum gloeosporioides*) continue to be a serious problem. In experiments conducted in co-operation with officers of the New South Wales Department of Agriculture, a new fungicide applied in a post-harvest dip at ambient temperature gave very good control of the disease.

Careful and detailed research will be required to develop the fungicide for commercial use. Efficacy, possible phytotoxicity and safety to operators and consumers are aspects which require careful consideration.

Crucifers. Twenty-two cabbage cultivars were tested for resistance to yellows (*Fusarium oxysporum* f. sp. *conglutinans*). Eleven were highly resistant, nine were susceptible and two were intermediate in resistance. Of the resistant lines, Rampo and Selection 1488 performed very well in Horticulture Branch trials.

Cucurbits. The value of spraying with a mineral oil-insecticide mixture or using reflective polythene mulch to reduce the spread of watermelon mosaic virus in zucchinis was investigated at the Redlands Horticultural Research Station. The results suggested that the treatment has some value when the level of inoculum is low during early growth.

In a similar trial on the Atherton Tableland, mulching with aluminium foil increased the yield of virus-free zucchinis by 750%. Weekly sprays with mineral and vegetable oils, surface active agents and systemic insecticides used alone or in combination with mineral oils were not effective.

Mango. In recent years, dipping mango fruits in benomyl at 52°C has become a common commercial practice in the Bowen district to control anthracnose (*Colletotrichum gloeosporioides* var. *minor*). A new fungicide gave equivalent control of anthracnose when applied at ambient temperature but did not control stem-end rot (*Dothiorella dominicana*). No phytotoxicity was observed. Further research with this fungicide is envisaged as a dip which is effective at ambient temperature is much better suited to commercial practice than one where temperature has to be accurately controlled.

Papaw. Anthracnose (*Glomerella cingulata* var. *cingulata* and *Colletotrichum gloeosporioides* var. *gloeosporioides*) and stem-end rots (*Glomerella, Alternaria* and *Mycosphaerella* spp.) are responsible for serious wastage of papaws after harvest. In two experiments, a new fungicide gave very good control when used as a dip at ambient temperature. This is the first report of successful control of post-harvest diseases of papaws in unheated dips.

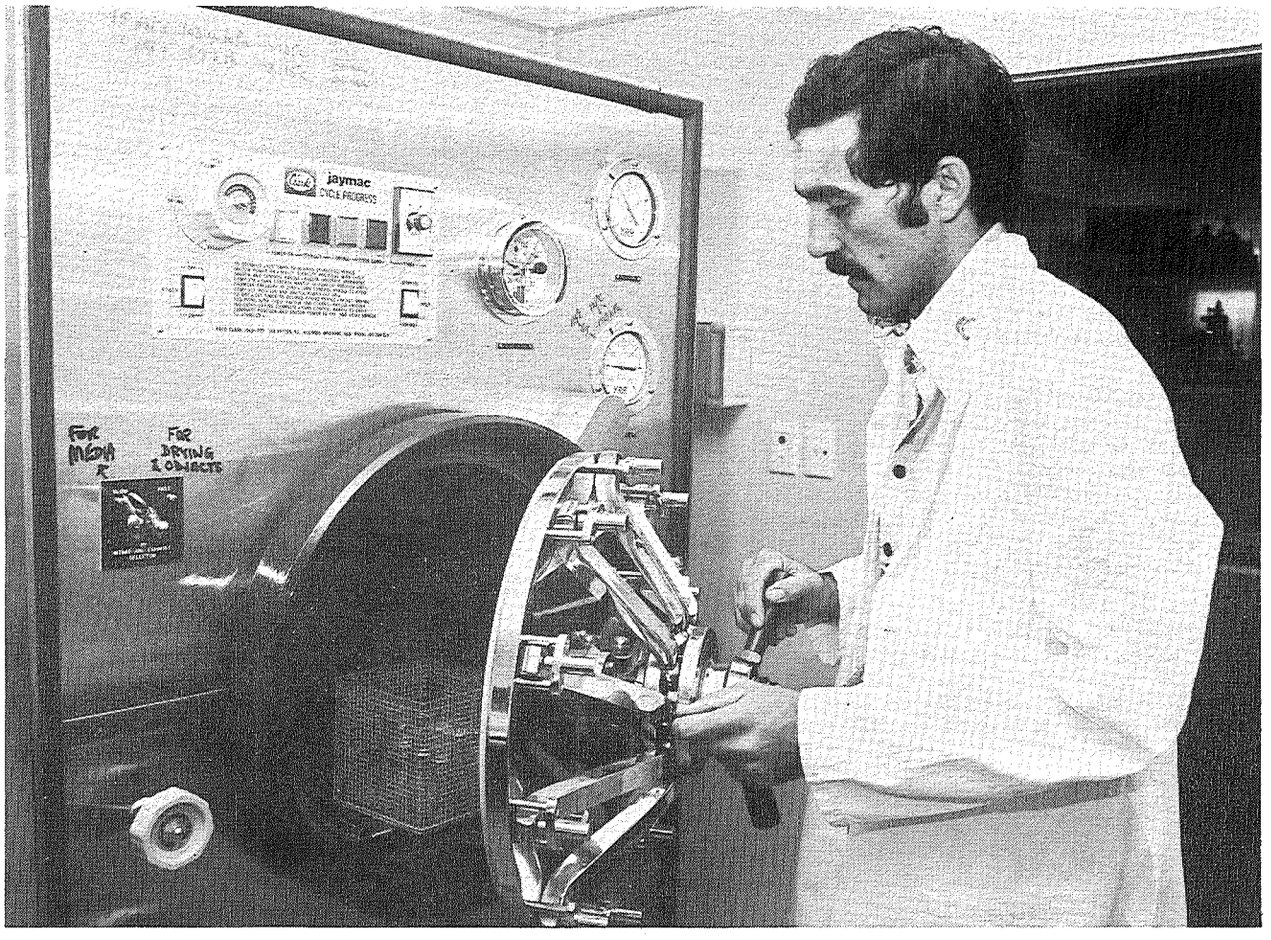
Ornamentals. Neck rot (*Stromatinia gladioli*) continues to be a major problem of gladioli growers. Soil treatments with iprodione, benomyl, vinclozolin or dicloran gave promising results in glasshouse tests and are now being evaluated under field conditions.

Pineapple. Although metalaxyl continues to give very good control of root and heart rot (*Phytophthora cinnamomi*) the development of resistance may follow continuous use. The value of fosethyl-Al, Dowco 444, RM442, RM445, RM449 and other systemic fungicides are being assessed in field trials.

Sweet corn. Breeding lines and hybrids were evaluated for resistance to sugarcane mosaic virus (SCMV-Jg) and wallaby ear disease. Five hybrids—QS467, three Kairi experimentals and Yates experimental 50—proved highly resistant to natural infection. Of the 22 Kairi Advanced Sweet 1 (AS1) and Advanced Sweet 2 (AS2) lines, 12 were highly resistent to SCMV-Jg and developed only mild symptons of wallaby ear disease. Four of these lines have been selected for use as new tester lines for the AS1 and AS2 populations and for use as parents for experimental hybrids with commercial potential in south Queensland.

Tomato. Fusarium wilt (*Fusarium oxysporum* f. sp. *lycopersici* Race 3) continues to threaten the future of the tomato industry in the Bowen district. Several tomato lines with some field resistance have been found, the most promising being the breeding lines U.S. 638 and U.S. 629. Some large fruited selections of U.S. 638 have been made and F_1 hybrids of U.S. 638 with Walter and Flora-Dade are being field tested.

Tomato yellow top (TYTV) occurred around Brisbane and D'Aguilar. In one crop 50% of the plants were affected. All commonly grown tomato cultivars in Queensland are susceptible to yellow top. In limited tests, some resistance was found in lines of *Lycopersicon hirsutum* f. *glabratum*, L. *peruvianum* and L. *pimpinellifolium*.



An experimentalist using the new autoclave to sterilize culture media at Applethorpe.

The properties of TYTV established so far indicate that it is a member of the luteovirus group serologically related to potato leaf roll virus.

Two races of *Verticillium dahliae* occur in south-eastern Queensland and, with further cultivation of tomato cultivars resistant to Race 1, an increase in Race 2 is predicted. More than 100 tomato introductions and breeding lines were screened for resistance to Verticillium wilt. Although several were resistant to Race 1, only one plant in the line Morden (Mel 26681706) has maintained resistance to Race 2 through two inoculations. A plant breeder at the Redlands Horticultural Research Station has crossed Morden and Flora-Dade.

New diseases

An ergot disease was prevalent on buffel grass in central Queensland and caused considerable loss of seed. Conidial characters are similar to those of *Claviceps fusiformis*.

Another ergot (*Claviceps maximensis*) was recorded in 1980 for the first time in Queensland from guinea grass on the Atherton Tableland. Subsequently the disease was found to be common on green panic in south-eastern Queensland.

Some fungi associated with dieback of mangoes at Bowen are being investigated. Several new taxa have been found including a teleomorph for *Cytosphaera mangiferae*.

Dematophora necatrix (white root rot) was isolated from declining apple trees at Pozieres.

Bacterial leaf spot (*Pseudomonas mori*) of English mulberry was recorded in a home garden at Stanthorpe.

Peach canker and gummosis (*Phytophthora cinnamomi*) was recorded from a young peach orchard at Stanthorpe.

An undescribed species of needle nematode (*Paralongidorus*) was found associated with severe stunting of rice near Ayr.

Diagnostic services

More than 2 200 inquiries requiring disease diagnosis were handled through Indooroopilly and the seven country field stations.

The specialist bacteriologist handled 155 samples which required detailed laboratory checking. The nematologists examined 1 800 plant and soil samples. In the virology section more than 700 specimens were examined with the electron microscope and 300 were indexed in the glasshouse.

Bacteriology

Isolates of *Pseudomonas tabaci*, the causal agent of wildfire in tobacco at Mareeba, were compared with two isolates from New South Wales and named isolates of P. *tabaci* and P. *angulata* from the National Collection of Plant Pathogenic Bacteria, Harpenden, U.K. The characteristics of these isolates were very similar but there were differences in the rate of lesion development on Burley 21 and in their toxin production. Toxin production was examined using a nutrient agar medium and the test organism *Escherichia coli*. Results of toxin production in a preliminary test could not be correlated with toxin production in plants.

Studies were made of the effect of various factors on the survival of *Pseudomonas solanacearum* in soil. The bacterium survived in fallow soil for 22 months apparently without loss of pathogenicity. Epiphytic populations on the cotyledons and true leaves of capsicum plants were affected by relative humidity and the concentration of inoculum surviving on the seed.

Legume bacteriology

During the year, 96 rhizobial cultures were supplied to agrostologists and farmers for 11 different legumes for which there are no commercial cultures.

Strains of rhizobia were selected for soybean cv. Davis, for guar cultivars and for leucaena. In addition, nodulation effects of fungicide seed treatments of soybean seed and slow establishment of cluster clover were investigated.

Virology

Two strains of potato virus Y (PVY) have been found in the Mareeba, Bowen and south-east Queensland areas. One strain causes veinal necrosis in tobacco cv. NC95 and vein-banding in Turkish tobacco while the second strain causes only vein-banding in both cultivars.

The reactions of tobacco cultivars and breeding lines to the veinal necrosis strain of PVY were assessed. The veinal necrosis symptom in susceptible tobacco cultivars was shown to be dependent on the temperature at which the plants are grown after infection.

Mycology

The relationship between *Phytophthora megasperma* isolates from chickpea, lucerne and soybean was investigated by studying growth-temperature relations, host specificity and the ability to induce a cross-protection reaction.

The cardinal temperatures for growth of seven isolates from lucerne and chickpea were similar with a minimum of 7°C, an optimum of 24 to 28°C and a maximum of 31 to 34.5°C. This was in contrast to isolates from soybean which had a minimum of 7 to 10.5°C, an optimum of 28 to 31°C and a maximum of 34.5 to 37°C.

Cross inoculation studies indicated that P. *megasperma* isolates from chickpea and lucerne are genetically the same and different from those from soybean.

Isolates of P. *megasperma* from lucerne and chickpea both provided a temporary level of cross-protection in soybean hypocotyls against P. *megasperma* f. sp. *glycinea* when the challenge inoculation was made into the same site into which the elicitor had been placed. P. *drechsleri* and P. *nicotianae* var. *nicotianae* provided higher and more permanent levels of cross-protection than did P. *megasperma* isolates from lucerne and chickpea while *Phytophthora* spp. from mangrove provided no cross protection.

A study of generic concepts in the complex of fungi commonly referred to as *Drechslera* sens. lat. was completed. The data obtained support the hypothesis that three genera can be recognized in this group, namely *Drechslera* sens. str., *Bipolaris* and *Exserohilum*. Aspects of conidial germination, maturation and hilum structure are useful indicators of generic affinity and are predictive with respect to the teleomorph correlations: *Drechslera-Pyrenophora*, *Bipolaris-Cochliobolus* and *Exserohilum-Setosphaeria*.

A number of marine species of *Phytophthora* has been found associated with mangroves. It was concluded that some stress has to be imposed on *Avicennia* trees before they are susceptible to invasion by these fungi.

Mycotoxins

The effects of water stress on aflatoxin development in two peanut cultivars were examined. Toxin was detected when stress was imposed on two maturing crop treatments having pod moisture levels between 28 and 35%. No more than trace amounts of toxin were detected in unstressed plants and in three treatments stressed when pods were immature and pod moisture levels were between 36% and 68%.

No cultivar differences in aflatoxin levels were detected in intact pods.

The effect of population and spatial arrangement on the aflatoxin level, yield and quality of Spanish peanuts was examined at four sites under drought stress conditions. Treatments had little effect on kernel quality although they affected yields.

Studies on the time course of aflatoxin development suggest that the toxin level in edible kernels increases as the crop ages but did not suggest that over-maturity on a whole crop basis is a prerequisite for contamination. In three of four experiments, toxin was detected 14 to 31 days before the attainment of maximum pod weight and while increases in kernel quality were still occurring.

Quarantine

Three hundred orchids (35 different cultivars) from New Zealand, Papua New Guinea, Philippines, Singapore, Solomon Islands and Thailand were found to be infected with Cymbidium mosaic virus.

Sesame seedlings from 42 lines of seed from China, Somalia, Turkey and the U.S.A. were observed with curled leaves and chlorotic leaf blisters. An electron microscopic examination indicated that the disease may have been caused by a potyvirus. The rate of seed transmission was 100%.

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 sugar-cane and forest products) and crop products grown in Queensland.

Through the extension services to make these control measures available to the primary producing community.

To investigate the taxonomy, biology and ecology of economically important insects (whether pests or beneficial species) with the aim of establishing a sound, scientific basis for the development of pest management systems.

To provide an insect identification service for other branches of the Department, quarantine authorities, primary producers and the community in general.

To develop improved methods of beekeeping and to provide an advisory service to apiculturists.

The Branch operates on a decentralized basis from Branch headquarters at Indooroopilly, five field stations in southern Queensland, three in central and one in north Queensland.

Pest activity

Locusts

Locusts were not a significant problem in Queensland during 1980–81. None of the three major locust species, Australian plague locust *Chortoicetes terminifera*, spur-throated locust *Austracris guttulosa* or migratory locust *Locusta migratoria*, caused any serious damage to crops and pastures.

The only notable activity by spur-throated locusts and migratory locusts occurred in January with the hatching of eggs of both species in widely dispersed areas east of the Dawson River in the Port Curtis region. Hatching of spur-throated locust eggs also occurred in localities west of the Dawson River. Only minor damage was inflicted on crops and pastures in the region and the locust populations eventually declined without forming dense concentrations. By the end of the year, only scattered, adult spur-throated locusts persisted in central and some southern areas, while few migratory locusts could be found.

During the early part of the year, the Australian plague locust existed in southern and central areas only as isolated and scattered adults, although a moderately dense population of adults was seen in the Roma district during November. The first significant activity by this locust was recorded from southern border districts in January, when hatching of eggs occurred at what was formerly an important outbreak site a few kilometres north-west of Goondiwindi. However, seasonal conditions did not favour the locusts and they did not attain the dense concentrations experienced with previous infestations. Damage to crops and pastures was minimal.

Small-scale breeding continued, resulting in the formation during late March and April of several adult swarms and medium-density concentrations in the far south-west and one adult concentration in the Goondiwindi district. Some egg-laying occurred in mid April and some of these eggs had hatched by early May, but the emerging hoppers did not form dense bands and little damage ensued.

Some southward migration by adult swarms into northern New South Wales from the far south-west occurred during April, but a few scattered individuals and low-density adult concentrations remained in southern areas.

At no stage did the Australian plague locust populations in Queensland attain densities sufficient to cause serious economic problems to landholders.

Heliothis

During spring, intense early season activity by *Heliothis* spp., mainly native budworm *Heliothis punctiger*, occurred on crops throughout such widely-separated regions as the Darling Downs, Lockyer Valley, South Burnett, Callide-Dawson Valleys, the Central Highlands and the Redlands district. Egg-laying was particularly heavy on lucerne and linseed crops in southern districts, on lucerne at Biloela and on sunflower plants in the Emerald Irrigation Area. Early-planted cotton on the Darling Downs also attracted considerable oviposition by *Heliothis* moths.

Several lucerne growers in the Biloela district sprayed their crops for control of *H. punctiger* to prevent excessive defoliation. In this district, insecticide applications are rarely needed to control this pest in lucerne as natural epidemics of a nuclear polyhedrosis virus often decimate populations of *Heliothis* larvae.

In the Redlands area, crops of peas, beans and tomatoes were severely damaged as a result of heavy infestations of *Heliothis armiger* during September–October. Such intense early-season activity by this species is quite unusual. *Heliothis* activity declined in all other areas during the period October to late December, although in the Emerald Irrigation Area the light infestations that did occur were sufficient to cause a certain amount of tip damage in seedling cotton crops.

Activity began to increase again in late summer and autumn with the development of moderately-large infestations of the budworm *H. armiger* in grain sorghum crops on the Darling Downs, South Burnett, Callide-Dawson Valleys and Central Highlands. Insecticide sprays were applied in most localities, except in the Central Highlands where, owing to prolonged dry conditions, fears of poor yield potential deterred growers from using insecticides against the early stages of infestation. By the time crop-saving rains were received in late March, the *Heliothis* caterpillars were large and well-established and the chances of controlling them successfully were poor.

During the same period, *H. armiger* infestations were common in sunflower and soybean crops in south Queensland. In the South Burnett region, attacks on soybeans were most prolific during the vegetative stage of crop growth, but in some crops, infestations also occurred during the post-flowering period.

With the exception of a localized, heavy infestation at Cecil Plains, *Heliothis* infestations in south Queensland cotton crops were comparatively light during the latter part of the season.

Armyworms

A few localized armyworm infestations, predominantly *Pseudaletia convecta* were found on the Darling Downs during spring. Large numbers of an imported braconid wasp parasite *Apanteles ruficrus*, which had been reared at Toowoomba, were liberated in an attempt to establish it in the region to control armyworm populations.

In coastal areas, armyworm activity was more common later in the season. Infestations of the common armyworm *P. convecta* attacked pasture grasses, cover crops and crops of sweet corn in the Redlands district during February–March, while pastures in the Nambour district were damaged by heavy infestations of the day-feeding armyworm *Spodoptera exempta* during late March to early April. This was the first large-scale outbreak of *S. exempta* recorded from the area. All types of pasture grasses, but particularly kikuyu, were affected and many pastures were reduced to bare earth. Fortunately, heavy rain intervened, promoting some pasture regeneration and also assisting in the development and dispersal of viral and fungal pathogens which eventually brought an end to the armyworm outbreak. Braconid wasp parasites *Apanteles* spp. were active and probably also contributed to the decline of armyworm populations.

The outbreak is believed to have arisen under the influence of a combination of climatic factors. A dry early summer period allowed armyworm populations to multiply in the absence of disease and then good rain in February promoted pasture growth which sustained the increase and led to the development of a massive population in the final generation. Past experience in north Queensland has shown that similar climatic conditions favour the development of *S. exempta* populations in that region.

However, despite the build-up of armyworm populations in coastal areas, overall, the situation in south Queensland was much less severe than that experienced during the armyworm outbreak in 1978-79.

In central Queensland, an outbreak of dayfeeding armyworms *Spodoptera* sp. in grain sorghum crops was the most severe for many years, the armyworms having invaded crops from surrounding areas of pasture. Fortunately, although the infestations were widespread, in many instances damage to sorghum was slight as armyworms seemed to prefer grassy weeds to sorghum crops in an advanced stage of growth.

Sorghum midge

Large populations of the sorghum midge *Contarinia sorghicola* caused severe damage in most grain sorghum crops in south Queensland during late summer - autumn. In fact, infestations of sorghum midge on the Darling Downs and in the Lockyer Valley were the most widespread and severe for many years. Except where irrigation was available, planting of sorghum had been delayed until November–December owing to the earlier drought conditions. This resulted in large areas of flowering sorghum during February at a time when midge populations can be expected to be at a maximum.

Also because of the seasonal conditions, the flowering period within individual crops extended over several weeks, thus making the crops even more vulnerable to increased midge attack. Growers who normally would plant early to escape midge attack had to apply four and sometimes five insecticide sprays to protect their crops. Despite the erratic crop development, overall yield potential fully justified this expenditure.

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During this period, large populations of midge parasites also occurred. Although they gave no protection to crops at this stage, their activity resulted in a sudden decline in midge populations in subsequent generations.

Sorghum midge was a major problem also in grain sorghum crops in central Queensland. As in southern areas, a combination of staggered plantings, uneven growth due to moisture stress and prolonged showery weather during February–March resulted in heavy midge infestations during the main flowering period.

Stored products insects

The grain industries continue to be the focus of major pests of stored products. Grain insects are a marketing problem in that the majority of grain is exported and buyers demand very high standards of freedom from insects. All central storages must meet these high standards as it is not practicable to segregate grain for export and local consumption.

The high standards at export continue to be met with the assistance of chemical grain protectants as the most economical and currently, as the most practical approach. Although there is a trend toward the installation of 'sealed' or 'air-tight' storage using fumigants or carbon dioxide, the special facilities required will not be available for the bulk of the grain crop for several years yet. Hence, protectants are expected to remain the mainstay of pest control in the industry for some time to come. It is pleasing to report that there is, as yet, no significant evidence of insect resistance to the organophosphorus, pyrethroid or carbamate insecticides despite up to 5 years of usage against grain pests.

The lesser grain borer *Rhyzopertha dominica* continues to be the most important pest species in bulk storages, although the other two major pest beetle species, the rice weevil *Sitophilus oryzae* and the rust-red flour beetle *Tribolium castaneum*, together with the tropical warehouse moth *Ephestia cautella*, possess the potential to be serious pests in Queensland. The emergence of any one of these as the dominant pest seems to depend on the complex relationship between pest biology and the characteristics of the protectant insecticide in use at any given time.

Interesting but less important problems during the year included a high level of field infestation in standing maize crops by the maize weevil *S. zeamais* and consequent migration of adult weevils into adjacent ripening crops of grain sorghum. Although little or no damage to the sorghum grain resulted, many farmers' loads were rejected by bulk handling authorities owing to the presence of live insects.

Research

Grain protectant studies

Intensive studies on newer grain protectants have been continued. Trials carried out during the year established that both emulsifiable concentrate and ultra low volume formulations of fenitrothion plus carbaryl were biologically effective against grain pests. However, both isophorone and dimethylformadine, which were used as solvents for the two types of insecticide formulation, proved to have undesirable attributes and further work must await alternative solvents.

Other investigations involved field proving of combinations of fenitrothion plus fenvalerate synergized with piperonyl butoxide and deltamethrin at a higher concentration synergized with piperonyl butoxide. Although the work is not yet complete, preliminary results appear promising. Deltamethrin, if successful, would be the first compound of the pyrethroid group capable of controlling all stored grain beetle pest species and this would be valuable as a possible counter measure to the further development of insecticide resistance.

In laboratory trials with candidate grain protectants, considerable work has been undertaken with the pyrethroid cypermethrin which, together with deltamethrin, has potential as a general purpose insecticide effective against the grain pest complex. Until now, the rice weevil *S. oryzae* has been the most difficult species to control. Current investigations indicate that the dose required to control *S. oryzae* will be about four times that of deltamethrin. However, cypermethrin is inherently cheaper and is less hazardous to use in that it has a lower mammalian toxicity and less tendency to produce respiratory irritation.

Additional carbamate materials have been screened against the weevil and, so far, bendiocarb has proved the most active compound. The required dose is high and further work is in progress to determine whether the minimum effective dose will be less than any Maximum Residue Limit likely to be set in the future.

Grain pests dispersal studies

Study of the dispersal patterns of the major stored products pests is an essential component in assessing the importance of farm infestations. Dispersal is not only the means by which infestation of commercial grain occurs, but also is important in spreading and diluting insecticide resistance genes. Most of these studies so far have been on emigration aspects of dispersal.

The total number of migrant insects that can be produced from relatively small food sources is surprisingly large. From one simulated farm residue of 27 kg of wheat more than 1m grain insects, predominantly rice weevils *Sitophilus oryzae* and to a lesser extent, lesser grain borers *Rhyzopertha dominica*, emigrated during summer–autumn. Such data show that farm populations may be very important in infestations of commercial grain. In earlier studies, large numbers of grain insect adults were caught in traps at a silo site on the Darling Downs during summer, while fewer were caught in traps remote from buildings. This suggests that there is a flux of migrating insects present in grain-growing areas.

Studies were undertaken also to evaluate the movement of insects between sites within a farm building. In major dispersal activity over some distance, flight is naturally important, but it may not be necessary within buildings. In one experiment, rice weevils *S. oryzae* and rust-red flour beetles *Tribolium castaneum* were able to cross-infest wheat bulks 25 m apart, within a week, simply by walking across the intervening space.

Buffel seed caterpillar control

A Pyralid moth *Mampava rhodoneura* has achieved recent prominence as a pest of buffel grass seed heads in the central Queensland region. The insect was first reported as a pest of buffel grass in April 1980 when it destroyed several seed crops in the Biloela district. During February–April of the past year, it caused widespread damage to buffel grass seed crops throughout central Queensland from as far west as Blackall to Mackay on the coast and south to Monto. Many affected crops were considered to be not worth harvesting and overall seed production was reduced substantially. The problem was of critical importance to several specialist growers who rely on buffel grass seed production for their major source of income.

The damage is caused by the caterpillar stage, which tunnels through the head, feeding on the developing seed. All varieties of buffel grass are attacked, but the tight-headed Biloela buffel variety seems to be preferred.

An effective control measure was required urgently, so a field screening trial was carried out at Biloela to select a suitable insecticide. Of the seven candidate insecticides tested, two—methomyl at 400 g ha^{-1} and fenvalerate at 80 g ha^{-1}—gave satisfactory control of the seed caterpillar.

Green peach aphid control studies

Potato leaf roll virus (PLRV) is a problem of autumn and winter potato crops in the Lockyer Valley and adjacent areas. In 1980, yields from winter-early spring crops affected by PLRV were a quarter of normal production.

The virus is transmitted by the green peach aphid *Myzus persicae* and a field insecticide trial was undertaken to determine whether the incidence of PLRV in potato crops could be minimized by controlling the aphid.

Precise monitoring of aphid numbers showed that effective control of aphid populations was achieved when insecticides were applied every 10 days, but at harvest there was no obvious difference between numbers of plants with PLRV symptoms in sprayed and unsprayed plots. Further investigation showed that 77% of the tubers harvested were infected with PLRV.

Additional research, as yet incomplete, is investigating the feasibility of protecting the plant from aphid attack from the time it first emerges. In an attempt to achieve this, granular systemic insecticides were applied at planting with the potato seed piece but, as yet, it is too soon to determine whether this approach will be successful.

Queensland fruit fly studies

An investigation of the ecology of the Queensland fruit fly *Dacus tryoni*, a major pest of fruit production in this State, in wild host areas of south-east Queensland has continued. The study is being carried out in an area of rainforest at Mt. Glorious to determine the influence of breeding in such areas on the development of infestations in commercial orchards. In this respect, it is important to be able to plot patterns of fruit fly dispersal and migration between the rainforest and orchards.

Three-quarters of a million marked fruit flies were released in the study area at Mt. Glorious during the spring and summer months. Their patterns of dispersal were plotted by recording the numbers of marked flies captured in traps located at specific sites around the release area. Marked flies were recaptured more than 15 km from the release site 3 weeks after release. Released flies survived for 4 months and recaptured females produced fertile eggs when held in the laboratory without additional food and water. Obviously these females were able to find adequate nutriment in the wild to enable them to mature sufficiently to produce eggs.

To complement the ecology study a protein hydrolysate-maldison bait spraying programme was carried out in a peach orchard adjacent to the ecology study area at Mt. Glorious in December 1980. Under the conditions of fruit fly population density occurring in the area at the time, the bait spray programme gave excellent control.

Gladiolus thrips control study

Gladiolus thrips *Taeniothrips simplex* is the major insect pest of commercial gladiolus crops in the Redlands district of south Queensland. Although heavy thrips infestations normally do not reduce the number of flower spikes produced, the quality of the blooms can be seriously impaired, resulting in rejection of blemished spikes at the market. Previous trials had shown that foliar sprays at 0.11% methamidophos or 0.06% omethoate gave satisfactory protection of blooms when used at weekly intervals. This spraying schedule has since been adopted as standard practice by commercial growers.

However, regular application of cover sprays can be expensive and time-consuming. To overcome the need to apply weekly cover sprays, the feasibility of controlling thrips populations by means of granular, systemic insecticides applied to the soil once during crop life was investigated. These systemic insecticides were applied either below the corms at planting or as a side-dressing when the flower spikes had emerged from the throats of the plants. Four application rates of each of the two insecticides, aldicarb and thiofanox, which had proved most effective in earlier trials, were tested. Two rates of each chemical were used as pre-plant applications and two as side-dressings.

Results comparable with the best cover sprays were obtained with pre-plant applications of 3.4 kg ha^{-1} or with side-dressings of 2.5 kg ha^{-1} of either aldicarb or thiofanox.

In terms of material and application costs, the use of granular systemic insecticides for gladiolus thrips control is more economical than conventional cover spraying and also is less disruptive to the above-ground environment.

Ovicidal trials against Heliothis

The tomato grub *Heliothis armiger* is one of the most destructive pests of tomatoes, necessitating intensive spraying programmes to minimize crop damage. Populations normally can be maintained at sub-economic levels by means of weekly applications of insecticides, but such programmes are not totally effective during plague outbreaks. At such times when massive egg-laying occurs, use of an effective ovicide to destroy a large proportion of the eggs would ease the pressure on later spraying programmes aimed at the larval stage.

During the spring–summer outbreak of *H. armiger* in the Redlands district, most of the insecticides normally used as larvicides against this pest in tomato crops were tested for possible ovicidal activity. Spray concentrations used varied from normal to quarter-normal strength.

Methomyl was outstanding as an ovidcide and caused substantial egg mortality at concentrations as low as quarter-normal strength. This result parallels earlier experience derived from cotton trials in the Emerald district, where low concentrations of methomyl also proved excellent ovicides against *Heliothis* eggs.

Previous trials in the Redlands area had shown that methomyl when used as a larvicide in weekly schedules did not give adequate protection of the crop. It is now clear, however, that as an adjunct to a regular spray programme, methomyl has considerable value as a specific ovicide during periods of intense oviposition.

Insect-resistant soybean studies

Earlier investigations had been undertaken to determine levels of insect resistance, if any, among existing commercial soybean cultivars and to refine methods of assessing insect resistance. The 1980–81 season saw the commencement of a research programme to evaluate the possibility of developing insect-resistant varieties. Resistant germplasm has been imported. During the past year, most emphasis has been placed on studying resistance of these lines to *Heliothis*, particularly *Heliothis armiger*. Initial results indicate that some of the soybean germplasm lines possess degrees of resistance to *Heliothis* species, the looper *Chrysodeixis argentifera* and the lucerne crown borer *Zygrita diva* and so are worthy of further study.

Studies on insect classification

With the current emphasis on energy conservation and the subsequent development of integrated pest control systems, a detailed knowledge of the natural enemies of insect pests is most important. Consequently studies on the classification of selected groups of natural enemies have continued.

These included a study of the larval and adult stages of predacious coccinellid beetles which have been shown to exert considerable control over populations of pests such as aphids, scale insects and spider mites. During the past year, the coccinellid predators of spider mites were investigated and, for the first time, both adults and larvae of these predators can be recognized.

Studies were also conducted so that scelionid wasps and tachinid flies could be readily identified. Scelionid wasps are parasites of insect eggs and have been shown to be very efficient at reducing populations of their grasshopper and bug hosts, while tachinid larvae are important parasites of a wide range of insect pests such as *Heliothis* and armyworms. A revision of Australian Scelionidae has been completed and it is now possible to recognize almost 300 species in more than 50 genera.

Departmental entomologists currently are engaged in a survey of parasites and predators present in autumn and spring potato crops in the Lockyer Valley. This study is developing expertise in a team approach to the investigation of natural enemies in a crop system.

Services

Insect identification service

With an estimated 108 000 species of insects in Australia, the problems associated with insect identification in this country are daunting. One of the responsibilities of Entomology Branch is to provide insect determinations in the areas of agriculture, quarantine and human health.

Biological and integrated pest control programmes require substantial taxonomic support and, during the past year, 3 000 identifications were provided in this area.

With the increased traffic of goods and people between countries, the chance of importing an unwanted insect pest is greatly increased. Early detection is our most effective weapon so quarantine authorities require a rapid and accurate identification service. Approximately 650 identifications of specimens intercepted in quarantine were provided during the year.

Health authorities frequently find insects associated with foodstuffs. However, before effective action can be taken, identification of the offending insects must be made. Such determinations are provided by officers of Entomology Branch.

Cotton pests activity monitoring service

During the past summer, light traps were again operated in the cotton growing areas of central Queensland at Biloela, Theodore and Emerald. The continued operation of this monitoring programme enabled Departmental entomologists and extension officers to provide growers with information on the seasonal incidence and activity of the major cotton pests. Each week, growers were advised by radio broadcast of changes in pest activity, alerting them to the need for control action and the appropriate insecticide to use.

As usual, most interest centred on the activity patterns of the two bollworm species *Heliothis armiger* and *Heliothis punctiger*. Prolonged outbreaks of *H. punctiger* occurred in December–January at Biloela and Theodore and in January–February at Emerald. At the height of the outbreak, peak catches of several hundred *Heliothis* moths per night were taken from the traps at Biloela and Theodore. As *H. punctiger* was the predominant species at this stage, endosulfan was recommended for control instead of the more expensive and less selective synthetic pyrethroid chemicals. This resulted in considerable cost savings to growers.

The usual seasonal change to an increasing proportion of *H. armiger* occurred in mid to late season at all centres. Before this, the *H. armiger* component in trap catches at Emerald comprised 5% of the total. At Biloela and Theodore, the proportion of *H. armiger* in catches increased to 50% by mid February and 80% by mid March. A change in insecticide was indicated, but by this time, most growers at Biloela and Theodore had already switched to pyrethroids to control infestations of the pinkspotted bollworm *Pectinophora scutigera*.

Pheromone traps were operated also to provide growers with timely warnings of pinkspotted bollworm activity. This insect has returned to prominence as a late-season pest of cotton in the Callide-Dawson Valleys, but it was not recorded from crops at Emerald this season.

Fruit fly survey in Papua New Guinea

At the request of the Plant Quarantine Service of the Commonwealth Department of Health, a Departmental Entomologist and a Quarantine Officer undertook a survey of fruit fly populations in Papua New Guinea to determine whether species in that region constituted a potential threat to Australian horticultural production.

Extensive trapping of fruit flies was carried out and numerous flies also were reared from large quantities of infested fruit. Information on the distribution of fruit fly species derived from identification of these specimens was supplemented by examination of fruit fly collections housed in scientific institutions in Papua New Guinea.

It appears that several fruit fly species that occur in Papua New Guinea as serious pests of fruit or vegetables, but which do not occur in Australia at present, could be considered potential risks to horticultural industries in this country. The melon fly *Dacus cucurbitae*, which is a major pest of the Asian and South-East Asian regions, is distributed along the southern coastline of Papua and, in the absence of quarantine controls, could gain access to the Australian mainland through the Torres Strait islands. At least three other species, closely related to *D. cucurbitae* occur in Papua New Guinea and these also constitute a potential risk.

A similar situation exists with regard to the *Dacus dorsalis* complex of species in Papua New Guinea. The oriental fruit fly *D. dorsalis* also is an extremely serious pest in South-East Asia and, although the taxonomic relationships within the species complex in Papua New Guinea are not clearly understood, there can be no doubt that a potential risk to Australia does exist.

Other species such as the *Dacus bryoniae* form, which attacks bananas in Papua New Guinea, are now considered to pose a threat which previously was not recognized.

The findings of the survey have emphasized the importance of maintaining a vigilant monitoring service to detect any possible intrusion into Australia by undesirable, exotic fruit flies. A quarantine survey has been in continuous operation in north Queensland for the past 5 years for just this purpose. So far, no exotic fruit fly species have been found in the region.

Apicultural services

Services to the beekeeping industry include the provision of advice on all aspects of honey production together with the implementation of regulatory duties associated with the *Apiaries Act* 1947–1972. 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. Regular inspections of bee colonies are vitally important as bee diseases continue to be a major problem for the industry. During the year, approximately 2 700 hives at more than 200 locations were inspected for disease.

Kashmir bee virus continues to occur in an estimated 50% of apiaries in south Queensland. The disease appears about October and remains until about February–March. Coastal apiaries are more seriously affected than those located west of the mountain range. Individual hive mortality is generally less than 5% of larvae, although isolated incidences of 30 to 40% larval mortality have been known to occur. Infected hives remain weak and honey surplus from them is reduced. Owing to the similarity of external symptoms to those of European brood disease, field diagnoses often cause confusion in identification.

Sacbrood continues to occur in most apiaries. Heavy larval mortality of up to 30% occurred during October–November 1980 on a large scale in both coastal and inland areas in southern Queensland. Colonies with more than 5% larval mortality produce less honey surplus.

An infection of American brood disease was diagnosed for two hives at Gumdale on the outskirts of Brisbane in April 1981. Both hives were destroyed by burning. A survey of neighbouring apiaries failed to find any other infected colonies.

Pesticide sprays. Major damage to apiaries occurred in an area 20 to 40 km west of Warwick during February 1981. The problem arose from the use of the insecticide carbaryl on grain sorghum crops. Approximately 2 000 colonies owned by 15 beekeepers suffered damage estimated at between 50 and 75% adult bee mortality. After-effects of poisoning included supersedure of queen bees and dying out of weak colonies.

A similar problem with pesticides occurred also in the Rockhampton district.

Honey flora. Owing to the dry seasonal conditions, little honey was produced up until October 1980. Following an improvement in seasonal conditions, fair summer crops were recorded and these were followed by an exceptionally good autumn crop, mainly from the brown box *Eucalyptus moluccana* and the gum-topped box *Eucalyptus hemiphloia*.

Botany Branch

Botany Branch acquires, analyses and publishes information on individual Queensland plants or groups of plants and plant communities. To a lesser extent it also acquires information on plants (Australian or exotic) which may become of economic significance as weeds or as crop or pasture plants. The information is made available to individuals and organizations that request it.

A significant part of the Branch's resources goes towards providing service to the general public, private industry, educational institutions, and State and Commonwealth agencies in identifying plants and advising on their properties. Assistance in solving ecological problems is also provided. Forensic botany has become a major activity.

Maintenance of a large and accurately named collection of dried plant specimens, the Queensland Herbarium, and active taxonomic research are necessary to the continued accuracy of identifications and soundness of advice.

A high level of service was maintained during the year. Maintenance of the herbarium continued at a satisfactory level and research activities increased slightly due in part to grants for some projects from the Commonwealth Government.

Officers have been organized into three interacting groups to deal with the wide range of Branch activities. A Taxonomy Group handles questions concerning individual plants and groups of plants, mainly those that occur in Queensland; an Ecology Group studies and maps plant communities in the State and advises on ecological matters; and a Supporting Services Group maintains the Queensland Herbarium and provides assistance to other groups.

Services and extension

Plant identification and related advisory services maintained by the Taxonomy Group and advice on environmental studies by the Ecology Group are major functions of the Branch.

About 21 000 specimens were identified by the Taxonomy Group, an increase of 17% from the previous year and the most in any one year. State Government Departments (including the Department of Primary Industries) accounted for 31% of the specimens submitted, the general public 27%, Australian tertiary institutions 18%, Commonwealth Government organizations (chiefly C.S.I.R.O.) 9% and private consultants 9%. There was a significant increase in the number of specimens submitted by consultants. A small proportion of these identifications was carried out by the Branch officer in Mareeba.

Forensic botany continued to be a major function of the Branch. Certificates of Identification were issued in connection with 1 225 samples of *Cannabis sativa* submitted by State police officers or occasionally by Commonwealth customs officers. Though slightly fewer than the number issued in 1979–80 (1 283), it maintains the greatly increased level reached last year over the levels of previous years.

Officers attended court on 25 occasions in connection with *Cannabis*, seven fewer than in 1979–80. The time spent in court was little more than half that of the previous year and indicates the effectiveness of the system of issuing Certificates of Identification and a realization of the futility of contesting identification of *Cannabis*.

Work associated with Commonwealth quarantine regulations was less than in 1979–80: 28 statements compared with 69 statements. Identifying plant material for such cases is more difficult and more time-consuming than identifying *Cannabis*.

Material submitted by the Animal Research Institute, Yeerongpilly in connection with suspected plant-poisoning of stock consisted of several herbarium specimens and 19 samples of rumen contents from post-mortem of stock.

Ecology Group's activities

The Ecology Group advised responsible authorities on botanical matters, including the establishment of native plants, in relation to developments in Queensland likely to have major environmental effects. Comments were prepared on impact assessment reports or other environmental studies on the following projects: Alcan Aluminium Smelter (Bundaberg), Theodore Coal Project, Queensland Electricity Generating Board (33 kV Feeder Line (North Mackay)), and two canal developments in south-eastern Queensland.

The leader of the Ecology Group continued as a member of the inter-departmental committee advising on rehabilitation after sandmining. Two week-long field inspections were held during the year and a special trip was made to North Stradbroke Island to inspect damage to a swamp from mining.

Officers of the Ecology Group were directly involved in surveys of areas being considered as reserves for environmental or scientific purposes. A report of the rainforest flora of Bulburin State Forest (near Miriam Vale) was prepared. It is proposed that a section of the State Forest be declared a Scientific Area. Inspections were carried out with officers of the National Parks and Wildlife Service of an area of predominantly *Cerapetalum apetalum* closed forest at Upper Currumbin Creek, proposed as a National Park, of areas near Monto being considered for inclusion in the Kondalilla N.P., and of an area near Caloundra proposed as an Environmental Park. Negotiations are under way with the Department of Main Roads for possible use of mangroves for river bank beautification near the Riverside Expressway.

Part of the Mulgrave Shire dune vegetation survey.

Educational activities

The educational and public relations activities of the Branch continue. Ten groups visited the herbarium and were given talks on the function of Botany Branch. Lectures were given to interested groups on poisonous plants, the history of the herbarium and other Branch activities. An officer assisted with talks and guided walks of **Forest Week 1980** at Lamington National Park.

The fourth part of *Austrobaileya*, a technical journal published by the Branch, was issued late in the year; and five articles in the series *Wildflowers of South-Eastern Queensland* were published in the *Queensland Agricultural Journal* during the year. The series of articles on wattles, with the addition of some colour photographs, is being published as a book. An article on aquatic plants of Queensland (on *Vallisneria* spp.) was published and manuscript of another was submitted to the editor of the *Queensland Agricultural Journal*. A check-list of ornamental plants cultivated in Queensland progressed well. The books *Flowering Plants in Australia* and *Sydney Parkinson: Artist of Cook's Endeavour Voyage*, to which contributions have been made by officers of the Branch, are both in press. A considerable amount of time was spent by members of the Taxonomy Group checking names (and author citations) of plants in manuscripts of technical publications, prepared by other organizations.

Research

Ecology

As well as continuing its own programme of research and vegetation mapping, the Ecology Group advises on ecological problems and liaises closely with other Branches of the Department and with other State Government organizations.

Three botanists were involved in the Western Arid Region Land Use Survey (WARLUS). The project is co-ordinated by Development Planning Branch, Division of Land Utilisation. The report on Part 2 (Adavale-Blackall) has been published. The vegetation map of Part 3 (Charleville area) is being printed and the land systems map is in the final stages of preparation. Work has begun on the preparation of maps of Part 6 (Boulia-Birdsville). Manuscripts of the botanical part of Parts 3 and 6 were completed about a year ago. The vegetation map and land systems map of Part 5 (Longreach-Winton-Muttaburra) are to be printed early in 1981–82.

Mapping and study of coastal vegetation continued. Dune vegetation surveys for beach erosion investigation reports were carried out for the Beach Protection Authority. The vegetation maps and descriptions prepared are used by the Authority as resource material on which to base the dune management chapters of their reports.

Two more field trips were made to the Cairns area as part of the survey of Mulgrave Shire beaches. Processing of field data has been completed and cartographic work has begun. Additional field trips were made to the Sunshine Coast (Teewah to Bribie Island). The report is being completed and the Beach Protection Authority is preparing the associated maps.

Mapping and description of mangrove communities have been carried out as part of a Queensland Fisheries Service Project.

The results of a survey of the Round Hill Head-Tannum Sands area were published during the year as a Queensland Fisheries Research Bulletin. A draft of a technical bulletin on the mangroves of Moreton Bay was completed and the maps were printed by the Queensland Fisheries Service. A draft report on the mangroves of Cape York has been prepared.

Construction of the floodway of the new Brisbane Airport was completed during the year and the banks were planted up with approximately 40 000 mangrove seedlings by a contractor. An officer of the Ecology Group continued as adviser for the project. The trial areas established at the airport were monitored. A report on results of the trials was provided for the Department of Housing and Construction. Good results have been achieved in establishing both nursery-grown seedlings and seedlings transplanted from other sites with both grey mangrove, *Avicennia marina* var. *australasica*, and river mangrove, *Aegiceras corniculata*.

Taxonomy

The correct naming and classification and description of all native and naturalized plants in Queensland are major concerns of the Taxonomy Group. Much botanical research, pure and applied, depends on correct identification of plants supported, if required, by competent taxonomic research. Range management, agrostology, ecology, phytogeography, geobotany and phytochemistry are fields where correct identification is of prime importance.

An analysis of the distribution of grasses, native and naturalized, in Australia and a paper (with Dr. H. T. Clifford, University of Queensland) on the biogeography of Australian grasses were published. A paper dealing with nine new species of grass from south-eastern Queensland was submitted for publication.

Collation of information from hundreds of herbarium specimens of wire grass (*Aristida*) proceeded prior to a revision of the Australian species. The work was made possible by a grant from the Commonwealth Bureau of Flora and Fauna. In the wild oat (*Avena* spp.) complex being studied in a joint project with Dr. B. Wilson, Queensland Wheat Research Institute, 40 taxonomic units were recognized.

Studies of *Acacia* continued. Two new species from Queensland were described and several others were recorded from the State for the first time. Critical examination of specimens from Western Australia of species related to *A. deltoidea* resulted in the recognition of an undescribed species. A tentative classification of Queensland species of *Acacia* has been drawn up and the classification of the genus as a whole is being critically examined.

A revision of the legume genus *Atylosia* was published, the relationships of *Atylosia*, *Rhynchosia*, *Cajanus* and *Nomismia* (a genus described from India, but not generally accepted) have been examined, and studies of *Tephrosia* continued.

Considerable time was spent completing a paper on cultivars of *Lantana camara* (Verbenaceae), a naturalized plant economically important in eastern Australia. Taxonomic studies and extensive field work in Australia and Central and South America were carried out by L. S. Smith and the results of his work were arranged for publication by his widow Mrs. D. A. Smith.

A paper dealing with revisions of the Australian members of the genera *Diploglottis, Atalaya, Jagera* and *Harpullia,* Sapindaceae, a family which has many species in the rainforests of Queensland, was published. Revisions of the genera *Ellatostachys, Cardiospermum, Cupaniopsis, Allophyllus, Castanospora, Ganophyllum, Heterodendrum, Alectryon, Lepisanthes, Cossinia, Dimocarpus, Lepiderema, Guioa* and *Rhysotoechia* have been completed. The work is in effect a revision of the family in Australia with the exception of *Dodonaea*. Another rainforest species, *Dansiea* (Combretaceae) proved to constitute a new genus.

A new combination in *Operculina* (Convolvulaceae) was published as a preliminary to the account of the family in the *Flora of Central Australia*. Preliminary descriptions have been prepared for about a quarter of the species of the family (including two undescribed ones of *Ipomoea*) for a revision of the family in Australia. A new species of *Comesperma* and one of *Polygala* (Polygalaceae) were described prior to the account of the family in the *Flora of Central Australia* and a study of specimens from the Northern Territory revealed another undescribed species of *Polygala* which also occurs in northern Queensland.

Progress was made towards the revision of some difficult complexes in *Melaleuca* (Myrtaceae) in Australia but considerable work remains to be done. A paper describing new species of *Homoranthus* was published; a draft paper on a new species of *Darwinia* has been prepared; and good progress has been made on the revision of *Austromyrtus* in Australia.

Preliminary studies in the field and in the herbarium were undertaken for a review of *Macarthuria* (Aizoaceae) in Queensland. *Romnalda* (Xanthorrhoeaceae), a genus believed to have a single species in New Guinea was found to be represented in north Queensland by another endemic species. A description of a species of *Polycarpaea* (Caryophyllaceae) from the Northern Territory has been drawn up with notes on the occurrence of the genus in Western Australia and progress was made on the study of Nymphaeaceae (water-lilies).

Contributions were made to the *Flora of Australia* project. Members of the staff completed accounts of the families Datiscaceae, Flacourtiaceae, Lecythidaceae, Moringaceae and Nepenthaceae.

The Flora of South-eastern Queensland progressed well. The manuscript of volume 1, the first of three volumes, is now in press. Considerable progress has been made with the families Myrtaceae and Asteraceae, and several smaller families were completed.

Special projects

Four projects were funded largely through grants from the Commonwealth Government. They are Herbarium Data Storage Project (HERBRECS), Vegetation Mapping of Queensland (1:1 000 000) and Flora Inventory of Cook Pastoral District, all supported by the Australian Biological Resources Study, and Moreton Region Vegetation Mapping, partly funded by grants under the National Estate Programme.

HERBRECS. A total of 23 000 place name qualifiers (PQs) was added to the master file, bringing the total of PQs to 44 100. Four hundred additional entries and 1 900 variations to entries were made on the masterfile.

Vegetation mapping of Queensland (1:1 000 000). Preliminary work has begun on unit descriptions for the South-western sheet. The Roma, Surat, St. George, Mitchell and Eddystone 1:250 000 sheets for the South-central sheet have been worked on; and field work was carried out in the area.

Preliminary field work for three 1:250 000 sheets (Holroyd, Rutland Plains and Hann River) of the Far Northern sheet was carried out and further field work will be carried out when the country dries.

Flora inventory — Cook Pastoral District. With additional field trips and technical assistance the project is gaining momentum: 3 755 specimens were prepared for the Queensland Herbarium.

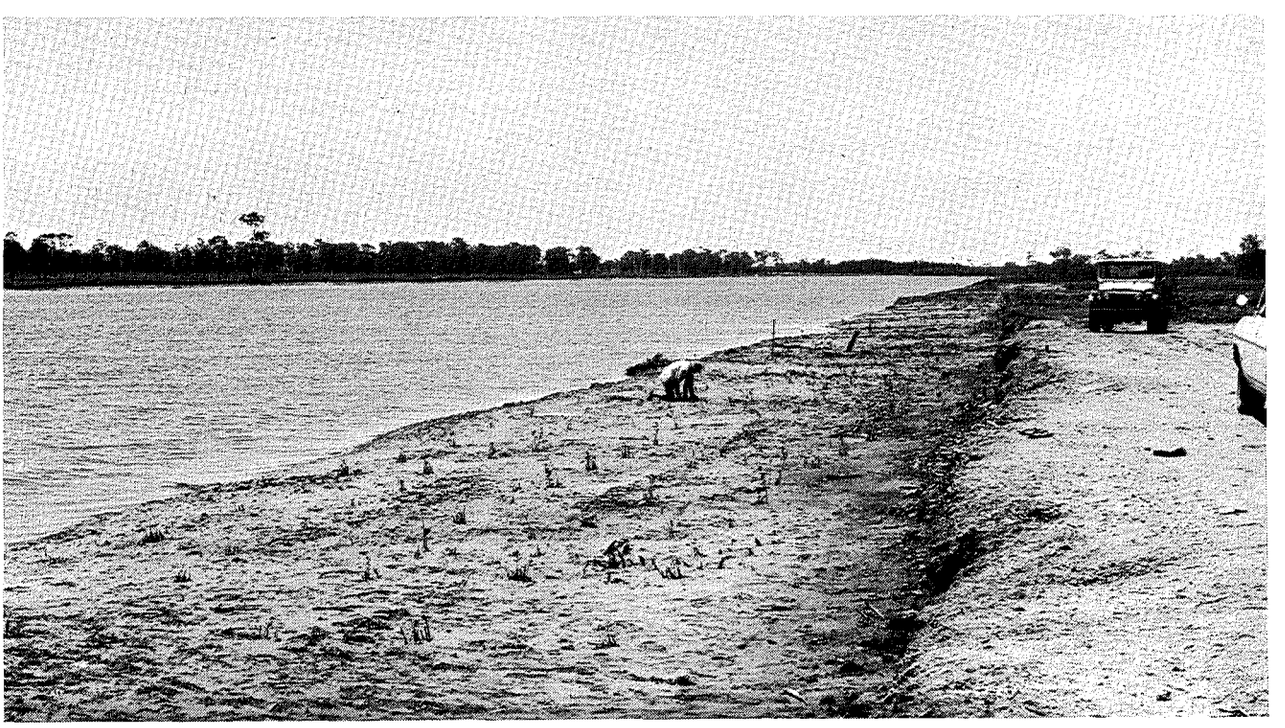
Moreton Region vegetation mapping. Work continued on the summary reports for the Caloundra, Brisbane, Beenleigh and Murwillumbah sheets already published and a checklist of 2 300 species has been compiled. No work on the 1:250 000 Ipswich and Gympie map sheets was possible.

Queensland Herbarium

The year has seen an increase in the rate of incorporation of specimens and an improvement in the quality of the herbarium curation but lack of storage space has reached a critical level.

During the year, 14 800 specimens were mounted and 7 400 were added to the herbarium, a considerable increase over the previous year's achievement. About 1 000 specimens were mounted and incorporated in the Mareeba reference collection.

The movement of specimens through exchanges and loans also increased: 2 700 specimens were received on exchange and 1 400 were despatched; 2 400 specimens were sent on loan and 3 200 were received back from other institutions; 5 300 specimens were borrowed from other institutions and 700 specimens on loan to Queensland Herbarium were returned. The large number of specimens borrowed was due to revisionary work on *Aristida*.



Establishment of mangroves to stabilize the drainage canal at the new Brisbane International Airport.

Miscellaneous

XIII International Botanical Congress

Branch officers were involved in preparations for the congress to be held in Sydney in August 1981. The Director continued as chairman of the Queensland Excursions Committee which co-ordinated the planning of pre-and post-conference field trips in the State.

One member of the Ecology Group is botanical guide for a tour of national parks in south-eastern Queensland, and another for a field-trip to Fraser Island. Both spent considerable time in reconnaissance and in preparation of detailed guidebooks for each tour. The botanist stationed in Mareeba also spent some time preparing for field trips in northern Queensland.

Priorities in rural research

The Director was commissioned by Standing Committee on Agriculture to prepare a report on priorities in rural research in Australia in the area of weed ecology and biological control. He also agreed to prepare for the Council of Heads of Australian Herbaria a current Index of Taxonomic Research on the Australian Flora to be published before the International Botanical Congress. The Director continued as a member of the Noxious Plants Consultant Committee to the Stock Routes and Rural Lands Protection Board and the Interdepartmental Committee for Timber and Woody Weeds. He was appointed a member of the Biology Advisory Committee at the Queensland Institute of Technology.

The Assistant Director was appointed to the Editorial Committee of the *Flora of Australia* and continued as a member of the Poisonous Plants committee.

Cultivating grasslands in the Central Highlands has led to major increases in run-off, resulting in serious erosion of natural drainage lines.

Division of Dairying and Fisheries

DURING the year the Queensland Fisheries Service was transferred from the Department of Harbours and Marine to the Department of Primary Industries and was incorporated with dairying to form a new Division of Dairying and Fisheries. The new Division now has four Branches and three Sections.

Activities are delineated into work programmes concerned with administration, research, regulatory, service and extension.

Dairying

Trends and production

Since 1970 there has been a consistent decline in the number of dairy herds in Australia and a corresponding decrease in milk production, although at a lesser rate. Market trends indicate a stabilization of the domestic market and, in 1980–81, only 20% of the milk produced was used for export. A major drought in the eastern States affected production from Gippsland in Victoria through to Queensland.

In Queensland, dairy farm numbers have continued to decline, but production per farm has risen. The number and types of supply of registered dairies in the State are set out in the following table—

Type of supply	1978–79	1979–80	1980–81
Cream	643	579	390
Milk	2 889	2 750	2 524
Milk raw	15	26	26
TOTAL	3 547	3 355	2 940
Goat	18	24	21

Milk production has been affected in most regions by severe drought conditions during the year. Conditions in the second half of the year improved with good rainfall in all areas except the Southern Downs.

Demand for pasteurized milk, fresh and cultured milk products, and cheese has increased during the year.

Product	1980–81	% Change on 1979–80
Pasteurized milk (M litres)	237.5	+ 2.5
Pasteurized cream (ML of milk equivalent)	38.0	+ 7.3
Flavoured milks (ML)	5.2	−18.8
Modified milks (ML)	24.8	+26.5
TOTAL MILK (ML)	305.5	+ 4.3
Butter (tonnes)	2 855	−26
Cheese (t)	10 568	−11
Casein (t)	461	−25
Powders (t)	8 243	−17

In spite of increased returns to farmers, the Queensland industry faces a major problem in the continual reduction in the amount of manufacture milk available for processing. The critical supply situation in central and north Queensland resulted in the Minister announcing that new registrations would be allowed in these regions subject to certain conditions.

Increased production is required to ensure year-round self-sufficiency in market milk and fresh milk products in this State. There is every indication that farmers are gearing up to take advantage of the marketing opportunities now developing. A major activity has been the planning for a seminar to be held in September 1981 dealing with the management of larger herds.

Herd improvement

The opening of alterations to the Wacol A.I. centre by the Minister for Primary Industries was the culmination of a series of events to celebrate 25 years of artificial breeding. During 1980, seminars, meetings and inspections of the centre were organized as part of the celebrations. Approximately 500 dairy and beef producers attended two open days at the Wacol centre in April 1981. Displays which featured the various components of herd improvements were inspected.

The testing of milk samples from production recorded herds was converted to a fully automated process during the year by the installation of a second infra-red analyser (Scan 203) with a capacity to determine butterfat, protein and lactose components of milk. During the year, the composition of more than 450 000 milk samples was determined.

Interest in the training of farmers to carry out inseminations of their own cows (D.I.Y.) is increasing rapidly. More than 300 farmers attended either initial training courses or follow-up refresher courses. Nearly all courses were organized by farmers themselves who provided 'on-farm' facilities for small groups of trainees.

Farm research

A major activity has been the provision of some of the necessary facilities before the commencement of a dairy cattle research programme at the Mutdapilly Research Station. The 28-unit rotary turnstile which was located on the Ayr research station has been transferred and re-erected on the new station. This unit, together with complementary facilities, is one of the major prerequisites for the initiation of research projects. Drainage work and installation of underground irrigation mains are also being carried out on the station. When these tasks are completed areas will be prepared for the first experiments which will commence early in 1982.

Results from on-farm trials carried out in south-east Queensland in the winter–spring period of 1980 support experimental data obtained at Ayr research station. The trials showed that, when ryegrass and clovers are grown in tropical or sub-tropical environments, clovers have a higher nutritive value and are capable of supporting higher per cow milk yields compared with ryegrass. Because of the lower bag nitrogen requirements of clovers, milk production costs in the warmer regions of the State have been lower with clovers than with ryegrass.

High grain prices and reduced availability of molasses have contributed to increased farmer interest in silage, haylage, and other forms of fodder conservation. Several silage demonstrations have been carried out in the Wide Bay and South Burnett regions with conventional pit silage, and on the Darling Downs the round bale system and the Silopress system were studied.

More than 30 dairymen in the Atherton Tableland, Mackay and south-east Queensland districts are milking some A.F.S. cows in their herds. These farmers are co-operating in the development of the new breed, and they are now maintaining approximately 350 A.F.S. cows and heifers.

The average production of recorded A.F.S. cows in 1979–80 was 2 322 L milk and 95 kg butterfat.

Manufacturing research

The NAGase procedure for detection of mastitis has been fully automated and has operated under commercial conditions for nearly 2 years. A patent application for this new automatic method has been lodged and has attracted world wide interest.

Pilot plant trials have confirmed laboratory work on cottage cheese whereby it was shown that the addition of sodium citrate, either alone or in combination with sodium caseinate, significantly reduced the amount of curd shattering during manufacture and gave increased yield.

Work has continued with development of manufacturing techniques for other non Cheddar varieties of cheese. As a consequence, three cheese factories in Queensland extended their production to encompass Cheedam, Feta and a Swiss-type cheese.

Fisheries

Licensing of commercial fishermen

A range of licences is issued under the provisions of the *Fisheries Act* 1976 to encompass all commercial fishing operations conducted in Queensland waters. Fees payable for such licences were reviewed during the past financial year. Fees for most commonly issued licences were not increased following a substantial increase in the previous financial year.

Master Fisherman's Licences. As in previous years, a minimum-catch quota was applied to all fishermen seeking to renew their licences. Because of the wide variations in production values of different fisheries and the poor season experienced in many of the fisheries, the principle of tying the quota to the Minimum Wage standard was abandoned and the $5,000 quota level of 1979–80 was retained. The application of a quota to fishing operations dedicated to the taking of fish not for consumption purposes, previously at a quota of $3,000, was removed.

Provision was made for a 'Retired Fisherman's' licence to be issued, instead of a 'Pensioner's' licence, with more specific requirements to be met by successful applicants.

Licencing Advisory Panels, introduced in the previous year and made up of Queensland Boating and Fisheries Patrol Officers and locally nominated Master Fishermen, were continued in an expanded role over the past year.

Limitations were placed on the number of licences issued to Master Fishermen endorsed to fish in the Gulf of Carpentaria and East Coast Barramundi/Set Gill Net fisheries as part of the Barramundi Management Programme introduced from 1 January 1981.

Special conditions applying to holders of licences endorsed to fish in the Gulf fishery and wishing to continue in the fishery were established in consultation with industry participants.

Commercial fishing vessel licences

All vessels used in commercial fishing operations are required by the *Fisheries Act* 1976 to be licensed. Specific policies with respect to vessels engaged in certain types of operations were introduced or updated.

On 25 September 1979, a 'freeze' was introduced on the issue of new licences to vessels intended for use as otter trawlers. A policy which allowed replacement of vessels lost by Act of God or otherwise removed completely from the fishery was restated for the 1981 licensing year. Replacement vessels may vary in length by up to 1 m from the length of the vessel being replaced.

Otter trawlers not operating from a Queensland port on a year-round basis and those vessels over 14 m holding endorsements to operate in the Moreton Bay prawn fishery had their operations restricted north from the New South Wales border to Sandy Cape (Fraser Island).

Vessels licensed to operate in the Northern (Gulf of Carpentaria) prawn fishery were subjected to conditions applied to that fishery by joint Commonwealth, Northern Territory and Queensland limited licence policy constraints.

The 'freeze' on licences was extended to offshore beam trawlers on 30 September 1980.

From 13 May 1981, a further 'freeze' was introduced on the issue of licences for vessels engaged in the inshore and river beam trawl fisheries. The Department continued to issue licences on behalf of the Commonwealth pursuant to the *Fisheries Act* 1952–1980 to Queensland commercial fishermen engaged in operations in Commonwealth waters.

Details of licences issued reflect a decline in the number of Master Fishermen controlling commercial operations in recent years.

Oystering and shell grit

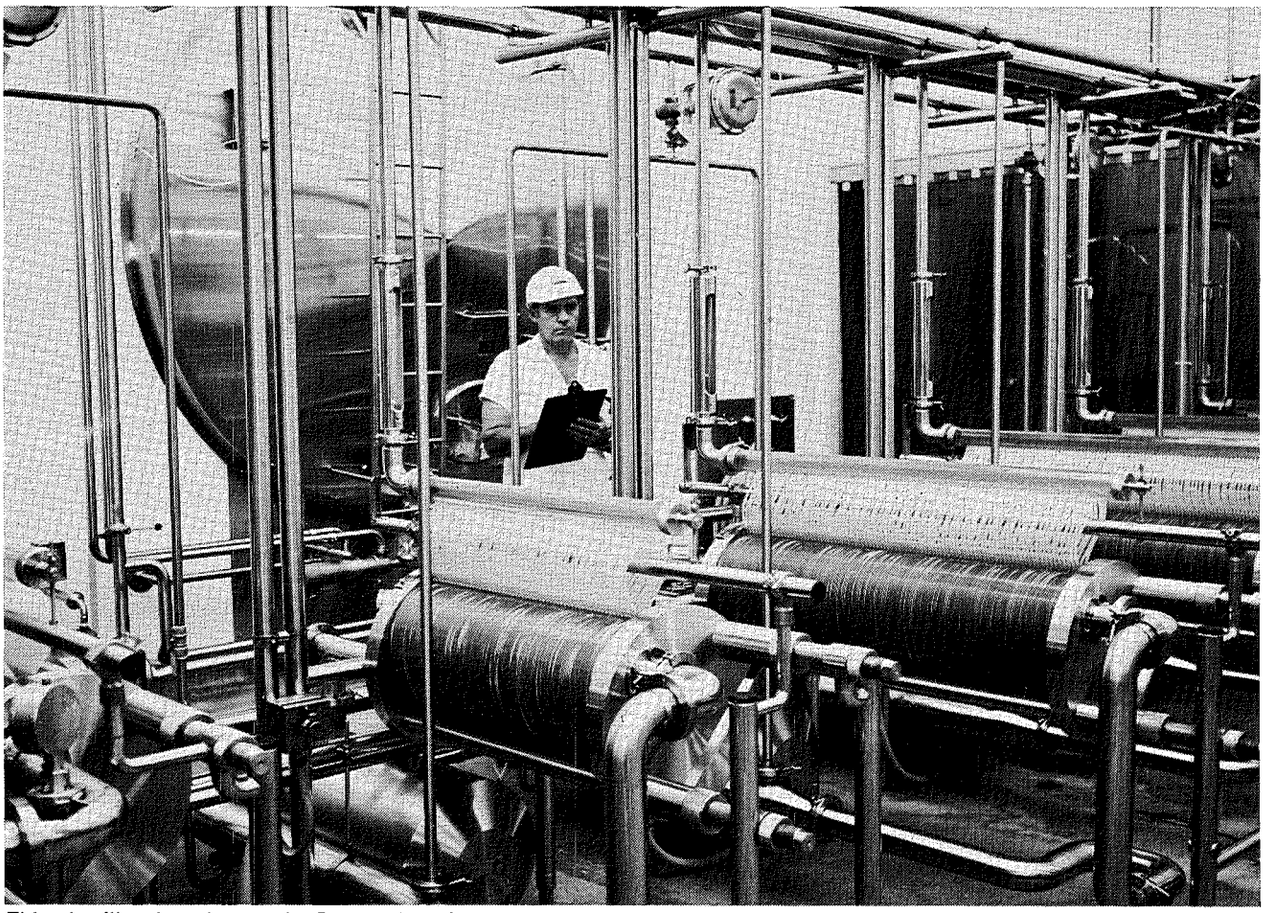
Periodic inspection of oyster banks was carried out in Moreton Bay and the State generally to ensure that oystering is undertaken in accordance with prescribed conditions.

Traditional methods of oystering either by ground cultivation or harvesting of wild stocks in areas best suited for this form of activity continued during the year. This type of operation provides a livelihood for a considerable number of operators throughout many parts of the State.

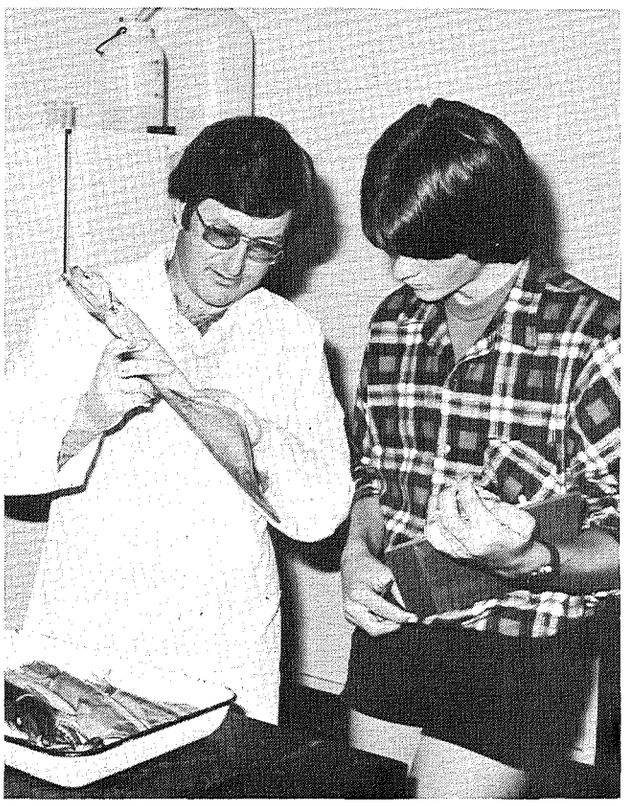
Shell grit operations remained at a relatively steady level through the year and formed a localized but lucrative industry for the operators.

Industry review

Overall, fishermen had a poor year in 1980–81. Prices fell in real terms in almost all fisheries while production costs, particularly for fuel, rose substantially. The prawn fishery was hardest hit. While catches were down in the Gulf of Carpentaria, overall production remained relatively stable. However, both prices for the product and the share of the market fell, particularly in the export market.



This ultrafiltration plant at the Booval dairy factory is the first outside Europe. Technologists at Booval are co-operating with staff at the Otto Madsen Dairy Research Laboratory (Hamilton) to find additional uses for retentate and permeate.



A Fisheries Research Branch biologist explains squid body functions to a High School work experience programme student.

The number of vessels engaged in prawning increased to 1 396 at 31 December 1980, representing a substantial capital investment to be serviced in the face of the depressed state of the industry. Attempts to identify and develop new trawl grounds of significance were unsuccessful during the year. A substantial movement of vessels from south to north Queensland in search of prawns or new trawl grounds occurred during the year.

The estuary and inshore net fishery has maintained its place as the principal employer of fishermen and as the mainstay of the domestic market. Mullet, bream, whiting, flathead, salmon and barramundi were most predominant among the species landed. The introduction of licence limitations on the taking of barramundi and the use of set gill nets applying to the fishery from Baffle Creek (near Bundaberg) north was implemented during the year.

Research into the mud crab fishery, now nearing completion, has shown that catches have remained stable for many years. A further consequence of the research activity has been that the only potential for large development in this fishery is in the Princess Charlotte Bay region. Commercial fishermen are restricted to working a maximum of 50 pots or units and amateurs four. Crab fishermen in recent years have been concerned at the incidence of damage to or theft of their equipment, now an offence under the Fisheries Act.

The level of effort applied to the scallop fishery, principally off the central Queensland coast, has been affected by the depressed state of the prawn fishery. The increase in effort has led to an increase in the taking of small scallop and this may affect the coming season. A joint economic survey of the fishery was recently completed with results expected later this year.

The hand line fishery has also been hit by rising fuel prices, fuel being a significant proportion of the total cost of the operation. Evidence of a decline in catches close to major centres of population suggests that there may be a local over-fishing problem developing. This situation is being closely monitored. The mackerel fishery has remained stable. An associated fishery for spanner crabs has shown encouraging signs of development in south Queensland waters in recent years, particularly in the last year.

Production levels in the commercial bait fishery continued relatively unchanged for the year. A substantial increase in the number of fishermen involved in beam trawling activities led to the introduction of a licensing 'freeze' on beam trawlers. A survey conducted during the year revealed that the bait worm fishery has increased to a value of approximately $1m a year. An increase in the level of production by this activity, centred mainly in Moreton Bay, has led to an increase in product sold to interstate markets.

Commercial coral collecting caters for an increasing and important tourist trade. The needs of the commercial diving operators and the diversity of areas needed to satisfy the demand for variety is recognized in provisions of the Fisheries Act which are used to maintain a controlled use of coral reef areas within Queensland waters.

Public aquarium displays are catering for an increasing tourist trade in providing a diversity of marine life and living corals. The quality of these displays is becoming increasingly professional. The collection of aquarium fish for commercial sale to enthusiasts is being maintained. Licences and permits appropriate for these activities are issued annually.

Pearl culture farms exist in the Torres Strait and Escape River areas. Although some stability was being reached, recent problems have occurred in locating wild stock pearl oysters due to some sand encroachment over the collecting area. Live mother-of-pearl oysters are fished by Islanders using diving apparatus. There is a trend away from the traditional diving helmet to 'HOOKAH' equipment, increasing the divers' capabilities under water.

The demand for trochus shell was reduced as a result of the use of plastics in button manufacture. A recent upsurge in demand for better quality products has resulted in a revival of this industry with units operating from Mackay, Townsville, Cairns and the Torres Strait.

The Fishing Industry Training Committee, which includes two Departmental officers, recently appointed a training specialist to co-ordinate and plan manpower skills improvements. It is expected that this training officer will be able to investigate the training needs of all sectors of the fishing industry, and to organize an economical and effective means of making training available to fishermen.

Recreational fishing

The Queensland Amateur Fishing Council is representative of recreational fishing bodies throughout Queensland as well as considering the general public view. This Council has been very active with a number of submissions and items of advice forwarded for consideration.

Reports from major centres throughout Queensland indicate that recreational fishing is increasing in popularity and with ever-widening community participation. Estuary angling particularly is increasing, involving numerous species not previously considered 'good sport' by northern anglers.

Enforcement

Inspectors. The Service received continued co-operation from the Superintendent and Officers of the Queensland Boating and Fisheries Patrol and the efforts of these officers in administering and enforcing the Fisheries Act and Regulations, very often under unpleasant conditions, is greatly appreciated.

Honorary inspectors. These honorary officers have in the past made a worthwhile contribution to the Service and the community by the submission of valuable information on general fishing activities and unlawful practices. Their assistance to permanent officers is appreciated.

The Fisheries Act provides for the appointment of Honorary Rangers in lieu of Honorary Inspectors. A review is currently being made of appointment and operational responsibilities of this group.

200-mile Australian fishing zone

Fisheries Service officers were involved in at-sea inspections and observations of various licensed foreign fishing operations.

One of these operations involving Japanese long-line vessels demonstrated that yellow-fin and big-eye tuna could be taken in commercial quantities using hand lines and poles. This fishery could be within the scope of Queensland fishermen using vessels capable of operating up to 80 miles offshore and given appropriate market guarantees.

Surveillance of the operations of foreign fishing vessels off Queensland's coast is now well established. The activities of surveillance officers together with the facilities of the Australian Coastal Surveillance Centre has minimized the incidence of fishing for clams by foreign operators with one vessel being detected and apprehended off Mackay by patrol officers during the year. Daily assessment of the reported movement of foreign vessels off Queensland's coast is undertaken by Departmental officers.

Field Services Branch

THE Australian dairy industry is in a process of continuing adjustment in response to economic pressures. There has been a consistent milk flow decline since 1970, involving a 20% decline in dairy herds since 1976. The downward trend in cow numbers is expected to continue but at a slower rate in future years.

Market trends indicate that the domestic market has stabilized. Although butter consumption has levelled off, local demand for cheese and fresh and cultured products has steadily expanded and market milk consumption has increased slightly. The outcome of these trends was that in 1980–81, 80% of total milk production was used on the domestic market.

Production in 1980–81 was affected by a major drought in the eastern States with the worst-affected areas stretching from Gippsland in Victoria through to Queensland.

The key point is that average gross returns to dairy farmers have risen by approximately 18% in 1980–81. Average net returns have also increased. This increase in income is due to higher prices but it also reflects the increase in average herd size (in 1979–80 average herd size increased by 10% to 148 head).

Queensland dairy industry

Dairy farm numbers in Queensland have continued to decline. The number of registered dairies in the State is now 2 940, with an additional 21 goat dairies. Details are given in the table in the previous section of this report.

Milk production has been affected in most regions by severe drought conditions during the year. The worst affected areas were the southern Darling Downs and the southern Coastal areas of the State. Production on irrigated farms was further restricted because of water shortages in the major irrigation dams in the south-east area and in farm dams which in some areas such as the Lockyer Valley have been dry for a number of years. Conditions in the second half of the year improved with good rainfall in all areas except the southern Downs.

Record falls were experienced in north Queensland during December. While this did not greatly affect production, it severely disrupted the distribution of market milk which resulted in a loss of sales of approximately 300 000 L of milk to the Atherton Tableland Co-operative Dairy Association.

In spite of reduced numbers and production difficulties, which include rapidly increasing prices of energy supplements such as grain and molasses, Queensland farmers have maintained production at a reasonable level. Production figures are: 1978–79, 565 ML; 1979–80, 538 ML; 1980–81, 506 ML.

Demand for pasteurized milk and fresh and cultured milk products and cheese increased during the year. Increasing population in some areas, for example, central Queensland, resulted in much higher increases in milk sales compared with the State average. The overall State figures also increased with a significant increase of 4.3% in total milk sales. Details are given in the table in the previous section.

Returns to farmers have increased during the year. Manufacture milk returns increased from an average of $2.50 per kg in 1979–80 to approximately $3 per kg in 1980–81. Prices paid for market milk increased substantially during the year (25.5¢ per L to 30.65¢ per L, though prices may vary among associations). Gross returns to dairy farmers have increased due to increased prices and slightly higher production per farm.

Improved returns to farmers is cause for optimism in the dairy industry. In spite of this, the Queensland industry faces a number of serious problems which must be overcome before a stable situation is achieved. A major problem is the continual reduction in the amount of manufacture milk available for processing. In some regions, dairy product manufacturing is facing extinction. Supply management for the domestic market is probably the greatest challenge to the survival of the industry in this State. The critical supply situation in central and north Queensland resulted in the Minister announcing that new registrations would be allowed in these regions subject to certain conditions.

It is clear that increased production is required to maintain year-round self-sufficiency in market milk and fresh milk products. It appears that an increase in production from existing farms is the most likely way to maintain self-sufficiency. There is every indication that a substantial proportion of farmers are gearing up to take advantage of the marketing opportunities which are now developing. This trend into larger herd size offers significant extension opportunities to this Branch.

Branch activities

The programmes and activities of Branch staff during the year were directed towards the achievement of the overall role of the Branch. This is to promote productivity and efficiency on farms and in the processing and distribution of milk and milk products and to maintain adequate product quality consistent with market needs and extension constraints. In order to achieve this role, the Branch is organized in two sections—the Farm Production Section and the Dairy Products Section.

Farm production section

Extension activities

Officers in the farm production section devoted a major portion of their work to planned extension activities. The current Branch policy is to devise programmes which will result in increased production per cow and per farm. During the year, the five main areas of activity were herd improvement, animal nutrition, milking systems and dairy sheds, mastitis control and farm management accounting schemes.

Herd improvement. There has been a steady increase over the year in the number of farmers using A.I. and herd recording. This has been brought about mainly by the increase in the number of farmers doing their own A.I. There have been 16 schools conducted in all regions. Most of the farmers on these schools are new A.I. users or have not used an A.I. service for some years.

The importance of D.I.Y. schools in overall herd improvement throughout the State cannot be over-stressed. These schools provide important extension platforms for many other activities. Once a farmer has been taught A.I., he realizes he has the sole responsibility for getting cows in calf. He becomes more aware of nutrition, reproductive performance and production performance of his cows. As a flow-on, interest is shown in the breeding management services and herd recording services offered by the Department.

Once a course has been conducted, the group of farmers concerned is easy to get together again for further extension exercises.

While the trend to D.I.Y. has continued, the existing insemination services in south-east Queensland are still providing reasonable input into herd improvement. However, there has been a steady flow of enquiries about D.I.Y. from farmers in the insemination service area.

There is a need to maintain co-operatives, but their functions may change from a farm service in A.I. to that of a supporting role to D.I.Y. farmers in the area. There is no doubt that D.I.Y. farms require support in semen and liquid nitrogen supply and relief insemination during times of sickness or holidays, or when farms change hands.

Refresher courses are conducted usually 6 months after a D.I.Y. course has been run. By this time, farmers are over the apprehension of doing their own insemination and are keen to develop herd improvement practices in other areas. After A.I. techniques have been checked, discussions on breeding management and sire selection are held.

Discussion groups are conducted usually using the original training group as a base. Group meetings have been conducted in the Harrisville area. Other herd improvement discussion groups are being formed in Oakey, South Coast and West Moreton areas.

Surveys on farmer attitude to herd improvement have been done in East Moreton and Darling Downs regions. Using information from these surveys, extension programmes will be formulated.

The breeding management option in herd recording has been a valuable assistance in improving reproductive efficiency in herds. The option isolates cows into four groups (pre-mating, aneostrus, conception difficulties and pregnant). By isolating these groups, farmers can take steps to remedy difficulties in each.

Field Services Branch staff discussing extension programming with International Training Course students from Bangladesh, Thailand and the Philippines.

Displays on herd improvement have been erected at several rural shows. The benefit of this style of extension remains unanswered. At some shows, there is keen interest by farmers and a good many enquiries. At others, interest is low for no apparent reason.

Field officers are promoting the use of proven bulls and/or the latest proving team during farm visits.

Successful 'open days' were held at the Wacol A.I. Centre. Approximately 350 dairy farmers attended both days. These days generated a good deal of interest, particularly in the mastitis cell counting and herd recording areas.

Animal nutrition. In all regions, efforts were made to get farmers to adopt practices which would result in the year-round supply of good quality feed for dairy animals. Most activities have been aimed at irrigation or part irrigation farms with emphasis being placed on filling the winter feed gap by the use of irrigated ryegrass, clover or mixtures of both. The trend in north and central Queensland has been towards pure clover stands with a subsequent saving in nitrogenous fertilizer. Trials with pure clover stands and mixtures of ryegrass and clover were initiated in the East and West Moreton and Wide Bay regions. At this stage, no suitable clover species have been found for the Downs region.

While most emphasis in recent years has been placed on irrigated winter species, it became obvious that a greater extension effort was required on non-irrigated dairy farms. Increasing emphasis was placed on fodder conservation to bridge the winter feed gap and to give some drought-proofing of farms. High grain prices and reduced availability of molasses have contributed to increased farmer interest in silage, haylage and other forms of fodder conservation. In the Wide Bay area, extension plans were drawn up to increase the use of fertilizer on dryland pastures. Several silage demonstrations have been carried out in the Wide Bay and South Burnett regions with conventional pit silage, and on the Downs, the round bale system and the Silopress were studied.

Milking systems and dairy buildings. There was increased interest in new buildings and renovations during the year. The majority of the new premises were of the herringbone type usually constructed from cement block. There has been some experimentation with other building materials including poured concrete and steel framed buildings clad with coated galvanized steel sheets. An interesting innovation was a herringbone pit completely moulded from fibreglass. Dairy buildings are generally becoming more attractive with the use of ceramic tiles now common. Automated milking equipment, particularly automatic teat cup removers, is becoming more popular. This is part of the reason for the strong trend towards the doubled-up milking machine configuration and to wider 1 800 or 2 100 mm herringbone pits.

Field staff have concentrated a considerable amount of extension effort on milking systems both in planning new or converted dairy sheds, and in holding discussion group meetings on this subject. The film 'Pleasant Milking' was purchased from the Victorian Department of Agriculture and has been used extensively throughout the State.

Mr Peter Maguire, a dairy officer from the Milking Research Centre at Werribee, Victoria, toured south-eastern Queensland in June 1980. He spoke to Departmental field officers and several milking machine technicians on trends in Victorian milking systems and the advantages of the recently formed Australian Milking Machine Technicians' Association.

A resource group in the subject areas of milking machines, dairy buildings and mastitis has been formed with three officers based at the Herd Improvement Laboratory, Wacol. Since the inception of this group in January 1981, two projects have been commenced. The first of these was the construction of a recirculation oiling system for vacuum pumps. The second was the construction of a fast concrete yard cleaning system. Both these projects have been relatively successful with demonstration units under evaluation on farms. The yard cleaning system uses the high volume (>220 L per minute) low pressure principle and has reduced yard cleaning times on three farms from 25 to 30 min to 3 to 5 min.

Increasing herd size has resulted in a lot of interest among farmers in new dairies or rebuilding old dairies with special emphasis on more efficient labour utilization. The resource group has provided field officers with a back-up service which allows farmers access to the latest developments in shed construction and milking techniques.

Mastitis. All farm bulk milk supplies throughout the State continued to have their cell counts estimated on a monthly basis using the Fossomatic Automatic Cell Counter. Cell count results were provided to both farmers and field officers. A summary of test results for the last 12 months is detailed below.

Cell count results have continued to rise from the low levels obtained in 1978–79. Twelve-month, Statewide mean cell counts for 1977–78, 1978–79, 1979–80 and 1980–81 were 553 000; 443 000; 459 000; and 489 000 per mL. It is likely that some of the improvement evident throughout 1979–80 was a direct result of increased culling of old cows in response to improved beef prices. Surveys of mastitis control practices in use on farms have shown reductions in usage of some practices, particularly teat dipping. This may have contributed to rise in cell counts over the last 2 years.

MONTHLY ELECTRONIC CELL COUNT RESULTS MAY 1980–APRIL 1981

Month	No. of tests	Mean cell count*
May 1980	2 417	509
June	2 290	546
July	2 558	528
August	2 435	557
September	2 019	506
October	2 452	536
November	2 218	521
December	2 250	542
January 1981	2 275	396
February	2 318	383
March	2 344	440
April	1 650	544

*All milk suppliers in the State

Routine calibration of the Fossomatic includes regular checks against the Direct Microscopic Cell Count and quarterly Australia-wide cell count calibration trials.

The Mastitis Cell Count Extension Programme has been continued in the current year on a low key basis. Most of the activity has occurred during the course of normal farm visits. However, in some districts, there has been more intensive work on farms with high cell counts or serious clinical mastitis problems.

An evaluation of mastitis extension programmes has been carried out by interview surveys with farmers to find out which mastitis control practices they are using and their knowledge of, and attitude towards, mastitis control. The first of these surveys was carried out in late 1973, the second in mid 1976 and a third in mid 1980.

Preliminary results from the 1980 survey are now available. Use of complete herd dry cow therapy has risen from 14% in 1976 to 36% in 1980. However, the use of teat dipping has declined slightly to 29% in 1980 from 33% in 1976, although these figures are still much higher than the 1973 figures of 18%.

Producer reaction to possible factory penalties on iodine residues in milk may be a contributing factor in the decline in popularity of teat dipping. Benefits due to teat dipping are of a long term nature and are not likely to be obvious to farmers. Increased extension activity may be necessary to publicize the advantages of teat dipping and that alternatives to iodophor products are now readily available.

A highlight of the Mastitis Control extension programme has been the successful completion of a trial with 85 herds on an individual cow cell counting service. This service proved to be very popular with co-operating farmers who found individual cow results to be of great value in making decisions relating to mastitis control. An extension programme to introduce the individual cow cell count service to farmers has been prepared. The service has now been offered to all recording members at the low cost of approximately 40 to 60¢ per cow per lactation (10¢ per test).

Dairy Farm Accounting Scheme. Dairy Farm Management Accounting Schemes operate in all dairying regions under one of two systems. A monthly recording system with quarterly computer summaries is one and a yearly recording system is the other.

In all, 94 dairy farmers are using one of the accounting schemes, more than twice as many as during the previous year. Interest is still high among farmers.

Figures obtained have been used in discussions at field days and night meetings. Some farmers are now using the figures for forward planning, while others use them to evaluate their farming methods and feeding systems.

The schemes also provide factual costs of production. A cost of production survey done by Economic Services for the Queensland Milk Board has validated figures gained through this service.

From 15 farms in the East Moreton, for example, the average return for 1980 was 22.68¢ per L (range 18.67 to 25¢) with total variable costs of 11.86¢ per L (range 1.83 to 16.66¢).

The figures obtained allow dairy officers to talk with producers from a factual cost angle and enables a useful comparison of costs of varying systems to be made.

These farm accounting schemes will be the base of on-farm computer packages in the very near future.

Extension, general. A trend was noted during the year towards the formation of industry-based district committees which are taking the place of District Extension Committees. Industry committees have the potential to work closer with dairy farmers in general and allows greater Branch input into field officers' work. In conjunction with this change, a start was made on the reorganization of District Extension Advisory Committees. The proposed change is to set up a number of smaller committees based mainly on a factory supply area. A manufacturers' representative will also be included in the revised group.

A highlight of the year was the increased interest shown by farmers in forming new discussion groups and also in revival of old groups. It was encouraging to note that most district Q.D.Os are now in regular contact with field staff—a situation which has not existed for a number of years.

Each region in the State maintained the production of a newsletter, which was distributed to farmers on a monthly or bi-monthly basis. These newsletters provide a method of direct written communication with farmers and seem to be very valuable.

The production of extension information remains a very important role for the Branch. During the year, numerous 'Farmnotes' and 'Refnotes' were produced. Two major extension publications were produced—a dairy goat book (by H. Brown and edited by L. Wishart) and Project P (a definitive work on Queensland pastures) which was a joint Dairy and Agriculture Branch publication. In addition to these, the Calf Rearing pamphlet series was revised and reprinted.

A correct situation analysis is critical for any extension programming. Extensive surveys were conducted in three regions to provide accurate, up-to-date information on current farm situations. Data from these surveys were analysed using Branch computer facilities.

Advisory and regulatory activity

Farm production staff in all districts were involved in an increase in regulatory work mainly due to the requirement for registration of all dairy farms in the State during the year following the advent of the new Dairy Produce Regulations. In addition to the farm situation, other registration work was carried out in regard to milk tankers.

Farm officers in all regions except north Queensland were involved in a considerable amount of work in regulation of the milk distribution system.

Raw milk quality remained at a satisfactory level. All associations now have a penalty system for substandard milk. Officers' work in this area was made easier due to the more positive attitude taken by factory management in most cases. A move was made during the year to upgrade the standard of buildings and hygiene in dairy sheds in all regions.

New farmers with no previous experience in dairying who purchased existing farms contributed greatly to officer's advisory work load particularly in regions such as north Queensland. However, contact with these new farmers on routine advisory work has presented significant extension opportunities.

Advisory work on milk compositional problems was required. The severe nutritional problems resulted in a large proportion of suppliers' milk failing to meet standards for composition. While bottle milk supplies were maintained at a satisfactory level, there does appear to be a long-term decline in compositional quality which needs investigation.

Officers in all regions reported continuing work with the Lands Administration Commission in processing farm development loans. The greatest activity was noted in the north Queensland region.

Dairy products section

Regulatory activities

Processing centres. As at April 1981, 40 dairy products processing centres were operating throughout the State. Taking into account that some of these plants are multi-product plants, the following processing units were operational: 9 butter, 2 cheese (Cheddar only), 7 cheese (Cheddar and other varieties), 4 cheese (non Cheddar varieties only), 19 pasteurized milk, 10 powders, 3 casein, 6 yoghurt, 8 other dairy products including ice cream.

Processing centres at Oakey, Pittsworth and Mt. Tyson ceased operation during the year.

New processing buildings and equipment. During the year ending 30 April 1981, factories in Queensland had applied for and received approval for expenditure of $862,313 on new equipment and $6,739,077 on new buildings and building extension. A major item approved was South Coast Co-operative Dairy Association's new factory complex at Southport.

A highlight in the processing industry was the commencement of commercial Feta cheese production by the Queensland Farmers' Co-operative Association with their new ultra-filtration plant at Booval.

Australian Code of Practice for Dairy Factories. All plans for new buildings or alterations and for installations of new processing equipment were checked for compliance with Code of Practice requirements before approval, and all building work and installations were inspected to ensure a satisfactory standard of materials and workmanship.

Code of Practice inspections of several existing processing plants were carried out as part of an on-going programme.

Registration of dairy produce laboratories. A new requirement under the *Dairy Produce Act* 1978–1979 was for dairy produce laboratories to be separately registered. Before registration, each laboratory in the State was inspected to determine compliance with minimum structural and operational requirements.

Dairy produce grading. Butter. A new development during the year was the commencement by three companies of direct marketing in Queensland of butter manufactured and patted in Victoria and New South Wales. Previously, the shortfall in Queensland production was filled entirely by importation from interstate of bulk butter only, with all patting being carried out within Queensland. All butter imported in pat form is graded before release to ensure compliance with local grade requirements.

Only two Queensland factories were able to supply bulk table butters to the Butter Marketing Board. Imported butter was made up of 6 842 t of bulk butter from Victorian factories for repackaging by the Butter Marketing Board, 1 946 t imported by the Butter Marketing Board for ghee and dehydrated fat products, and 661 t of butter brought into Queensland from Victoria and New South Wales as pat butter for direct retail sale. All imported pat butters including 'Dairy Soft' graded 93 or 92 points and were sound table butters.

The following table shows the total amount of butter imported into Queensland as bulk table butter or pat butters during the past four years:

Year	1977–78	1978–79	1979–80	1980–81
Tonnes	9 061	9 006	9 210	7 504

The drop in table butter imports in 1980–81 is attributable to: an apparent overall drop in butter consumption; a suspension of pat butter exports; and a very low butter stock situation at the Butter Board due to national butter shortages.

Cheese. All Queensland Cheddar cheese manufacturers have a substantial proportion of their production graded in-factory by State officers. Some non-Cheddar cheese is also graded on this basis.

Certificates of Competency. During the year 112 Certificates of Competency were issued under the Dairy Produce Act to operatives involved in various aspects of processing. A total of 60 permits pending examination for a Certificate of Competency was also issued. Certificates were issued for the three new areas defined under the *Dairy Produce Act* 1978–1979: market milk pasteurizing, dairy products processing, and dairy produce laboratory testing.

Advisory activities

The Branch offers a range of advisory services to the dairy processing industry. One of the major activities is assisting processors to maintain and improve product quality for all existing and new product lines. This assistance can be in the form of in-factory line surveys, inspection of buildings and equipment, organoleptic grading, and general information and advice. Much of this work is in response to routine monitoring of product quality by Dairy Research Branch.

Liaison is maintained with the Queensland Milk Board on matters of milk quality through a joint Milk Board-Dairy Division Milk Quality Control Committee. This committee meets at monthly intervals and reviews quality trends and action taken to rectify problems.

Special investigations

During the year, work has continued on or was initiated on a number of special projects in dairy processing. Major activities were—

Shattering of cottage cheese curd. During the year, Mr G. Dennien was involved in a study of cottage cheese curd shattering. The project was commenced in the 1979–80 year and was funded by the Dairying Research Committee. During 1980–81 work continued under D.R.C. and State funding. The aims and objectives of the project were as follows: (i) to gain an understanding of the causes and factors influencing shattering of curd and grit formation in Cottage Cheese manufacture, and (ii) to develop a systematic approach to the control of curd shattering by manipulation of manufacturing procedures-milk composition.

Shattering of cottage cheese curd during manufacture can be a serious problem causing excessive losses of curd particles or 'fines' in the whey and wash water.

Previous studies revealed that milk composition may have been a contributing factor as it was established that cottage cheesc manufactured from Jersey milk shattered less than cheese made from Friesian milk.

Herd milks used in this study included Jersey, Friesian, and A.I.S. as well as bulk factory milk. Analyses of various milk components and subsequent manufacture of cheese from these milks revealed a correlation between various casein fractions and citrate in fines formation. The addition of sodium citrate and sodium caseinate to milk known to shatter resulted in an improvement in fines loss.

Blowing of rindless Cheddar cheese. A serious problem of gas production in rindless Cheddar cheese at the Southbrook Co-operative Dairy Association was investigated. Bacteriological tests revealed the organism responsible to be *Clostridium tyrobutyricum.*

Although cited in literature as a gas producer in eye-type cheese, no cases of blowing in Cheddar cheese were reported. Investigations suggested that *C. tyrobutyricum* is a serious potential cause of blowing in Cheddar cheese when the following criteria exist at a Cheddar plant: milk intake is low (drought conditions) and farmers are feeding stock in confined areas; levels of spores in the bulk milk exceed 5 per mL; cheese composition is variable, particularly pH and salt levels.

The defect was eliminated by maintaining strict control over cheese composition. Cheese pH must be maintained at 5.1 or lower and salt content 1.8 to 2.0%.

Survey of losses in dairy processing. A survey to determine the levels of usage of product, water and energy in Queensland dairy factories was commenced. Usage ratios (for example, product-water, percentage milk loss) will be calculated, so that a given factory can be compared with other local and overseas factories. The survey will highlight problem areas, which can then be investigated more thoroughly.

Recovery of whey fines. The production of dairy products such as cheese and casein results in generation of a considerable amount of by-product in the form of whey. In addition to containing fat, soluble protein and lactose, the whey also contains curd fines. A project to determine effectiveness of small aperture screens to recover these curd fines has been initiated. Their effectiveness in reducing the final B.O.D. of whey is to be assessed. Incorporation of the recovered fines into dairy products will also be considered.

Keeping quality of pasteurized milk. A new form of keeping quality test, known as the Moseley Test, was introduced in 1980 for pasteurized milk and cream products on an advisory basis by Dairy Research Branch. Officers provided assistance to industry during the introductory phase of the test by conducting in-factory surveys to locate sources and causes of contamination, and by conducting organoleptic grading on samples stored both in the laboratory and in the factory.

Industry training and information

Dairy Products Bulletin. The Branch continues to publish Dairy Products Bulletin, which is widely distributed throughout the processing industry in Queensland. It also attracts interest from interstate and overseas. The Bulletin is now being produced three times a year, with 800 copies distributed. A wide variety of material is included in the Bulletin ranging from local and overseas technical developments to more general industry news and information.

Technical reports. Work commenced during the year on a new series of technical reports for the processing industry. Each report covers a specific area of processing, and is designed to serve as an operatives handbook.

Factory operatives training group. A committee, comprised of representatives from Dairy Field Services Branch, Dairy Research Branch and the commercial processing industry, meets at regular intervals to oversee industry operative training and to plan specific activities. A major activity during the year was a 1 week school at Gatton College in July 1980 on cheese manufacture. The number of participants was 14.

Regional industry training. Depending on availability of resources and local industry interest, some regional or in-factory operative training exercises were conducted. The Wide Bay-South Burnett region was most active in this regard, conducting a total of eight regional half-day programmes during the year on topics such as hygiene, safety and tanker driver operations. Local officers continued to provide assistance as required to operatives undertaking Certificates of Competency courses.

Special activities

Residues in dairy products

Chlorinated-hydrocarbon and organo-phosphate residues. The monitoring of pesticide residues in Queensland dairy produce continued during 1980. One hundred samples of pasteurized milk from 15 pasteurizing plants were analysed by Dairy Research Branch and 280 samples of butter and cheese were submitted to Commonwealth Laboratories for analysis.

For comparison, the percentage of samples found to be above the M.R.L. for the period of 1970–1980 are listed in the accompanying table.

PERCENTAGE OF SAMPLES ABOVE MAXIMUM RESIDUE LIMIT (M.R.L.)

Year	Chlorinated-hydrocarbons						Organo-phosphates		
	DDT	Dieldrin	Aldrin	Lindane	BHC	HCB	Ethion	Dursban	Nexagen
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	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
1979	Nil	0.8	Nil	Nil	0.5	Nil	Nil	Nil	Nil
1980	0.5*	2.1†	Nil	Nil	1.30‡	Nil	Nil	Nil	Nil

*2 samples †8 samples ‡5 samples

All samples above M.R.L. were pasteurized milk. No butter or cheese samples were found to be above M.R.L.

The table indicates that the incidence of pesticide residues in dairy produce has progressively increased since 1978 when no sample was recorded above M.R.L.

With the limited analytical resources available it was possible to follow up the residue problem identified in only two of the problem factories. Individual farm supplies from each of these factories were taken for analysis to allow source of the residues to be identified. Use of vegetable scraps from canneries as cattle feed has emerged as one of the 'new' sources of residues in milk.

Iodine and heavy metals. During 1980, 1 735 samples of milk were checked for iodine and of these 17 (0.98%) were found to contain residues above the legal limit of 500 μg per L. Over the last couple of years, the number of samples above the legal limit has declined and remained steady at around 1%.

During 1979, Dairy Research Branch analysed the 456 samples of dairy produce for heavy metals. The metals tested for were: cadmium, chromium, copper, iron, lead, mercury (only on pasteurized milk), nickel and zinc.

Overall the levels of the metals in dairy products were considered to be very low and consequently no further monitoring has been undertaken. However in some of the Cheddar cheese and powdered milk samples the zinc levels could have been considered high, that is, > 40 mg per kg.

Data processing

The Dairy Registration Computer System was re-designed to allow for changes made in the *Dairy Produce Act* 1978–1979. The computer system will now record, in addition to previously held information, all persons listed on the registration certificate together with the address of the dairy and the postal address of the registered proprietor. It is envisaged that the Mastitis Reporting System will be linked to this information when all dairy farms have been entered onto the computer system.

Extension research

A research grant of $13,950 was awarded by the Reserve Bank to Miss C. A. Underwood, Husbandry Officer, to conduct an extension research project entitled 'The Learning Efforts and Learning Strategies of Dairy Farmers'.

This study extends the work done by Miss Underwood on the learning strategies of extension officers while on study leave at the University of Melbourne. It is believed that the identification of farmers' learning strategies, focusing on the resources they prefer to use, will allow the Branch to provide a more effective and efficient extension service. One hundred and fifty dairy farmers will be interviewed in this project.

International training courses

An International Dairy Production Training Course was conducted from 16 July 1980 to 20 January 1981. The course was attended by representatives from Bangladesh (7), Thailand (2), Mexico (10), Malaysia (1) and Philippines (1).

The course was most successful. However, it placed a heavy demand on Branch resources, directly involving five officers in an organizing and co-ordinating capacity, and numerous other officers in assisting in various aspects of the course.

Winter forage

The main emphasis was on use of ryegrass and/or clover for winter forage. Three trials were completed during the year in conjunction with Dairy Cattle Husbandry Branch staff. The trials were at Rockhampton, Gympie and Beaudesert, and were to compare various clover species with nitrogen-fertilized ryegrass by milk yield and dry matter production data. Detailed reports were written and the results presented in more detail elsewhere. Clover produced equivalent milk yields on all trials but was lower in dry matter production. Also, at Beaudesert, the berseem clover did not compete with ryegrass when planted as a mixture.

These main trials were supported by clover demonstrations in other regions and districts. Clover species have been shown to be a viable alternative to nitrogen-fertilized ryegrass.

In excess of 15 trials and demonstrations are being carried out by Dairy Field Services Branch. All of these are aimed at providing more, better quality or cheaper feed for grazing.

'Dairy Management in the 80s' seminar

This is a Statewide project sponsored by the Queensland Dairymen's Organisation and Dairy Field Services Branch. The object of the seminar is to bring together research and practical experience, and to highlight the decisions and practices required to optimize economic dairy production over the next 5 to 10 years. This is particularly so in relation to increasing herd sizes.

The programme has been finalized and includes a trade display, farm tours to Farmfest '81, discussion groups, the seminar and social activities.

The seminar topics are: breeding management and herd health; milking management and dairy shed design; and feeds and feeding systems. These topics have speakers from Victoria, New South Wales and from throughout Queensland.

Dairy shed design competition

As a lead up to the Seminar and publicity for it, a dairy shed design competition has been organized. There are 63 entries in Section A (dairy shed design) and 29 entries in Section B (dairy innovation).

The seven regional winners will be judged before mid July and a State winner in both sections will be announced at the seminar in September.

Wacol open days

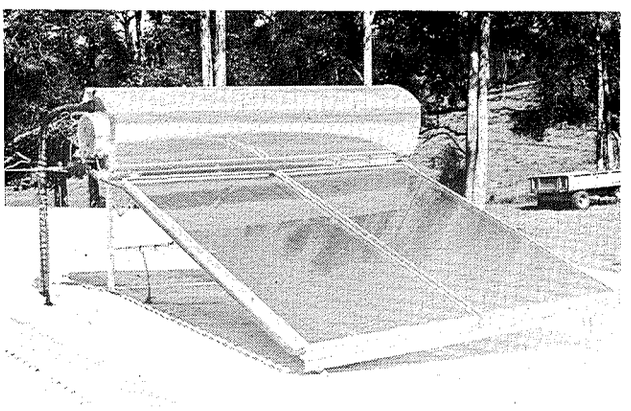
Two successful days were organized in April in conjunction with Dairy Cattle Husbandry Branch officers. A new look open day attracted about 350 dairy farmers to the A.I. Centre, Wacol. Dairy Field Services and Dairy Cattle Husbandry Branch field officers played a major role in the organizing of the day, in manning the various displays and in ensuring farmers knew about the days and could get to Wacol (three busloads from outlying centres were organized by D.F.S. officers).

Large-herd management workshop

Dairy Field Services Branch organized a wide ranging training workshop attended by 20 D.F.S. officers full time, and 13 part time. There were 18 visitors, of which eight were guest speakers.

The Workshop covered the major areas to be covered at the Seminar: breeding management, dairy shed design and performing, and feeds and feeding systems. Subjects also included material on topics to be covered by discussion groups at the seminar such as computers in dairy management as well as farm dams and irrigation systems. Economic considerations featured heavily throughout the Workshop. The opportunity was taken to plan action-work connected with the Seminar, the shed competition and herd improvement extension.

The workshop was held as part of Dairy Field Services Branch C.E.S.G. projects.



Solar heating of water for dairy purposes.

Dairy shed trials

Trials have been conducted in the Mundubbera area to assess the potential of solar hot water systems for providing hot water for use in the dairy.

Another trial has shown that significant savings in farm refrigeration costs could be accomplished by use of a pre-cooler using recirculated water and an evaporative tower system.

Staff training and development

General staff development

A staff development programme based on annual confidential officer-supervisor interviews was introduced in the Branch in 1979. All officers in the Branch participated in the programme, which is designed to foster personal development and effectiveness of each officer. A new format for the interview was introduced in 1981. Some supervisors have attended role specification workshops to improve their supervisory skills in this area.

Induction training

The method of training new appointees to the Branch has been reviewed, and a modified system of training cadets is being trialled. This system involves identifying gaps between the officers' knowledge and the knowledge required for the role he is eventually to fill. A training programme is then developed utilizing the officers' preferred learning strategies, with feedback to the supervisor after each segment is completed.

Training courses

The Assistant Branch Director was granted full-time study leave to undertake studies towards a Graduate Diploma in Business Administration at the Queensland Institute of Technology. A Husbandry Officer was also granted full-time leave to undertake studies towards a Masters Degree in Extension Studies at the University of Queensland.

Dairy Cattle Husbandry Branch

DAIRY Cattle Husbandry Branch operates three major sub-programmes in order to achieve its objectives and discharge its responsibilities. These are: dairy cattle research, dairy herd production services, and artificial breeding services.

Dairy cattle research

The aim of the dairy cattle research sub-programme is to conduct applied research in dairy cattle production technology and to provide information for direct application by Queensland dairy farmers.

This sub-programme has two major operational areas: research stations projects and on-farm trials or demonstrations.

Research stations

Ayr Research Station. The work of irrigated tropical and temperate pastures which has been carried out during the last decade ceased in December 1980. During the period, many dairy farmers have inspected the research projects. Groups travelled from Rockhampton, Mackay and the Atherton Tableland while individual farmers from all districts visited the Station.

Mutdapilly Research Station. The 28-unit rotary turnstile has been transferred from Ayr and erected at Mutdapilly. This structure, together with the associated milk room, laboratory and complementary features, provides the first essential requirement in the development of the new station. Initial drainage works have been completed and underground irrigation mains are being installed in preparation for projects which will begin early in 1982.

An advisory committee has been formed to examine proposed projects and allocate a priority rating for their implementation.

Kairi Research Station. Two major projects were undertaken at the Kairi Station during the year. These were: the effect on milk production of four grain feeding strategies; and the effect of frequency of nitrogen fertilizer application on milk yield.

Milk yields per cow for each treatment at each stage of lactation and over the whole lactation are presented in the following table—

Treatment	Milk yield (kg/cow) for designated periods of lactation (days)				Lactation length (days)
	11-100	101-190	191-280	1-300	
High early/low late	1 640	1 418	936	4 280	300
Flat rate	1 492	1 300	998	4 094	300
Low early/high late	1 388	1 199	1 026	3 938	300
All early	1 582	1 176	669	3 639	281

(Total grain fed per cow 500 kg)

The results of this project are still being analysed but it is obvious season has a marked effect on the 'carry over' response to grain feeding.

From the second grazing experiment the frequency of nitrogen fertilization of dryland pasture was seen to have little effect on milk production. The cumulative milk yield (kg per cow) over 36 weeks for each treatment is shown in the following table—

Frequency (weeks)	Milk yield (kg/cow) over 36 weeks	
	Nitrogen application (kg N $ha^{-1}yr^{-1}$)	
	200	400
3	3 078	3 018
6	3 119	3 158
12	3 140	3 169

Apart from the two chief projects, work has continued on defining the requirements in terms of stocking pressure for the recovery of overstocked grass-legume pastures. It is hoped that this experiment will be completed by the end of the current year.

Also new studies are beginning to elucidate the question of phosphorus supplementation of lactating cows when high levels of molasses are being fed. This is a particularly topical question for many of Queensland's dairy farmers.

Farm trials and demonstrations

From C.E.S.G. funds, large-scale grazing trials were conducted on three properties in the Rockhampton, Gympie and Beaudesert districts during the year.

On each farm, an area of annual winter feed (ryegrass and/or clovers) was planted, sufficient, according to results from Ayr Research Station, to supply the total grazing needs of the entire milking herd from mid June until at least the end of October. On the farms at Rockhampton and Gympie, full-time grazing on the trial area over this period was achieved and excellent data on the relative merits of ryegrass and clover were acquired. Unfortunately, clover areas on the Beaudesert farm were not grazed full-time. The reasons for and implications of this will be discussed more fully later in this report.

On each farm, equal areas of three annual winter pasture types were planted: ryegrass receiving regular bag N; ryegrass-clover receiving regular bag N from planting until September; and clover receiving bag N at planting only.

Pasture treatments were grazed in rotation (21 to 24 days total) with the animals remaining on each treatment for 7 to 8 consecutive days. Electric fencing was used to supply fresh pasture daily. Individual cow milk production was monitored by recording one morning and one afternoon milking on each pasture type each rotation, but only after animals had been grazing that pasture type for at least 5 days. Pasture yield and composition data were also collected.

Relative milk production potential. Results from this series of trials support trial data obtained at Ayr Research Station which indicated that, when ryegrass and clovers are grown in the tropics, clovers have a higher nutritive value and are capable of supporting higher per-cow milk yields compared with ryegrass. On both the Rockhampton and Gympie farms once clover pasture yields matched ryegrass yields (that is, from August onwards), per-cow yields at identical stocking rates were higher from clover treatments than ryegrass treatments by 0.5 to 2.5 L per cow per day.

However, production per cow is not the only criterion which should be taken into account when assessing the relative merits of the two pasture types for milk production. Carrying capacity or stocking rate is also important. Consequently, the milk production measure used to assess these pastures was production per hectare.

On the Rockhampton and Gympie farms, the entire milking herd obtained all of its grazing requirements from the trial area from late June until November. Since all treatments on a farm were grazed for similar durations, the average stocking rates of all treatments over this period were almost identical, and fluctuated according to farm and numbers in the milking herd between 5.0 and 7.0 cows per ha. Stocking rates in this range are commonly used on high N ryegrass pastures in Queensland.

Milk production data from the Rockhampton and Gympie farms showed very similar trends. With identical stocking rates across treatments, milk production per cow, and hence per hectare, was higher off ryegrass than clover in July, similar in August and below from September onwards. No ryegrass was available on either farm by the end of November while the white and red clover components of clover mixes provided good grazing well into summer. In fact, Ladino white clover was still providing excellent grazing on the Rockhampton farm at the end of January 1981.

Results from all three farms confirmed that ryegrass establishes faster than most clovers and provides more feed and milk in early winter, that is, June and July. However, results from the warmer tropical and subtropical areas (that is, Rockhampton and Gympie) confirmed that clovers will at least match and generally outproduce ryegrass in milk output per hectare over the entire winter–spring period. In addition, when they are needed and where suitable clover species have been sown in the mixture (especially Ladino white), they can be maintained economically well into summer.

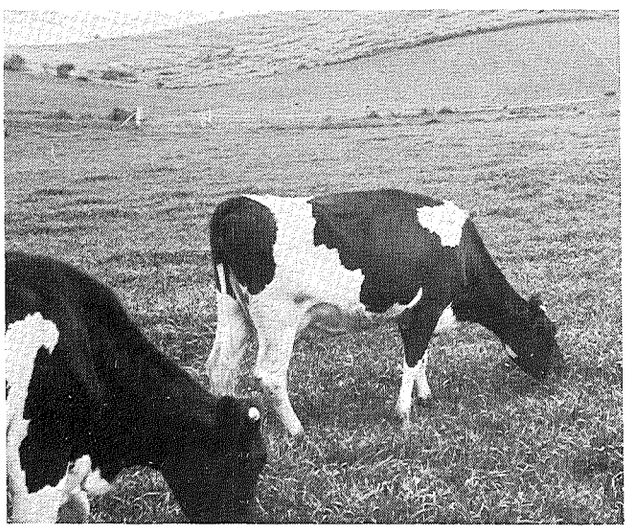
The relative merits of clover and ryegrass in colder subtropical environments, for example Beaudesert, are far less clear. There is a number of possible reasons why clover areas on the Beaudesert farm did not perform as well as those on the other two farms.

The reasons are—

1. Clovers may well be more sensitive to cool temperatures especially during establishment. Hence the slower establishment noted for most clovers at Rockhampton and Gympie (2 to 3 weeks slower) may be exaggerated in colder environments.

2. Clover areas at Beaudesert were planted some 1 to 3 weeks after the ryegrass areas. Plot trial results at Gympie showed that time of planting has a marked effect on the early performance of both ryegrass and clovers. A 4-week delay in planting time (April to May) reduced dry matter yields over the May–June (inclusive) period by 40%.

3. Flood rains in April resulted in the entire trial area at Beaudesert being covered for a period with 0.4 m of water. This may have had a more severe effect on the younger clover seedlings than on the older ryegrass seedlings.



Winter grazing trials at Dayboro using ryegrass pastures.

4. Grazing time on clovers at Beaudesert was often reduced because of bloat fear. Hence it was difficult to determine how much of the total grazing requirements were provided from clover treatments. Grazing time may not be a good indicator as it has been noted that grazing behaviour on clover is different from that on ryegrass. Animals grazing clover (higher quality) seem to satisfy appetite more quickly than animals on ryegrass (lower quality). Hence, even though grazing periods may have been short on clovers, the amount of feed provided may have been considerably greater than grazing times would suggest.

It is clear that more comparative work needs to be done on ryegrass and clovers in colder environments. By planting early and by choosing most suitable species, clover pastures may still be economically attractive compared with ryegrass even in colder climates, for example, East Moreton, Darling Downs and North Burnett. However, in these areas the situation is not clear cut.

The aim of planting the ryegrass-clover mixture was to see whether the best attributes of both ryegrass (quick establishment) and clover (higher milk yields and reduced costs) could be combined. Nitrogen fertilizer was applied to the mixture up to and including the August grazing and then withdrawn (the Rockhampton and Gympie farms only). It was hoped that, by September, the clover component would be sufficiently well established to be able to continue milk production levels without further N. However, at the ryegrass seeding rates used in these mixtures (15 to 20 kg per ha) the good early growth of ryegrass prevented strong clover establishment by September and milk production fell when N was withdrawn. Trials on other farms this year have suggested ryegrass seeding rates in mixed ryegrass clover pastures need to be less than 10 kg per ha if clover growth is to be strong enough to allow early withdrawal of N. However, Ladino white clover dominance of the mixed pastures treatment at Rockhampton was established quickly once ryegrass growth declined in November. By January, Ladino growth in the mixed treatment was equal to that in the clover only treatment.

Production costs. In the warmer areas of Queensland at least, milk production costs are considerably lower with clovers compared with ryegrass. This is largely due to the considerably lower bag N requirements of clovers. Topdressing with nitrogen on clovers is not necessary and savings of more than 1 tonne of urea per ha per season can be made. That is $250 to $300 per ha per season. However, seed costs are higher with clovers and antibloat treatment is recommended, cutting the net saving to between $150 to $200 per ha. This is shown in the following table.

A COMPARISON OF PRODUCTION COSTS BETWEEN ANNUAL HIGH N RYEGRASS AND ANNUAL CLOVER PASTURES

Treatment	$/ha	
	Ryegrass	Clover
Land preparation and planting (2 discings and 1 harrowing)	24	24.00
Seed	44	76.00
Basal fertilizer		
500 kg super @ $120.00/tonne	60	67.50*
125 kg muriate @ $175.00/tonne	22	22.00
125 kg urea @ $265.00/tonne	33	33.00
Application of basal fertilizer	6	6.00
Topdressing nitrogen 1.125 t/ha ryegrass	300	Nil
Topdressing muriate 0.125 t/ha clover	Nil	22.00
Application of topdressing fertilizer	17	2.50
Irrigation pumping costs: assume 900 mm applied/ha/year 9 ML/ha @ $20/ML	180	180.00
Interest and depreciation on pumping equipment	180	180.00
Antibloat—purchase and application	Nil	80.00
TOTAL	$866	$693.00
Production cost (c/L) assuming identical production of 15 000 L/ha (i.e. pasture production costs only)	5.8	4.6

*Clovers require Mo super every second year.

One farmer at Rockhampton has now converted his winter feed programme almost entirely to clovers. The farm is now producing more milk from clovers than it did previously from a similar area of ryegrass while, at the same time, saving $5,000 in urea costs. The Rockhampton farmer in this project expects to achieve a similar result in future years by converting all his winter feed to clover-based pasture. The owner of the Gympie farm also plans to use largely clover pastures in future.

Grazing and pasture management. Annual ryegrass and clovers should be considered only where irrigation is available. Under dryland conditions, oats is generally a better alternative.

The aim on all farms in this series of trials was to apply 25 to 50 mm of irrigation every 5 to 10 days. In the few instances where breakdowns prevented this, clovers held up better than ryegrass. The tap-root system of clovers seems better able to handle droughting effects than the surface root system of ryegrass.

Clovers performed better when given a slightly longer inter-grazing interval (24 to 28 days) than is recommended for ryegrass (18 to 21 days).

Pasture dry matter production. Pasture dry matter figures indicated the extent of the slower establishment of clovers relative to ryegrass. For example, on the Rockhampton farm at the first full grazing of the trial area in July (approximately 10 weeks after planting) dry matter production from clover treatments was less than half that of ryegrass treatments (632 v 1 666 kg DM per ha). Clover DM yields in August were still only 70% of ryegrass yields but the superior quality of clovers resulted in almost identical milk yields. In fact, it has been a consistent trend in a number of trials for milk yields from clovers and ryegrass to be identical when clover yields are approximately 70% of ryegrass yields. From September onwards, ryegrass and clover yields were reasonably similar until ryegrass finished at the end of November. Ladino white clover yields of 1 500 kg DM per ha per 24 days were still being recorded in January.

Dairy herd production services

The aim of the dairy herd production services sub-programme is to make available to dairymen production recording systems, herd management information services and facilities for genetic improvement of herds and breed development.

The activities covered in this sub-programme are—laboratory and field herd recording; bull proving; and dairy breed development.

Herd recording (laboratory). The number of samples tested in the Herd Improvement Laboratory, Wacol, during the last 3 years was 428 502 in 1978–79, 418 611 in 1979–80 and 452 034 in 1980–81.

In June 1980, a new Scan 203 was installed and in February 1981 a second Scan 203 was put into operation. Both are operating with the minimum amount of trouble. One bank of Milko Testers was closed, stored and serviced before one was transferred to the Dairy Research Laboratory in Toowoomba. The other bank of Milko Testers is maintained in working order and is used to support the Scans when needed.

The three staff members operating the data input equipment have all attained levels of proficiency in excess of 12 000 key strokes an hour. In spite of this, only 60% of herd data has been entered through the centre. Processing of the remainder through the State Government Computing Centre and the State Electoral Office is both costly and of doubtful tenure. Provision of new data capture equipment (orders placed May 1981) is expected to ease this position. However, constant monitoring of this aspect is maintained. Withdrawal of support from either the S.G.C.C. or the Electoral Office would slow herd record return rates.

Visiting farmers and technical and overseas groups have been conducted through the milk testing facility. Approximately 200 farmers were shown through the laboratory during the Wacol Open Days held on 22 and 23 April 1981.

Herd recording (field). A total of 44 245 cows completed recorded lactations in 669 recorded herds during the year. The average production of 2 976 L of milk and 113 kg of butterfat was the highest ever recorded.

The replacement of herd recorders (wages employees) with contractors has continued. There are now only five recording officers providing a field service. The increases in operating costs which contractors face are reflected in the projected fees for the forthcoming year. It is expected that contractor services will cost $190,000 next year. The cost to the Department of providing contractors still remains approximately half that of employing recorders.

The farmer own sampling service, introduced in 1979, has attracted 14% of the total recording members. There are five small farmer groups operating, with members sharing equipment costs.

Mastitis cell count project. This (84 herds) will terminate on 30 June 1981, and will be replaced by a mastitis cell count evaluation service available to all herd recording members commencing on 1 July. A testing fee of 10¢ per test will be charged for this service.

The recording and processing of milk measurements only service has been requested by several farmers who are unable to accommodate sampling techniques in their shed programme but desire an individual cow milk production performance. It will begin on 1 July 1981.

Another project is seeking to determine the loss in accuracy of prediction of lactation performance which would occur if either morning or afternoon or alternate morning—afternoon sampling replaced the current morning and afternoon routine. Separate samples are taken from all cows in the 12 co-operating herds at each observed milking, as well as a composite sample from those milkings. Milking intervals are also recorded. Butterfat, protein and lactose are determined for each sample.

Statistical analysis of this milk volume and content data will allow the four systems to be compared. Preliminary analysis is expected to be completed at Biometry Branch in July–August 1981. This project is important in the light of farmer demand for simplification of the sampling part of lactation performance prediction. It is also relevant to the integration of lactation data in N.D.H.I.S. comparisons.

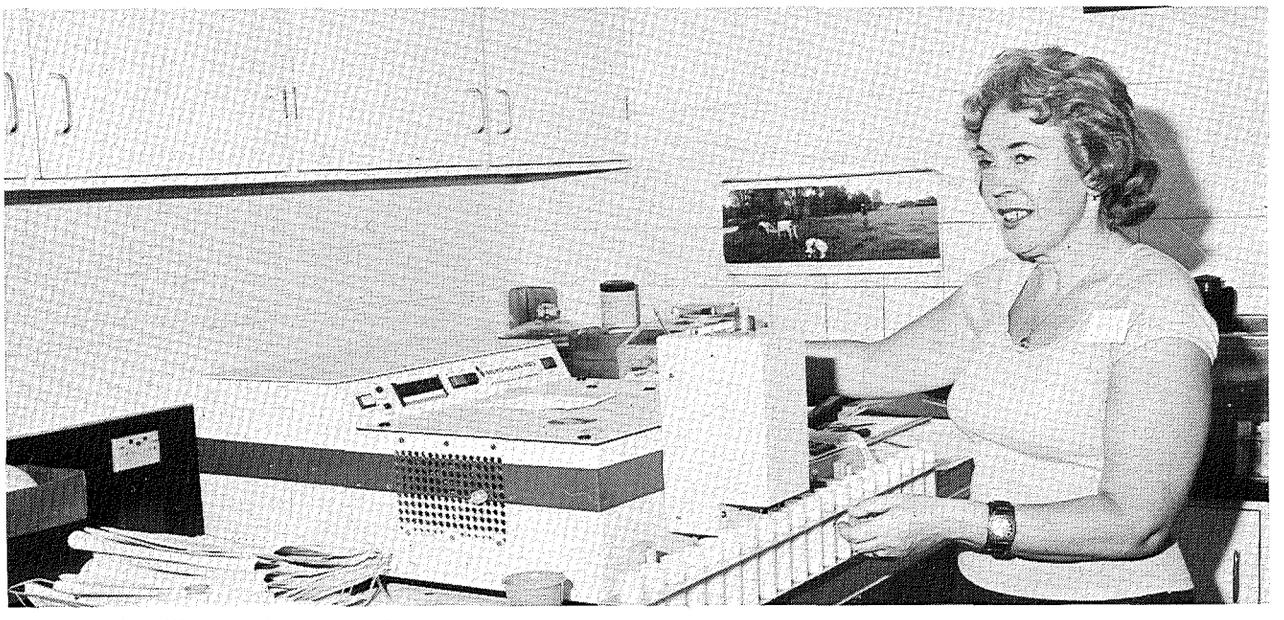
A milk composition project seeking to identify patterns of variation in butterfat, protein and lactose production during lactation or between seasons has commenced.

Results available from Scan equipment will now be provided in all Herd Recording Reports. Computer programmes have been amended to process individual cow protein records.

At the request of breed societies, 300 days' milk and fat production records are now being printed on Herd Production Sheets. This service commenced in May 1981.

The breeding management service provides production and similar management information as an adjunct to the recording system. Farmer co-operators in the progeny test scheme are included among those using this service, which has been provided in pilot form. A more extensive scheme is now being developed.

The revised fee structure introduced in late 1979 is functioning satisfactorily. Fee charges were increased by 35% on 1 July 1980, and a further increase of 40% will apply from 1 July 1981. The increases are in line with current policy for farmers to pay 100% of the field



Testing milk at Wacol, using new equipment.

service costs by June 1982. Farmers will meet 80% of these costs during the 1981–82 recording year. No decline in members is expected, but the trend towards farmer own sampling is likely to increase.

Computer programmes relating to recording accounting functions are now functioning satisfactorily. Modifications to these programmes are required to handle fee increases and to include testing charges for the mastitis count service.

The transfer of processing of data from the A.B.S. system to the S.G.C.C. was undertaken successfully in January. The processing strength of the S.G.C.C. computer should eventually allow provision for a greater range of services related to feeding and reproduction management.

Bull proving

Administrative changes introduced in 1979–80 have been consolidated and refined during the current reporting period. Excellent co-operation has been received from farmers, officers and recorders on this programme. Improvement in heifer identification procedures by use of ear tags and photographs has also been effected.

Monitoring of the scheme using data supplied through the Herd Recording Scheme has proven quite successful.

Collaboration with N.S.W. Department of Agriculture is continuing satisfactorily with the Jersey breed now in its third year and the A.I.S. breed in its second year.

This is the first year that a bonus has not been paid to co-operators on a matings basis but to the inseminating organizations who have carried out the matings. Bonus payments now apply on the basis of completed heifer lactations.

Sires proven from the 1976 teams are listed below—

Breed	Name
Friesian	Dasfries Robin Airman
A.I.S.	Tabbagong Mayflower's Mascot
Jersey	Sweet Meadows Flashlight

A B.L.U.P. programme will be evaluated on data from the 1979 and 1980 recording years. This will provide a ranking of proving bulls within the whole recording population.

Dairy breed development

The A.F.S. and Sahiwal projects are essentially research orientated.

A.F.S. bull proving

During the year, A.F.S. bull proving was included as part of the routine bull proving operations of the Branch. In 1981, the conditions under which A.F.S. bull proving operates were amended to make them consistent with the Friesian, A.I.S. and Jersey schemes. Branch regional staff have now undertaken supervision of this programme as part of routine duties.

Daughters of the first proving group continued to calve during the year. The number of effective daughter lactations has been too low to enable a proven bull to be identified at this stage. Additional lactation data from A.F.S. x Friesian heifers in co-operators' herds is being collated to improve the precision of the ranking of these three bulls. This data will be re-analysed via a B.L.U.P. programme in the near future.

A.F.S. cows

South-east Queensland. The number of A.F.S. cattle on loan has increased from 165 (May 1980) to 260 (May 1981). A total of 51 cows and pregnant heifers was received from Ayr and Kairi during the year. Thirteen loan cows were culled during the year. Two A.F.S. co-operators withdrew from the programme and three new co-operators were started during the year. The total number of co-operators in south-east Queensland is now 14.

Eungella-Sarina. Five co-operators with 15 loan cows remain in the programme.

Atherton Tableland. The number of A.F.S. cattle on loan has increased from 27 to 68 during the year. This increase is a result of loaning lactation-tested F_1 A.F.S. animals from the Kairi Research Station to co-operators, and the loaning of pregnant later generation A.F.S. heifers to co-operators. The number of A.F.S. co-operators has increased from 10 to 16 during the year.

Northern Territory. Five cows on loan to Mr Fitzgerald's 'Elizabeth River Dairy' near Darwin have performed well during the year. The average daily production of the A.F.S. cows was 11.2 L per day compared with 9.9 L per day from A.M.Z. loan cows on the same farm. A further nine cows were loaned to this co-operator in April.

A total of 35 Friesian cows are on loan to three co-operators in central and south-east Queensland.

Tick resistant dairy herds programme. Nine co-operators are currently participating in this project: three on the Atherton Tableland, five in the Wide Bay Region and one in the West Moreton region.

Interest among co-operators is high, particularly as heifers are now beginning lactations. Greater emphasis has now been placed on calf and heifer rearing in co-operators' herds in the hope that greater numbers will be available in the future for comparison purposes.

Five F_1 A.F.S. heifers, and three A.F.S. cross heifers were purchased for distribution among the three Atherton Tableland co-operators.

The purchase of these heifers is intended to supplement the numbers of A.F.S. heifers in co-operators' herds with the aim of providing more reliable data on the performance of these animals under commercial conditions.

Sahiwal projects

An embryo transfer programme at Ayr Research Station in July 1980 involving seven Sahiwal and six A.F.S. cows was carried out with the assistance of Drs A. Baker, D. Jillella and Mr A. White, of the University of Queensland. Several of the donors were aged and/or had poor reproductive histories, and some did not cycle at the required time. Only eight eggs were transferred. No pregnancies were obtained.

This disappointing result was largely due to the unsuitability of some donors, and possibly also to a seasonal effect. It has since been reported that *Bos indicus* cattle are relatively poor donors of ova, and the Ayr results support this.

Sahiwal herd. The Sahiwal herd was transferred to the Mutdapilly Research Station in February 1981. The rearing of some of the full blood progeny still causes concern due to low birth-weights, poor suckling ability and unwillingness to suckle other cows or calf-a-teria teats.

The reproductive performance of the herds has been closely monitored during the year. Reproductive performance has been adversely affected by the insemination problems at Ayr and Mutdapilly since December. These problems have now been corrected.

Sahiwal bull proving. Sahiwal bull proving operations began to wind down during the year, with the last series of matings to produce F_1 A.F.S. animals being completed in November 1980.

Calvings of a group of F_1 heifers sired by J120, J126, J130 and J133 were completed during the year. Of the 29 heifers that calved, only five persisted for a useful lactation and have been retained in the programme.

Calvings of this group of F_1 heifers sired by J051, J125, J160 and Tallabilla Ghandi began during the year. Of the 21 heifers sired by these bulls, five have been retained on the basis of lactation persistency.

Progeny of the group J076, J113, J147 and J150 were reared during the year. The mating of some of the earliest born of this group has commenced.

Progeny of the bulls J037, J070, J086 and J098 have been born during the year. This is the last group of bulls used, and calvings should be completed by September 1981.

Artificial breeding services

The aim of the artificial breeding services sub-programme is to provide for the requirements of livestock producers (except insemination services) to undertake artificial breeding programmes in their herds.

The remodelled office-laboratory complex at the Wacol A.I. Centre was opened in November. The extra facilities and revised workflow have been well tested and are contributing to efficient operations.

An additional demountable building was provided at the A.I. Export Centre for semen and equipment storage and for staff amenities.

Revised accounting procedures have reduced the number of problems in several areas particularly privately owned bulls and semen storage. While these changes have brought current accounts up to date, there is still a considerable backlog of work in some areas (for example, privately owned bulls). Consignment trading procedures were amended to operate on inventory control rather than controls through Accounts Branch ledgers. It is also possible now to sub-consign semen.

A review of marketing to rationalize semen distribution is under way. The extension of agency arrangements to reduce the number of individual despatches is eagerly awaited as this should reduce the clerical and despatch workload.

Equipment valued at $66,510 was sold in the 12 months ended 30 April. This represents an increase of approximately 350% over last year. Invoices raised up to the above date totalled $652,137, an increase of 43% over 1979–80.

There were 138 animals held on the Wacol and Ormiston A.I. Centres at the 31 May 1981. Of these, 121 were owned by the Department and 17 by C.S.I.R.O. or clients of the Centres.

Bulls entering and maintained on the A.I. Centre met with A.H.C. testing requirements during 1980–81.

The recent 1981 annual health test included sampling of all stock for the Commonwealth Bureau of Animal Health frozen serum bank and Friesian bulls for blood typing necessary for future registration of progeny with the Friesian Cattle Club.

Semen production

Licensed semen (figures for 1979–80 in brackets). A total of 1 005 (1 390) collection attempts at Wacol and Ormiston resulted in 167 100 (287 500) doses being placed in storage. The success rate in processing was 90% (89.2). Included in this amount were 24 700 doses (57 900) stored from privately owned bulls, 88.7% (89.1) success rate.

Unlicensed semen. Of the 21 088 doses of unlicensed semen which were processed in the laboratory, 18 633 were of good quality and placed in storage. This represents a success rate of 88.4%.

Technical services

Training in the practice of artificial insemination of cattle was sought by 168 persons who participated in 17 courses. A further 142 persons attended refresher courses which were conducted in nine districts.

Recent refresher courses and a survey of A.I. usage showed that more than 80% of trainees implement A.I. programmes on the completion of training. This is significantly higher than previous estimates (60%). The majority of those who stop using A.I. do so because they have discontinued dairying. Of those using A.I., 42% use it as their sole means of breeding while a further 47% use A.I. on the whole herd except maiden heifers.

Marketing of semen

An index of marketing activities is the value of semen sold from the A.I. Centre. In 1980–81, this was $652,100 which was 43% above that for 1979–80.

Promotion and advertising. The April 'Open Days' were one major highlight of a year in which there was further consolidation of the promotional programme. The several hundred visitors to the Centre appeared to favour the informal approach and access to specialist officers.

Official opening. Extensions to the office-laboratory complex were opened in November by the Minister. This function was also the culmination of the Silver Jubilee celebrations which attracted considerable public interest. An A.I. feature supplement was prepared for the *Queensland Country Life* newspaper and reprints were mailed to all A.I. Centre clients.

Promotional materials. Display boards to promote various aspects of dairy herd improvement and A.I. Centre services were prepared. Several of these boards are now located in country offices and others are held at Wacol for shows and field days.

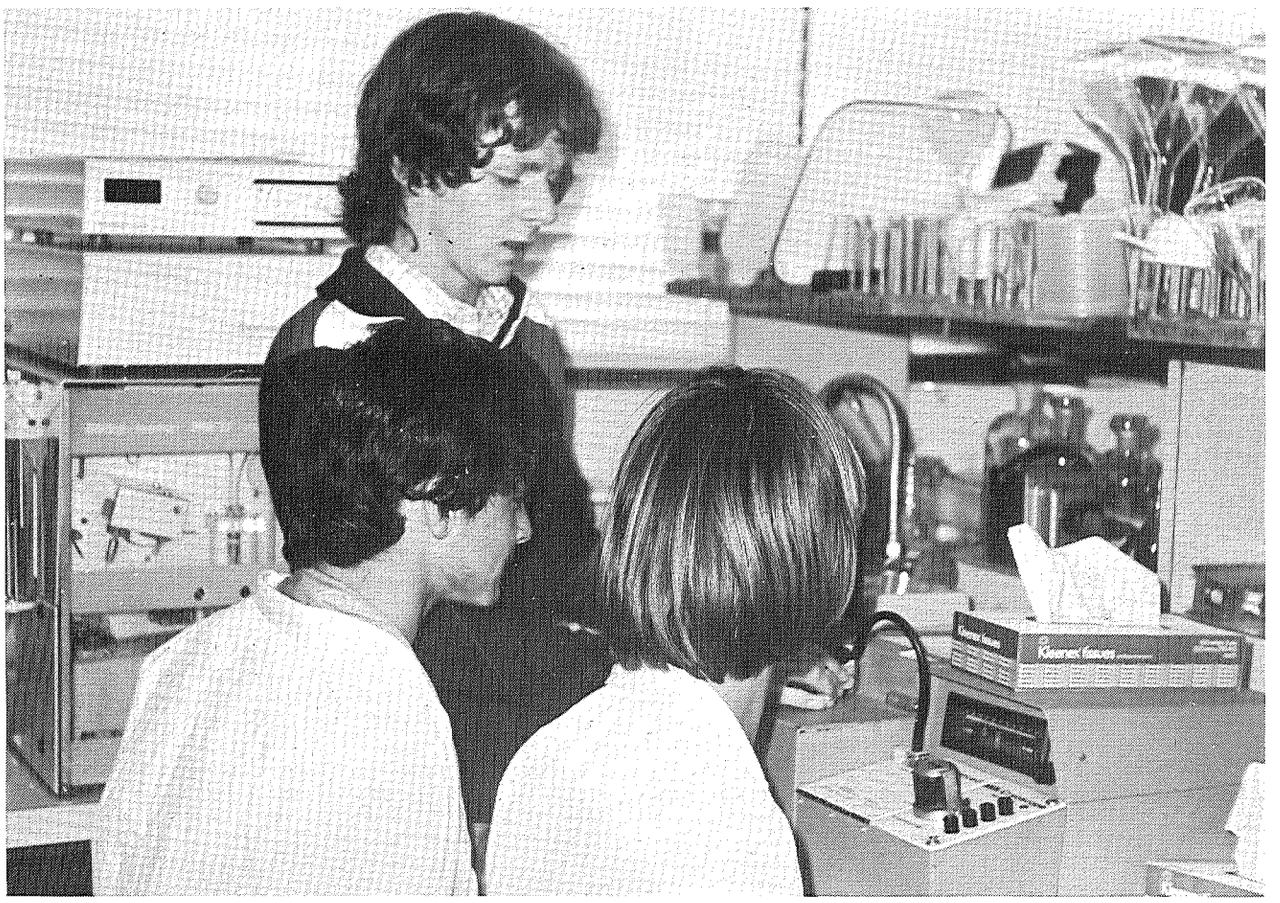
Breed catalogues were distributed and individual catalogue pages were prepared for most bulls.

Monthly advertising has continued in the *Queensland Dairyfarmer* newspaper. The national magazine *The Dairyman* has also been used together with cattle journals and publications.

All herdsman inseminator courses have been attended for at least one day by a member of the promotional team. Displays have been presented at a number of shows and field days including the 1980 Brisbane R.N.A. during which a team of four Wacol bulls received several awards.

Dairy Research Branch

RESEARCH Branch continued to provide technical laboratory support for the Queensland Milk Board, the Butter Marketing Board and for regulatory, advisory and research officers within the Division of Dairying. By providing these laboratory services, the Branch is simultaneously safeguarding the interests of the consuming public.



Two secondary school students who obtained work experience with Dairy Research Branch are being shown how to detect added water in milk.

It will be noted from this report that the relative importance of the various programmes is changing as the Queensland dairying industry continues to become market milk oriented.

—	1980–81		1979–80	
	Samples	Tests	Samples	Tests
Bacteriological	17 611	54 491	16 376	46 932
Chemical	22 840	56 357	18 871	51 893

Because of the significance given to quality evaluation, key personnel within the Branch participate in the development of Australian standards; lecture to dairy factory operatives and to Maternal and Child Health sisters; and serve on an increasing number of committees.

Research findings are transmitted to peers by research publications, presentation of papers at scientific gatherings and to a lesser extent by informal discussions and meetings. Emphasis is being given to the methods of disseminating research findings to industry and commercial bodies.

Staff are hosting an increasing number of visits by student groups from secondary and tertiary educational establishments. Three secondary school students have participated in work experience programmes at the Otto Madsen Dairy Research Laboratory.

It is expected that the liquid milk quality services computerized system will be operating later in 1981. All design stages are complete and documentation is almost complete. Of the 11 main programmes and 12 subsidiary programmes required in the system, seven main and all 12 subsidiary ones have been written and tested with multiple sets of typical input. A printer to handle pre-printed stationery has been ordered for attachment to the existing terminal in June 1981.

Dairy product evaluation

Raw milk

	1980–81	1979–80
Bacteriological analyses		
Farm-to-factory tankers		
Total count—no. of samples	1 542	1 582
% less than 150 000/mL	92.5	93.5
Factory-to-factory tankers		
Total count—no. of samples	1 780	1 747
% less than 150 000/mL	82.5	79.0
Chemical analyses		
All tankers		
No. of samples	3 413	3 450
Fat—% unsatisfactory	0.3	*
Solids-not-fat—% unsatisfactory	8.1	7.2
Freezing point—% unsatisfactory	10.1	6.7
—% > 1% added water	5.1	3.4

*Not reported

Bacteriological results reflect the success of the Divisional programme aimed at reducing bacterial counts at all stages of raw milk handling. Compositional problems still occur particularly on the Atherton Tableland.

Total bacterial counts were determined on 29 samples of individual farm milks. These examinations were for penalty purposes and were carried out on behalf of and by arrangement with Metropolitan Milk Producers' Association.

Pasteurized milks and creams

Approximately 100 samples of cream and flavoured products were of interstate origin. The remainder were of Queensland manufacture. Generally, quality of pasteurized products was satisfactory. Instances of inefficient pasteurization, post-pasteurization contamination (coliforms) and compositional irregularities occur as listed hereunder.

All products—Phosphatase test
- No. of samples 8 614
- —% Fail 0.33 (29 samples)

Coliform test—no. of samples 8 410
- —% Fail 17.2

Whole milks—Freezing point
- No. of samples 3 236
- —% unsatisfactory 13.5
- —% > 1% added water 6.4

Skim-milks—Composition
- No. of samples 553
- —% Substandard solids-not-fat 7.7
- —% Substandard fat 11.2

Creams—Composition
- No. of samples 1 416
- —% Substandard fat 2.4

Some of the positive phosphatase results can be explained by reactivation of the phosphatase enzyme (caused by high pasteurized temperatures and resultant elevated temperatures of storage). Many milks from the Atherton Tableland continue to give abnormal freezing points which seem to reflect the dietary intake of the animals in the region and the climatic conditions, as most of the solids-not-fat results for these milks were normal.

The Moseley Test, introduced in May 1980, has been used on all products, whereas the previous keeping quality test could be applied only to white milks. Initially, many products from a number of processing plants had high failure rates. As the year progressed, results improved and only a few plants now produce products which do not pass the standard.

Butter

With the closure of the Oakey and Dalby butter factories during the year, Warwick and Toowoomba are the only two butter factories remaining on the Darling Downs. Though a total of 1 030 samples of butters was analysed, 395 were from interstate and, for the first time, include samples of interstate pat butters. Incidence of over-moisture Victorian butters is 4.3% as compared with 13.1% last year. Copper determinations are now being carried out using atomic absorption spectroscopy and the ease of this determination has greatly increased the rate of sample throughput. Copper levels in butter have improved with only six samples having > 0.07 p.p.m., compared to 85 the previous year.

Yoghurt and other cultured products

Yeasts and moulds contamination continued to cause intermittent quality problems in all cultured products during the year. Frequent compositional irregularities include substandard fats for yoghurts, and high moisture contents in the other cultured products.

Dried milk products.

Only three milk powders were tested for chemical composition but 54 were examined bacteriologically. All samples were free of *Salmonella*. Twenty-five casein samples were analysed from one factory. *Salmonella gaminara* was detected in one sample. NATA certificates were issued for most of the samples.

Junex and Meletone.

NATA certificates were issued for 112 samples of Junex and Meletone. All conformed to the required standards.

Cheese.

During the year, no cheese was tested for export and two factories, Mt. Tyson and Pittsworth closed, reflecting the trend within the Queensland industry from manufactured dairy products towards market milk. It is noteworthy that a new ultrafiltration plant was commissioned at Booval mid 1981. Many analyses (67) have been performed to assist that factory standardize composition of Feta cheese manufacture from retentate produced in the U.F. plant.

The testing of imported cheese ceased during the year.

Starter cultures

Starter cultures were distributed to industry and individuals. It is noteworthy that an increasing number of people are making various fermented products within the home.

Trials with cheese and yoghurt starters showed no appreciable loss of viability or activity if pilot cultures are frozen in reconstituted skim-milk for up to 12 weeks.

Stable phage-resistant cultures of E8 were obtained by growing the culture in the presence of E8 phage. This whey-adapted starter culture shows activity suitable for practical cheese-making.

Residues monitoring

Antibiotics. Of 4 226 samples submitted for inhibitory substance analysis, 23 (0.54%) contained penicillin and two (0.05%) contained inhibitory substances other than penicillin.

Iodine. A total of 4 314 samples of pasteurized milk, skim-milks and raw milks was tested for level of residual iodine. There has been a continued maintenance of the high quality obtained in the previous year with regard to iodophor residues in these liquid milk products. More than 98% of all samples tested throughout the State had residual iodine levels less than 500 μg per L.

A total of 336 raw and pasteurized milk samples was analysed to pinpoint known organochloride residue problems in several districts, where vegetable scraps have been fed to dairy cattle. Other pesticide residue problems in milks relate to control of cane beetle in sugar-cane areas.

Service work for other Branches

This Branch continued to provide laboratory support for the Dairy Cattle Husbandry Branch. Two trials were finished: Trial DH156 (efficiency of maize grain concentrate feeding) and Trial DH190 which required supplementary analyses only. Analytical work for two new trials, DH155 (efficiency of nitrogen fertilizer use on a tropical green pasture) and DH178 (phosphorus supplementation of lactating cows) began during the year.

As part of the brucellosis eradication campaign the staff at the Malanda laboratory carried out quarterly analyses on all dairy herds in the northern region. Two herds were found to be positive in the last round of testing.

Bacteriological analyses have been carried out on pasteurized milks, waters and on ingredients used at a food processing plant manufacturing dairy based dip.

Milko-Scan standards have been regularly prepared for staff of the Dairy Cattle Husbandry Herd Recording Section at Wacol. Freezing point standards prepared at O.M.D.R.L. have been distributed to regional laboratories and to the dairy factories throughout the state. Thermometers were checked and standardized at O.M.D.R.L. on behalf of Dairy Field Services Branch.

Service work for other organizations

During the year, a number of projects was undertaken for external organizations which involved assistance in either evaporation or spray drying or both.

These projects included the following:

- Approximately 20 kg of a blood powder were produced for C.S.I.R.O. (Meat Research). This powder was required for a C.S.I.R.O. programme to help eradicate screw fly from New Guinea.
- A trial was carried out for C.S.I.R.O. (Meat Research) on the Centritherm to concentrate a liquid meat solution made from meat waste.
- Six trials were undertaken for a dairy co-operative to produce a modified baker's powder. For these trials, skim-milk and ultrafiltration permeate were blended. The resultant powders had the following solids composition: 100% skim-milk solids; 50%–50% skim-permeate solids; and 75%–25% skim-permeate solids. The physical properties of the powders were good and there were no processing problems. A larger batch of the 50–50 blend was produced for test baking.
- A project was undertaken during the second half of the year to produce a pharmaceutical powder for use in a peptic ulcer cure. The project involved drying 900 L of a prepared bismuth citrate complex to produce 336 kg of the powder.
- Work was undertaken for Queensland Farmers' Co-operative to use permeate from their ultrafiltration process in the formulation of a cattle feed block.

The permeate stream is a dilute solution of lactose and mineral salts and could be a disposal problem. Permeate was concentrated to 70% total solids by a combination of reverse osmosis and vacuum evaporation. This concentrate then crystallises to form a solid block. However, at this solids level, process control is difficult. Additives were added to lower solids level to harden the block and molasses was added to improve palatability. It was found that the block would not harden satisfactorily at the lower solids levels and this option for permeate utilization seems less attractive than it had previously.

Goat milk

More than 130 raw goat milk samples involving over 1 149 bacteriological tests from various areas of the state were tested. Quality of these ranged over the whole spectrum from very good to very poor quality depending on the source and the distribution system.

Overall, 147 goat milk samples were tested for chemical composition throughout the year.

Margarine

Only 24 margarines (produced by two Queensland factories) were analysed during the year. Most were of high bateriological quality and conformed to chemical standards including the requirement for cis-cis-methylene interrupted polyunsaturated fatty acids.

Dairy produce graders inspecting experimental cheese.

Research

Contacts with the manufacturing sector of the dairying industry are becoming closer and a considerable portion of technologists' work is a result of local industry queries, requests or problems. The remainder of the research within the Branch is funded in part by the Dairying Research Committee (DRC) though one project is supported by the Poultry Research Advisory Committee (P.R.A.C.).

Two long standing DRC sponsored projects, cheese ripening enzymology and studies on enzymes in milk, were finished. However, much of the work still in progress on these projects was incorporated into new DRC projects. Full reports of the work carried out in the above projects have been prepared and submitted to the Dairying Research Committee.

Milk enzymes

Lipolytic enzymes in the dairy industry. These enzymes are important in the dairy industry because of their ability to cause rancid off-flavours and to affect the physical stability of some products.

The most important lipolytic enzymes are those produced by psychrotrophic bacteria, contaminants of raw milk and cream. These do not usually affect these products but can cause problems in the manufactured products such as butter and cheese. It has been found that the lipases produced by *Pseudomonas fluorescens* selectively release the unpleasantly-flavoured, short-chain acids, especially butyric acid, from milk-fat. This means that in butter a strong off-flavour can be produced by very low levels of contaminating enzyme. Furthermore, such low levels cannot be measured by conventional methods.

More than 100 psychrotrophs which produced lipases or phospholipases were isolated and identified to genus level or further. Fluorescent pseudomonads were the most common with *Pseudomonas fluorescens* as the dominant species. Non-fluorescent pseudomonads were next most common, followed by *Flavobacterium* and *Serratia*. Less common were *Alcaligines, Enterobacter, Aeromonas, Bacillus, Streptococcus* and *Acinetobacter*. All isolates were forwarded to O.M.D.R.L. for enzyme property studies.

To assess the storage potential of a butter, a procedure has been worked out in which the butter is incubated at an elevated temperature (up to 40°C) for a few days to produce lipolysis which would normally occur over months at low temperature. By combining this method with the sensitive gas chromatographic analysis of the free fatty acids it is now possible to assess the potential storage stability of a butter with respect to lipolysis.

Another sensitive method currently being investigated for detecting free fatty acids in dairy products includes the use of high-pressure liquid chromatography (H.P.L.C.) of p-bromophenacyl esters of fatty acids. Also, the possible use of new thio esters as lipase substrates has been examined.

The phospholipases produced by *Ps. fluorescens* have been studied in some detail. These are important in milk because they can degrade phospholipids in the milk-fat globule membrane and destabilize the cream emulsion. *Ps. fluorescens* was shown to produce several phospholipases (A_1, C, lysophospholipase). These results indicate that this organism secretes a range of lipolytic enzymes which in combination can degrade the fat fraction of milk.

Psychrotrophic spoilage in milk

A detailed 3-month bacteriological survey of proteolytic psychrotrophs in raw milk from four regional factories has shown that dominant species of bacteria occur frequently. Dominant psychrotrophic species are those that (a) account for greater than 75% of the total proteolytic count, (b) are present in numbers greater than 10^5 c.f.u./mL, and (c) produce a heat-stable protease.

Species of this type were isolated from 22 of 67 raw tanker milk samples. Twenty were identified as *Pseudomonas fluorescens*; the remainder were *Ps. alcaligenes* and *Serratia liquefaciens*. This survey is currently in progress for a further 12 months during which raw milk from the same regional factories will be monitored for possible changes in the type species of the dominant psychrotrophic, proteolytic microflora.

During the 3-month survey, 306 proteolytic colonies were isolated on brainheart infusion agar, 267 of which were psychrotrophs: 84% of isolates were Gram negative; fewer than 4% were thermoduric.

Several extracellular proteases isolated from the above survey are being examined for their physicochemical properties and ability to hydrolyse milk proteins. Work on the protease from the strain *Ps. fluorescens* K8 has shown the enzyme to be stable to pasteurization and UHT heat treatments, to possess a non-globular configuration and a monomeric molecular size of 35 000 ± 3 000. Substrate specificities show the enzyme to have a preference for tryptophan and arginine p-nitro phenyl esters and polypeptides of molecular size greater than 2 000. The molecule also contains tightly bound Zn^{2+} and Ca^{2+} ions.

Antisera raised against the enzyme from the K8 isolate have been used in a cross-over immunoelectrophoresis technique developed to test for bacterial antigens in whole milk. In an attempt to improve the sensitivity of this test, a new approach utilizing the principle of the enzyme linked immunosorbent assay (ELISA) test has been recently adopted.

Preliminary work with commercially prepared conjugated sera has shown that highly titred antisera can be raised in rabbits. Initial problems with unstable antisera have been overcome and three different methods for the laboratory reduction of conjugated antisera are being tested.

Storage of milk supplies at refrigerator temperatures has resulted in psychrotrophic organisms being responsible for most milk spoilage. Current methods of detecting these organisms are very tedious, therefore a rapid, reliable and sensitive analytical technique is being developed for the detection of psychrotrophic spoilage in milk and milk products.

Proteolytic enzymes from milk leucocytes

The significance of proteases originating from milk leucocytes in causing breakdown of milk proteins and stability problems in certain dairy products is being studied.

Initial investigations involved an examination of methods for extracting the enzymes from the leucocytes and for determining their proteolytic activity.

Polymorphonuclear (PMN) leucocytes have been successfully ruptured by ultrasonication and separated into 'soluble' and 'insoluble' fractions by low speed centrifugation. The 'insoluble' fraction which consisted of cell wall debris and cell nuclei contained approximately 28% of the total proteolytic activity of the sonicated extract. The 'soluble' fraction consisted of granular and cytosol material and contained approximately 47% and 25% of the total caseolytic activity respectively. The granular fraction, which contained the highest proportion of proteolytic activity, could be pelletized by high speed centrifugation.

Several properties of the bovine blood PMN leucocyte granule proteases were activated by treatment of the granules with Triton X-100. However, Triton X-100 and sonication did not solubilize the proteases present in these granules.

The heat stability of a crude PMN leucocyte granule protease extract was determined. Exposure of the extract to 60°C for 30 min caused a 60 to 70% loss in proteolytic activity.

Leucocyte granule proteases had a pH optimum of 8 towards casein while two pH optima were found at pH 3.5 and 8 when haemoglobin was used as the substrate.

PMN leucocyte granule protease preparations were shown by SDS–PAG electrophoresis to cause extensive breakdown of α_S-, B– and K– caseins at pH 6.8.

Goat milk alkaline phosphatase

Goat milk was found to contain a lower level of the enzyme alkaline phosphatase than cow's milk. Values between one-tenth and one-fifteenth of cow's milk have been observed. As the extent of heat inactivation of alkaline phosphatase is used as a measure of the efficiency of pasteurization of milk, it was of importance to compare the heat stability of the enzymes from the milk of both species.

The activity of phosphatase in goat milk was reduced to levels where the milk would pass the test for pasteurization after shorter heating times than cow's milk. This was due mainly to the lower levels of the enzyme in the goat milk before heating. It has not yet been ascertained whether goat milk alkaline phosphatase is inherently less heat stable than cow's milk alkaline phosphatase.

Mastitis

A total of 617 sets of milk samples from individual cows has been analysed for mastitis pathogen content. Coagulase-positive staphylococci were in 32% of the samples and 17% contained *Streptococcus agalactiae*. Statistical analysis of results has indicated differentiation between the somatic cell count levels for samples with haemolytic coagulase-positive staphylococci compared with those containing non-haemolytic coagulase-positive staphylococci. Also, lower average NAGase readings and somatic cell counts occur in samples with no bacterial growth in contrast to those containing coagulase positive staphylococci, whether haemolytic or not.

Enzymatic studies on the detection of secretory disturbances in the bovine mammary gland. Glucose levels in normal and mastitic milk were examined by an enzymatic procedure. Lower levels of glucose were found in mastitis milk and storage trials showed that this was not due to breakdown by elevated leucocyte counts. The large variability in glucose results between normal and infected quarters indicated the test was unsuitable for development as a rapid diagnostic procedure.

A pH indicator test was evaluated for on-farm use in mastitis screening. The test was simple, rapid and inexpensive and could be done on blotting paper impregnated with spots of bromothymol blue indicator. A comparison with somatic cell counts, however, showed the test lacked sensitivity, since 30% of results were false negative. Farm trials to further assess the value of the pH test are currently in progress.

Further aspects of the NAGase test have been examined in the last 12 months. These include its use in bulk milk testing for location of problem farms and its use on composite samples from the milk meter. The NAGase test was found to equal currently used procedures (for example, somatic cell count) for mastitis diagnosis. A fully automated NAGase procedure has been developed and it has been operating under commercial conditions for nearly 2 years. A patent application involving this new automatic method for mastitis diagnosis has been lodged.

Milk-fat globule membrane

The aim of this project is to examine the effects of cow factors and processing conditions on the composition of the milk-fat globule membrane and to relate these effects to the flavour and stability of dairy products.

Analysis of milk-fat globule membrane material from mastitic milk has shown the composition of the membrane changes considerably as a result of the infection. The stability of mastitic milk to processing conditions is reduced as compared with normal milk.

Milk-fat globule membranes isolated from commercial products (pasteurized cream-line milks and pasteurized creams) contain complexed B-lactoglobulin incorporated at a level dependent on the severity of the heat treatment received during processing.

Pasteurized homogenized milks contain a membrane consisting of some original milk-fat globule membrane components with caseins and whey proteins appearing to be the major constituents.

Detergent release studies have shown that components are released from intact fat globules and isolated milk fat globule membrane at different levels. This suggested an asymmetrical arrangement of components within the membrane matrix and may lead to those components largely responsible for the stability of the milk fat globule membrane.

Milk quality investigations

The introduction of the Moseley Test as a routine test for estimating the keeping quality of milk brought with it a number of problems. Consequently, a series of experiments and trouble shooting surveys were initiated at a range of factories to investigate reasons for high and low Moseley counts.

Samples of milk were stored for 7 days at 7°C so that Moseley counts could be compared with taste panel grades on a five-point scale and assessment by the State Grader on a 10-point scale. Chi-square analysis indicated that the Moseley count was related to grades, especially for milks without reduced fat.

Experiments simulating a range of vendor vehicle conditions demonstrated that storage of milk at 5°C, 10°C, 15°C and 20°C for 5 hours before the 7 days' incubation at 7°C had no effect on Moseley counts.

During trials which followed total counts, psychrotroph counts and grades of milks over 14 days, the total count growth curves were S-shaped with psychrotrophs becoming the dominant flora after 3 to 5 days even if their initial levels were below 1 per mL.

Surveys have been conducted at a range of factories to investigate reasons for low and high Moseley counts.

Microbial count investigations

Enumeration of coliforms, in particular injured coliforms, was enhanced with resuscitation technique involving a combination of desoxycholate agar and trypticase soy agar in a 2 : 1 ratio. When 0.1% peptone diluent was used, an increase of 149% occurred over the standard desoxycholate agar method, and 73% of isolates from both methods gave acid and gas in both. Without diluent, the increase was 54%, with confirmed coliform isolates in 62% of resuscitated test plates and 70% in standard plates.

Storage at 0°C for 4 hours did not affect test or standard methods. Modification of the trypticase soy agar by the addition of 1% lactose and neutral red improved colony appearance, facilitating differentiation. Replacement of desoxycholate agar or desoxycholate lactose agar did not give enhanced numbers when compared respectively with violet red bile agar or desoxycholate lactose agar alone.

Cheese

Cottage cheese. The basis of the project 'Use of B-galactosidase in cheese manufacture' was to increase the yield of curd by reducing the set time with B-galactosidase. Following the failure of this enzyme to reduce the set time, attempts were made to decrease the set time by adding large doses of frozen starter concentrates. Six paired vat trials were carried out utilising about 2 500 L of skim-milk. The following results were obtained for various set time reductions—

Set Time (compared with control)	Yield (compared with control)
same	−1.3%
− 8%	+3%
−12%	+1%
−18%	+7%
−26%	+6%

Although only a relatively small number of trials was carried out, there appears to be a trend towards increased yields of about 5%, when the set time is significantly reduced.

Due to the high cost of the frozen starter, this technique can be considered only a research tool and not a commercially viable process.

Twelve, 200-L vats of cottage cheese were produced to verify results of laboratory scale trials designed to eliminate curd shattering in cottage cheese. Laboratory-scale trials had shown that sodium citrate, alone and in combination with sodium caseinate, significantly reduced the amount of curd shattering in cottage cheese. These pilot plant trials were designed to confirm the above results on a larger scale manufacture and to measure the effect on yield.

Four, two-vat trials were carried out comparing a control and citrate addition vat. Sodium citrate was added at the rate of 212 g per 200 L of skim. The yield of curd from the citrate milk was slightly, though probably not significantly, higher than the control yield. The mean yield improvement was + 2.3%.

Another two, two-vat comparison trials were carried out to measure the effect of the combined addition of citrate and caseinate. The yield of curd increased proportionally with the increase in casein content of the fortified milk.

Cheedam cheese. Trials have taken place with Cheedam cheese during the year.

Cheedam cheese to date has been made using *Streptococcus thermophilus* almost exclusively as the starter organism. This has resulted in slow flavour development and low levels of flavour development. The addition of other starter organisms in the cheese vat have shown improvements in the rate of flavour development.

It is noteworthy that a Queensland cheese factory has begun production of this cheese variety.

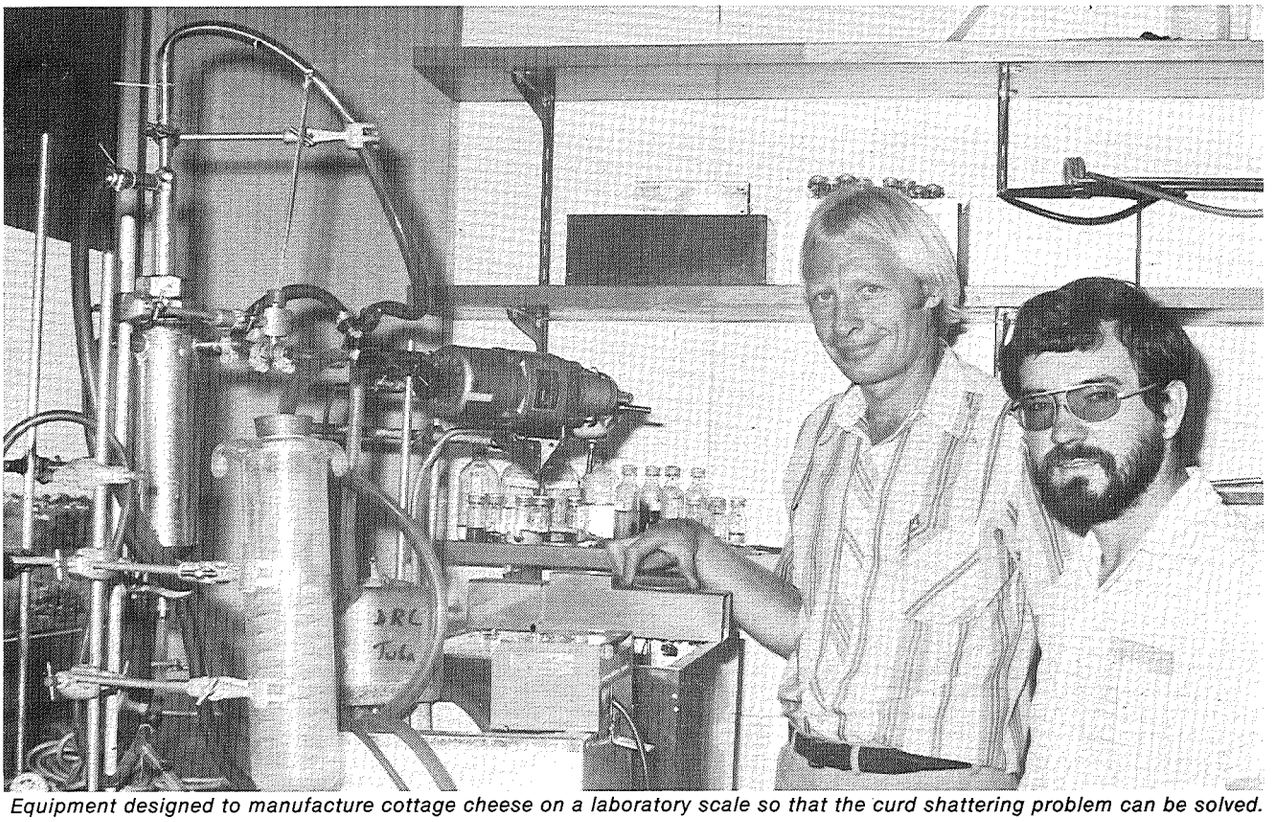
Accelerated cheese ripening

The development of methods for accelerating the ripening of cheese will enable the cheese industry to reduce its consumption of energy by shortening the cool storage period. A world-wide upsurge of interest in accelerating flavour development in cheese had led to the formation of a special group within the International Dairy Federation to investigate this area. The Branch has a representative on this international committee.

Two techniques, use of mutant starter and manipulation of the cheese maturing temperature, have currently been used to accelerate the ripening rate of Cheddar cheese.

When the mutant starter was produced commercially as a concentrate for addition to cheesemilk, it was found to contain a mixture of mutant and revertant cells. Experiments demonstrated that reversion occurs within 20 subcultures in broth containing lactose, but not in broth containing glucose.

Differential starter counts on experimental cheeses containing mixtures of lac$^-$ mutant starter and normal starter strains were carried out using high titre specific bacteriophages. These were successfully grown by inoculating bacteriophage plaques into M17 + lactose broths in which the specific starter had been grown for 2½h. The supernatants from these broths were frozen and titres remained high for 6 to 12 months. A modified M16-bromo cresol purple arginine agar containing glucose was also substituted for M17 agar. Mutant colonies were white on this media and normal colonies yellow.



Equipment designed to manufacture cottage cheese on a laboratory scale so that the curd shattering problem can be solved.

Both the addition of this mutant and storage of cheese at 20°C for 1 month independently accelerated the ripening rate of Cheddar cheese as assessed by taste panel scores and measurement of the products of proteolysis and volatile sulphur compounds.

Of the chemical determinations examined as ripening indices, only amino acid levels and gross proteolysis levels were considered useful. The levels of these protein breakdown products increased with flavour over the entire 9-month ripening period and correlated well with the flavour assessments at individual sampling ages.

The use of volatile sulphur compounds as ripening indices was rejected for two main reasons:

1. the naturally occurring levels of these compounds varied widely in cheeses of similar flavour assessments; and
2. the levels of these compounds (except carbonyl sulphide) tended to decrease late in the ripening period.

Carbonyl sulphide may be useful as a ripening index but further work will be required to establish this.

Cooloola cheese. With most of the development work on this cheese variety finished, an agreement was entered into to provide the Wide Bay Co-operative with about 400 kg of cheese per month for 6 months.

One problem with this cheese was that it was not developing sufficient flavour. It was suspected that the recently declining flavour levels were associated with reduced starter growth due to dry salting and slightly high cooking temperatures. Manufacturing trials soon confirmed this and several steps were proposed to remedy the situation.

Drying salting rates were gradually reduced from 3.0% to 2.6% and cooking temperatures also reduced from 41°C to 40°C and then 39°C. Moistures were not significantly affected, flavour improved and the pH of the day-old cheeses was reduced.

Since the requirement to manufacture for the Wide Bay Co-operative has been fulfilled and the cheese is of satisfactory quality, manufacture of this cheese variety has been discontinued.

Processed cheese. During the year, work began on processed cheese products using Cheddar cheese. This work has been implemented to assist Queensland dairy factories. Processed cheese imports have risen dramatically in recent years and there is scope for both sliceable and spreadable processed cheese products to be produced locally.

Thirty-three trials were conducted on products of this type and a spread product is close to being perfected.

Alterations have been made to the steam supply on the Stephan Kettle to allow constant processing conditions. Consequently, it is possible to heat cheese to the desired temperature in a set time, thus allowing a constant moisture addition in the form of condensed steam to the cheese.

It is possible to make cheese of composition close to the legal limits. The main problems have related to the texture of the product which has affected its slicing and spreading properties.

The work has centred on altering such variables as raw materials additions to the blend including age of cheese, amount and type of emulsifying salts, processing conditions in the Stephan Kettle and post treatment storage. To achieve the desired result, the above variables have to be finely balanced.

Cheese from ultrafiltration. A small number of trials has been carried out on ultrafiltration retentate to make fresh cheese products.

In the ultrafiltration process, the whey proteins are retained in the retentate while most of the low molecular weight solids are lost to the permeate. Use of the retentate in cheesemaking offers some considerable potential benefits. These include an increase of up to 20% in cheese yield, reduction in rennet usage, reduced effluent loadings and increased portion control.

However, ultrafiltration retentate has certain compositional characteristics which make the resultant cheese different from its conventionally produced counterpart. The texture is the main problem with the cheese and this appears to be related to the high level of minerals which have been retained in the retentate by the ultrafiltration process. These minerals would in normal cheesemaking be lost in the whey due to the lower pH developed but in the retentate remained bound to the protein.

This would indicate that adjustments during the ultrafiltration process are necessary to lower this mineral level.

Jarlsberg cheese studies. Trials on Jarlsberg-type cheese have continued throughout the year. Chemical analysis of imported Jarlsberg cheeses indicated that propionic and acetic acid levels are both important pre-requisites for Jarlsberg flavour, but that other factors interfered with grades obtained. Other chemical components measured included butyric and lactic acids, TCA soluble tyrosine and PTA soluble amino nitrogen.

In the pilot plant, 40 cheeses were manufactured to specifications based on imported cheese. These were graded and analysed for salt, fat, moisture, pH, lactic streptococci, propionibacteria, lactic, propionic, acetic and butyric acids, TCA soluble tyrosine, PTA soluble amino nitrogen and acid degree value. Results indicated that flavour grades were not directly related to any single factor, but that at least 5.5 mg per g of propionic acid is necessary for Jarlsberg flavour. Weighing and trimming of later batches has been standardized to result in better consistency in weight, thickness, salt, moisture and salt in the moisture.

Propionic and acetic acids and PTA and TCA soluble nitrogen levels all increased rapidly during the cheese 20°C incubation period, and then remained fairly stable. Thus, the 20°C incubation period length would be a way of manipulating the level of these parameters.

Experiments were conducted with fixed (1%) addition of lactic streptococci and varying (0.01 to 0.05%) addition of propionibacteria. Increasing the propionibacteria gave increasing level of PTA soluble nitrogen but constant TCA soluble nitrogen. The constant TCA soluble component is probably related to the fixed lactic streptococci levels. Manipulation of the two nitrogen fractions should be possible by varying propionibacterium addition.

Another series of trials was designed because of reports in the literature regarding other methods of manufacture. The cheese was therefore cooked in the whey to higher temperatures (45°C), Cheddar starters, propionibacteria and *Lactobacillus helveticus* were used in the vat and altered storage conditions examined. Cheese of good composition could be manufactured but subjective gradings did not indicate any improvements in flavour, eye formation or body and texture over cheese made by any other method.

These trials have been beset by a number of serious problems. These include the general downgrading of cheese manufactured with milk received from the Gympie district. This downgrading has been due to a 'sulphide' flavour. Also, there were instances of cheese developing excessive gas and becoming misshapen. These cheeses were found to have high counts of anaerobic spore formers. The source of this contamination is unknown.

Other trials on the addition of multi-strain mesophilic starters have given variable results. Flavour and eye formation are developing too rapidly and use of single strain starters and *Lactobacillus* have caused high levels of bitterness in the cheese.

In conjunction with the Jarlsberg type cheese, a number of vats of cheese has been manufactured without the addition of propionibacteria and without the normal 20°C incubation. In this cheese there has been considerable eye formation at lower temperatures which tend to indicate that the propionibacteria are not solely responsible for eye formation defects.

Yoghurt

Yoghurt made with Dutch or Danish starters, reported to be extra-cellular polysaccharide producers, was compared with that made with locally-used cultures. Parameters included viscosity, pH, flavour and keeping quality. The Dutch starters did not compare favourably, whereas the Danish ones B3, B37, and CH1 in most cases produced better viscosity and acceptable flavour.

An incubation temperature of 43°C for 4 to 6 hours and 2% inoculum in a yoghurt base containing not more than 6% sucrose is best for the Danish starters. Local cultures LB1 and TS2 consistently produced good flavour, acid production and viscosity.

Studies of yoghurt starter growth rates in reconstituted powdered goat milk have been undertaken, two batches of yoghurt each have been manufactured from fresh goat milk and from reconstituted goat milk, and a brochure has been prepared for industry and public use.

Plating methods to ascertain survival or not of *Lactobacillus acidophilus* in the human gut have been reviewed with the intention of studying nutritive properties of acidophilus yoghurt.

Egg yoghurt. Technology section, together with the microbiology section, is working on the Poultry Research Advisory Council funded project, the development of an egg-cultured milk product.

Twenty-kilogram batches of yoghurt are being produced regularly in the pilot plant using only makeshift equipment. A Pasilac C31A processing vat has been ordered and should arrive by mid 1981, to improve the quality of yoghurt manufactured.

Low fat dairy spread

A comprehensive final report was prepared in 1980 on the development of a low fat dairy spread. Work carried out in conjunction with Dr Deeth and Mr Alan Reed included a literature survey, formulation trials, manufacturing procedures, keeping quality, choice of raw materials and analyses.

The report provides specifications for a product which could be taken up by a factory with only minor final development work outstanding.

Tick resistance of dairy cattle

An exploratory study was undertaken to determine whether enzyme markers might be used to predict tick resistance in Australian Friesian Sahiwal dairy breeds. A range of enzymes in blood and semen of pure Friesian and Sahiwal bulls was examined by electrophoresis. The work did not reveal any isoenzyme linked breed differences which could be related to tick resistance.

Fisheries

THE Queensland Fisheries Service was absorbed into the Department of Primary Industries on 23 December 1980 and became a part of the Division of Dairying and Fisheries. The Field Services and Enforcement duties associated with Fisheries remained unchanged and are carried out by the Queensland Boating and Fisheries Patrol, Department of Harbours and Marine.

Fisheries is made up of Fisheries Research Branch, Estuarine and Foreshore Management Section and Marine Parks Section.

Fisheries administration and research activities are funded from Consolidated Revenue, Fisheries Research Fund and the Loan Fund.

Fisheries Research Branch

THE Fisheries Research Branch has the responsibility to provide recommendations and guidelines for effective management of offshore areas and the Great Barrier Reef; to foster the development of Queensland's fisheries resources, and to promote the State's fishing industry.

To fulfill this role the Branch is involved in numerous activities which include:

- the assessment of the biological status of aquatic resources and the effects of amateur and professional fishing and other activities on these resources;
- the consideration of socio-economic factors which may affect the fishing industry;
- the identification and evaluation of the potential of unexploited fisheries resources and the development of appropriate fishing techniques and product handling and processing procedures;
- the improvement of freshwater recreational fisheries through impoundment stocking programmes;
- the development of improved handling, processing and storage techniques to upgrade the standards of Queensland fisheries products.

Fisheries facilities

The two major occurrences affecting research activities of the Research Branch during 1980–81 were the opening of the new Northern Fisheries Research Station at Cairns and the purchase of a second research trawler.

The Cairns station, which houses about 20 staff, is the headquarters for work along the reef, inshore fisheries of northern Queensland as well as the Gulf of Carpentaria prawn programme.

The Walkamin Research Station on the Atherton Tableland is a centre for freshwater fish breeding programmes. Major improvements to pond facilities were carried out during the year and the six new fish ponds constructed will be fully operational for the 1981 breeding season.

The Research Branch has a small station at Bundaberg. This station has an algal rearing unit and an experimental laboratory for rearing of larvae. A 13.5 m trawler, the 'Bar-ea-mul', is stationed at Bundaberg for work on the scallop programme.

The southernmost station operated by the Fisheries Research Branch is at Deception Bay, 40 km north of Brisbane. This station is to be enlarged in 1981–82 and the extensions will house facilities for work on product development and handling in addition to offering increased space to new research programmes.

Fisheries management activities

As part of its function to provide information on fisheries management, the Branch was closely involved in drawing up a management scheme for the set gill net fishery. This fishery relies largely upon barramundi in the Gulf of Carpentaria and the northern east coast, but other species of fish such as salmon are important on the central east coast. The management scheme introduced includes a limitation on the number of fishermen, a closed season relating to the breeding season and bag limits for amateur fishermen. The effect of the management scheme on population structure and numbers is being monitored by means of a logbook programme.

The Research Branch is now formulating proposals for the management of the east coast trawl fleet. The fisheries economist participated in two surveys of the fleet which were carried out jointly by the Research Branch, Commonwealth Department of Primary Industry and the Great Barrier Reef Marine Park Authority. Information from these surveys will be of value in providing advice on management.

Considerable loss of earnings has been occurring in the scallop fishery due to fishermen catching juvenile scallops. The Research Branch is presently investigating ways of overcoming the problem and has carried out detailed studies of the design and efficiency of sorting equipment.

As a result of a considerable growth in the number of beam trawlers operating in estuaries, a research programme to investigate the effects of beam trawling has been initiated. The programme will operate in Moreton Bay and the Bundaberg area and will attempt to gain information for management on problem areas such as the possible conflict between inshore and off-shore trawl fisheries operating on the same prawn species and the possible taking of juvenile fish in beam trawls.

The Research Branch has compiled information on fishing activities in the various areas of Great Barrier Reef waters after extensive discussions with the fishing industry. This information has been considered in the zoning proposals of the Capricornia section of the Great Barrier Reef Marine Park.

Trinity Inlet study

Cabinet provided funds to enable an investigation of water quality and biological resources of Trinity Inlet at Cairns. Results of this investigation are to be used in compiling a management scheme for the Inlet. The Fisheries Research Branch initially carried out a survey of the wetland communities of the area. An 18-month survey of the benthic fauna showed that the highest densities occurred in the upper reaches of the system and that there was a strong seasonal cycle with the highest densities occurring in early summer before the wet season.

A 12-month prawn survey revealed that the Inlet acts as a nursery area for many juvenile fish of commercial and angling importance including barramundi and mackerel. The Inlet is used extensively by recreational fishermen and offers an area of sheltered water in close proximity to the city. A final report is being prepared and will contain recommendations on management of the area.

Fisheries statistics

Production statistics for commercial fishing in Queensland are compiled by the Fisheries Research Branch. In 1979–80, the total Queensland fisheries product was worth $62.8m, an increase of $4.6m on the previous year's catch. Queensland ranks second only to Western Australia in value of fish catch.

A detailed report on the extent of involvement of licensed master fishermen in the various types of fishing activities in all areas of Queensland was published during the year. This report has proved valuable for the management of several important fisheries and also for providing basic data on the fishing industry for industry, fishermen and the public in general.

Fisheries statistics development has been enhanced by the acquisition of a remote terminal to the C.S.I.R.O. computing system. This has enabled access to accurate and up-to-date information on the catches of foreign fishing vessels operating within the 200 nautical mile Australian Fishing Zone.

Aquarium fish trade

Several million exotic fish are imported into Australia each year by the aquarium and ornamental fish trade. Since a very large number of species is involved, accurate identification is important.

In order to assist Customs and State officers in carrying out their work, a collection of exotic fish is being built up. This will include preserved and, in some cases, live specimens as well as photographs and relevant literature.

Advisory services

At the request of the Queensland Fishing Industry Training Committee, seafood handling workshops are being conducted in major coastal centres. A series of workshops in Yeppoon, Mackay,

Townsville and Cairns in June 1981 dealt with current quality problems in the industry. These workshops were chiefly oriented towards fishermen but also attracted participants from the processing, administration and marketing sectors of the industry.

A complete advisory service on all aspects of seafood handling, processing and storage is maintained for the benefit of fishermen, processors, retailers and the general public.

At the request of the South Pacific Commission, Dr. I. W. Brown (biologist, Fisheries Research Branch) carried out an evaluation of the Commission's Deep Sea Fisheries Development Programme. The consultancy involved visits to New Caledonia, Fiji, Tonga, Vanuatu and Rarotonga (Cook Islands) during January and February 1981. A detailed report on the evaluation was completed in March and has been submitted to the S.P.C. Secretariat.

Research

Narrow barred Spanish mackerel

Fisheries for the narrow barred Spanish mackerel (*Scomberomorus commerson*) occur in coastal waters of the Gulf of Carpentaria, the northern Torres Strait and on the east coast south to the northern N.S.W. border. The apparent migration of stocks of *S. commerson* along the length of the coast gives rise to overlapping local seasons. On the Queensland east coast where most landings are recorded, the fishery is linked to the northward migration and spawning season in northern waters. Significant landings during the southward migration do not occur until the fish reach their summer residence areas in southern Queensland and northern N.S.W.

Official figures show that 1979–80 landings were down to 772 t liveweight. This 25% reduction from the landings of the mid 1970s is thought to be related to market anomalies and unfavourable environmental conditions. Approximately 150 to 200 fishermen were engaged in the north Queensland fishery during 1980–81. The seasonal nature of the fishery in southern Queensland prevents a reliable estimation of the number of fishing units, although 'amateur' involvement is known to be high.

A 2-year *S. commerson* tagging programme funded by the Fishing Industry Research Trust Account has been completed. In total, 1 813 tagged mackerel were released by Fisheries Research Branch officers. At the end of April 1981, 58 tag recaptures had been reported. More returns are expected in 1981–82.

It appears that movement within the north-east Queensland fishery, up to and during the October–November spawning season, is small, with movements of resident and newly immigrant fish generally limited to the same or adjacent reefs. At the conclusion of the spawning season, movements may either remain generally localized or long ranging to southern waters—several tag returns indicate migrations in excess of 1 000 km.

Barramundi pre-management study

The aim of this project was to develop the knowledge necessary to permit the rational management of Queensland's barramundi fishery. To achieve this goal, particular attention has been focused on the following topics: distribution, migrations, growth, reproduction, larval and juvenile biology, food habits and the nature and extent of the commercial fishery. Study sites were established in the Cairns, Tully-Cardwell and Princess Charlotte Bay regions, with a smaller amount of work being conducted in rivers in the Gulf of Carpentaria.

More than 4 000 barramundi have been tagged and released with an annual recapture rate of around 18%. Results of this tagging programme have confirmed that there is a significant migration of mature fish from inland freshwater habitats to coastal environments during the summer months, apparently for spawning. Apart from this spawning migration, other movements seem to be random and there appears to be no other significant migratory trend. Tagging has also permitted accurate predictions of growth rates to be made and for ageing studies using scales collected at the time of capture.

Another priority area of research during the last year has been the larval and juvenile study. Information has been obtained on size and age of juvenile barramundi at time of colonization of nursery habitats as well as the duration of occupation. Work during previous years in identifying nursery habitats has already allowed a number of reserves to be declared.

As a direct result of work undertaken during this project, and in consultation with commercial and amateur fishermen's organizations, the Queensland Government has recently implemented management initiatives designed to conserve the State's barramundi resource.

This project, which has been under way for 3½ years and was funded by the Fishing Industry Trust Account, concluded on 30 June 1981. It will be succeeded by an inshore gill net programme both on the fish and on fishermen. A log book system is being established to monitor commercial catches in the Gulf of Carpentaria and on the East Coast.

Giant clams

The objectives of the giant clam study were (i) to determine the distribution and abundance of giant clams—particularly the two largest and therefore commercially important species *Tridacna gigas* and *Tridacna derasa*—on reefs of the Great Barrier Reef; (ii) to describe the illegal fishery by Taiwanese in terms of where and when clam boats had been fishing and to examine their catches and the methods used to take clams; (iii) to assess the overall impact of poaching activities of foreign vessels on clam stocks of the Great Barrier Reef; and (iv) to determine aspects of the biology and ecology of giant clams related to their exploitation such as rates of growth, mortality and recruitment.

Manta-board surveys were made to obtain estimates of clam numbers on numerous reefs between Townsville and Thursday Island, and in the Swain Reefs. In keeping with many other coral reef animals, giant clam densities were found to vary greatly from one reef to another, and on different parts of the same reef. Furthermore, the largest species, *Tridacna gigas*, which attains a length of more than 100 cm, does not occur on reefs south of about the Whitsunday Islands. Thus, in the Swain Reefs, only the smaller species of *Tridacna derasa* is found. Its shell attains a maximum length of about 60 cm. In the Swain Reefs, on a reef of average size (say 6 km x 4 km), the total number of giant clams varies between 5 000 and 10 000. In contrast, on more northern reefs where both species occur, the total number of clams on a reef of average size is approximately 3 000 to 4 000.

Of the 33 clam boats arrested between 1969 and 1979, 13 had been fishing in the Swain Reefs and the remainder had been fishing on reefs between Cairns and Thursday island. From estimates of the weight of the seized clam catches and examination of samples of clam meat, it is possible to estimate the total number of giant clams taken : 120 000 from the northern reefs and 300 000 from the Swain Reefs.

Assuming there are 2 500 reefs making up the Great Barrier Reef and the clam population on a single reef of average size is 5 000, then the total population is about 12.5m. Thus the arrested clam boats have taken about 2.5% of the total population. The proportion taken is probably higher than this because of the unknown number of vessels which took clams but which avoided detection and arrest. In the last few years there has been a marked decline in the number of clam vessels visiting the Great Barrier Reef due to greatly increased surveillance activities and to certain fishing agreements made with the Taiwanese. It is now most unlikely that giant clams on the Great Barrier Reef are threatened with extinction.

In late 1980 the population of more than 1 300 giant clams in a 2.7 hectare study area on Michaelmas Reef was re-surveyed when all previously tagged clams were remeasured, dead clams were noted and recently-settled juvenile clams were measured and their positions plotted. The growth of juvenile clams is surprisingly rapid. They can grow from 5 cm to 10 cm in less than 1 year and it takes about 11 years for them to reach 50 cm. Growth then slows markedly and it might take another 60 to 70 years before they reach 100 cm by which time they are growing at a rate of less than 0.5 cm per year.

Data on mortality and recruitment rates are still being analysed. However, it does appear that within the study area there is a steady turnover of clams with some large specimens dying and considerable numbers of juveniles appearing, most of which die before they reach a size of 20 cm. It is suspected that the high mortality of juveniles is due to fish predation. Large clams probably die of old age and/or disease.

Crown of thorns starfish infestations

Detailed surveys of the starfish population on Green Island Reef in 1980 revealed a massive infestation of between 1m and 2m individuals, a proportion of which were destroying corals within the glass-bottom boat coral-viewing areas. Volunteer divers were utilized in a series of trials to establish the best method of destroying starfish. Injection of individual starfish with a 15 mL dose of saturated copper sulphate solution was found to be most effective treatment. The chemical was applied using a modified automatic drenching gun coupled to a bulk supply of solution.

Using this method, an attempt was made to control starfish numbers within the coral-viewing area which represents only 0.3% of the total reef area of approximately 1 700 ha. During the summer, hired divers destroyed more than 25 000 starfish at an average rate of 600 per diver per day and at a cost of approximately 15¢ per starfish. This level of control was insufficient to save the bulk of living corals within the coral viewing areas. Furthermore, coral mortality over the entire reef was estimated to exceed 90%. With the reduction in food supply, hundreds of starfish began moving into the swimming beaches where they posed a serious hazard to bathers. Warning signs were erected and collectors were paid to remove starfish from these swimming areas.

From a preliminary series of otter trawls and underwater television surveys conducted in inter-reef areas around Green Island, evidence was obtained to support the belief that starfish can migrate from reef to reef as their food supply diminishes.

Massive starfish infestations have been detected on several other reefs between Green Island and Lizard Island. While the cause or causes of these plagues still remains obscure, it has been established

from previous studies that coral communities can recover in 10 to 20 years. Certainly this has been the case at Green Island where a previous plague of starfish in the mid 1960s destroyed more than 90% of the corals yet these corals had recovered sufficiently by 1979–80 to support another massive infestation.

Gulf of Carpentaria prawn research

The research programme is primarily designed to yield information which will assist in predicting long-term trends for the fishery of tiger and endeavour prawn stocks in Queensland waters of the Gulf and rational management of these stocks. The project consists of three main elements—

1. A field study of juvenile prawn populations occurring in and around the Mornington, Bountiful and Sweers-Bentinck Island groups in the south-eastern Gulf. A preliminary aerial survey of potential tiger prawn nurseries, that is, shallow sheltered sea grass-sea weed areas was completed in July 1980. Arrangements for the establishment of a base of operations on Mornington Island are well advanced and delivery of a small research vessel, an 8 m diesel-powered, shallow draught aluminium launch, is expected in August or September. The vessel will be fitted with electronic equipment, refrigeration and light-weight trawl gear and extensively trialled in Cairns before being transported to Mornington Island.

It is expected that a comprehensive survey and mapping of tiger prawn nursery areas in the region will be completed and a routine (monthly) sampling programme initiated during the first half of 1982. Towards these ends, routine beam trawl sampling of juvenile prawns in the Cairns Inlet was begun in June 1980. This preliminary project has already enabled project personnel to distinguish small juveniles of all commercial species, to sex juvenile prawns as small as 5 mm carapace length and to accurately moult stage such prawns. The results to date already indicate that the two common tiger prawn species (*Penaeus semisulcatus* and *P. esculentus*) have distinct post-larval recruitment seasons.

2. Investigation of the distribution, breeding season, growth and population structure of tiger-endeavour prawns caught on commercial trawl grounds in the south-eastern Gulf of Carpentaria. Prawn samples (in specially printed cartons) from commercial trawlers are sent to Cairns for detailed laboratory analyses. It is planned that this scheme will be fully operational by late 1981.

3. Certain aspects of prawn behaviour, including bottom-type preferences and escape responses and speeds, are to be investigated in the laboratory in order to improve sampling techniques. Remote sensing equipment and controlled environment aquaria systems are currently being acquired, assembled and tested.

In addition, Gulf Prawn Project personnel are assisting colleagues within Northern Territory Fisheries, C.S.I.R.O. and Commonwealth D.P.I. in the collection, compilation and analysis of Northern Prawn Fishery log book catch-effort data. These data are being used to monitor the level and distribution of fishing pressure and catches. Log book contractors employed by the Fisheries Research Branch have been stationed in Karumba, Cairns and Weipa.

Demersal reef fish programme

The objectives of the demersal reef fish project have been to (i) determine the range of reef fish stock densities over a large part of the Great Barrier Reef; (ii) to determine the inter-relationships, if any, between fishing pressure and stock density; and (iii) to locate additional stocks of exploitable fishes and gather information about their general biology.

Shallow water areas have been surveyed using manta boards and the densities of several species of fishes along reef edges have been estimated. A total of 76 reefs is included, providing 360 sample sites. The researchers covered in excess of 650 km under water and recorded thousands of individual fishes.

Results of the shallow water surveys indicate a significant relationship between the abundance of a predator species and the distance from major human population centres. Removal of this predator through fishing has the effect of bringing about changes in the relative abundance of other large predatory species including several that do not comprise part of the usual catch.

Although the changes in community structure are apparently unpredictable, it is possible to calculate a measure of community flux which reflects the rate of this change relative to variations in the abundance of the keystone species.

Joint exploratory trawling exercises with the Commonwealth have also been undertaken. These trawls, which were carried out between the reefs, may help to complete the picture of fish distribution and may suggest areas into which the industry could expand. Funds were sought from FIRTA and AMSTAC to employ a graduate to identify trawl material. Trawl samples are being sorted, identified and preserved at the Queensland Museum.

Results of the deep water trawling are not yet complete since data are still being processed. The bulk of the material will be processed by early 1983.

Tropical freshwater fish breeding

Work at the Walkamin Research Station on the Atherton Tableland is directed towards maintaining and upgrading the quality of Queensland's freshwater recreational fishery and is centred on the development of mass production techniques for several native angling species. Fingerlings produced at the station are stocked in rivers and storages to form new populations.

Stocking programmes commenced during the previous year and continued during the current year included sooty grunter (*Hephaestus fuliginosus*) to the Pioneer and upper North Johnstone Rivers, and sleepy cod (*Oxyeleotris lineolatus*) to Ross River Dam.

Several new stocking programmes were commenced with these two species. Sooty grunter were introduced to the Herbert River to supplement existing stocks and to Awoonga Dam (Boyne River system) and Gunpowder Dam (Leichhardt River system). Sleepy cod stocking was carried out in Eungella Dam (near Mackay), Awoonga Dam, and the upper reaches of the Burdekin River above Charters Towers.

Pond breeding of northern saratoga (*Scleropages jardini*) for stocking of Tinaroo Dam continued during the current year. A new hatchery project on silver perch (*Bidyanus bidyanus*) was commenced and initial stockings of this species to Tinaroo Dam were made. Earlier stockings of Tinaroo Dam with bony bream have been extremely successful and large shoals of these forage fish are now present.

In addition to the angling species produced, stocks of rainbow fish and firetailed gudgeon were supplied to the Department of Aboriginal and Islanders Advancement for introduction to a new freshwater impoundment on Boigu Island as a mosquito control measure.

Scallop research

Adult biology. Research conducted at the Burnett Heads Fisheries Laboratory is aimed at elucidating the biology of the saucer scallop, *Amusium japonicum balloti*. This scallop is trawled in waters off the central Queensland coast and a notable feature of the fishery is the variability of annual landings which, in the last 5 years, have ranged between 60 t and 1 000 t of meat.

Tags have been used to demonstrate growth, movement and natural mortality. *A. japonicum balloti* grows very rapidly, with the shell diameter reaching approximately 90 mm in the animal's first year of life, and individuals become vulnerable to fishing gear at approximately 9 months of age. Spawning occurs in winter months and following a larval stage juvenile scallops settle in aggregations and apparently move little in the remainder of their life. Female scallops carry upwards of 1m ova and thus a small number of scallops, given ideal conditions, can rapidly repopulate an area.

For the past 4 years, fishermen have kept detailed records on the distribution of fishing effort and catch rates. This information is presently being analysed to give information on the relative values of fishing-induced and natural mortality and various aspects of the economics of the fishery. Preliminary examination of these data indicates that the spatial distribution of fishing effort varies from year to year, and thus larval dispersion may be an important factor in determining the success of each year's fishery.

Larval studies. Laboratory tests have shown that the spawning of male scallops can be brought about by using temperature shock increases of 5 to 8°C and of female scallops with similar temperature shocks and the addition of sperm suspension. Fertilization of eggs requires control of sperm density additions in order to avoid multiple penetration of eggs by sperm which leads to abnormal larvae. Presently, the fertilization success rate is in excess of 80%.

Fertilized eggs develop into ciliated gastrula, size 80 μ, within 12 hours, and into trochophore larvae, size 100 μ, within 28 h. Straight hinge veliger larvae develop after 40 h and are about 120 μ in width. Feeding commences after 1 to 3 days at this stage and scallop larvae actively select food within a definite size range. To date, algae best consumed at this stage are *Pavlova lutheri, Isochrysis galbona* and *Chlorella* species. Larvae have presently been grown for 14 d at a growth rate of 10 μ per d.

Settlement time of larvae depends on temperature but appears to be within 3 to 6 d after fertilization of eggs. Presently, 700 sea-surface drifters are being released between Bundaberg and Gladstone in a study of ocean eddy currents around known commercial scallop grounds to ascertain larval drift and settlement areas. This may aid in predicting future scallop concentrations and reducing fishing trawler searching time.

A biologist holding large female and male mud crabs.

Mud crab research

Mud crab biology. During the past 3 years, a variety of aspects of the mud crab fishery has been studied in relation to its management. The value of all aspects of existing legislation is being reviewed in the light of research findings and a report will be compiled by the end of 1981. This research programme has included aspects such as investigating the proportion of females which are fertilized in areas where the number of males has been depleted by fishing, the current size restriction, as well as proposals to fatten newly moulted or 'empty' crabs.

An examination of mud crab burrows was carried out to determine the effects of 'hooking' on the crab population.

Population estimates and stock assessment using tagging methods on a regular sampling basis were carried out in Pumicestone Passage and Deception Bay. This programme provided valuable information on population dynamics, seasonal fluctuations, movement and growth, and more importantly resulted in the development of techniques for surveying.

Population investigations were also carried out in other areas including the Gulf of Carpentaria, Princess Charlotte Bay, Maryborough (Sandy Strait), and Gladstone (Narrows). A programme to investigate recruitment of mud crabs was initiated using plankton studies as well as quantitative sampling of juveniles.

A crab larval rearing system was constructed to rear captured crab larvae (termed megalopae) through to the early crab stage since larval stages could not be identified to species.

Morphological observations on the larvae housed in the system provided a valuable description for the positive identification of mud crab megalopae. Thus, from the plankton samples, mud crab megalopae as well as sand crab megalopae were identified and their abundance through the year monitored.

Several larval rearing experiments also provided valuable data on growth rates and requirements of the megalopae and early crab stages.

Mud crab storage and transport. Mud crabs are traditionally distributed to restaurants and other points of sale in a live condition. Although they are able to survive out of water for extended periods, heavy crab mortalities in commercial consignments cause heavy financial losses for some fishermen and limit the utilization of crab resources from more remote areas of the State. In order to determine which factors influence the survival of mud crabs out of water, batches of these animals were stored at various temperatures and relative humidities. Humidity conditions were found to be critical to crab survival. The potential survival time of crabs stored at 95% RH is double that at 85%. Lowering the temperature also has a significant effect on survival. Consequently, alternative packaging incorporating adequate insulation and a reasonable vapour seal are being recommended for the transport of live crabs.

Mud crab freezing. Most of the mud crabs handled through commercial channels are utilized for catering purposes. As mentioned previously, the crabs are distributed in a live condition. This is partly because adequate methods of maintaining the crabs in a fresh condition have not been available and partly because fresh uncooked crabs are preferred by *cordon bleu* chefs for the preparation of seafood dishes.

Seasonal and day-to-day fluctuations in the supply of live crabs tend to limit demand and affect the price available to fishermen. The possibility of freezing mud crabs was examined in conjunction with the Sandy Trout Food Preservation Laboratory. The principal problem affecting the acceptability of frozen-thawed crabs is that of a loss of texture in the body meat. This is a direct result of digestive enzymes leaking from the gut. A combination of a blanching process, a rapid chill step and blast freezing to $-30°C$ resulted in a product that could be cooked and eaten after 2 months' storage and remain almost identical in flavour and texture to freshly caught crabs.

Oyster research

Oysters can suffer severe mortalities during the hotter months of the year with consequent economic losses to oyster farmers. The factors involved in these 'heat' mortalities, and some protective measures, were investigated during the year. Spraying exposed oysters with water during hot weather appears to provide the best protection. Shade cloth also provides adequate protection in most circumstances.

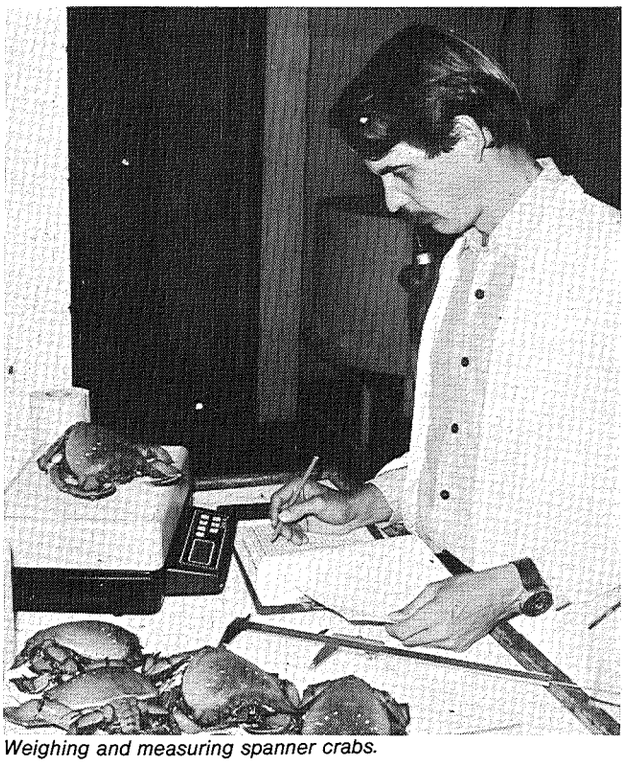
An investigation of aspects of the oyster disease known as QX disease was concluded during the year. Previously unknown stages of the life cycle of the disease organism, *Marteilia sydneyi*, were discovered during the study and have now been described. Oysters growing at lower tidal levels were found to be more susceptible to the disease.

A study of several selected sites in Moreton Bay to assess their relative merits for commercial oyster spat collection was concluded during the year. Myora, on North Stradbroke Island, had the best characteristics of the sites investigated.

Spanner crabs

Spanner crabs (*Ranina ranina* Linn.) have long been known to occur in Queensland waters, but in the past they have generally been regarded as a curiosity because of the very small quantities landed. Until recently, the only commercial-scale fishery for this species has been around the Hawaiian Islands.

Within the last year or so, a small fishery based on the use of tangle nets has been developing in the area between Mooloolaba and Stradbroke Island. In contrast to most of the State's offshore fisheries, the spanner crab fishery is characterized by a low level of technology and capital investment in vessels, gear and navigational equipment: vessels currently in use are typically fast outboard-powered boats in the 6 to 8 m range carrying a crew of two.



Weighing and measuring spanner crabs.

Submissions by commercial fishermen concerning the need for some management controls prompted the initiation of a project aimed at acquiring information about the distribution, range, and basic biological-ecological characteristics of the stock.

A pilot study (commenced in October 1980) has established that spanner crabs spawn in November–December, and that the population contains a large preponderance of male crabs (M:F sex-ratio = 3.5:1) which are, on average, significantly larger than the females. On the basis of length-frequency data collected during 11 sampling trips, a minimum legal size of 100 mm carapace length has been recommended. This should afford a degree of protection to the sub-adult sector of the population as well as assisting to stabilize the market price, which is inclined to become depressed when large quantities of small crabs are landed.

Experiments currently in progress are aimed at evaluating the relative effectiveness of two different types of net in use in the fishery. Catch rates, clearing times and size-frequency of the catch are the major factors under consideration.

An 18-month survey of off-shore crab resources in the area between Sandy Cape and Pt Lookout, funded by the Fishing Industry Research Trust Account, is to be conducted by a professional crab fisherman, with support and advice from the Fisheries Research Branch. The main objectives of this survey are to establish the depth-distribution of spanner, coral and spider crabs on the continental shelf and slope, and to determine the magnitude of seasonal variation in the distribution and catchability of each species.

A second project (under the control of Fisheries Research Branch staff) will examine the size of the resource, the extent of variation in stock density within the region, and reasons for observed daily, geographical and seasonal variation in catchability. An attempt will be made to assess whether recruitment, growth and fecundity are adequate to support a significant, long-term fishery, and factors relating to product marketing are also to be examined.

Squid research

Fishery development. A programme to investigate the fishery potential of Queensland's squid resources commenced during the year. Two species with considerable commercial potential have been identified to date. *Loligo chinensis* is the common squid caught by trawlers in Moreton Bay. It is widely distributed along the Queensland coastline and can grow as large as 40 cm body length and 0.5 kg in weight. This type of squid is very popular in southern European markets. *Sepioteuthis lessoniana*, often called calamary, is caught by net fishermen in Moreton Bay and Great Sandy Strait. This species grows to 3 kg and is also widely distributed along the Queensland coast. It is the most commercially valuable of the squid species.

Short surveys were conducted from Cairns, Bundaberg and Mooloolaba during the year. On one survey in December, concentrations of another squid species, *Nototodarus gouldi* were observed east of Noosa. This is the species on which the southern Australian jig fisheries are based. As a result of this and other observations, the 'Hoyo Maru No. 81', a Japanese squid fishing vessel sponsored by JAMARC (Japan Marine Fishery Resource Research Centre) and provided under the terms of the Australia-Japan Agreement on Fisheries for research on Australian squid, spent 8 d fishing off the southern Queensland coast during April. No *N. gouldi* were taken during this cruise, but interesting catches of the oceanic species, *Symplectoteuthis oualaniensis* and *Ommastrephes bartrami* were taken in deeper waters. Fisheries for these species exist off Taiwan and Japan.

The research programme is continuing and will be expanded to include the Gulf of Carpentaria and Torres Straits regions when the new Cairns based research trawler becomes available.

Squid products. In Australia, except for a small ethnic minority, squid is not a popular domestic seafood item, although frequently offered in various dishes in restaurant menus. Squid may have a wider appeal if incorporated into breaded fabricated products that are more familiar to the Australian consumer. Preliminary trials with a product fabricated from minced squid flesh showed it to be highly acceptable, and more extensive trials with sophisticated flaking equipment are planned.

Freshwater fish–south Queensland

Many of the major water impoundments of southern and central Queensland contain relatively few edible or sport fishes. This project is evaluating future stocking programmes utilizing native fish species. The yellowbelly (*Macquaria*), silver perch (*Bidyanus*) and the Dawson River barramundi (*Scleropages*) are the principal fish presently under consideration.

In particular, the Dawson River barramundi appears to be a most suitable fish for introduction to impoundments. It is an attractive, spectacular sport fish which grows rapidly to a relatively large size. It also has a proven ability to survive and breed under the conditions imposed within water storages. Research by the Fisheries Research Branch has been directed towards investigations of the growth, diet and breeding biology of this species. It is expected that this information will be applied during the coming year when it is hoped to stock this species into a major dam in south east Queensland.

Fish handling and storage

Darkening in tailor and mullet. Tailor and mullet are two commercial fish species which are caught in very large quantities in short times by beach seine fishermen. It is usually necessary to freeze them before they can be marketed or even sometimes before they can be processed. Both species are prone to darkening of the flesh during frozen storage, due to oxidation of blood pigments. The problem can be minimized by cutting and bleeding the fish soon after capture, a practice that cannot be used during normal fishing operations because of the amount of product normally handled.

Trials performed with commercially-caught fish showed that blood in tailor muscle could be removed substantially by packing the fish vertically in ice. Fish stored in this way produce fillets that are significantly less prone to darkening than fish handled in the normal fashion.

Vacuum packaged fish. Retail supermarkets provide a major outlet for marketing fresh fish. In recent years, there has been an increasing movement towards the display of chilled fish in trays covered with transparent film.

In the past 12 months, the Queensland Fish Board introduced a range of chilled seafood products in a vacuum packaged tray pack—the first time that this form of packaging has been used in Australia for chilled fish. The effect of different types of films on the shelf life of the vacuum packed product was investigated by the Fisheries Research Branch before introduction. It was found that film permeability has no effect on shelf life, even though the rate of bacterial growth was much less in fish packed in film impermeable to air. It was found that shelf life is most affected by a H_2S-producing organism known as *Alteromonas putrefaciens*. Methods for monitoring the levels of this organism were developed.

Ciguatera

Ciguatera is a form of food poisoning caused by eating certain fish species from coral reefs associated with a rare toxic alga. Ciguatera has occurred in north Queensland for many years although its incidence is very low. However, several hundred cases have occurred in south Queensland in recent times. The resulting publicity has drastically affected fishermen in southern areas.

A survey, the purpose of which was to identify ciguateric areas of coral reef, and to provide a better picture of ciguatera incidence and the fish species involved, was commenced among the public, angling clubs and commercial fishermen. A good response in southern Queensland has provided a great amount of information on possible ciguateric areas and species to be avoided. However, the survey elicited very little response in northern Queensland and the information about the problem in this area remains scanty.

Sand crab research

Several aspects of the biology of the sand crab, *Portunus pelagicus*, and its fishery in Moreton Bay are being studied. The sand crab fishery has traditionally been based upon capture in pots. In recent years, however, increasing numbers of sand crabs are being landed from trawlers. The possible effects of this increased fishing pressure are being evaluated by means of a study of population structure and movement. A tag has been tested in aquarium conditions and field trials are now under way.

A survey of the incidence of the Rhizocephalan parasite, *Sacculina granifera*, in sand crabs in Moreton Bay has shown that parasitized crabs are most prevalent in southern Moreton Bay. This study also indicated the futility of trying to reduce the incidence of the parasite by increasing fishing pressure on affected crabs. Feeding studies have examined the types of foods eaten and the effects of factors such as moult stage, habitat and time of day, on feeding.

Recreational fisheries resources

Surveys of anglers and returns from tagging of fish show that the total catch by anglers in certain fish species and especially in the case of tailor and bream, exceeds the commercial catch. This indicates the importance of taking both amateurs and professionals into account in management schemes.

Tagging experiments by the Fisheries Research Branch show that tailor are extremely mobile fish, migrating back and forth between south Queensland and New South Wales. Bream populations by contrast are mainly confined to an estuarine system, for example, Moreton Bay. There is little movement of bream from one estuarine system to another, although mixing occurs within estuaries particularly during the spawning season (April–July).

To determine whether changes have occurred in the abundance of fish stocks in south Queensland, a detailed analysis of the catches of anglers is being undertaken. Records of catches dating from 1945 and totalling approximately 100 000 angler catches have been computerized. The analysis has provided no evidence of a decline in population sizes of bream and whiting in southern Queensland.

However, the average number of fish taken by anglers on each outing has decreased during the past 5 years in some areas where fishing pressure is intensive. This decline seems to be directly associated with increasing fishing effort in recent years and appears to be the result of spreading the same total catch over more individual anglers. Commercial landings in the same period have remained relatively constant, suggesting that there has not been a decline in total population.

Gamefish logbooks and tagging kits have been issued to game and sportfishing clubs throughout Queensland. A total of approximately 2 000 fish has been tagged and released by club fishermen and many of these fish have been recaptured. The results confirm that most of the large pelagic fish such as marlin and sailfish move great distances along the Queensland coast. Other popular angling species such as sooty grunter and jungle perch are confined to single river systems.

Reef fish tagging programme

A joint reef fish tagging programme between Fisheries Research Branch and Great Barrier Reef Marine Park Authority began in December 1980. A total of 2 400 fish including sweetlip, coral trout, parrot, rock cod and sea perch has been tagged and released on six reefs in the southern part of the Great Barrier Reef.

Forty-five fish have now been recaptured and this number is expected to increase. The results indicate that reef fish tend to remain on the same reef. None of the recaptured fish had moved from the reef where they were tagged.

Estuarine and Foreshore Management Section

THE functions of this Section are integrated with many of the projects undertaken by Research Branch to ensure that the specific interests of fisheries conservation and management can be represented in consideration of a wide range of environmental issues.

These issues range from regional investigation of land-use options, assessment of the environmental impact of specific projects, provision of guidelines and advice for future proposals and day to day management of fisheries resources.

Estuarine inventory

The Section has been engaged in an inventory of the State's estuaries to provide base-line data as part of the responsibility under the Fisheries Act for conservation and management of the fisheries resources of the State.

This inventory has now been completed and the task of collating data is under way. Preliminary results of the inventory have enabled identification of localities which should be embraced in the marine reserve system of the State—either as Marine Park, Fish Habitat Reserve, Sanctuary or other land-use allocation for fisheries purposes.

The social and economic benefits available to the community from recreational and commercial fisheries is considerable and the establishment of unified resource-based planning for aquatic resources and the habitat on which they depend places a high priority on implementation of the inventory results.

There are 23 existing Fish Habitat Reserves; some 20 other major marine reserve proposals are in train. Habitat management planning for the total coastline is to be the subject of a report during the year 1981–82, following final summation of the inventory results.

Research projects associated with the inventory include the assessment of habitat change, mangrove mortality and the evaluation of estuarine features to establish areas of critical concern for habitat protection and management.

Additionally, on completion of the map sheets of the estuaries between Tannum Sands and Round Hill Head, an appraisal was undertaken of the cost-effectiveness and suitability of vegetation mapping as a means of data storage and base-line monitoring of estuarine communities. Such a review followed the completion of a study tour in U.S.A. by Mr. F. Olsen of this Section, incorporating visits to Miami, Florida, to discuss mangrove and sea grass research, and to Sioux Falls, South Dakota, to undertake a course in Remote Sensing and Resource Management.

The review of the procedures employed in the vegetation mapping programme showed that the use of such maps as a data base for estuarine inventory should be terminated and replaced by direct acquisition of data from satellite imagery, air-photography and field surveys of habitat zones and wetland communities as a data sheet presentation for computer analysis and storage. Such procedure has now been initiated and the intermediate procedure of vegetation mapping discarded as an inadequate means of portraying the information required for assessment of the estuarine environment.

The year also saw the completion of control surveys and mapping of oyster bank areas in the State. The programme was based on a control survey of the Amity-Dunwich area carried out by the Survey Section, Department of Harbours and Marine, complemented by detailed mapping of individual licence areas carried out by the Estuarine and Foreshore Section as part of the overall estuarine inventory.

Project assessment, environmental issues

A heavy work-load has been experienced in the past year in the fields of evaluation of the environmental effects of past disturbance in the more heavily settled parts of the State, proposed port and industrial developments, the provision of guidelines and technical advice to consultants and for various inter-departmental committees dealing with regional and local issues. Consultation and discussion with Local Authorities and Government Departments has also formed a considerable volume of work; particular emphasis is necessary in relation to the continued close co-operation of the Land Administration Commission and Harbours and Marine Department in matters affecting use of tidal lands.

However, considerable concern continues to be expressed by amateur and professional fishermen at the denial of access to or use of fishing grounds by closure of roads and traditional foreshore areas as a result of acquisition of hinterland areas for alternative uses. The erosion of the traditional freedom of use of waterways and fisheries is regarded as the major threat to their interests.

During the year the Section completed field work on Trinity Inlet at Cairns and a report and recommendations are being prepared. Mapping of a number of new habitat reserves has been completed and it is expected that declaration of these reserves will take place in the coming year.

The biological complexity of decisions required of this Section is proving a severe strain on its resources. Major projects, such as mining and harbour developments which involve wetlands, are preceded by extensive and detailed environmental impact statements. Advice to companies on the scope of these statements requires a high level of expertise and the need for qualified scientific staff is becoming apparent.

Wetland communities

Projects related to estuarine and foreshore management include the inventory programme, mangrove mortality, and the assessment of changes in habitat areas.

The preliminary results of the estuarine inventory show that there has been a general increase in both area occupied by mangroves and density of mangrove stands over the recorded history of Queensland, despite the publicized loss of wetlands in localized areas. Over the majority of the coastline, there has been a marked landward incursion of tidal wetlands with rapid colonization of substrate by marine vegetation.

Mangrove mortality investigations undertaken by the Branch, with specific reference to the Gladstone region, also formed the subject of a co-operative effort with Plant Pathology Branch in field collection of material for investigation by that Branch of the occurrence of plant pathogens in mangrove communities.

The general review of the disorder commonly known as 'mangrove dieback', however, separately relates to occurrences of locally extensive mangrove mortality first recorded in 1948. This disorder typically occurs in frontal mangrove stands between the levels of high tide and high water neaps, affects seedlings and mature trees of *Avicennia marina*, and is now recorded for the whole of the Queensland coastline in pristine and near-pristine estuaries as well as more intensively used regions such as Moreton Bay.

Once initiated, the spread of the disorder is quite rapid, even in undisturbed and apparently healthy stands in the tidally flushed parts of the estuary. No evidence has been found to indicate that filling or excavation of tidal wetlands is a primary cause of this type of mortality.

The investigation of changes in habitat areas has been undertaken as part of the evaluation of estuarine inventory results. Advantage has been taken of natural events, for example, cyclone and storm datage, or of man-made alterations to determine the dynamic response of estuarine features to disturbance. Baseline data have been obtained in a number of estuaries and programmes initiated to assess changes in habitat zones, and dependent biota. Results of the overall inventory will determine the final selection of sites for long-term monitoring of these changes.

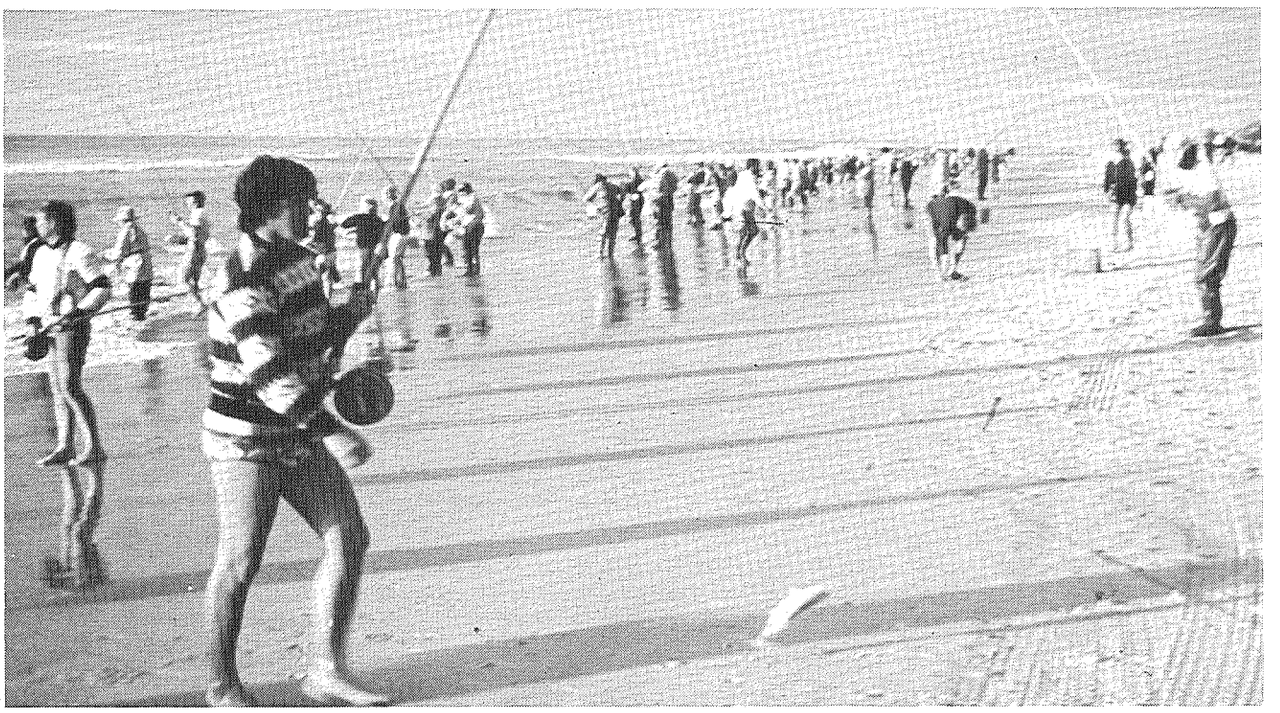
Marine Parks

THE Division is responsible for the management of Marine Parks and Fish Habitat Reserves declared under State legislation. Currently there are two such marine parks (one surrounding Heron Island off Gladstone and the other surrounding Green Island off Cairns) and some 23 habitat reserves, the latter covering a wide range of mangrove swamps and tidal wetlands along the mainland coast.

Four marine park 'rangers' police the regulations protecting these areas, and carry out interpretive and educational programmes to enhance public appreciation and enjoyment thereof.

Fisheries staff have been extensively involved with the Great Barrier Reef Marine Park Authority in the development of plans for managing park areas declared under the Commonwealth legislation administered by that Authority. Following the implementation on 1 July 1981 of the zoning plan for the Capricornia Section of the Commonwealth Marine Park, the Department's rangers will become responsible for the day-to-day management of the Section, and it is expected that the ranger staff numbers will be increased progressively over the next 3 years to cope with this added responsibility.

A number of surveys and investigations has also been carried out with a view to the declaration of a series of new marine parks in the northern region of the State, as well as additional fish habitat reserves at various locations along the entire Queensland coast.



The sandy beaches of Fraser Island are favoured by recreational anglers who regularly make good catches of tailor.

Division of Marketing

The main activities of the Division of Marketing are centred on providing necessary advisory and regulatory services relating to the economics and marketing of Queensland primary produce. This requires the provision of marketing intelligence, financial and economic advice, management planning and quality control services, all of which are supported, where necessary, by appropriate research.

Divisional functions in policy, extension, research and regulatory matters are attended to by three Branches: Marketing Services, Economic Services and Standards. At 31 May 1981, 182 staff were employed in the Division of Marketing. The only senior appointment in the Division during the year under review was that of Mr I. B. Robinson as Supervising Agricultural Economist, Economic Services Branch.

Marketing organization

During the year, an intensive inquiry was undertaken into the activities of the Queensland Fish Board. The Fish Marketing Investigation Committee, headed by the Director of Marketing, first met on 24 March 1980 and presented its final Report to Cabinet on 23 January 1981. The Committee, with assistance from officers of the Division of Marketing made a thorough investigation of the Board and the industry generally. Its major recommendation called for the continuation of the Board, but its operation requires substantial upgrading particularly in the area of marketing.

The Division was heavily involved in setting up the Planning Committee on Future Grain and Oilseed Handling, Storage and Transport in Queensland which is due to report to the Minister for Primary Industries by 30 September 1981. During the course of the Committee's deliberations, the Branch has provided professional and secretarial support to the Committee and to its numerous Working Parties.

A Compendium of Australian statutory agricultural marketing authorities prepared in the Division was published by C.S.I.R.O. on the authority of Australian Agricultural Council. A similar Compendium is being prepared on Australian co-operative associations for future publication.

Divisional staff continue to provide detailed input into the State's rural marketing organizations, other statutory authorities and producer organizations. Following the re-organization of fish marketing arrangements, support is now provided to the Queensland Fish Board.

During the year, a paper highlighting the interdependence of hen levy and hen quota policy assisted materially in resolving contentious policy issues in the Queensland egg industry.

Legislation

The Division of Marketing was involved in the introduction of the following legislation during the year—

Primary Producers' Organisation and Marketing Act. Several amendments were passed. One allowed the Queensland Commercial Fishermen's Organisation representation on the Council of Agriculture. The organization had previously been a member of the Council but lost that status when its constituting Act was changed to the Fisheries Act.

Following on an opinion by the Solicitor-General that Marketing Boards were not bodies corporate and therefore unable to hold special leases under the Lands Act, it was necessary to amend the Act to correct the anomaly.

A further important provision allows marketing boards to deal in futures in commodities other than the commodity for which that particular Board was constituted. Prior approval by the Minister is required.

In order to allow boards greater flexibility to trade in a commercial manner, it was considered necessary that boards be permitted, again with the approval of the Minister, to hold shares in limited stock companies. It was envisaged that approval would be forthcoming where it would be necessary for the holding of shares in a joint venture type marketing arrangement and where it was considered appropriate that a board should provide grower services through a company.

Another provision permitted boards to offer the commodity as security for moneys advanced to them by commercial lenders.

The final amendment dealt with the manner in which the Queensland Cane Growers' Council holds property as trustee for Mill Suppliers' Committees and District Executives. The amendment ensures that any instrument of trust entered into between the Council and another organization has the force of law in the event of a winding up.

Primary Producers' Co-operative Associations Act. The Act was amended to provide for fishermen to be defined as primary producers. This will enable groups of fishermen to form co-operatives with registration under the Act.

Milk Supply Act. Five significant amendments were introduced. It became apparent that certain changes would have to be made to the Act in view of a ruling that co-operative associations were unable to claim, as deductions against income, repayments of moneys made to the Land Administration Commission for the purchase of market milk entitlements. The Act was amended to provide that repayment of the moneys to the Lands Administration Commission be deemed to be repayment of a loan and that the loan itself be further deemed to be a loan from the State Government.

Another provision clarified the procedures to be followed when franchise agreements come up for renewal. The amendment corrected certain deficiencies which became apparent when a writ was taken out in the Supreme Court to prevent the Tribunal proceeding with a hearing.

Other amendments spelt out the powers of inspectors in the Act instead of by regulation and discouraged milk vendors from electing to deliver on only 5 days a week or fewer.

The Milk Entitlement Committee's right to determine a processor's entitlement was made more specific.

Hen Quotas Act. The amendments had two objects. First, persons who are not quota holders will be permitted to commence and operate businesses as hatchery men. This was expected to improve the availability of started pullets without creating surplus egg production. Second, the Hen Quota Appeals Tribunal was given greater flexibility when dealing with matters that come before it.

Meat Industry Act. The Act was amended to increase the size of the Meat Industry Authority from 10 to 12 persons to cater for increased representation due to the Authority's increased activities. Another amendment extended the capacity of district abattoir boards to arrange for bank overdrafts from the previous limit of $5,000 to $50,000. The regulation making power under the Act was amended to set standards for office, change room and dining facilities at abattoirs where there is a permanent inspection service.

Agricultural Standards Act. The main objectives of the amending Bill were, first, to improve administrative procedures, second, to achieve a greater degree of uniformity in terminology and procedures with other States and, third, to remove redundant, outmoded and some over-restrictive provisions contained in the Act.

Farmers' Assistance Act. The overall objective of the amendments was to facilitate the transfer of farms to other family members, sharefarmers or private lessees as a means of improving farm efficiency. It was aimed at encouraging family members to remain on farms. Major benefit would flow to younger farmers with demonstrated farming ability but whose equity and servicing capacity were marginal.

Sugar Experiment Stations Act. The Act was amended to ensure that members of Cane Pest and Disease Control Boards could be legally paid expenses for meeting fees and other associated expenses. The legality of the payment of such moneys had been questioned and it was necessary to amend the Act to put the matter beyond doubt.

Agricultural Bank (Loans) Act. The amendments had two objectives. First, the Bank would be permitted to loan moneys to small businessmen located in declared disaster areas and, second, loans of that nature which had already been made would be validated.

Canned Fruits Marketing Act. Because of the development of a considerable over-capacity by Victoria, South Australia and New South Wales to supply the Australian market with canned apricots, peaches and pears, it became necessary for complementary Commonwealth-State legislation to be passed to rationalize production by the setting up of a corporation to acquire canned fruits, to establish an equalization market and to divide that market between established canners by States. Queensland was involved only in the packing of pears and then only to a minor extent. However, Queensland was invited to pass complementary legislation to give the operation the status of a Commonwealth-State Scheme.

Dairy Products Stabilization Repeal Act 1981. Since July 1977, the Commonwealth-administered Australian Dairy Corporation has replaced the Commonwealth Dairy Products Equalisation Committee Ltd., which has been wound up.

The Dairy Products Stabilization Board, along with similar Boards in other States, was a support measure for the operations of the Equalisation Committee. The Board has completed its function.

Regulation of Sugar-cane Prices Act. With the resignation of the Accountant-Member of the Central Sugar Cane Prices Board, it was appropriate to alter the qualifications of the Member to allow for selection of a replacement from a wider background of experience. A person experienced in economics or commerce as well as accountancy or audit is required. Provision has been added for a Member to resign or have services terminated if he ceases to remain qualified. There was no previous provision for this.

Economic and marketing studies

A major research bulletin was published during the year demonstrating the application of input-output analysis to evaluate structural relationships in the north Queensland regional economy based upon survey work undertaken in the early 1970s. This innovative study was utilized to estimate the impact, in terms of secondary benefits, of agricultural development in the Burdekin River Project on other sectors of the economy. When the scheme is in full operation, the total annual increase in regional output (based on the increase in gross value of agricultural production of over $150 million a year) should exceed $375m annually.

Work is well advanced in evaluating the effectiveness of industry stabilization schemes and in determining objective criteria for the assessment of financial effectiveness of the State's rural marketing organizations.

A comprehensive survey of milk production costs, involving more than 100 producers throughout the State, was conducted on behalf of the Queensland Milk Board. Smaller cost-of-production surveys were undertaken in the tobacco and egg industries for consideration by the respective marketing boards in price determination.

A mango survey of more than 300 commercial growers in north Queensland is being undertaken as part of an overall study of horticultural development in the Bowen-Burdekin region. The survey will establish the production potential for mangoes and possible need for a processing facility.

A national review of cost-of-production methodology was sponsored in a workshop session at the Australian Agricultural Economics Society Conference in New Zealand in February 1981. All States contributed to this review outlining their involvement in these studies. This information, along with the proceedings of the workshop, will be published in a bulletin.

An agricultural economist was seconded to the Queensland Meat Industry Organization and Marketing Authority for 4 months to assist in the economic evaluation of carcass classification trials. Assistance was also provided in computerizing the Livestock Market Reporting Service which should be fully operational in mid 1981.

Extension activities

To improve the need and coverage which daily fruit and vegetable market reports may be made available, especially to producers, a telephone recorded message service has been installed. Daily messages involving a brief summary and a detailed report of Brisbane and interstate prices and market trends are available from 10.30 a.m. each day. The printed market reports continue to be available daily at Comalco House and the Brisbane Market for collection.

Marketing intelligence services have been subjected to extensive evaluation and review. As a result, the standard of output has been improved and certain efficiencies effected. Past publications entitled Report on Production Trends, Report on Winter Grains and Seeds, Report on Summer Grains and Seeds, Report on Peanuts, Navy Beans and Soybeans, Report on Potato and Onions, and Weekly Market Review have been abolished. Three new groups of reports have been created. These draw on the most relevant information in the earlier reports and include additional comment and information identified as pertinent in the course of the evaluation. These reports are entitled Agricultural Trends, published bi-monthly, Horticultural Trends, published monthly and Trends in Animal Industries, published quarterly. Client reaction to these reports has been favourable.

With 22 regional agricultural economists now located in 18 centres, advice on farm business management is being provided throughout the State with visits being undertaken during the year to remote centres in the Gulf and Peninsula areas and in far Western Queensland. Increased demand for advice, training and publications in farm business management reflect a growing awareness of the importance of economic considerations in primary production.

A microcomputer has been purchased with Commonwealth assistance to assess the suitability of this equipment for on-farm use. Considerable interest is evident in microcomputers and software programmes will be developed with industry wide application and in the fields of farm management accounting and machinery investment decisions.

An extension film promoting the criteria of seed quality was made and shown extensively throughout the State in a major extension exercise funded by the Commonwealth Extension Services Grant. Audiences were drawn mainly from grower organizations and industry groups in major rural centres.

Other items of interest

Escalating land prices are generally in excess of productive values. This upward movement in land values, combined with higher interest rates, has eroded the feasibility of a young farmers' establishment scheme intended to assist experienced young people with limited equity to purchase their first viable property. Officers of Economic Services Branch continue to work on alternative schemes aimed at providing opportunities for young people to enter farming.

A workshop on seed processing was held over 3 days in June 1980 at the Queensland Agricultural College, for farmers, seed cleaners and others connected with the seed industry. A similar workshop was held over a 2-day period later in the year at Indooroopilly for staff drawn from five commodity boards. In both cases, the Branch staff took responsibility for the content of the lectures and demonstrations.

Seed certification continues to be an important element in pasture seed production. Large increases were recorded during the year under review in areas registered. Seed production for final sealing and labelling of pasture seed increased at an even greater rate, yielding just over double the quantity produced in 1979–80.

An officer of Economic Services Branch was seconded as Chief Economist to the Northern Territory Department of Primary Production for 12 months. Another officer undertook an overseas aid assignment in water resource economics in Thailand under the auspices of the Australian Development Assistance Bureau.

Marketing Services Branch

THE role of Marketing Services Branch has been defined as: 'to service the agricultural marketing requirements of the rural sector in Queensland in the first instance and also the non-rural sector to the extent that it is affected by, or has an interest in, developments in the marketing of rural products.'

Servicing is taken in its widest sense to include the provision of information, interpretation and advice in the areas of agricultural policy, legislation, product marketing economics, market intelligence, and market research and to ensure an efficient utilization of resources.

Such servicing involves a communication programme incorporating internal and external training in the field of agricultural marketing and resource use.

To fulfil this role within the Departmental context of programme management, the organizational structure of the Branch provides for three sub-programmes in addition to the normal function of administration which include the clerical-typing services required to carry out the various tasks.

The **Marketing Economic Research** sub-programme has the following objectives—

- To research and evaluate current marketing systems and to co-ordinate Branch resources used in research projects.
- To maintian a Research Register.
- To provide advice and act as a resource base on macro and micro economic issues affecting the economy generally and the rural sector in particular. This incorporates a watching, advisory and co-ordinating brief in a variety of special interest areas including trade, energy, fertilizers, tariffs, finance, currency movements and rural adjustment.
- To provide a financial management advisory service.
- To design, co-ordinate and conduct internal and external training programmes in rural marketing.

The **Marketing Intelligence Services** sub-programme has the following objectives—

- To provide rural and commercial recipients with up-to-date and accurate information on crop prospects.
- To provide marketing information to as wide a cross-section of the public as needed.

- To provide market situation reports on the fruit and vegetable market at Brisbane.
- To maintain a rural statistical data bank.

The **Organized Marketing Services** sub-programme has the following objectives—

- To provide advice to the Department and to statutory and non-statutory primary producer marketing organizations on agricultural marketing policies.
- To administer the *Primary Producers' Organisation and Marketing Act* 1926-1981 and other State statutes relating to the marketing of primary produce of Queensland origin.
- To assist in the administration of the various industry stabilization schemes and, in this context, to provide an appeals tribunal secretariat for the egg, tobacco and milk stabilization schemes.
- To provide a registration facility for vignerons.
- To provide an inspection service for farm produce agents.
- To provide marketing advice to primary producers' organizations, growers and commercial interests.

In working towards meeting the above objectives, the Branch engaged in a wide range of activities during the year. Some of these activities, under the respective sub-programme headings, were as follows.

Marketing Economic Research

During the year, officers of the Branch completed a variety of work directed towards providing assistance to rural marketing organizations.

The year's research programme continued to give a measure of priority to the on-going evaluation of marketing systems. In this regard, several projects have been of particular importance.

A detailed paper on hen quota and hen levy policy highlighted the components of the industry's stabilization arrangements in Queensland and discussed their interdependence. It was recommended that an integrated approach be taken to the hen levy and hen quota problem and proposed a longer term policy in this regard.

The report on 'Aspects of the Queensland Egg Industry' dealt with the organization of the egg industry in Queensland, price and equalization arrangements and the hen quota scheme.

A study was also undertaken to determine objective criteria that could be used for the assessment of the financial performance of agricultural marketing organizations. A comprehensive review of the theoretical aspects of the problem was completed during the year and in 1981–82 specific case studies of particular marketing boards will be conducted.

Stabilization schemes have been used increasingly throughout Australia and in Queensland in recent years to achieve certain desirable industry goals. During the year, a study was commenced to evaluate these schemes as a tool of rural marketing. The study concentrated on the egg, rice and tobacco industries.

A discussion paper on Open Door Trading for Livestock was released by the Branch early in July.

The intention of open door trading is to allow livestock producers the option of retaining ownership of their livestock for sale on the export market after being slaughtered on their behalf.

The paper sought to outline a minimum requirement in terms of Queensland legislative provisions for a technically workable open door policy. The paper also discussed the major problems likely to be encountered and suggestions for overcoming these so that industry might be better informed when making decisions in relation to open door trading.

Throughout the year, the Branch produced and published a comprehensive monthly macroeconomic report entitled 'Economic Newswatch' for distribution to appropriate Divisional staff. This publication was designed to keep Divisional personnel informed of trends and developments in the economic environment in which agriculture operates.

A report entitled 'Export Restrictions on Meat and Bone Meal — a Review' confirmed strong opposition to the relaxation of export controls, especially from the livestock feed industry. As a result, Queensland has taken a strong stand against the removal of these products from the Third Schedule of the Commonwealth Government Prohibited Export Regulations.

At the request of the Queensland Milk Board, a comprehensive survey of the costs of distributing milk in declared milk pricing areas in Queensland was undertaken. The resultant data provided the Board with certain information necessary for the development of an index which is used to assist in the determination of milk prices.

The Branch was closely involved with the work carried out by the Committee of Enquiry into matters relating to fish marketing and the future operations of the Queensland Fish Board. During May 1981, the final report was submitted to Cabinet. Work of a high priority nature is continuing in this area.

The Branch also continued to participate in hearings before the Industries Assistance Commission. Submissions were prepared and presented on apples and pears, ginger, fruit and fruit products and imported manufactured tobacco.

A compendium of statutory agricultural marketing authorities, the compilation of which was commissioned by the Australian Agricultural Council, was prepared by the Branch and printed by C.S.I.R.O. as part of that organization's Technical Report Service. A similar compendium for Australian primary producer co-operatives was in the process of being prepared by the Branch at the end of the current year.

As in previous years, the Branch conducted an external and internal training programme.

Following the publication of the study 'Queensland's Marketing Board System: An Evaluation', the Branch was requested by rural marketing organizations to prepare an 'Administration Manual for Rural Marketing Organizations'. The manual which was distributed during the year to management and directors of marketing boards and co-operatives, provides guidelines on legal aspects, financial planning and management and responsibilities of directors. A series of workshops with managers and directors was held to discuss the scope of the manual and its applicability in the workforce situation. It was evident that the value of the manual would be further enhanced if additional material were prepared and inserted on the more complex financial and management areas.

To this end, attention will be given in 1981–82 to compiling further insertions. Areas of particular emphasis will include—

1. Budget formulation, budget execution and progressive evaluation.
2. Financial and non financial assessment of performance of individual organizations.
3. Borrowing of funds: off-shore borrowing, leverage financing and leasing.
4. Techniques for capital expenditure analysis.
5. Quantitative tools for decision making.
6. Manpower planning.
7. Export documentation.
8. Marketing.
9. Legal obligations of co-operatives.

As part of the training programme, an officer of the Branch is also involved in familiarizing Departmental officers with the principle of remote sensing and discussing the benefits and pitfalls of possible application of remote sensing to primary industries.

The Branch has continued with its internal training programme. This consists largely of having Branch personnel attend seminars, workshops and short courses run by various professional bodies. The aim of the programme is to keep officers abreast of the latest professional developments so that they may better advise rural organizations.

Marketing Intelligence Services

The Branch has placed a high priority on the evaluation of the Marketing Intelligence Services' sub-programme, including the objectives, content and format, during the year. This was carried out by reference to the information needs of the users of the present reports. In many instances, it was apparent that the recipients of these reports today have a wider variety of information needs than in the past when these reports were created. Furthermore, the evaluation has confirmed the need for more timely information accompanied by comment on trends in the relevant industries.

To satisfy these requirements, major changes have been made to the content, format and number of reports published. The following reports have been deleted: Report on Production Trends (monthly), Winter Grains and Seed Report and Summer Grains and Seeds Report (bi-monthly), Report on Peanuts, Navy Beans and Soybeans (3 per annum), Potato and Onion Report (4 per annum) and the Weekly Market Review.

In their place three new reports have been created: Agricultural Trends (bi-monthly), Horticultural Trends (monthly) and Trends in Animal Industries (quarterly). These reports contain the most relevant information in the earlier reports combined with additional information and comment identified as pertinent in the course of the evaluation. Reaction to these new reports has been very favourable.

In addition, significant changes are being introduced into the dissemination of daily fruit and vegetable price and marketing information from the Brisbane Market, additional to those mentioned above. There will be a reduced dependence on the printed report and an increased use of the electronic media to disseminate information. This will include radio and telephone recorded messages as well as newspapers. Through these means it is expected that daily fruit and vegetable market information will be available much more quickly to producers.

In addition, a Working Party of the Standing Committee on Agriculture (S.C.A.) was convened during the year under the chairmanship of a senior marketing officer of this Department to look into the problems of standardization of terminology in fruit and vegetable market reporting among the States. This group comprised

the three eastern States but its work is of relevance to all States. By reducing the uncertainties and complexities in the language of market reporting, it will be much easier for producers in each of the States to compare prices in the different markets. The Working Party has finalized its report which will be presented to the S.C.A. in August 1981.

The Section continues to publish its Weekly Rural Trend Report and Monthly Marketing Newsletter which, together, provide a comprehensive coverage of rural events of both a production and marketing nature in Queensland, Australia and overseas.

The need for an improvement in the timeliness of information and intelligence disseminated by the Branch has led to an extension of the computerization of the work done within this sub-programme. With the recent installation of computer equipment at Comalco House, conversion to computer handling will be speeded up. This facility will enable a large volume of data, in part presently manually processed, to be handled much more efficiently, accurately and quickly.

Organized Marketing Services

These services continue to have high priority within the Branch, mainly because of the operation of statutory marketing authorities for many rural products in Queensland. Marketing officers in the Branch act as Deputies for the Director of Marketing on all of the State's commodity marketing boards. In this capacity, they attend meetings of boards and provide input on all relevant matters pertaining to the marketing of the products handled by the boards.

Officers of the Branch became heavily involved in the important work of a Planning Committee which was set up by Cabinet in September 1980 to identify the needs of the grain and oilseeds industries to the year 2000. Secretarial and supportive services were provided to working parties that were established to assist the Committee to examine in detail a number of specific areas which included future production, port facilities, transport, storage and handling, pest controls, financial requirements and administrative matters. The Committee's report, which is required to be submitted to the Minister for Primary Industries by 30 September 1981, will provide the opportunity for planned development within the grain and oilseeds components of the agricultural sector over the next 20 years.

With the transfer of the administration of the Fish Supply Management Act to the Department towards the end of the year, an officer of the Branch began attending Fish Board meetings in an observer capacity. The operations of the Fish Board are continuing to be monitored closely and assistance is offered to the Board on request.

The Branch also maintains a watching brief on energy, exchange rates, fertilizers, interest rates, taxation policies, tariffs, trade agreements, transport and domestic monetary policies.

Economic Services Branch

ECONOMIC SERVICES BRANCH provides economic information and training for primary producers to increase the profitability of their decisions in farm business management. Agricultural economics research is undertaken in fields such as industry surveys to provide advice to primary producers, industry organizations and agribusiness, and to government in rural policy matters.

To fulfil these functions the Branch has 22 regional agricultural economists in 18 centres with a support staff of 13 graduates and six clerical staff in Head Office involved in research and administration.

In addition to extension and research activities, economists also represent the Director of Marketing on the Central Queensland Egg Marketing and Grain Sorghum boards and on the Atherton Tableland Maize Marketing Board.

Regional agricultural economists are actively involved in departmental extension activities particularly through industry committees and direct to farmers and agribusiness. Three economists also perform the additional duties of district extension leader.

Extension activities

It is the responsibility of an economist to provide information and advice in a form suitable for decision-making by farmers and for general use by extension officers and agribusiness clients. Emphasis is placed on the profitability of enterprise options available to producers which are consistent with the efficient use and management of his resources.

Regional agricultural economists are actively involved in departmental extension activities particularly through industry committees and direct to farmers and agribusiness. Three economists also perform the additional duties of district extension leader.

As demonstrated in the horticulture, beef and dairy industries on the Near North Coast, the economist plays a very significant role in situation appraisal and analysis particularly in relation to setting priorities for industry extension programmes in terms of economic significance.

Increasing emphasis is being placed on the applied research role of regional economists and in providing specialist back up support for extension staff who are becoming more involved in farm management economics.

However, economists still maintain regular contact with individual primary producers. On average, each economist received more than 70 inquiries from individual farmers, conducted around 40 farm visits and prepared 25 detailed farm budgets. Extensive use is made of the media, particularly local press, and newsletters and in the distribution of Branch publications at field days such as Expo 6 at Queensland Agricultural College and Farmfest near Toowoomba.

While relatively favourable market prices and prospects were maintained in the major rural industries during 1980–81, severe drought persisted in southern and western Queensland.

Despite the drought there has generally been an increase in the number of enquiries about farm purchase and capital expenditure in farm improvements. This reflects confidence in agriculture and in land generally as an appreciating asset with good potential for investment.

However, with inflated land prices few industries would be making significant returns on capital.

Farm business management advice was readily sought in such topics as taxation, rural credit, irrigation and farm development. Being a drought year, attention was also focused on the economics of various drought strategies and assistance was provided in preparing applications for assistance from the Rural Reconstruction Board.

Numerous inquiries were received on farm machinery costing, financing and replacement.

With increasing capital requirements for farm machinery, greater use is being made of contract services with owners often seeking the advice of economists on appropriate costs to charge for outside contracting to cover the ownership and operating costs of their equipment.

Similarly, escalating land prices are reflected in more farm leasing and sharefarming as has occurred overseas. In the past, annual lease rentals were normally around 10% of market value but at current prices a lower percentage would be more realistic.

Irrigation is favoured wherever practicable to achieve higher and more stable returns and to take advantage of taxation benefits. For example, the area under irrigation on the Darling Downs has increased with greater use being made of ring tanks with electricity rather than diesel as the source of power for cost saving.

Training activities

Economists as trainers in farm business management organized and participated in more than 100 training activities for farmers and departmental extension officers, agribusiness and students.

Farmer training included farm office schools for rice growers at Mareeba, dairy farmers at Mundubbera and graziers at Mt. Coolon, Aramac, Barcaldine and Blackall.

A further farm business management workshop entitled 'Farming for Profit' was conducted at the Dalby Agricultural College in association with other branches.

Increased trading activity and media coverage has promoted interest in live cattle futures trading particularly as a price insurance mechanism.

A series of introductory futures courses have been conducted for producers groups, accountants, bankers and departmental extension staff. An address on futures trading was also given to the State Rural Youth Annual Conference in Rockhampton.

Emphasis is placed on the practicalities of trading and problems which may arise and whether they can be overcome by producers trading in the market. It is stressed that hedging is not without risk.

In addition to departmental courses, regional economists also participated in training programmes conducted by two futures brokers at various centres throughout Queensland.

Apart from specific courses, economists also participated in more than 200 industry and general discussion group meetings and field days which provide an excellent opportunity to teach farm business management concepts relevant to the technical topics being discussed.

For prospective farmers, three seminars were conducted for retired army personnel at Ipswich who were interested in going on the land.

Introductory courses on agriculture are being developed for hobby farmers in the West Moreton in association with the Technical and Further Education Adult training programme. A course on farm records for dairy farmers will also be included in this programme.

In recognition of the important role of bankers and accountants in farm business management, departmental officers have conducted a series of meetings for them in Rockhampton. At the initial meeting in August 1980, a survey was undertaken to ascertain their priorities between industries and areas of interest within each industry.

The beef industry was given top priority with topics of interest in order of importance being pasture introduction, property management, breeding policies, herd management and marketing.

Through such meetings local agribusiness people may be kept fully informed on important technical and economic factors affecting prospects in all major local industries.

This is a continuing project and visits to local research facilities and farmers are included in the programme. Banks in Rockhampton and Biloela are also willing to co-operate in displaying Branch publications on their premises.

For students, introductory classroom sessions and farm visits relating to economics and marketing of agricultural products were conducted at the Goondiwindi High School. Economists in other regions also gave talks to school students and participated in career information programmes.

Work experience was provided for two Senior economics students each spending a week with head office and regional staff to gain an insight into the work of the branch as a career in agricultural economics.

Farm management publications

Branch publications in farm business management continue to be in strong demand with 85% of the distribution going direct to primary producers. The remainder were distributed mainly to educational institutions and agribusiness. Some publications are evaluated at a regional level using mail-in questionnaires to assess their usefulness.

Fifty-seven 'farmnotes' were prepared with additions and revisions of costs and returns for major crop and livestock activities throughout the State. New additions included gross margins for Angora, meat and milking goats.

The 'farmnote' series on taxation has been extended and revised along with the extension publication on 'Farm Business Management and Taxation'.

A trial to assess the extension value of departmental 'farmnotes' using the Agdex-based filing system was undertaken with the co-operation of 65 farmers drawn from 10 industries in southern and central Queensland.

The aim of this trial was to see whether producers wished to receive regular supplies of 'farmnotes' and whether they could store them according to the Agdex system.

Results obtained strongly supported the development of the Agdex storage and retrieval system of agricultural extension information which could necessitate the establishment of a centralized distribution system to provide a direct mailing service for 'farmnotes'.

Extension publications were prepared on a wide range of farm machinery topics including tractor and farm implements prices bulletins, ownership and operating costs of farm machinery and obtaining value for money in new tractor purchases.

A tractor fuel economy guide publication illustrates how substantial savings in fuel use can be made on the farm by giving attention to make and model.

A comprehensive 'Irrigation Costs Workbook' has been published. In addition, a smaller publication on farm dams has been revised as an aid to extension officers required to make preliminary economic assessments of farm dams financed under the Farm Water Supplies Assistance Act.

To overcome a dearth of information on rural land values in Queensland, a joint study was undertaken with the Valuer-General's Department. Land values at existing state of development were determined from property sales and classified according to land system, industry and location.

These values at November 1980 were published in the seventh Annual Budget Guide Supplement prepared for the *Queensland Country Life* and incorporated in a revised edition of the *Farm Management Handbook* now in course of preparation.

These data will also be combined with information provided by regional agricultural economists on profitability of farming systems throughout the State to produce a booklet outlining agricultural investment opportunities in Queensland. This publication will meet an increasing demand from people wishing to take up farming in Queensland.

At a regional level, two comprehensive cost and return publications were prepared covering all enterprises and farming systems in the Wambo and Tara Shires.

'Rural Credit in Queensland' was substantially revised and this comprehensive text is being printed for inclusion in the list of other departmental publications for sale.

Additional Branch publications in farm management extension included 'Costs of Soil Erosion' and an introductory course on live cattle futures entitled 'Futures for Beginners'.

While Branch publications are mainly in the extension field, a major research bulletin was published during the year on regional economics. Based upon survey work in the early 1970s, it demonstrated the application of input-output analysis in studying regional development in north Queensland.

Further farm management research was undertaken on methodology for costing farm machinery under inflation which has been accepted for publication in the Transactions of the American Society of Agricultural Engineers.

Special projects

Farm Management Accounting Service

Almost 200 annual summaries were processed during the year including 100 dairy farmers as part of a cost of production survey. The balance were mainly beef producers co-operating with economists in examining performance criteria affecting profitability on a regional basis.

More than 50 members subscribe to the monthly farm management accounting service. A similar number of dairy farmers participate in a manual recording scheme conducted by Dairy Field Services Branch. Both schemes are having a significant impact on the dairy industry through this business management oriented extension service.

To ensure accounting information is utilized for decision-making, accounting groups were established on the Western Downs at Moonie, Meandarra and Columboola. These groups are involved in the collection and revision of costs of production. This activity provides producers with an accurate indication of their costs and profitability together with appropriate efficiency ratios and budgeted returns as a guide to their performance through comparative analysis. Interest cannot be maintained in any accounting service unless members can make effective use of the results obtained.

In addition to these computer services provided through the State Government Computer Centre, emphasis is now being placed on developing suitable financial management accounting packages, in association with accountants, to run on the type of microcomputer installed in their offices.

Microcomputers on the farm

Farmer interest in the role of microcomputers on farm has grown during the year particularly in the intensive livestock industries.

Commonwealth financial assistance was obtained for the purchase of an Apple II microcomputer system in June 1981. A wide range of computer hardware is now available as evident from the 18 quotations received. The deficiency is in the limited number of software programmes available for agricultural application. Package programmes are being imported from overseas, and these may need some modification to suit our conditions.

In demonstrating the important role of microcomputers, emphasis will be placed on developing programmes with industry-wide application. For example, a programme has already been developed to analyse piggery performance data.

A 'Computers-in-Agriculture' seminar was conducted successfully at Dalby Agricultural College in conjunction with the Queensland Graingrowers' Association and the Rural Management Information Centre at the Queensland Institute of Technology. The Queensland Council of Agriculture was also addressed on the role of computers in farming.

Two editions of an inventory of EDP programmes for use in agricultural extension and farm management have been published and will now be placed on the CSIRONET computer system. This will allow researchers throughout Australia to have access to a current inventory of agriculturally-oriented software and should minimize duplication of effort.

Developments interstate are being monitored through representation on a Working Party under Standing Committee on Agriculture on computers in farm management. Articles have also been contributed to a new journal 'Computers in Farming' being issued by the Victorian Department of Agriculture.

Farm machinery survey

While interviewing for this survey was undertaken in December 1979–January 1980, the editing of 280 completed questionnaires and card punching for computer processing was not finished until December 1980. This study on costs of ownership and operation of farm machinery on different soil types throughout the Darling Downs and adjacent regions has overtaxed staff resources available to complete this major project funded by the Queensland Wheat Industry Research Committee. Preliminary computer analyses are now available and a detailed report will be available late 1981. This study will provide much needed actual farm machinery cost data for a wide range of equipment.

Farm machinery economics significantly affect farm viability and the results of this survey should assist decision making in farm machinery investment and replacement.

Grain handling

As part of the future Grain and Oilseed Handling, Storage and Transport Study in Queensland crop projections were made, in association with Agriculture Branch officers, of a two-fold increase in grain production on average in central and southern Queensland by the year 2000. Port storage, loading and unloading capacities have been examined to meet this anticipated increase in grain production.

Land use management

Economic aspects of land use management on the foreshores and catchment area of Wivenhoe dam were examined in relation to the need to ensure run-off water does not have a detrimental effect on water quality in the dam and raise treatment costs.

A planning study has been initiated to assess the water requirements of agriculture in south-east Queensland in 10 years time under efficient management and optimum land use. The Branch will be involved in assessing the economics of existing and potential land use in areas which are or could be commanded by irrigation.

Irrigation studies

Co-operation was extended to the Department of National Development in a review of the economic evaluation of the Burdekin Irrigation Project following the Commonwealth's commitment to provide funds for the construction of the Burdekin Falls dam estimated to cost $84.5m at June 1980.

Field studies and a preliminary economic assessment were undertaken of a water conservation and flood mitigation project on the Proserpine River. While most cane-growers use some supplementary irrigation from underground sources and direct from the river, the general level of crop yield response is not high and conserved water would have to command a wide area to justify large scale capital expenditure to construct a dam for irrigation purposes.

Current studies include an update of the Lower Mary Irrigation project and assessing the economic feasibility of a dam on the Maranoa.

Carcass classification

An economic evaluation of benefits and costs of carcass classification from trials conducted at Bundaberg and Kilcoy was incorporated in reports prepared for the National Carcass Classification Supervisory Committee. Two beef and four pig classification trials were involved.

This work was undertaken through part-time assistance and by secondment of an economist to the Queensland Meat Industry Organization and Marketing Authority for 4 months early in 1981.

A butcher trading trial at Kilcoy is now in operation which will investigate various aspects of trading using classification information.

Livestock Market Reporting Service

Assistance has been given to the Queensland Meat Industry Organization and Marketing Authority to computerize their manually-operated Livestock Market Reporting Service. Unfortunately, operational difficulties were encountered with the computer hardware equipment, originally installed in March 1980, and further capital expenditure has been necessary to upgrade the system which should be functioning satisfactorily in July 1981.

Young Farmer Establishment Scheme

Following State Cabinet's approval in principle in November 1980 to establish a scheme for young farmers, further economic investigations have been undertaken in association with the Department of Lands for subsequent discussions with State Treasury concerning funding.

The profitability of a range of farming systems was re-examined throughout the State to assess loan repayment capacities under various financing alternatives. Some concessional assistance was incorporated in financing proposals considered in recognition of the low equity of prospective applicants.

The feasibility of a farm purchase has been eroded by high interest rates and land prices escalating beyond productive values. To purchase a viable farm in Queensland would normally require a capital investment of more than $200,000. The repayment capacity of most farming systems would generally be inadequate for a purchaser to survive on low equity (below 40%) without substantial concessional assistance.

Processing feasibility studies

Assistance was also given to the Department of Commercial and Industrial Development in assessing the feasibility of establishing a wool processing facility in central-western Queensland. An appraisal was also undertaken of a proposal to establish an edible animal blood processing plant in Brisbane.

Industry studies

Agriculture

Grain and oilseeds. Favourable grain, oilseed and cotton prices were reflected in relatively high returns for dryland and irrigated cropping. For example, in the Central Highlands, dryland farms priced from $200 to $300 per hectare returned gross margins from $70 to $80 per ha under crops such as wheat, safflower, sorghum or sunflower. Gross margins under irrigated cropping ranged from around $200 per ha for wheat to almost $1,000 per ha for cotton. Irrigation blocks at Emerald are now being offered at more than $3,500 per ha, compared with less than $2,000 per ha in 1980. In addition, established growers would have a capital investment in farm machinery around $250,000.

The profitability of navy beans was assessed for comparison with alternative crops to assist the Navy Bean Marketing Board in its promotion campaign in central and northern Queensland.

Returns from navy beans and alternative crops were also discussed in a paper presented to a Navy Bean Seminar at Kingaroy in September 1980. Risk and uncertainty in gauging crop prospects are significant factors influencing farmers decisions on which crop to grow.

An analysis of changes in costs for the production of seed beans from 1975–80 was carried out for the Seed Bean Growers' Association in Biloela. The resultant increase in production cost was 49% compared with the increase in the C.P.I. index of 61%.

In a similar study, the costs of lucerne hay production for the Callide Lucerne Growers' Co-operative since 1978–79, it was found that costs had increased 11.6% in 12 months bringing the total cost to $103 per t (including an allowance for a return on capital).

The economics of installing additional drying facilities at Kairi and Atherton silos were examined on behalf of the Atherton Tableland Maize Board. A recommendation against installing these facilities was accepted by the Board.

The economic feasibility of establishing a livestock protein industry in north Queensland was examined. In the short term, there was neither the demand nor the supply of soybeans and lupins for this industry. However, the situation is likely to change with increased production of soybeans now evident in the Burdekin.

Studies undertaken for the rice industry in the Burdekin included the impact of differential water charges and economies of farm size.

Rice studies at Mareeba included an assessment of grower returns under rotational cropping with soybeans and sorghum and monitoring new grain dryers installed by the Rice Marketing Board.

Management practices and farm machinery investment were examined in a Peanut Survey report undertaken in the South Burnett late in 1979 at the request of the Peanut Sub-committee of the Queensland Graingrowers' Association and with financial support from four local shire councils.

Survey results were grouped according to yield and land system.

The gross margin for the 1979 peanut crop was $246 per ha for the low yield group and $368 per ha for the high yield group. For the whole peanut crop rotation, the gross margin for the low yield group was $206 per ha compared with $275 for the high yield group.

Farms in the Cloyna-Murgon land system grew six peanut crops in 10 years on the same land compared with four crops in 10 years for farms in the Kingaroy system. Double cropping of peanut land is more prevalent in the Cloyna-Murgon land system.

Farmers in the Kingaroy system were almost exclusively specialist peanut growers with a relatively stable peanut-maize rotation. In the Cloyna-Murgon system, peanut lands were cropped intensively to almost a peanut monoculture with an occasional rotation crop of sorghum and frequent (1 year in 2) winter crops of barley or wheat. The gross margins for the whole peanut crop rotation were $271 per ha for the Kingaroy system compared with $277 per ha for the Cloyna-Murgon system. While returns are comparable in the short term, more frequent cropping of peanuts could possibly be at the expense of long term viability.

Survey results have been discussed at two meetings of the J. Bjelke-Petersen Research Station Industry Consultative Committee, three district graingrowers' meetings and four farmer discussion group meetings with emphasis being placed on good management practices associated with high yields.

In north Queensland, alternative energy sources for on farm drying systems were evaluated to effect cost savings for peanut growers.

The cost of heliothis in Queensland crops was assessed in a joint study with Entomology Branch. The study revealed a very high cost in terms of both chemical and residual damage indicating a need for further research into biological control measures.

Tea. A joint report on the economics and agronomy of tea production in far north Queensland was released. A capital investment of more than $1m is required to develop a 200-ha tea plantation. In the price range of $1.60 to $1.75 per kg tea growing on the Atherton Tableland requires yields of 2 000 to 2 500 kg per ha to make the venture a sound investment. Profitable tea growing in coastal far north Queensland requires yields of at least 2 500 kg per hectare.

Assuming an upward trend in tea prices, tea growing should be a profitable investment in far north Queensland as yields of 2 500 kg per hectare and above can be maintained.

An economic evaluation was also undertaken to determine the break-even yield required to cover the additional costs involved in clonal tea production in north Queensland. The results obtained did not favour production research in clonal tea.

Tobacco. A labour use and capital investment survey was undertaken of 50 tobacco growers in Mareeba-Dimbulah area and 10 in northern New South Wales before preparation of a cost index for the Australian Tobacco Board. This index provided a basis for price negotiations for the 1981 season. Information supplied by consultants to the Victorian Tobacco Board was also incorporated in the cost index.

The economist at Mareeba has assisted the Tobacco Quota Committee in handling grower enquiries. He has also been monitoring trials of a modified mechanical harvester and is a member of the North Queensland Tobacco Research Committee.

Horticulture. Cost of production indices for processing beetroot, carrots, peas and beans in the West Moreton were revised and presented to growers, processors and the Committee of Direction of Fruit Marketing.

These indices provided a sound basis for price negotiations and the prices for peas and beans were increased by 30 to 40% and 14.5% respectively. Returns from these vegetable crops are now competitive with alternative grain crops.

This cannot be said for beetroot and carrots whose prices increased by only 10%. Concern exists about the long-term competitiveness of these crops when compared to the highly profitable summer oilseeds.

An economic assessment was undertaken of pineapple production for presentation at a Yeppoon fruit growers' field day in October 1980.

Pineapple production in the Fitzroy and Livingstone Shires is valued at more than $3.5m and represents 20% of the Queensland crop. Assuming yields of 80 and 40 t per ha for plant and ratoon crops respectively at $150 per t, the average gross margin over 3 years should exceed $3,500 per ha per year in central Queensland.

However, there has been a significant drop in the price of pineapples supplied to the Number 2 pool at the cannery and subsequent over-supply and drop in price of pines on the fresh fruit market. Currently, certificate holders can supply 5 t of pineapples per certificate to the cannery with 4.2 t going to the Number 1 pool at $160 per t and the balance to Number 2 pool at around $40 per t. The current market value of cannery certificates is around $1,200.

Follow-up visits to Burnett growers who attended a farm office school for citrus growers last year revealed a general improvement in their farm recording systems.

Three citrus orchards and the co-operative packing shed in Mundubbera-Gayndah area have microcomputers. This has highlighted the importance of a generally accepted recording scheme which has been developed through this training programme.

In view of the rapid expansion taking place in the mango industry in north Queensland, a postal survey of commercial growers from Sarina to Mareeba was initiated in April 1981 to assess production potential in the light of available markets. Grower response to the postal survey exceeded 65% and should establish whether there is a need for a processing facility.

This survey is part of an overall study to provide guidelines for producers, processors and other parties interested in the future horticultural development of the Bowen-Burdekin region, particularly associated with the Burdekin dam project.

This study is being undertaken by an inter-departmental committee which should complete its report by the end of 1981. Members of the committee visited the area in April 1981 for discussions with growers and industry representatives, marketing organizations and departmental extension and research staff.

In response to local requests, a profitability study is being undertaken of mango production on the Atherton Tableland.

Livestock

Beef. The severity of the drought in 1980 along the southern border was highlighted in a survey of beef properties in the Goondiwindi district in which four of the seven properties incurred non-recoverable losses in excess of $200 per breeder. Costs measured included loss of income from forced sales, deaths, agistment, purchased feed, droving freight and extra labour and materials, but excluding any government drought rebate which applied on stock and fodder movements.

The Branch also contributed to an overall review of drought relief measures particularly in relation to taxation.

A management service to monitor profitability in the beef industry has been extended to cover the major beef regions utilizing the annual summary provided through the farm management accounting service. Results are discussed individually with graziers and in discussion group meetings in areas such as the Burnett.

This information is also widely disseminated through newsletters as in the 'Burnett Beef Series' of farmnotes which have focused attention on pasture improvement and herd management systems.

Economists have worked with C.S.I.R.O. scientists in examining economic aspects of pasture research programmes. For example, a joint paper was presented at a field day at Narayen emphasizing the role of legumes in low key pasture improvement. Assistance was also provided in a paper on pasture improvement in the Burnett published in the C.S.I.R.O. journal *Rural Research.*

Taxation provisions relating to the brucellosis and tuberculosis eradication campaign were examined and discussed with graziers at meetings in far western Queensland. Subsequent discussions were held with the Australian Taxation Office in association with Veterinary Services Branch officers.

The economics of alternative herd management strategies available to graziers affected by the B.T.B. eradication scheme will shortly be examined with the aid of a microcomputer using a programme developed by the Bureau of Animal Health.

In north Queensland, economic aspects of the agrostology programme for the dry tropics were examined. Assistance was also provided in preparing property development plans for graziers in the Peninsula including an aboriginal group.

Economic constraints to the beef industry in the dry tropics were examined in a paper to a seminar in Townsville sponsored by the C.S.I.R.O. and the North Queensland Sub-branch of the Australian Institute of Agricultural Science.

A report on the economics of installing liveweight scales at the Mareeba cattle saleyards was completed in May 1981.

Cattle price studies are under way in central and southern Queensland in which relationships between prices of various classes of cattle and between futures and saleyard prices are being examined. A knowledge of these relationships is important when using futures and it appears that there is an annual cycle in the futures-saleyard price relationship.

Assistance was again provided to the Royal National Association in the computer analysis of their carcass competitions at the Brisbane Show. The eleventh beef bone-out competition attracted 27 entries with average yields of 70.4% meat, 13% fat and 16.6% bones.

Sheep. The successful Property Managers' School at Charleville early in 1981 provided a good opportunity to present results of economic surveys of western land resource regions to more than 100 graziers who came from as far afield as Bourke and Longreach.

The 'Eastern Mulga' survey which covered the 'tougher' areas of the Charleville district has been updated to include all years from 1972–73 to 1979–80. The average income of the graziers surveyed over this 8-year period was $19,400 (before deducting interest on borrowed money) representing a return to an average of 1.6 family labour units (unpaid), 21 000 ha of land, 5 500 sheep and 550 cattle. At 1980–81 wool, sheep and cattle prices the properties surveyed have the potential to produce an average net income before interest in a normal year of $25,000.

Incomes during the survey period fluctuated markedly mainly because of extreme variability in the cattle enterprise in both price and turn off. By comparison, the sheep enterprise was more stable and profitable.

A similar survey has been undertaken in the Paroo mulga land from 1974–75 to 1978–79. A frontages survey on the northern end of the Cunnamulla Land Resource region has begun to monitor economic performance of properties with mulga and frontage country combined for comparison with the other mulga regions.

These surveys provide essential factual information on local economic conditions for research and extension conducted at the Charleville Pastoral Laboratory. This information was of value to the

Australian Wool Corporation Production Research Advisory Committee in a recent review of the Charleville Pastoral Laboratory. It was also presented to the Grants Commission hearing in Charleville to illustrate the detrimental effects of prolonged drought on the capacity of graziers in the Murweh and Quilpie shires to meet rent and rates and what percentage they represented of total costs.

In conjunction with the Paroo Resource Region Survey, information is also being collected on forms of business ownership. This study is concerned with the intergenerational transfer of property assets between members of the family particularly in relation to how they have been financed and if any difficulties have been encountered during transfers and in working of resultant partnerships. The outcome of this study will be an extension publication on the use of partnerships in rural industry.

Dairying. To arrest a declining flow in milk production particularly in areas such as the Near North Coast and West Moreton, considerable emphasis has been placed on the economics of expanding milk production through the adoption of improved technology and facilities, use of irrigation and fodder conservation and acquisition of additional land where appropriate. All sectors of the dairy industry have been involved in promoting increased milk production.

Rising optimism and increased profitability is evident in the dairy industry with small increases in market milk quotas and recent rises in both market and manufacture milk.

A Statewide survey of the costs of production of milk in 1979–80 was conducted on behalf of the Queensland Milk Board. More than 100 dairy farmers were personally interviewed to provide information to update the basis for the milk cost of production index maintained by the Board to monitor changes in the costs of milk production as a guide in price determination.

Survey participants received a computer printout of their individual results and it is pleasing to note that a number of these producers have now joined the dairy farm management scheme to record on a continuing basis.

Considerable emphasis has been placed on dairy farm records with the development and testing of physical and financing recording schemes in the Burnett and Moreton regions.

Economic aspects of dairy heifer replacement were examined on the Atherton Tableland. The objective was to get replacement heifers into the herd earlier. Results indicated that this management practice would be highly economic because, with fewer replacement heifers, more milking cows can be carried.

Pigs. Profitability of pig production was depressed with the influx of cheap overseas imports from Europe and New Zealand combined with high feed grain prices. The worst affected producers are the newcomers who have made a large investment in the industry.

In response to a growing concern on pigmeat production costs, the importance of controlling feed consumption and cost and break-even prices, according to size and performance, were examined in extension articles and discussed at grower meetings.

Membership of the piggery performance analysis programme on the Darling Downs has been expanded. This manual system entailing quarterly group comparisons is being computerized to facilitate calculations.

The second superporker carcass competition at the R.N.A. Show had 10 entries which averaged 81.3% edible meat compared with 81.8% from 13 entries in 1979. A joint article on the superporker competitions has been prepared for the *Queensland Agricultural Journal*.

Poultry. Quarterly and annual updates of egg costs of production were provided through the Egg Marketing Board Suppliers' Organization Cost of Production Committee for consideration by the South Queensland Egg Marketing Board in price determination. Costs of production were also monitored for the Central Queensland Egg Marketing Board.

A random survey sample of 20 egg producers in southern Queensland was undertaken late in 1980 to gather data on labour input, production expenses, overhead costs and capital investment as a basis for reviewing the cost of production model.

The cost-of-production methodology was reviewed by an independent authority in accounting to consider the theory relating to insurance coverage for risk of flock destruction and return to capital to establish appropriate costs for these items to include in the egg model.

Bread. Following the 1978–79 Statewide survey of bread manufacturing costs contact has been maintained with the Bread Industry Committee in providing advice on the construction and operation of the index established to monitor cost changes in the industry.

Fish. Economic studies were undertaken for the Fish Marketing Investigation Committee which reported to Cabinet in January 1981 on the role, functions and composition of the Queensland Fish Board, the structure of fish marketing in Queensland, pricing policies and the relationship between fish marketing and fisheries management.

These investigations have contributed to a significant improvement in the Board's financial position and marketing activities. Subsequent Branch commitments have included involvement in planning of new legislation for the fishing industry and in further consultations with the Board on project evaluation, marketing policies and financial performance.

A joint paper is being prepared on the 'Structure and Economics of Fish and Seafood Marketing in Queensland' for presentation at a conference on managing Queensland fisheries to be held at Griffith University in August 1981.

Economics Research

Regional economics

Structural relationships of various sectors of the north Queensland regional economy in the early 1970s were estimated in a report released in June 1981. This was an innovative study as few quantitative investigations have been undertaken to assess the impact of agricultural development on other sectors of the economy.

The northern region's gross regional output was approximately $225m in 1970–71, $283m in 1971–72 and $347m in 1972–73. After allowing for inflation of 6.5% in 1971–72 and 5.8% in 1972–73, gross regional output grew in real terms by approximately 18% in 1971–72 and 16% in 1972–73, indicating the strength of the northern region economy during the study. Rural production based primarily on sugar and beef averaged approximately 11% of regional output while agribusiness, including processing industries, accounted for a further 20%.

This study was undertaken to provide an effective method of measuring the regional impact of large-scale irrigation projects. It provided the methodology and sector output, income and employment multipliers used to estimate the secondary benefits of the Burdekin Irrigation Project.

This important research has demonstrated that regional input-output analysis can be effectively applied in the evaluation of structural relationships, the evaluation of resource use and product output levels and for forecasting regional economic activity.

Cost-of-production methodology

Increasing involvement of economists in cost of production studies, as a guide in price determination of products such as eggs and tobacco, prompted the need to review the methodology used in Queensland with approaches adopted in other States.

This review was undertaken at the 25th Annual Conference of the Australian Agricultural Economics Society in New Zealand in a workshop convened by Mr S. J. Mill on the 'Theory and Practices of Measuring Costs of Production'. All States contributed to a background paper prepared for the workshop which summarizes the extent and type of their involvement in this field. This review and workshop proceedings will be incorporated in a research bulletin.

Research stations

The Branch is represented on all major research stations for economists to be involved in planning and analysis of various research projects. For example, in central Queensland, projects involving the economist included an assessment of the limited potential for maize production, chemical weed control and fertilizer trials in wheat and the effect of stubble retention and tillage methods on sorghum yield.

In the latter experiment on surface management at Biloela, the results indicated that, even though good yields can be achieved with zero tillage, the chemical costs are prohibitive to make this a practical technique at this stage. Conventional tillage still provides the most economic return.

Staff

Appointments. Mr I. B. Robinson, M.Econ.Studies (University of Qld), former Senior Agricultural Economist in charge of the Drought Secretariat, was appointed Supervising Agricultural Economist (Research) in May 1981.

A second economist at Atherton was relocated in Mareeba in January 1981 to provide an improved service to the tobacco, rice, beef and horticulture industries on the northern tableland and adjacent regions.

An economist was reappointed to Emerald in May 1981 after the centre had been vacant since September 1979. Emerald had been serviced on a part-time basis from Rockhampton in the interim.

Inservice training. Inservice training was provided for Branch staff in a wide range of fields including computer programming and systems analysis, extension, futures trading and management development.

At a Branch workshop for officers in southern Queensland in June 1981, a teaching segment was devoted to the economic analysis of biological research which was conducted by Professor J. R. Anderson from the University of New England.

Standards Branch

THE purpose of Standards Branch is to benefit primary industries by maintaining appropriate standards and control systems for agricultural requirements and agricultural products.

Its objectives are—

1. To ensure that agricultural chemicals, stock foods and veterinary medicines offered for sale are effective.
2. To ensure that agricultural chemicals, stock foods and veterinary medicines and seeds offered for sale are true to label and up to standard.
3. To facilitate the marketing of agricultural produce by ensuring that commodities:
   (a) comply with prescribed domestic, interstate and overseas requirements;
   (b) agree with their trade description;
   (c) are acceptable to consumers;
   (d) are packed, handled and transported economically.
4. To ensure that the commercial distribution of agricultural chemicals is carried out in a safe, responsible and competent manner, and to assist people whose crops and stock are damaged as a result of accidental drift.
5. To maintain a seed technology unit to service objectives 2 and 3 above and to provide information on seed quality to farmers and seed merchants.

Staff

The total staff strength of the Branch is 97. This number is four fewer than for 1979-80 and includes one graduate officer transferred to Entomology Branch to help handle current problems in the beekeeping industry.

Legislation

Assent was given in April to numerous changes to the *Agricultural Standards Act* 1952-1972. This Act, which has been in force since 1953 without any major changes, relates to the sale of materials used by primary producers and covers seeds, stock foods, fertilizers, limes, pest destroyers, veterinary medicines and growth-regulating materials.

The alterations will improve administrative procedures, achieve a greater degree of uniformity in terminology and procedures with other States as well as remove redundant, outmoded and some over-restrictive provisions in the present Act. Firms selling the relevant materials, Standards Branch, and the consumers of these materials (the primary producers, the home gardener and the pet owner) should benefit.

The changes are embodied in the *Agricultural Standards Act Amendment Act* 1981 and will be introduced when the necessary administrative procedures and machinery have been developed.

Agricultural Standards

An important aim of the Agricultural Standards Act 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.

The amendments to the Act will significantly affect the procedures used for the registration of agricultural requirements. An important change will be a streamlining of the procedures to allow for renewals every 3 years by the payment of fees rather than by the consideration of detailed applications. The Agricultural Requirements Board and the Chemical Services Section will be relieved of much inconsequential work.

A new provision will oblige the wholesale dealer of a registered material to submit information of which he comes into possession and which contradicts any information supplied in the application for registration. Such information would include any which indicates that the material would have a previously unrecognized detrimental effect or for some reason is no longer effective.

Registrations

A total of 4 899 applications for registration, including reregistration and renewal, was processed. This represents an increase of 379 over last year. This increase reflects the continuing interest in companion animal medicines and home garden chemicals. Approval was also granted for the supply of five special mixtures of pest destroyers, and 23 special mixtures of fertilizers.

The Technical Committee on Agricultural Chemicals referred to its member in Standards Branch 55 submissions for clearance of new agricultural chemicals and new uses of agricultural chemicals already being sold. Consultants from within and outside the Department contributed advice on the effectiveness of each of the subject pesticides. Subsequent clearances from this Technical Committee were used in applications for registration in Queensland.

Expansion and updating of Standards Branch Pamphlet No. 74 did not proceed as quickly as in the previous year. Information on the approved uses, methods of application, limitations on use and toxicology of 21 pesticides was added. Similar information on 43 pesticides already in the pamphlet was updated.

Data sheets have now been issued on most of the fungicides and insecticides used on plants in Queensland.

The information received in questionaires completed by recipients of Pamphlet No. 74 has now been collated. From these results it is obvious that this publication has been well received.

Agricultural Requirements Board

The Agricultural Requirements Board considered the claims made by primary dealers regarding the efficacy of 1 555 preparations. This represents a slight decrease (119) compared with the previous equivalent year (1977-78) in the registration cycle.

The following table provides an indication of the Board's activities—

—	1977-78	1978-79	1979-80	1980-81
Pest destroyers	509	830	1 195	599
Veterinary medicines	919	924	757	764
Stock foods	162	117	47	120
Fertilizers	47	43	15	36
Growth regulating materials	37	30	38	36
TOTAL	1 674	1 944	2 052	1 555

Requests for approval of five Departmental recommendations were also considered by the Board.

During the year, the Board requested primary dealers to withdraw from the market place those preparations containing DDT and recommended for use on cotton. This action followed a decision to cancel registration of these preparations in New South Wales from 1 July 1981. This withdrawal of the cotton recommendation will result in use against dimple bug in apples and pears and certain pests in bananas being the only acceptable recommendations for preparations containing DDT.

The purpose of the inspection and associated chemical analysis service on agricultural requirements is to provide protection to primary producers and consumers by ensuring that agricultural requirements offered for sale in Queensland are of an acceptable standard, true to label guarantee and are distributed by commercial spray operators in a responsible manner.

Inspection and sampling of agricultural requirements, as provided for by the *Agricultural Standards Act* 1952-1972, continued during the year with some modifications to existing practices. These changes were introduced to improve the level of compliance with the Act and its Regulations.

A major innovation was the use of the penal provisions of the Act. Five firms were charged with offences against the Act during the year.

The following table provides a summary of inspection activities—

ACTION ON AGRICULTURAL REQUIREMENTS OFFERED FOR SALE IN QUEENSLAND

—	Seed	Pest destroyers	Veterinary medicines	Stock foods	Fertilizers and limes
No. of lines sampled	1 535	146	34	307	61
No. of lines that failed to comply	190	27	6	87	18
Action taken for non-compliance					
Lines seized	121	10	..	13	..
Quantity seized	..	2 864 kg 204 L	..	9 120 kg	..
Action taken for non-registration					
Lines seized	..	20	170	2	44
Quantity seized	..	367 kg 102 L	6 420 pks	1 550 kg	11 kg

A system for the co-ordination of sampling activities and dissemination of results was introduced to improve efficiency and effectiveness of seed inspection and sampling. This programme has

reduced the incidence of multiple sampling of lines of seed and sub-standard seed offered for sale. Large quantities of soybean seed were found to be sub-standard in germination and seized. Concern was expressed that merchants might not be able to satisfy planting demands. This problem was resolved after discussions with seed industry representatives.

The failure on the part of some seed merchants to label lines containing restricted seeds in accordance with regulations introduced in 1978 is still being tackled through an extension programme. Stronger action may be required in the future. A survey of seed held at representative outlets was conducted to gain information on seed quality. The most common reasons for non-compliance were the presence of live insects and non-labelling of lines containing restricted seeds.

Analyses of samples of pest destroyers revealed a higher level of compliance than in the previous year. Those pest destroyers listed in the above table as being seized because of non-registration were all pet lines.

Increased attention was given to the sale of unregistered veterinary medicines which is reflected in the previous table. Most preparations seized were pet lines and products used in the horse and greyhound racing industries. The number of unregistered veterinary medicines offered for sale, particularly those for pet use, is a continuing problem mainly because the manufacturers of these preparations are located interstate or overseas. Closer liaison with the Queensland primary dealers who are responsible for the registration of these preparations could help overcome many difficulties.

In spite of the efforts made by inspectorial staff, the degree of compliance of stock foods with label guarantees and prescribed standards remain unsatisfactory. Use of the penal provisions of the Act may be necessary to achieve an improvement in stock food quality. A review of legislation in Australia relating to stock food is currently being conducted.

The standard of fertilizers sampled during the year was very high and less effort is now required in this area. The situation with limes, however, was not as satisfactory although most problems could be rectified by modification of label claims.

Assistance was provided to Commonwealth bodies monitoring 2,4,5-T for dioxin; grains and fees for aflatoxin; and dairy detergents and sanitizers for compliance with Australian standards.

Aflatoxin B in excess of prescribed levels was found in a number of samples of peanut by-products and in feeds in which these by-products were used. The Peanut Marketing Board and independent processors are attempting to overcome the problem.

The work of District Inspector Linnett in developing a three-way divider for use in sampling agricultural requirements was noted by the Australian Academy of Technological Sciences for listing in their publication 'Innovations in Australian Technology 1979-1980'.

Inspectors in most districts are becoming increasingly involved in carrying out investigations under the *Agricultural Chemical Distribution Control Act* 1966–1978, and in preparing reports on such investigations. Other activities in this area include the examination of candidates for restricted and unrestricted licences, as well as checking records kept by commercial operators to ensure compliance with prescribed requirements.

Seed Certification

The spectacular increases in areas registered for pasture seed certification and in quantities of pasture seeds finally sealed and labelled, reflect the outstanding success of the reconstitution and release of Callide as a greatly superior cultivar of Rhodes grass and its pure seed production within the seed certification scheme. Areas registered for certified pasture seed production increased from 833 ha in 1979–1980 to 1 320 ha in 1980–1981. Of these areas, 389 ha and 640 ha (respectively) were Callide Rhodes grass. Samford Rhodes grass increased from 64 ha to 110 ha, Graham stylo increased from 100 ha to 158 ha and Fitzroy stylo increased from 40 ha to 66 ha. The total quantity of pasture seeds finally labelled and sealed as certified seed was 21 300 kg, compared with 5 900 kg in 1978–1979, and 10 000 kg in 1979–1980.

Cold storage for bean seed

After discussions between the principal producer of bean seed and the Department on the problem of maintaining germination strength of certified bean seed held in the Burdekin district through one or more summer seasons, that company has now installed cold storage facilities at Brandon. This development represents a substantial improvement in the overall bean seed certification scheme as it will allow certified stock seed to be held in good condition for several years, thus obviating the substantial losses which occurred in past years.

New maize hybrid

With the decline in popularity of Q1280 which had been important in the Hybrid Maize Seed Certification Scheme in south-east Queensland for many years, and in the absence of any new hybrids from Queensland Agricultural College, arrangements were made with the New South Wales Department of Agriculture to supply parental seed for the mid season hybrid GH5004 to the certified seed grower in the Beaudesert district.

As GH5004 had produced the highest grain yields in a Departmental trial at Kingaroy, it is expected to enjoy a good demand in southern Queensland. An initial area of 2.5 ha has been grown this year for the production of certified seed of GH5004. Production from this area will be shown in next year's report.

Improved procedures

Procedures in the printing of certification labels and in the final labelling and sealing of certified seed have been modified during 1980–81 to reduce the time delay between seed cleaning and eligibility for sale as certified seed. Equipment has been provided for the preparation of certification labels in country centres. With pasture seeds, this saves at least 1 week's delay between the completion of germination testing and the attachment of certification labels.

SEED PRODUCTION
CERTIFIED AND BASIC SEED (TONNES)

—	1978	1979	1980
Hybrid maize	161	185.5	158.0
Hybrid sweet corn	0.15	. .	0.5
French beans	58	79	95.9
Navy beans	18	9	24.2
Oats	. .	1.4	8.6
Pasture	5.8	10.1	22.0
Tomato	0.03	0.37	0.08
	242.98	285.37	309.28
Special mother bean			
Stage A	0.8	0.2	0.17
Stage B	9.1	3.7	1.17
	9.9	3.9	1.34
Approved oats (hectares accepted)			
Stout	525 ha	109 ha	30 ha

Fruit and vegetable quality

Activities carried out under the fruit and vegetable inspection and extension service benefit consumers as well as the fruit and vegetable industry and associated industries. This is done by ensuring that fresh fruit and vegetables offered for sale in Queensland are of an acceptable standard and are handled, transported and stored under conditions conducive to the maintenance of freshness and shelf life.

Inspection service. The following table is a record of action taken under the *Fruit and Vegetable Act* 1947–1972 by inspectors in the Brisbane Market, Rocklea.

Commodity	Number of actions taken	Quantity seized for not complying		
		Packages	Bins	Calculated total weight (kg)
Fruit	2 139	50 689	66	859 000
Vegetables	1 180	29 418	303.5	518 000
Heavy produce	445	11 703	12.5	614 000

In addition 2 790 inspections were made of retail fruit and vegetable outlets in Brisbane, Ipswich and the Moreton and Near North Coast Regions. Eight hundred directions were issued in respect to produce being offered for sale but which did not comply with the provisions of the Act.

Regular inspections were also made of wholesale fruit and vegetable markets and retail shops in major provincial centres and roadside stalls in production areas.

Dry weather in late winter and spring was followed by very hot conditions and heavy rain in the summer vegetable growing districts of Queensland. This resulted in shortfalls of some commodities on the local market. As a result increased supplies were drawn from southern States to meet local demands. Similar unfavourable conditions on the Granite Belt caused shortages in quality stonefruit and grapes while supplies from southern States, particularly grapes, also showed the effects of adverse weather conditions in the early part of the season.

As a consequence, increased quantities of fruit and vegetables were seized by Inspectors (1 991 t) compared with 1979–1980 (1 413 t). Much of this produce was released for sale after sorting or otherwise being made to comply. However, there was a significant increase in the quantity of unsound produce destroyed.

Fruit still accounts for the greatest part of these losses which were only slightly higher than those in 1979–1980. Rockmelons again attracted greatest attention and with 11 387 packages seized, losses were higher than for 1979–1980 when only 8 549 packages were seized. Tomatoes with 6 740 packages seized also showed a substantial increase while grapes, apricots and peaches recorded heavy losses.

Vegetables and heavy produce showed the biggest increase with quantities seized in both lines almost double those for 1979–1980. Cucumbers (4 048 packages), capsicums (3 820) and carrots (4 772) are still of greatest concern and it is considered that losses could be reduced with better attention to post-harvest handling practices. The increase in lettuce losses on the other hand was a direct result of hot weather and poor quality.

In heavy produce lines, potatoes accounted for 525 t of the 614 t seized. This was a 100% increase on losses recorded in 1979–1980. Weather conditions were again the major contributing factor and potatoes from all growing districts suffered.

During the year, inspectors tested 705 samples of fruit for compliance with maturity standards. Samples from growers numbered 339, while the remainder (366) were samples taken by inspectors from lines offered for sale on the Brisbane Market

FRUIT MATURITY TESTING—BRISBANE MARKET

Commodity	Growers' samples tested	Inspectors' samples tested	Total no. of samples failed
Mangoes	. .	88	19
Plums	. .	47	Nil
Rockmelons	. .	72	40
Pineapples	. .	16	6
Citrus	117	63	75
Avocadoes	150	20	56
Grapes	72	60	32
TOTAL	339	366	228

In addition to taking action as above, inspectors gave advice and performed associated extension tasks. Straw used for packing watermelons going to southern markets is required to be fumigated, and 216 certificates to this effect were issued on behalf of animal health services.

Activities under the Diseases in Plants Act saw 936 consignments of southern stonefruit checked for *Sclerotinia laxa* certification together with 714 consignments of southern grapes for *Phylloxera* certification.

During the year two inspectors from the Brisbane Market and one technologist had the opportunity to visit the Sydney and Melbourne Markets to gain experience and knowledge of interstate inspection procedures. Two inspectors from the Sydney Market visited Queensland. This interchange of knowledge and experience has proved of great benefit to each officer concerned and will be useful in the maintenance of uniformity of inspection procedures between States.

Extension service. The attention given to post-harvest handling and marketing practices by this Department through the Market Extension Service has been increased with the appointment of two Horticultural Officers to the project. This was achieved with the transfer of one technical position from Standards Branch to Horticulture Branch who now have the responsibility for co-ordinating these post-harvest extension activities.

Standards Branch involvement in this project is now concentrated on providing market information to growers and district extension officers. Activities in this area have been increased. This is reflected in the 741 'Infringement Notices' and 'Market Reports' sent to growers this year compared with 471 in 1979–1980. Copies of these were also sent to district extension officers. 'Seen in the Market' prepared by officers in the Market is being continued as a regular feature in the fortnightly publication *Fruit and Vegetable News*.

Reports of unsatisfactory out-turn of produce sent to northern centres from the Brisbane Market is still a major concern. A project has now been initiated to develop and promote the adoption of better practices in respect to cooling, handling and transporting. The aim of the project is to minimize wastage and improve shelf life of produce in these centres. Quality and temperature at loading are now being monitored for some produce at the time of loading onto refrigerated road and rail transport.

The system of rationalized packages with benefits of ease of palletization, unitization and forced air cooling is gaining popularity in all sections of the industry. The efforts of market officers in promoting this system has been largely responsible for its acceptance and usage. In conjunction with officers of Horticulture Branch, considerable efforts have been directed towards the implementation of a returnable crate for fresh produce.

Agricultural chemical distribution control

Standards Branch services The Agricultural Chemicals Distribution Control Board which was formed under the *Agricultural Chemicals Distribution Control Act* 1966–1978. The activities of the Board provide landholders with some protection from damage caused by commercially distributed agricultural chemicals. Responsibilities include the licensing of agricultural pilots and commercial weed control operators and recommending controls on the use of agricultural chemicals in the State.

Assistance is given to the owners of damaged crops and livestock when the damage has been caused by the drifting of agricultural chemicals from aerial spraying and of herbicides from ground spraying. Their cases of damage are investigated under the provisions of the Act. Crops and livestock are inspected, the records of licensed pilots and operators are examined, inquiries are made and samples are analysed in co-operative work by officers in various sections of the Department. The Board considers that reports from officers and issues statements on the findings to the owners of the damaged crops or livestock.

Branch activities included the issue and renewal of licences for agricultural pilots and commercial weed control operators; ensuring that contractors held adequate security as a source of recompense in the event of accidental damage or injury to crops or stock; the investigation of such complaints; and the consideration of requests for permits to use restricted chemicals in hazardous areas.

Licensing

During the year, 81 examinations for unrestricted Commercial Operator's Licences were held in 25 centres. One hundred and forty-eight applicants for Commercial Operator's Licences and nine for Pilot Chemical Rating Licences were examined. From these and earlier examinations, the following licences were issued or renewed—

119 unrestricted Commercial Operator's Licences issued
143 restricted Commercial Operator's Licences issued
1 038 Commercial Operator's Licences renewed
15 Pilot Chemical Rating Licences issued
51 Pilot Chemical Rating Licences renewed.

Investigations

Forty notifications of complaint on damage were received and investigated during the year. Five of these related to injury to ornamental plants and shrubs growing in home gardens, 11 to honeybees and the remainder to horticultural and agricultural crops in south-east Queensland and coastal areas of the State. Statements of these investigations were issued by the Board.

Permits

Nine applications for the issue of permits for the distribution of herbicides in Hazardous Areas were received. Three of these applications were for the distribution of ester formulations of 2,4,5-T or a mixture of ester formulations of 2,4-D and 2,4,5-T onto approximately 2 180 ha of forest in Hazardous Area No. 1. Another four applications were for the use of ester formulations of 2,4,5-T in Hazardous Area No. 2.

Of the remaining two applications, one related to the aerial distribution of ester formulations of 2,4-D and 2,4,5-T from a helicopter onto wattle and groundsel bush growing in 8 ha of pasture in Hazardous Area No. 1. This application was refused because the spraying would have been an unacceptable risk to susceptible crops in the vicinity. The other application, relating to the spraying of regrowth of willows in certain streams in the Glengallan Shire, is still under consideration.

Computer programme

During the year, Standards Branch staff assumed responsibility for operating the Agricultural Chemicals Distribution Control computer based filing system. The system continued to store information on licence holders, licence restrictions, employers of holders of Commercial Operator's Licences and details of security held by owners of distribution equipment.

In May 1980, licence holders were issued with applications for the renewal of their Commercial Operator's Licence on which the details recorded on the computer file were shown and given the opportunity to submit changes. Updated information was recorded and licence renewals were printed by the computer for issue to licence holders.

Lists of licensed operators and related information were produced by the programme and distributed to inspectors appointed under the Act.

Export supervision

The purpose of the export and inspection service is to facilitate, on behalf of the Commonwealth, international trade by providing information, inspection services and documentation in respect to the Quarantine requirements of overseas countries for plants and plant products. This service also serves to maintain the quality and demand for Queensland plants and plant products on overseas markets by the inspection and documentation in line with Commonwealth export legislation.

Associated duties involve ship and container inspection before commodities are loaded. This year 39 vessels were inspected at the port of Brisbane and 24 vessels at Gladstone.

Empty container inspections at metropolitan container depots totalled 1 602, of which 182 were rejected and a further 509 containers were withdrawn pending fumigation, spraying, cleaning or repairs.

Regular inspections are carried out at the two export grain terminals at Pinkenba and the terminal at Gladstone, to ensure that hygiene standards are properly maintained.

Other duties include supervision of fumigation, heat treatments and other disinfestation measures, fruit maturity determinations and sampling of exported commodities for pesticide residues.

Cereals and coarse grains

Drought and other adverse weather conditions were responsible for a general reduction in grain exports from the port of Brisbane. In central Queensland, however, exports of both wheat and sorghum from Gladstone increased slightly to 319 196 tonnes.

Total shipments of cereal and coarse grains from Queensland were 850 312 tonnes made up of wheat 395 606 t, barley 60 816 t and sorghum 393 890 t.

Details of shipments are—

Destination	Wheat (tonnes)	Barley (tonnes)	Sorghum (tonnes)
Japan and Far East	49 053	14 292	286 734
South-East Asia	249 004	46 524	11 851
Papua New Guinea and Pacific Islands	32 182	. .	14 384
Near and Middle East	45 113	. .	
Russia	. .	. .	80 903
China	20 254	. .	. .
United Kingdom	. .	. .	18
TOTAL	395 606	60 816	393 890

Other grains and seeds

Substantial increases in exported quantities of seeds for sowing are largely due to sales of sunflower, maize and sorghum to Taiwan, South-East Asia and the Pacific Islands. These shipments, mainly from the Darling Downs, increased from 25 t in 1979–80 to 346 t in 1980–81.

Carpet grass (*Axonopus* spp.) and *Panicum maximum* were again the two main tropical pasture species exported.

A small but significant market of 9 t of tropical pasture seed was developed in China.

A shipment of 20 t of tea seed (*Camellia sinensis*) was exported commercially from north Queensland for the first time.

Birdseed grains, peanuts, mung beans, rice and other crops for culinary purposes were exported to traditional markets from southern and central Queensland districts.

The macadamia nut industry continued to expand and the 160 t exported were more than treble exports in the previous year.

Stock food consignments accompanying livestock shipments to overseas countries increased to 985 t.

Inspections under Export (General) Regulations and/or Phytosanitary Certificates are summarized hereunder (in tonnes)—

Destination	Seeds sowing	Seeds culinary	Peanuts	Bird seeds	Malt	Rice	Stock foods
U.K. and northern Europe	19	599	747	. .	. .	1 012	. .
Southern Europe	. .	34	. .	754	. .	. .	. .
North America	113	962	34	3	. .	110	. .
South America	109	. .	. .	. .	. .	. .	. .
Central America	53	. .	. .	. .	. .	. .	. .
New Zealand	6	. .	289	743	. .	. .	. .
Papua New Guinea and Pacific Is.	168	123	110	37	2 432	738	231
South-East Asia	177	. .	. .	. .	. .	. .	14
Far East–Japan	68	159	1 018	1 703	1 969	. .	492
Far East–Taiwan	61	955	. .	2 454	. .	. .	. .
Far East–Korea	. .	. .	. .	. .	1 508	. .	. .
Far East–China	9	. .	. .	. .	. .	. .	. .
Far East–others	. .	. .	69	. .	. .	90	248
Near & Middle East	. .	. .	119	. .	. .	. .	. .
Africa	11	. .	. .	451	. .	. .	. .
TOTAL	794	2 832	2 386	6 145	5 909	1 950	985

In addition to the above, numerous small consignments of miscellaneous grocery trade products totalled 156 t. These included dried beans, peas and lentils, and other culinary items exported to Papua New Guinea and Pacific Islands.

Other exports of significance were a gift shipment of 1 300 t of maize to East Timor and 4 650 t of flour to Burma on behalf of the Department of Administrative Services.

A consignment of 3 409 t of raw cotton was inspected on behalf of the Government of the People's Republic of China. Another shipment of 49 t was inspected for Thailand.

Other inspections included duboisia leaves to Italy, wheat gluten to Middle East countries and dried ginger to South Africa.

Fruit and vegetables

Citrus. Export citrus fruits were again in demand on world markets, with the Middle East, Canada and Europe receiving the largest quantities. Mandarins predominated with 6 749 t approximately two-thirds of the overall export total of 10 403 t of citrus.

A large shipment of 82 900 cartons of citrus was exported in July 1980 from Brisbane and was said to be the greatest quantity ever to leave Australia in one vessel.

Apples. Because of extreme drought, sunburn and hail damage, early expectations of a record apple export season did not eventuate. It was only through the determination of growers, exporters and packers that 1 212 t were shipped, compared with 979 t last year.

Two District Inspectors completed a week's training course in Melbourne in March 1981 on cold sterilization calibration techniques for apple and pear shipments to the United States of America.

Pears. Approximately 333 t of pears were exported. At inspection most were in a sound hard condition. However, some rejections were incurred with fruit too forward and in blemished condition. There was cause for some concern with an increase in rejectons for San Jose Scale infestation.

Vegetables. Heavy vegetable exports increased from approximately 893 t in 1979–80 to 1 636 t in 1980–81. Light vegetable exports increased less markedly.

The following table summarizes tonnages of fruit and vegetables exported during 1979–80 and 1980–81—

Citrus fruits	1979–80 (tonnes)	1980–81 (tonnes)
Oranges	4 346	2 992
Lemons	378	169
Grapefruit	543	493
Mandarins	6 594	6 749
TOTAL citrus	11 861	10 403
Other fruit and vegetables		
Apples	979	1 212
Other fruit	665	718
Heavy veg.	893	1 686
Light veg.	668	875
TOTAL other fruit and vegetables	3 205	4 491
TOTAL all fruit and vegetables	15 066	14 894

Plants. An increase in exports of plants was noted. A total of 303 consignments was inspected for phytosanitary requirements, compared with 200 consignments last year.

Fumigation. Supervision of fumigation of fruit with EDB was carried out to meet both export and interstate requirements. The chambers situated at Clapham Junction ceased operating this year. A small chamber was approved for use at Eagle Farm, Brisbane.

The following table lists quantities of fruit fumigated at Brisbane and country centres—

Kind of fruit fumigated	1979–1980 (packages)	1980–1981 (packages)
Mangoes	34 084	45 459
Oranges	46 036	15 026
Lemons	3 652	5 220
Mandarins	160 368	134 148
Grapefruit	4 070	9 704
Capsicums	43 954	29 727
Rockmelons	Nil	56

Quarantine

Sampling and inspection of imported seeds for sowing and fruit and vegetables was carried out on behalf of Plant Quarantine Service at the port of Brisbane.

Ryegrass seed (*Lolium* spp.), lucerne (*Medicago* spp.) and clover (*Trifolium* spp.) comprised more than three-quarters of the 825 t of seed inspected.

Citrus fruit from United States of America and onion and garlic shipments from New Zealand represented the major fruit and vegetables imports inspected.

Branch officers also worked closely with quarantine officers at the ports of Townsville and Gladstone, assisting with cargo inspections and other items subject to quarantine inspection.

Seed testing and research

The Seed Testing Service exists to provide information for regulatory purposes and to verify seed quality for research purposes. In addition, the service provides assistance to intending purchasers of seed in the selection of an appropriate quality for planting. Tests on seed submitted by an owner for his own sowing are carried out free of charge.

The following table indicates the extent of general seed testing carried out conjointly during the year by the Queensland Seed Testing Station at Indooroopilly, the Seed Testing Sub-station at Toowoomba, and the North Queensland Sub-station at Mareeba.

Samples received at Indooroopilly during the year were again predominantly pasture grass seeds, the main species being *Panicum maximum*. By contrast, the Toowoomba Sub-station analysed the bulk of cereal, birdseed and oilseed samples. The Mareeba Sub-station handled mainly field crops.

Sources of seed samples received for analysis at the Departmental Seed Testing Laboratories—

Source of Sample	Purity	Germ.	P. & G.	*Brd. sd.	+T.T.C.	Totals (Samples)
Merchant	119	1 176	4 625	6	275	6 201
Farmer	12	429	1 144	. .	2	1 587
Inspector	8	392	1 351	1	200	1 952
Import	119	3	15	. .	. .	137
Departmental	4	48	797	. .	50	899
Other departments	8	26	307	. .	1	342
Experimental	. .	. .	644	. .	50	694
TOTALS	293	2 085	9 911	134	584	13 007

*Bird seed +Tetrazolium chloride tests

Two additions to the 'Agricultural Standards (Seeds) Regulations of 1969' were gazetted as follows—

- *Themeda quadrivalvis* (grader grass) was added to the Restricted Weed Seeds List with a maximum of 500 seeds allowable per kilogram
- *Alternanthera philoxeroides* (alligator weed) was included in the Prohibited Weed Seeds List.

For the first time, heavy 'ergot' contamination is severely affecting the buffel supplies this year. The 'Claviceps' in the 'honeydew' stage are now being identified and recorded on the analysis certificate from the laboratory. The larval stage of *Manparva rhodonenia* is also causing severe damage in the Banana Shire and surrounds.

Bird seed testing by the Department has altered in that a Grain Analysis Certificate is now issued for all seed intended for purposes other than sowing. The Department does not accept responsibility for the sampling of such lines of seed, with the results obtained relating only to the sample as received by the Department.

Several amendments to the I.S.T.A. Rules, in relation to the testing of *Cenchrus, Brachiaria, Setaria, Stylosanthes, Beta, Dactylis, Festuca, Hordeum* and *Oryza*, were agreed upon at the I.S.T.A. Congress held in Vienna in 1980, and these amendments are to become effective from 1 July 1981. Of major significance is the I.S.T.A.'s acceptance of the so-called 'Irish' method for buffel grass seed.

Approximately 250 Blue International Seed Sample Certificates were issued during the year, together with 162 Orange International Seed Lot Certificates. These numbers indicate a greater awareness by the use of these internationally-accepted analysis certificates.

Comparative tests on French beans, navy beans and soybeans were held between the State laboratories in Queensland, New South Wales, Victoria and Tasmania. Mr D. Genn, of Standards Branch, visited all laboratories during the conduct of these tests.

Variation between laboratories in terms of seedling assessment was negligible. However, there was considerable variation in recorded germination percentages, particularly for Tasmania, and this variation was attributed to differences in testing techniques (especially substrate moisture control).

Participation in various I.S.T.A. Referee Testing Programmes is highlighted again this year. A series of germination and T.T.C. comparative tests was conducted throughout the year, with the Brisbane laboratory fairing extremely well once again. Of particular significance was the T.T.C. work where endeavours are being made to present methods used by the Branch in testing tropical grasses to the I.S.T.A. Tetrazolium Committee for consideration. To this end, an experienced analyst in this field, Miss Isobel Lamberth, is to attend an I.S.T.A. T.T.C. Workshop in Oslo from June 21 to 28. Miss Lamberth will conduct a similar workshop in Brisbane in September to inform other Australian analysts of the latest developments in TZ testing.

Research work included an investigation of germination in green panic grass. Despite the occurrence of some complex interactions, it has been found that the combination of acid scarification (15 min), potassium nitrate without light promote germination of partially dormant green panic seed more than any other combination.

A project by Mr S. Kwaengsopha (a Thailand student at the University of Queensland) investigating the effect of dry heat on hard-seededness in *Leucaena leucocephala* was supervised by Mr Butler. Exposure between 70°C to 80°C for 2 to 4 hours gave the best effects.

A further project showed that acid scarification for periods of 20 to 25 min was not only more effective but had a quicker impact on hardseededness.

Research and publications

Following dormancy problems with sunflower seed, the Research Section had, this season, been conducting field trials at Hermitage Research Station. Seed testing staff members have undertaken the planting and assessing of the plots, an activity that also provides valuable field experience for our analysts.

The Seed Testing Laboratory again was a centre of interest for overseas, university and college study groups. University, Q.I.T. and Gatton College students were given talks by senior members of staff combined with practical demonstrations of the techniques of seed testing. A number of overseas students on returning from participation in various International Training Courses visited our laboratory to compare testing methods with those in their homeland.

A booklet entitled *Weed and Crop Seeds found in Samples analysed during 1978* was compiled by Helen Low and printed this year, while the *Queensland Seed Testing Procedures* book has been revised and considerably expanded and is currently being printed for distribution to all analysts.

Brisbane staff were involved in two workshops during the year. The first, a Seed Cleaners' Workshop, held at the Gatton Agricultural College at Lawes, involved the participation of three senior analysts for a half-day. Mr Genn, Mrs Fanton and Miss Low conducted lectures and practical demonstrations in the discipline of seed testing and also assisted the Inspectors in the practical demonstrations of seed sampling.

The second workshop was a two-day 'Commodity Board' workshop, involving the Brisbane laboratory, the Barley Marketing Board, the Wheat Board, the Navy Bean Marketing Board, the Peanut Marketing Board, and the C.O.D. Throughout the 2 days, lectures and practical exercises were conducted and the individuals from the Boards were shown the latest techniques in testing their particular commodity. Interpretation of seedling categories was of most significance.

The workshops proved to be most successful and it is hoped that similar workshops will be conducted on a regular basis in the future.

Because of a higher than usual turnover of staff, there has been a considerable input into our internal training programme. All new seed testing personnel undergo this intensive training. The programme has been extended to include inspectorial staff to broaden their knowledge of seed testing and seed quality.

Division of Land Utilisation

THE Division of Land Utilisation has as its charter to assist the sound utilization of the State's land resource. This includes, of course, the preservation, rehabilitation and subsequent maintenance of that land. The Division also provides an agricultural engineering service to both the farming community and the rest of the Department and has a drafting section to assist in the production of maps and other drawings relative to the work of the Division.

To achieve its major purpose, the Division must study the use to which land is currently being put, its future potential and the effect of a range of management techniques on its viability as a natural resource. It must therefore collect information about the State's resources, evaluate opportunities for development based on that information, research problems of land degradation to find practical solutions and provide extension and farm services to put those solutions into effect.

The Division has organized its operations into a suite of sub-programmes. Each of these sub-programmes comprises related areas of activity and each is a clear portion of the work which the Division must do to achieve its goals.

Within the land use area, these sub-programmes are Land Resource Assessment, Development Planning and Evaluation, Land Management Research, General Soil Conservation Services and Area of Erosion Hazard Services. This report is presented under these sub-programme headings. Engineering Services contains two sub-programmes, Agricultural Engineering Research and Environment and Resources Research. These are reported together.

Implementation of soil conservation measures

A record total of 62 402 hectares of grazing and cropping land was treated with soil conservation measures during the year, representing a 21% increase over the area treated in 1979–80. Emphasis was again placed on the treatment of cropping land, with grazing land accounting for only 2% of the area treated. Record treatment rates were achieved in both the extensive and intensive cropping lands because of the high level of interest in soil conservation by grain growers developing marginal cropping land in central and southern Queensland, and cane growers developing land for expansion along the coast. Even with these record treatment rates, the area still requiring treatment is increasing because of continuing development of land for cropping. Accurate data on current rates of development of land are unavailable, but available data indicate that an average of 64 000 ha a year has been developed for cropping over the last 5 years. Some 90% of this land requires protection against soil erosion. If this rate of development continues, it will not be possible to control soil erosion effectively in the cropping lands of the State without major changes to the Soil Conservation Branch programme.

The progress of treatments applied in the present cropping land of Queensland can be shown as follows—

Treatment Required	% Treated
Intensive treatment	53
Simple practices	23
Intensive cropping lands	14

In addition, there are estimated 23m ha of grazing land in Queensland which require, as a minimum, the adoption of conservation grazing management practices. The development of such practices is still in progress.

Soil Conservation Authority

The reconstituted Soil Conservation Authority met three times during the year. Matters discussed included Project Area policy, Isis and Gin Gin Advisory Group Committees, Advisory Committees for Central Queensland, Condamine River diversion and project plans for Areas of Soil Erosion Hazard.

Financial assistance to landholders

In the Areas of Soil Erosion Hazard, State Government dollar-for-dollar grants, up to ceiling of $1,500 in the Darling Downs Areas of Erosion Hazard and $1,000 in the Burnett Area of Erosion Hazard, are available to landholders for measures associated with approved soil conservation schemes. Financial assistance is also available to local authorities for road cross drainage structures required in approved Project Plans. During the year, grants totalling $282,396 were paid to landholders, and $33,239 were paid to two local authorities on the Darling Downs.

Three landholders obtained approval for advances from the Agricultural Bank under Section 80 of the Soil Conservation Act. The total amount approved was $14,528, with $11,383 advanced to landholders on approved loans.

Liaison

The effective installation of soil conservation measures, particularly run-off control structures, requires considerable discussion, reviewing and planning with other concerned bodies. Development planning and resource assessment similarly require consultation with outside bodies. Officers have been constantly involved in liaison with other Government Departments, Statutory Authorities and producer organizations in the planning and co-ordination of soil conservation schemes, the mitigation of soil erosion, and development projects.

Officers provided technical advice to the Central Sugar Cane Prices Board and the Local Assignment Committee on the suitability of expansion or substitution land for cane growing from a soil erosion viewpoint, and on the need for soil conservation measures to control soil erosion. Liaison with the Land Administration Commission resulted in Branch officers preparing a subdivision and soil conservation plan for 1 000 ha of Crown land suitable for sugar cane at Mt Ossa, Mackay, and providing soil conservation requirements for inclusion in conditions attached to the lease of Crown land at Torbanlea for a cassava plantation.

Soil Conservation officers have been actively engaged with Mines Department, the Queensland Graingrowers' Association and exploration companies in developing guidelines to ensure that seismic surveys do not lead to land degradation in agricultural areas.

Soil Conservation and Agriculture Branch officers provided technical advice to the Agricultural Bank on the likely effects of soil loss and damage on future farm production following the floods in early 1981, in relation to the Relief Loan Scheme for the Darling Downs, Goomeri, Warwick and Stanthorpe disaster areas.

Assistance was given to the Water Quality Control Council in the preparation of guidelines to prevent erosion and pollution from feedlots and quarries. Advice on run-off and soil erosion control was provided to a number of local authorities for the preparation of town plans and the consideration of rural subdivision. Information on erosion hazards and control measures associated with transmission lines was provided to electricity boards across the State. The Division has continued its involvement in the inspection of Environmental Impact Statements and in other assistance to Government in its decision making.

Land resources

The huge western arid land use survey which has been in progress for several years has been finalized. The survey covered 60m ha of western Queensland. It is now in the reporting phase. Three of the proposed six parts of the report have now been published.

Land resource studies in a number of other areas including the South Burnett section of the Wide Bay Region and horticultural use and erosion surveys in the Nambour district are nearing completion. The report on a major land use study of the Millmerran-Moonie-Tara area was published during the year while another such study is under way on the eastern Darling Downs.

Sugar land use studies

Two increases in quota affecting sugar production occurred during the year. The result was a significant expansion in assigned area for the sugar crop overall with consequent difficulties in distribution of those increases over individual mill areas. There was concern within the industry that this expansion might take place in areas less suitable, for a number of possible reasons, than others might be. The Division has become involved in reporting, on request from local committees, on the suitability of specific parcels of land suggested for use for cane farming.

In addition, possible sites for cane expansion in more general terms are being studied, particularly in north Queensland. As might be expected, there are some objections being encountered in the suitability of specific districts. One very obvious example of these objections is the very serious erosion evident in the Innisfail-Cairns district.

Work in the Maryborough area on land suitability has been completed while studies are continuing at Mackay, Isis and Rocky Point.

Drought and natural disaster administration

Moderate to severe drought conditions affected primary producers in many areas of Queensland during 1980. Other natural disasters affecting primary producers in early 1981 included floods in northern Queensland and on the Darling Downs and severe storms in the Goomeri, Stanthorpe and Warwick districts.

The Secretariat continued to play an effective role in co-ordinating the administration of natural disaster measures for primary producers affected by these events. This would not have been possible had it not been for the co-operation of personnel in other parts of the Department and in other Departments and organizations.

Drought conditions

The drought conditions existing in most of southern Queensland in May 1980 worsened throughout the remainder of that year. Officially declared areas increased from 17 as at 26 May 1980 to 29 as at 30 December 1980 and included shires in the Central Highlands and far western areas in addition to the southern inland areas of Queensland.

The 1980 winter season was exceptionally dry throughout most of Queensland. These dry conditions intensified the drought conditions caused by a very dry 1979 winter season and an exceptionally hot summer in 1979–80.

The worst affected areas towards the end of 1980 were the Western Downs and Border River districts, the Maranoa, Warrego and Far South-west.

Good rain in early 1981 eased conditions considerably over most of Queensland. Although some good falls were recorded in the drought-affected southern areas, falls were generally scattered and drought conditions continue to persist in this area. Other drought affected areas, however, have now been relieved and as at 11 May 1981 the areas officially declared had decreased to 19.

The increasing severity of drought has resulted in further extensions to the relief measures for drought affected primary producers.

After Cabinet approval of additional measures in May 1980, relief measures consisted of road and rail freight concessions for movement of stock, fodder, water (including on-property cartage of water) and essential machinery and equipment including equipment for provision of water to drought-affected stock. In addition, a concession for droving stock on stock routes and reserves was available.

Extensions to these measures introduced throughout 1980 included making the existing concessions available for horse breeders where the horse breeding enterprise was the principal source of income; abolishing the distance limit on movements across the State's border; increasing the maximum concession for fodder transported by hired vehicles and extensions to the concessions on the transport of machinery. In addition, a scheme was introduced to provide a concession to producers who purchase fodder from a produce agency, for the cost of transport to the agency.

Throughout 1980–81 a drought relief loan scheme has also been operating through the Agricultural Bank. The main provisions of the scheme are carry-on loans for primary producers and small businesses and restocking loans.

Expenditure on available relief measures is as follows—

Assistance measure	Expenditure (30-6-80 to 30-4-81) ($)
Road transport—	
Concessions on fodder, water and stock	10,402,626
Rail transport—	
Concessions on fodder and stock	1,389,840
Drought Relief Loans—	
For carry-on and restocking purposes for primary producers	10,297,845 (798 approvals)
For small businesses	267,550 (13 approvals)

During 1980–81 as drought conditions deteriorated, the rate at which claims for road transport concessions were lodged escalated. At the peak of the drought, the rate of inflow of claims was about 500 a week and staff numbers in the Claims Section reached a maximum of 10 officers. Processing time has been reduced to less than a month.

Since the start of the drought, more than 21 000 claims have been processed, more than 16 000 being processed in 1980–81. It has been estimated that more than 4 000 properties have received funds through this scheme during the current drought.

The Drought Liaison Group functioned effectively during the year and met monthly while the severe drought conditions continued to be experienced. Proposals resulting from discussions by this group involved both current drought administration issues and procedures which may be adopted in future drought relief schemes.

Proposals for future drought relief assistance included both long term assistance designed to encourage a better long term approach to drought and short term assistance measures.

Natural disaster administration

Flooding and severe storms between Christmas and New Year caused losses to primary producers in the Goomeri, Warwick and Stanthorpe areas. In all, about 180 producers incurred losses amounting to more than $2.5m. A scheme of low interest loans was implemented through the Agricultural Bank to assist affected farmers to recover. At 30 April 1981, loans worth $154,568 had been approved for 20 producers under this scheme.

A monsoonal trough over northern Queensland during the first half of January caused heavy rain and extensive flooding in areas north of Proserpine. It was estimated that the total value of crop production lost was $7m and that replanting costs could be in excess of $3m. A low interest loans scheme was introduced for eligible farmers affected by the floods and as at 30 April 1981 loans have been approved to seven producers worth $76,461.

Severe storms and flooding on the Darling Downs in early February caused losses to more than 2 000 producers. The estimated value of losses and damage was in excess of $2m and of this at least half was for erosion damage and damage to soil conservation works. A scheme of low interest loans was implemented and approvals at the end of April totalled $233,012 for 24 producers.

The terms of the low interest loans schemes implemented for the three disasters listed above included a concessional interest rate of 7%. As a result of representations from the Queensland Graingrowers' Association, the rate was decreased to 5%. However, this rate only applied where soil losses and damage were assessed as being severe enough to substantially reduce overall production in a future season.

General Soil Conservation Services

UNDER the General Soil Conservation Services sub-programme, soil conservation extension and planning services are provided outside of the declared Areas of Soil Erosion Hazard on the Darling Downs and in the Burnett. These lands account for approximately two-thirds of the non-arid lands requiring soil conservation treatment in Queensland.

During 1980–81, this sub-programme was directed at achieving greater levels of soil conservation activity in the cane growing and developing grain growing areas by placing greater emphasis on group or catchment planning and the active involvement of land users in soil conservation planning. This sub-programme was supported by a Statewide information services project which provides educational-extension material on soil conservation, and technical projects which develop conservation management practices for general application.

Land degradation incidence

Serious soil erosion occurred on the Wet Tropical Coast and parts of the Atherton Tableland as a result of high summer rainfall. Cane farms in the Innisfail area were the worst affected with average soil losses of 50 to 100 t per ha, and some paddocks losing up to 500 t per ha. Isolated damage occurred in other parts of the State as a result of high intensity summer storms.

The area affected by soil erosion continued to increase with the development of marginal cropping land across the State. Large areas of land previously used for grazing were developed for extensive cropping in the Central Highlands, Dawson–Callide Valleys, Roma and Goondiwindi areas. The erosion situation in the Central Highlands is aggravated by the continued cropping of sunflowers which provide little vegetative protection against erosion.

Approval for increases of 5% and 3% in assigned cane land during the year resulted in the further development of land on the coastal strip for cane growing. Even though precautions were taken to

ensure that unsuitable land was not granted assignment, most of the new land assigned does require protection against soil erosion.

Extension

Extension activities carried out by Soil Conservation Branch staff in this sub-programme were aimed at creating awareness of soil erosion problems, the need to protect marginal cropping lands at the time of development, and the role that conservation tillage practices can play in providing immediate soil erosion control. During the year, Soil Conservation Branch staff engaged in 153 group extension activities and prepared 86 published items in relation to the above objectives.

General awareness material on soil conservation for both farmers and the general community was produced by the information services project. Major emphasis was placed on the production of educational material for use by school children, including a project kit relating to land degradation in the Bremer Catchment in the Moreton Region, a pamphlet entitled 'To conserve our Soil'. A soil erosion feature in the simulated helicopter ride exhibit was prepared by the Department for the Brisbane and Toowoomba Royal National Association Shows. Information booklets on land use planning in the Moreton Region, and the use of solodic soils on the Eastern and Western Downs of Queensland were produced for distribution to farmers.

The potential role of conservation cropping practices in providing immediate soil erosion control, in addition to water and energy conservation considerations, has emphasized the need for greater landholder adoption of these practices. To assist landholders in overcoming practical difficulties with these practices, Soil Conservation and Agriculture Branch officers embarked on a major conservation cropping extension project in the grain growing areas of the State. This project will focus on the use of pilot farms to demonstrate conservation cropping practices resulting from research and development activities in this field.

Land-user involvement

Landholder interest in soil conservation in non-statutory areas was considerably higher during the year than in the previous years, as shown in the following table—

LANDHOLDER REQUESTS FOR SOIL CONSERVATION SERVICE IN NON-STATUTORY AREAS DURING 1979–80 AND 1980–81

Year	Requests for service		Property Visits	New Co-operators
	Initial	Follow up		
1979–80	497	1 611	2 666	234
1980–81	700	2 089	3 440	307

The 41% increase in initial inquiries was attributable to the development of marginal cropping lands, together with the expansion in the sugar industry. When combined with the 30% increase in requests from existing co-operators, the inquiry rate confirms a growing concern in rural industries for the conservation of the soil resource. Soil Conservation Branch officers carried out 29% more property visits in the non-statutory areas than in the previous year, resulting in a similar increase in the number of landholders implementing their first soil conservation measures.

Considerable concern about soil erosion and interest in soil conservation was displayed by industry and local community groups in areas covered by this sub-programme. The Central Highlands Branch of the Queensland Graingrowers' Association formed a Soil Conservation Committee to liaise with Soil Conservation officers on the soil conservation programme needs in their area. The formation of a similar committee was initiated by the Dawson–Callide branch of the Association.

Following a previous request from the Atherton Shire Council for the preparation of soil conservation schemes in its shire, the landowners of the Cherry Creek catchment formed a Catchment Committee and requested that a poll be conducted to determine the level of support for the constitution of the catchment as a soil conservation project area.

Interest in the development of a catchment soil conservation plan was expressed by landowners in a catchment at Billa Billa, following an approach by the Waggamba Shire Council. Landowners in the Mackey Creek Catchment, near Gordonvale, also expressed interest in developing an overall catchment plan to overcome erosion, flooding and drainage problems in this 4 600 ha catchment.

Development of soil conservation measures

Soil Conservation Branch staff were actively engaged in projects designed to identify and develop practical conservation management practices to complement or substitute for traditional soil conservation works. A joint Departmental–Industry review of surface management research in Queensland supported the need for major emphasis on the development of conservation cropping practices. Current objectives include the development of practical techniques for zero tillage in cracking clay soils, and for increasing the reliability of wheat cropping in the Central Highlands. The development of a conservation cropping system for the red soils of the South Burnett was largely completed, and the system will now become the subject of an extension project in that region.

As a result of development work carried out in the co-ordinated soil and water conservation project in previous years, a report was prepared on the ways for incorporating water harvesting techniques in soil conservation plans. Other development projects investigated the soil conservation management requirements of horticultural lands in south-east Queensland, and the peanut lands of the Atherton Tableland.

Soil Conservation officers prepared interim specifications for soil conservation measures for the soils of the Mackay and Monto–Mundubbera districts, and assisted in the preparation of a soils base for farm planning in the Roma, Wandoan, Mackay and Biloela districts, as part of the soil conservation field manual project.

A controlled gradient surveying target was developed for use in surveying graded lines for the location of contour banks in extensive cropping land. The electronic control device for the target was developed jointly by Soil Conservation Branch and Engineering Services Section officers, and promises to increase greatly the effectiveness of Branch officers in laying out soil conservation measures.

Soil conservation planning

During the year, whole-farm plans were issued for 63 farms with a total area of 37 288 ha. These plans contained maps showing for each land unit its agricultural capability, limitations and management requirements, and recommended type of use.

Although individual farm plans accounted for most of the planning carried out by Soil Conservation Branch, there has been increasing acceptance of the need for planning on a sub-catchment level, in order to overcome problems of co-ordination of run-off. Planning activity in a number of sub-catchments initiated in the previous year was continued during the year and further activity commenced in additional areas.

The planning of the Boonah–Kalbar horticultural areas was adopted as a Regional Extension project, and information collected on soils, land use, slope categories, main run-off distribution and land ownership for three sub-catchments with a total area of 4 500 ha.

A general soil conservation plan for the 2 500 ha catchment of Cherry Creek on the Atherton Tableland was prepared for the information of landowners before a project area poll was conducted during May 1981.

Following an investigation of the agricultural suitability of 2 500 ha of Crown land at Mt Ossa, Mackay, Soil Conservation Branch staff identified 1 000 ha as suitable for cane growing and prepared subdivision and soil conservation plans for the area for use by the Land Administration Commission in leasing the land to cane growers. Similar plans were also prepared for 150 ha of land at Royston Park in the same district.

Soil conservation implementation

Soil Conservation Branch officers carried out the final design and location of soil conservation measures on 44 460 ha during the year, as shown in the following table. The implementation of these measures was carried out by landholders.

SUMMARY OF SOIL CONSERVATION TREATMENT NEEDS AND PROGRESS FOR CROPPING LANDS IN THE GENERAL SOIL CONSERVATION SERVICES SUB-PROGRAMME

—	Extensive cropping lands		Intensive cropping lands
	Cat. I*	Cat. II†	
Area requiring protection (ha)	909 000	450 000	135 000
Area treated in 1980–81 (ha)	40 905	1 843	1 712
Progressive total area treated (at May 1981) (ha)	468 539	110 945	15 626

*Category I land needs intensive treatment with contour banks, contour strip cropping or contour grass strips for long-term cultivation.

†Category II land can be safely cultivated with simple practices of strip cropping and contour cultivation.

Most of the area treated during the year was extensive cropping land in central and southern Queensland, in particular the developing cropping lands in the Central Highlands. The intensive cropping land treated was almost exclusively cane land.

Areas of Erosion Hazard Services

THE statutory soil conservation sub-programme operates in declared Areas of Soil Erosion Hazard under the terms of the *Soil Conservation Act* 1965–1980.

The Darling Downs Shires of Wambo, Chinchilla, Jondaryan, Millmerran, Pittsworth, Allora, Clifton, Rosalie, Cambooya, Crows Nest and Glengallan and the Isis and Gin Gin cane growing areas are declared as Areas of Soil Erosion Hazard.

Although the declared Areas contain only one-third of the non-arid lands requiring protection against soil erosion in Queensland, their agricultural importance, combined with their serious erosion problems, make these areas the highest priority for protection.

This sub-programme concentrated during 1980–81 on maintaining the level of project planning activity in the Darling Downs Areas of Soil Erosion Hazard, expanding the project planning activity in the Burnett Areas of Erosion Hazard, increasing the rate of implementation by farmers of soil conservation measures specified in approved Project Plans and having Advisory Group Committees formed in all declared Areas of Erosion Hazard.

Land degradation incidence

For the second year in succession, the Darling Downs suffered severe erosion and flooding following widespread, heavy rainfall over a 5-day period in February. A total of 220 000 ha was affected, with some fallow land being eroded to depths of 40 cm, crops being destroyed by floodwaters or silt deposits, farm dams failing because of the high run-off, roads and railway lines being damaged, and the town of Dalby suffering severe flooding and damage to property.

Direct damage to crops, soil conservation works and fences on the 2 400 affected farms amounted to an estimated $2.2m, with an unquantified effect on future productivity of the land following the loss of fertile topsoil. The total damage to local authority and government facilities was estimated at $3.6m, without considering the damage to private property in the town of Dalby.

These losses emphasize the need for farmers, local authorities and government departments to work together to develop and implement conservation management plans for whole catchments to reduce the damage from such events in the future.

Development of soil conservation measures

Soil Conservation Branch officers used the above floods to assess the performance of soil conservation measures on valley floors and flood plains under extreme rainfall and run-off conditions. Soil erosion was considerably reduced where farmers were practising strip cropping by growing summer and winter crops in alternating strips at right angles to flood flows across flood plains or creek flats.

Of the summer crops being grown at the time, sorghum was more effective than sunflowers in reducing the velocity of flood flows, and thus reducing soil erosion. The advantages of keeping crop residues anchored in the soil by tillage, of removing and levelling old fence lines, and of slashing grass along roadsides and fencelines were apparent. Where any of these had not been done, flood waters were diverted and concentrated, causing considerable damage.

The observations made during this erosion survey will be used to refine the specifications for soil conservation measures being implemented on the Darling Downs. Interim specifications for soil conservation measures for the Clifton district were prepared following a similar survey conducted during the previous year and interim soils bases prepared for the Gin Gin and Isis areas. This information will be included in field manuals for those districts. A final draft of the field manual for the Crows Nest district was prepared during the year.

Extension

Within the statutory sub-programme extension activities in the grain-growing areas concentrated on the need to maintain soil conservation works and implement conservation tillage practices, and in the cane-growing areas concentrated on the need to protect newly developed marginal cropping land at the time of development. In carrying out these extension objectives, Soil Conservation Branch officers engaged in 66 group extension activities and prepared 27 published items. A pictorial report was published on the flood damage on the Darling Downs and the effectiveness of soil conservation measures in controlling run-off and erosion under such conditions.

Two major soil conservation field days were held on the Darling Downs during the year.

The first was held in the Cambooya district in September to mark the payment of $1m to landholders in the Darling Downs Areas of Erosion Hazard as dollar-for-dollar grants for the implementation of approved soil conservation measures. The Minister for Primary Industries presented the one-millionth-dollar cheque to the landholder concerned during the day's proceedings. The field day emphasized the need for whole farm and catchment planning to include soil and water conservation together with crop and animal management considerations.

The second field day was held at the conclusion of a soil conservation competition organized by the Southern Downs Soil Conservation Advisory Group Committee to identify the farmer in the southern downs area who had achieved the highest level of land management. A Clifton farmer won the competition, and the field day was held on his property in March in order to describe his soil conservation programme to other farmers.

Land-user involvement

Landholder requests for soil conservation service in Areas of Soil Erosion Hazard showed a major increase in interest in soil conservation, particularly from landholders with no previous soil conservation experience. Information on landholder interest in soil conservation during 1979–80 and 1980–81 is summarized in the following table—

LANDHOLDER REQUESTS FOR SOIL CONSERVATION SERVICE IN THE AREAS OF SOIL EROSION HAZARD DURING 1979–80 AND 1980–81

Year	Requests for service		Property visits	New Co-operators
	Initial	Follow up		
1979-80	140	1 776	4 031	136
1980-81	236	1 951	4 418	186

The large increase in the number of new inquiries is largely attributable to increased landholder concern following the severe storms in the Clifton area in February 1980, and the flooding in the Dalby area in February 1981. Increased interest was also evident in the Burnett cane lands following the expansion onto marginal cropping land by the sugar industry.

Because of the pre-existing high level of interest, soil conservation officers were fully committed and could only increase the number of property visits during the year by 10%. Even so, some 80% of the initial requests resulted in farmers implementing soil conservation measures for the first time and so becoming new co-operators.

Advisory Group Committees comprising landholder and local authority representatives provide advice to the Soil Conservation Authority on the development and implementation of soil conservation programmes in declared Areas of Soil Erosion Hazard. Four advisory committees have been operating on the Darling Downs since 1978 and have assisted the Authority by considering landholder objections, investigating landholder concerns, recommending on contentious issues involving landholders, and on project planning priorities.

The Isis Advisory Group Committee was established during the year to represent landholders, the local authority and the Isis Sugar Mill in the Isis Area of Soil Erosion Hazard. The formation of an Advisory Group Committee for the Gin Gin Area of Erosion Hazard was also initiated during the year.

Soil conservation planning

During the year, six project plans covering 8 642 ha and involving 82 landholders on the Darling Downs were prepared and advertised and four Project Plans advertised during 1979–80 were approved. In addition, 265 provisional Project Plans were prepared covering 36 984 ha on the Darling Downs and in the Burnett cane lands, and involving 256 farms. Soil Conservation planning was completed for the area to be affected by stage 2 of the Cordalba–Gregory River tramway extension from the Isis Central Mill, Childers.

Potential sites for 20 farm dams with a total estimated storage capacity of 1 300 ML were identified in 11 Project Plan areas on the Darling Downs, as part of the Co-ordinated Soil and Water Conservation project.

The planning of strip cropping layouts on the Darling Downs was impeded by the lack of detailed topographic information needed for planning low sloping areas.

Soil conservation implementation

The final design and setting out of soil conservation measures specified in Provisional Project Plans or Project Plans was carried out by Soil Conservation officers, with the construction of these measures being the landholders' responsibility. A total area of 16 987 ha was treated with soil conservation measures in declared Areas of Soil Erosion Hazard during the year, as shown in the following table—

SUMMARY OF SOIL CONSERVATION TREATMENT NEEDS AND PROGRESS IN DECLARED AREAS OF SOIL EROSION HAZARD IN QUEENSLAND

—	Extensive cropping lands		Intensive cropping lands
	Cat. I	Cat. II	
Area requiring protection (ha)	333 000	358 000	27 000
Area treated in 1980–81 (ha)	10 683	5 373	931
Progressive total area treated (at May 1981) (ha)	190 522	75 310	6 792

The area treated in the extensive cropping lands represents a 30% increase over the area treated in 1979–80, which is completely attributable to the implementation of 5 373 ha of strip cropping on the valley floors and flood plains of the Darling Downs following flooding in 1980 and 1981. The area of intensive cropping land treated during the year was 90% greater than in the previous year, largely as a result of the awareness of the need for soil conservation measures generated through extension activities during the expansion of cane assignments.

Financial assistance to landusers

In the Areas of Soil Erosion Hazard, dollar-for-dollar grants, up to a ceiling of $1,500 on the Darling Downs and $1,000 in the Burnett, are available to landholders for the implementation of measures associated with approved soil conservation schemes.

Grants totalling $282,396 were paid to 312 landholders during the year for 1 176 km of contour banks, 77 km of diversion banks, and 153 km of waterways constructed at a total cost of $571,669. This brings the total grants paid to landholders since the scheme began in 1974 to $1,285,992. In addition, $33,239 were paid under Section 58 of the *Soil Conservation Act* 1965–1980 to two local authorities for road cross drainage structures required in approved Project Plans in Areas of Soil Erosion Hazard.

Land Management Research

THE aims of the land management research programme are to determine the extent and significance of land degradation in Queensland, to describe the mechanisms involved in this degradation, and to develop and extend practical management systems to ensure land productivity and stability.

Soil erosion by water is the major cause of land degradation in the State, accounting for 98% of the degradation in cultivated lands and 75% in grazing lands. The land management research programme is therefore directed almost completely at soil erosion by water. Research is carried out in two main streams: land degradation, and land management investigations.

Within the land degradation investigations, the erosion research programme has been developed considerably in recent years. Two broad levels of research have been followed: those where artificial rain is used under controlled or selected conditions; and those where natural rainfall is used under managed field conditions.

In addition to soil characteristics, topography and climatic factors, management of lands and crops plays a major role in determining the level of erosion. The land management investigations are aimed at evaluating existing practices and developing of guidelines and techniques for stable land use.

As a result of a review of the Departmental surface management research programme another two important projects are planned. One project will be established in the Emerald area on black earth soils with the aim of studying the effects of stubble and surface tilth on run-off and soil erosion under both summer and winter cropping regimes.

In the other project, the next phase of the studies on the small experimental catchments on Brigalow Research Station near Theodore will be implemented. These will assess the effects of developing virgin land for pasture and cropping on run-off, soil erosion, soil salinity and soil nutrients. Another important consequence of the review was the establishment of a modelling group whose main objectives are to develop and integrate models of crop growth, soil water, run-off and soil erosion.

Erosion research

Techniques used to predict soil loss in Queensland such as the Universal Soil Loss Equation were developed overseas. However, as soil loss predictions or estimates are specific for soils, climates, slopes and local management practices, practical methods developed under Queensland conditions are urgently needed.

An understanding of the erosion processes, together with the effects of management practices on these processes, is needed for the development of these techniques.

Water erosion processes are being studied under controlled conditions using a small field rotating disc rainfall simulator, a large mobile rainulator and an indoor rainulator.

The infiltration characteristics of some Darling Downs soils were studied using a rotating disc rainfall simulator. Infiltration rates, run-off and sediment loads (as affected by surface cover), antecedent moisture content and rainfall intensity were measured.

Preliminary results have shown that surface cover maintains high infiltration rates in swelling clay soils by preventing surface sealing. Once surface sealing has occurred, infiltration is low even if the rainfall rate is reduced.

After 80 min of rain, infiltration into straw mulched soil was four times that into bare soil. While constant infiltration rate for the bare plot was reached only after 30 min of rain, infiltration rate in the mulched plot was still reducing after 80 min.

When the soil surface was covered with straw high antecedent moisture content increased run-off substantially. Even so, run-off from a bare and dry soil was even greater.

These preliminary results are encouraging and further study on the infiltration rates as affected by the above factors will be extended to the major soil types of the region.

A method for determining Plant Available Water Capacity (PAWC) of soils has been developed. Measurements on selected soils of the Darling Downs range from 7.1 to 9.3 cm for solodics up to 21.6 to 25.6 cm for krasnozems.

Using these data models to estimate the PAWC of soils by using either the electrical conductivity of the profile or their morphological profile properties have been developed. The electrical conductivity profile model reliably estimated the PAWC for black earths, grey, brown and red clays. The morphological profile models reliably estimated PAWC for black earths and grey, brown and red clays. On the other hand, these models are not valid for solodized-solonetz and solodic soils. These techniques provide a useful, rapid appraisal of the PAWC of most soils in that region.

The large mobile rainulator was used to study the effects of slope length, tillage orientation and surface tilth on run-off and erosion in two clay soils on the Darling Downs, a black earth (Irving) and a krasnozem. While total run-off and soil loss were not affected by slope lengths on an Irving clay, increase in slope length resulted in heavy soil loss in the krasnozem.

Tillage orientation had an important effect on soil erosion. Ploughing across the slope substantially reduced total soil loss by delaying run-off and decreasing total run-off volume. This effect was observed on all slope lengths on both soils. Tillage orientation had no effect on sediment concentration in both soils. On the other hand, a marked difference in sediment concentration was found between sheet and rill erosion in both soils.

Soil erodibility values derived from these varied with slope length and the rainfall event for each soil type. In addition, the properties of soil sediment (aggregate density in particular) appeared to have a large effect on sediment concentration. This finding suggests that a simple laboratory method could be developed to derive soil erodibility values for these soils.

In areas where stubble is grazed, the benefits from zero tillage are likely to be very minimal. On an Irving clay under bare zero till conditions, surface sealing and run-off started very quickly resulting on a higher rate of sheet erosion and a similar rate of rill erosion to ploughed surfaces. Erosion control benefits from zero tillage on this soil appears to be entirely due to the maintenance of a good stubble cover.

In conjunction with the two field rainfall simulators, an indoor rainulator is being used to study the effects of soil properties and surface covers on the infiltration rates of various soils under laboratory conditions.

Field studies under natural rainfall conditions have been used mainly to study the effects of various crop and residue covers, soil tilth and soil moisture on run-off and associated soil erosion. These studies have been established on horticulture, cropping and grazing lands.

Soil erosion on sugar-cane farms near Mackay has been investigated. Slopes ranged from 2.9% to 8.3% and surface soil textures from fine sand to a sandy clay loam. Rates of soil movement ranged from 50 to 220 t per ha over one wet season which is far in excess of the 'acceptable' rate (12.5 t per ha) for long-term productivity. Sandy soils appeared to be more erodible than loams. Fallow cane fields are often subjected to severe erosion in the summer months, especially during cyclonic periods. To reduce this risk a planting and cutting strategy that can maximize crop cover during this period needs to be developed.

Land slopes, and especially the form of slope, have an over-riding effect on soil movement in pineapple rows. An increase in canopy cover of the pineapple crop was shown to reduce the level of soil loss dramatically.

The benefits of stubble retention on crop yield, soil moisture retention and soil loss reduction have continued to be evident in grain cropping on two major Darling Downs soils. In one black earth soil, wheat yields produced under stubble burnt, stubble incorporated, stubble mulched and zero till conditions were 1.5, 1.8, 1.9 and 2.0 t per ha respectively. At the same time, soil losses during those fallow treatments were 150, 5, 2 and 0 t per ha.

In the 1980 wheat crop, a significant yield reduction (400 kg per ha) was recorded in plots where stubble had been removed. This was due mostly to increased run-off and reduced fallow moisture accumulation. In economic terms, the use of bare fallow compared with stubble mulching in the 1979–80 season resulted in a loss of approximately $70 per ha ($40 for loss in wheat yield, $30 for maintaining and repairing damaged structures). In addition, the loss in long-term productivity and soil nutrients as a result of soil loss must be added.

Soil erosion in cultivated areas in central Queensland has been recognized as the major limitation to future stability of crop production. In the Central Highlands alone, 184 000 ha require soil conservation measures and the total area could rise to more than 1m ha in the future. The broad base graded banks, presently being recommended, are expensive and do not by themselves reduce soil loss to an acceptable level.

Estimates of potential soil losses for a range of crops and cropping systems in the Central Highlands indicate that the combination of banks and surface cover is probably the most practical method of achieving erosion control.

Results to date indicate that reduction in vegetative cover by grazing animals has consistently produced higher run-off coefficients in relation to peak rainfall intensities than those from ungrazed catchments. Measurements using erosion pins revealed that greater soil movement occurs within the grazed catchment than the ungrazed one and is affected by the type of cover.

The importance of trees in agricultural ecosystems, particularly their benefits for maintaining stability of landscapes, is only just being realized by the farming community. The over-clearing of many areas is now leading to problems of soil salinity and erosion. However, little information is available on the balance between tree density and pasture productivity for the major communities. A knowledge of the effects clearing has on soil loss, productivity and soil process is needed to effectively use this important management practice and maintain future productivity. A joint trial with the Woodland Ecology Group of C.S.I.R.O. has been initiated to study these processes.

In addition to studies on small plots and contour bays, erosion patterns of whole catchments must be understood so that economic and stable land use management can be developed for the whole catchment.

Run-off and soil loss from two upland catchments in the eastern Darling Downs have been monitored in the last 4 years. Two more catchments were instrumented last year. In central Queensland, run-off monitoring began in 1965 and soil loss in 1979 on three small catchments located at Brigalow Research Station. The objectives of this study were to determine rainfall-run-off relationships for 'brigalow' soils for use in the design of soil and water conservation structures in cropping and pasture lands. Sufficient run-off records have now been obtained to permit catchment calibration. In view of the emergence of salinity and productivity problems in some parts of the brigalow region, the programme will be expanded to include consideration of these aspects.

Salinity

Dryland salinity in Queensland is being assessed with identification to date of approximately 8 000 ha affected by seepage salting, and 590 000 ha affected by scalding. This assessment is part of the co-ordinated Australia-wide assessment and a final Australian report should be published this year. Detailed investigations on dryland salinity are in progress on selected sites in the Bremer-Lockyer areas and in central Queensland.

At present, more than half of the lands affected by seepage salting in Queensland occur within a 50 km radius from Rockhampton. This area is the worst affected part of the State and a network of piezometers has been established at Barmoya and Tanby in the Rockhampton area to measure changes in groundwater levels with time and changes in vegetative cover.

The aim of this detailed work is to obtain data for local extension on the causes of salting and remedial measures which may be applied. Salt-susceptible lands which will require special land management will also be delineated. These data will form the basis for formulating preventive measures against salinization in central Queensland.

In the Bremer-Lockyer, it has been found that clearing of 50% or more of a sub-catchment in this region can initiate salting within a susceptible sub-catchment. Valley floors with poor quality groundwater at shallow depth, and poor drainage, are particularly susceptible to salting when cleared. The source of salts is saline groundwater (4 000 p.p.m. T.D.S.) supplied from sandstone aquifers discharging into alluvia. The salt source is virtually infinite. There are variations in quality and supply of groundwater, and there is potential for using better quality waters by preventing them from reaching the poorer quality groundwater. The affected areas are spreading at an average rate of between 5% and 10% a year. Over-grazing or cultivation of susceptible areas hastens development of bare scalded areas.

Management practice evaluation

A successful soil conservation programme relies on control measures working in situations for which they were designed. These soil conservation practices must therefore be continually monitored to examine their performance. Techniques for monitoring the performance of soil conservation measures are currently being field tested. In addition, evaluation surveys for waterways and strip cropping have been completed.

Erosion surveys have been used to record the effectiveness of structures and the amount of soil movement in an area after a major rainfall event. The technique provides a means of rapidly and accurately assessing the performance of structures and practices.

Erosion reports were compiled jointly by Soil Conservation Research and Field Services officers on the severe storm events for the period 26 January 1980 to 5 February 1980 (Clifton, Cambooya and Pittsworth Shires) and for the period 6 February 1981 to 7 February 1981 (eastern Darling Downs).

The survey showed that, in general, structures built to design specifications and properly maintained did not fail. Some design specifications, however, were not adequate. Reduced tillage techniques and maintenance of stubble cover are necessary to reduce run-off and soil loss. Such a reduction in run-off and soil loss also reduces pressures on and reduces the maintenance requirements of the drainage network. Land levelling should be undertaken to remove old depression lines and thus reduce siltation induced bank failure.

The effectiveness of strip cropping practices and waterways on a regional and State basis has been examined. On the whole, current strip cropping practices are working effectively. The system can be improved, however, by using narrower strip widths than are currently employed, stricter crop rotation and better stubble management, and by eliminating obstructions to uniform water flow. Waterway failures generally appear to be associated with inadequate design specifications, poor construction methods, farmers' reluctance to establish effective vegetative cover and poor maintenance.

Farm planning for soil conservation requires a clear definition of specifications for soil conservation measures and conservation management systems. Field manuals are being prepared to provide resource bases for farm planning, specifications for soil conservation structures and agronomic and conservation management systems. This should lead to standardization of soil conservation practices, continuity of design specifications across regions of the State and provision of management systems for further erosion protection.

Conservation practices development

A high proportion of waterway failure in Queensland can be attributed to either the lack of effective grass cover or the use of unsuitable species. Considerable effort has been expended on selecting suitable species and on methods of establishing and maintaining an effective grass cover.

Among the species tested so far, Indian blue grass (*Bothriochloa pertusa*) has been the most promising species. It has most of the desirable characteristics needed for waterway and land stabilization: fast spreading, excellent rooting from nodes, drought tolerance, fairly unpalatable to stock, established by seed, good seeding and, most importantly, it will grow on a wide range of soil types and fertility levels, ranging from fertile alluvials and black earths to badly eroded podzolic soils.

Results to date also show that Indian blue grass can be either established on bare soil or with grass mulch and when irrigation is available a cover crop such as Japanese millet can also be sown with it to give early protection from erosion. It was also found that, when properly established and maintained, waterways planted with Indian blue grass can receive contour bank discharge within 12 months.

The primary role of the vegetative cover in farm waterways is to reduce water flow velocity. The retardance category of cover depends on the combined effects of density, stiffness and height of the sward to water flow.

Work has also begun on the use of flowering shrubs to beautify recently stabilized slopes of industrial sites and road cuttings. More practical methods of establishing these shrubs are being investigated. Preliminary results also show that *Leucaena leucocephala* seedlings can be established on the badly eroded old cane farms near Childers.

Land Resource Assessment

THE development of sound land use policies and project planning can be achieved only if the basic land resources are adequately documented. It is only when these data are available that conflict between the various industries for land can be resolved rationally.

Competition for land continues to escalate, particularly on the coastal and sub-coastal regions. Cropping industries are seeking expansion, the mining industry and related infrastructure continue to grow, urban development is spreading and public demands for more recreation reserves and National Parks continue to mount, while other industries such as grazing and forestry are endeavouring to maintain their present position. All these are legitimate land uses.

One of the prime aims of this area of work is to supply advice based on the evaluation of resource data so that valuable or potentially useful agricultural lands are maintained to ensure long-term stability and growth potential for rural industries. The level of detail of data required by various industries differs and so land use studies are structured to the requirements of the industry.

The objectives of land resource assessment are to collect soil and land use information for planning purposes, to identify prime agricultural land, to assess potential uses of land and indicate suitable management systems and to establish a basis for monitoring pasture conditions.

Intensive land use studies are confined mainly to the cropping lands of the coastal region. They usually have a specific crop orientation and are published at a scale of 1:50 000 or less. This enables use at the farm level by soil conservation officers or other people interested in farm planning. These studies not only delineate land suitable for future crop expansion but highlight areas currently being used which are considered unsuitable for crop production due to various limitations.

Semi-intensive land use studies are carried out in the sub-coastal regions supporting both mixed farming and grazing. These data are compiled at scales of approximately 1:100 000 and are usually published at a scale of 1:250 000. These studies supply information for the recognition of agricultural management units which have their own characteristic soil conservation requirements and management strategies.

The extensive grazing land studies are restricted to the semi-arid and arid lands of western Queensland. They are compiled at a scale of 1:250 000 and published at 1:500 000 or 1:1 000 000. The western grazing lands are used for sheep and wool production and beef cattle production. These studies provide guidelines for long-term, safe management of these fragile lands and indicate safe stocking parameters for the land systems identified. The interplay of social and economic factors at times over-ride these guidelines and land degradation results. Dispute concerning the size of adequate living areas in the semi-arid lands of Queensland is one such example.

All these studies are in demand by various industry organizations Local Authorities and Government Departments who have a commitment to maintaining these lands in a highly productive and stable state.

Sugar industry land use studies

The aim of resource studies in sugar-cane growing areas is to map, classify and describe land suitable for sugar-cane production which is readily accessible to a mill. The identification of suitable lands assists in minimizing the risk of losing this land to other industries or urban development and ensures growth potential for the future. These studies also identify currently assigned areas considered unsuitable for sugar-cane production and the measures that can be initiated to reallocate such assigned areas to suitable areas in order to give stability to the industry and continued high production. Recommendations are also made on alternative uses for land considered unsuitable for cane production. Such options range from horticultural tree crops to forestry and grazing.

Northern district. One of the most important issues which has been undertaken was to carry out a reconnaissance inspection of a number of 'conflict' areas considered to be suitable for sugar-cane expansion. The most serious land use issues facing this group are the serious soil erosion occurring in the Innisfail to Cairns area, the serious flooding problem associated with catchment land use and limited amount of land available for expansion in the area north of Tully.

When the issue of available land for expansion is considered, three areas in north Queensland are worth further investigation. These are the Herbert River district, the Cardwell to Tully area and the Tablelands from Julatten in the north to Milla Milla in the south.

At the same time, reconnaissance studies of the Atherton Tableland and the upper Murray and Tully River valleys are taking place to assess the suitability of information for use in land evaluation and to plan future requirements for surveys for this region.

Central district. The objectives of this study are to map and describe those areas and their relative suitability for sugar-cane production in the Mackay district.

Achievements have included the mapping of the north coast section (45 000 ha) and of land north of the Pioneer River (55 000 ha). Fifty-five soil profile classes were decided and current cane assignment map completion field work in 100 000 ha south of the Pioneer River was undertaken.

The survey team reports regularly to the Mackay Land Use Committee made up of growers, millers and Local Authority representatives.

This study is the first of 'new technique' projects which will utilize automated data processing techniques more fully. The resource data have been used extensively in the design of 40 ha farms in the Mt. Ossa area. These new farms will be released with land tenure covenants covering land management practices for soil erosion control. The main land use problems concern erosion of half this portion, while salinity, sodicity, drainage and flooding problems make up the remainder.

Evaluation of land in the Plane Creek Mill Area has also commenced with photo-interpretation, farmer discussions and field work in soils recognition.

Southern district. Maryborough. A land suitability study of the steep, stony and eroded assigned land in the Maryborough mill area, commenced in 1978 at the request of the Queensland Canegrowers' Council and the Maryborough District Canegrowers' Executive, has been completed.

The number of farms considered eligible for assignment transfer were: Hervey Bay 10 farms, Bauple 10, Yerra-Pilerwa 8.

The local sugar industry is promoting an investigation into the potential use of the vacant Crown land north of Maryborough to relocate the interested farmers who do not presently have sufficient available land for substitution of current production areas. As grower interest in the proposal at this stage is low, the Mill Suppliers' Committee has requested a detailed investigation of the soils and potential use of the vacant Crown land north of Maryborough to will form the basis of a feasibility study of a fully planned farm development scheme. A land use and management plan for the development of soil and water resources will be prepared.

Isis. The suitability of land for sugar-cane production within a 50 km radius of the Isis mill is being studied. The study area is approximately 208 000 ha in extent.

The objectives are to compile a report and produce maps at 1:50 000 which assess suitability of both assigned and unassigned lands for sugar-cane production and provide a basis for future development.

Considerable progress has been made, including mapping of currently assigned land, collation of area data, much of the interpretation of aerial photography, zoning of steep lands with sugar potential and commencement of field work.

Rocky Point. Requests to extend the suitability study area of 1979 to re-evaluate certain areas have been received. A sugar-cane land suitability map of 2 850 ha of land, extending from the Coomera River north to the original study area, has been completed. Some 640 ha of land were considered suitable for sugar-cane production. A detailed re-evaluation of 920 ha of land on Woogoompa Island indicates a gross area of 390 ha are suitable for sugar-cane production.

Horticultural land use studies

Horticultural production in the Near North Coast Region is affected by increasing subdivision of prime horticulture lands and inappropriate land use.

Since 1979, a study has been conducted into horticultural land suitability in the region. It aims at determining the potential for improved horticultural production, the current and potential degradation problem and the land management practices necessary to combat degradation and maintain production.

The project involves both a pilot survey of 92 farms (9% of the total) and the mapping of land suitability for horticulture use.

The study area covers the eastern sections of Maroochy, Landsborough and Caboolture Shires, an area of approximately 2 700 km^2. Preliminary results of the farm survey show that of the 132 pineapple management units assessed 64% exhibited serious erosion while only one unit exhibited no erosion. Seriously affected areas included the Monteville-Mapleton basalt plateaux, (100% of units eroded), the Palmwoods red earths (74% of units eroded) and the Caboolture yellow podzolics (54% of units eroded).

Of the 91 units under tree crops assessed 27.5% exhibited serious erosion while 28.6% exhibited no erosion. At the same time, 62% of units under plantation crops showed serious degradation.

On this basis, the Near North Coast Region requires amendments to 4 618 ha of seriously eroded horticultural land and 3 453 ha of slightly eroded land.

Erosion of waterways is common, often because of inadequate design, poor maintenance and neglect. Of 197 waterways assessed, 132 were bare and 103 of these were seriously eroded.

One hundred and thirty-seven roadways were bare (82% of which were badly eroded) of the 339 assessed.

Preliminary discussions have been held with the three Local Authorities concerning the benefits of the mapping to their land use planning. The draft map of the Maroochy Shire area has been given to the town planning consultants preparing new statutory and strategic plans for the Shire and the suitability data incorporated into the plan.

Further discussions on strategies for prime land will be held with the Local Authorities as the mapping progresses and these prime lands are defined in each area. Continued analysis of the survey results will proceed during the next 12 months to determine the actual land management practices necessary to control erosion.

Agricultural land use studies

Wide Bay-Burnett. Already this region contributes significantly to the gross value of Queensland's rural production (approximately 13%) and expansion and development of rural industries is continuing. Most of the prime agricultural lands are currently being cropped and expansion onto marginal lands is occurring at an increasing rate. The grazing industry is endeavouring to increase production by clearing or thinning timber and the use of improved pasture species to supplement existing native pastures. Detailed data on the resources of the region were not available before 1978 and the results of new management strategies and continued development could not be predicted accurately. This situation is now being rectified. The region, comprising about 6m ha, is being mapped in a number of stages.

In the South Burnett, investigation of land resources was completed during the year. The area covers some 1 064 000 ha and was mapped into 65 discrete units on the basis of geology, topography, soils and vegetation. Within these 65 mapping units, some 273 component land units were recognized and described.

Approximately 27% of the area (286 700 ha) is suitable for continuous agriculture. Some 8% of the area is cultivated and potential exists for expansion of cultivation on the more marginal soils. Land degradation is not a major problem in the area as 80% of those cultivated lands requiring soil conservation measures are now protected and conservation cropping techniques are gaining acceptance.

In excess of 70% of the area (770 000 ha) is primarily pastoral land. Some 15 000 ha of this in the Boondooma-Proston and Wigton areas are suited to fine stem stylo. A large potential exists for the introduction of other improved pastures in the remaining pastoral areas. Land degradation occurs to a limited extent in the grazing lands.

Saline outbreaks affect some 500 ha and are mainly associated with cleared or cultivated land on deeply weathered rocks, in particular, the lateritized basalts.

Land management needs for the area include:

- selective timber regrowth control;
- continued protection of cultivated lands by soil conservation measures and cropping techniques;
- correct siting of roads and associated drainage works;
- destocking of badly degraded pastoral areas;
- adjustment of stocking rates to pasture levels;
- increased internal fencing to assist in pasture management;
- the addition of legumes to native pastures to lift production; and
- revegetation of landslip areas.

Land resource survey of the Central Burnett began this year. The region includes the shires of Mundubbera, Gayndah and Biggenden and represents some 82 000 ha. Some 180 soil profiles have been described, field work is complete for the Gayndah and Biggenden Shires and a current land use map is nearing completion.

In the North Burnett, surveys of land resources commenced in 1980. They cover 1 143 000 ha in the shires of Eidsvold, Monto and Mt. Perry. After description of 100 soil profiles, field work in the south western sector has been completed.

Field work is about to commence in the Wide Bay and South Port Curtis areas.

The eastern and western Darling Downs are important grain-producing areas. In many cases, the limitations of the soil resource are not recognized and land degradation is occurring. Studies are being undertaken to describe the soil resources of the area to define their potential, their limitations and management requirements to minimize further degradation

Western Darling Downs. The land use study for the Millmerran-Moonie-Tara area was published in 1981. The survey describes in detail the agricultural land resources of the region which covers some 972 500 ha. Eight major soil groups were identified which were subdivided into 38 sub-groups on the basis of morphological properties that affect agricultural use. The soils were then grouped into 23 Agricultural Management Units which are unique groups, each with its own soil conservation and agricultural management requirements. The management requirements were defined for the Agricultural Management Units.

The study revealed that 307 100 ha were suitable for cropping, of which 90 200 required intensive soil conservation measures, and that 167 800 ha were suitable for improved pasture establishment. The remaining 497 600 ha were suitable for native pasture and forestry production with some potential for improved pasture production when economic conditions permit. Of this area suitable for native pasture production, 284 500 ha occur on slopes and extreme care with management is required to prevent degradation.

Eastern Darling Downs. A current survey being undertaken will provide detailed resource information for the Brigalow-Belah Walloon Land Resource Area. The soils are being studied in three representative areas : Moola, Acland and Millmerran. This study will provide recommendations on the agricultural and soil conservation management requirements of the important Agricultural Management Units. These recommendations will apply directly to some 110 000 ha of land on the eastern Darling Downs.

Grazing land use studies

The Western Arid Region Land Use Study (WARLUS) aimed to map and describe the land resources of 60m ha in western Queensland's semi-arid and arid zones to provide information on land types needed to formulate land management policy.

The field studies have been finalized and maps are available for all areas. It has been a huge task. Some 230 land systems and 550 land units have been described. The study is being reported in six parts. Three of these have now been published and the other three are in various stages of preparation.

The section covering 10m ha in central south-western Queensland was published this year. It indicates that most of the land is stable and productive and must be maintained in an acceptable condition if a stable pastoral industry is to continue. The alluvial plains are subject to over-grazing and degradation by scalding and species change. The mulga lands are sensitive areas. If adequate ground cover and tree densities are not maintained these lands are subject to degradation by erosion, nutrient decline and weed encroachment.

The report indicates a need for further biological research to formulate long-term management programmes and a need for careful management of both Mitchell grass pastures and mulga lands so as to optimize returns. It also suggests the gazettal of National Parks or other reserves to preserve representative plant and animal communities.

The demand for these reports continues to escalate. Major users include grazing organizations, local authorities and Government departments committed to ensuring that rural industries continue to flourish.

The study identified a problem of land degradation of some western lands, particularly hard mulga lands and alluvial frontage country. Permanent monitor sites have been established with regular photographic studies and biomass yield measurements being taken.

Attempts are being made to relate these measurements with Landsat photography. Preliminary studies in the Paroo region with low-level colour and infra-red photography investigating woody weed infestations indicate that timing of photography in relation to rainfall and growth flushes offers the best chances of success.

A map showing 17 resource regions in south-west Queensland has been published. A resource region is a geographic area in which properties have a similar mixture of land types, similar rainfall patterns, a relatively uniform enterprise type and similar management options.

Preparation of management plans for a number of properties has indicated that 80% of the managers were receptive to advice offered and their awareness of land degradation was increased substantially. Most would like to rest or rehabilitate degraded areas but have insufficient financial flexibility. More than half the properties studied had areas of country badly affected by woody weeds or soil erosion. A need for a co-ordinated long term programme combining improved drought assistance policies, adequate living area standards and extension programmes (including property plans) was shown.

Land resource methodology

A preliminary investigation of the potential of the Japanese Geostationary Meteorological Satellite as an indicator of rangeland conditions and drought status has been undertaken. This satellite transmits imagery including temperature data from the land surface.

Major land types can be identified and smaller areas within these need field investigation. Areas affected by rainfall can be delineated when the rainfall events are distinct in both time and area. The information is cheap and readily available and has potential as an aid to broad scale assessment of land degradation in arid areas.

Computing

The Government's Area of Soil Erosion Hazard programme currently involves some 3 000 landowners within the Darling Downs and this number is expected to rise to 5 000 in the future. A computer-based information system (ASEHIS) has been developed to record works required, works completed and subsidies paid for each landowner, to monitor the implementation and cost of the soil conservation works and to provide information for planning future schemes.

The WARIS software page is a general purpose system for processing land resource data. This package is now used throughout Australia. Internally the system has been used in the Mackay Cane Land Use Study to sort and extract data on a map unit basis.

A survey (BRAS) uses the units of the Atlas of Australian Soils as a basis for recording such data as unit area and its adaptation to certain crops and pastures. Programmes have been written to calculate the gross, net and modified potential area of each crop and pasture species on map unit and shire bases.

The purchase of a computerized digitizer will allow calculation of areas of each map unit and any label point given the co-ordinates and positions of the four corners of the map. This information will be stored by the computer and merged with resource data collected for the map units. The combined data file can then be processed by conventional means such as by use of the WARIS package.

Development Planning and Evaluation

THIS section seeks to apply resource data, obtained by the Land Resource Section, to the planning of specific agricultural land use developments. Such information is more effectively employed in the initiation and early implementation of land development.

Irrigation land evaluation

A central theme is the retention of an adequate supply of prime agricultural land, with potential for irrigation, to meet the food, fibre and energy needs of the future. This requires not only recognition of the resources themselves, but an assessment of their suitability to fulfill the various needs, and knowledge of the management practices which prevent undue erosion and degradation.

The major programme covers investigation of and feasibility studies for new irrigation projects. Today, most water supplies are fully committed, while new important demands on water resources are still emerging from both the agricultural and non agricultural sectors. Allocation of these scarce water resources among the various users requires knowledge of location and timing of present and future needs. Only through better management of both water and land resources will effective use be made of the water allocated to the agricultural sector.

Irrigation investigations

South-east Queensland water resources assessment. This interdepartmental study area is approximately 88 000 km², extending from Maryborough south to the New South Wales border, and from the near coastal islands west to about 150° east longitude. The study is attempting to identify the size and timing of water needs for the next 10 to 20 years. The needs of agriculture, mining, power generation, industrial and urban requirements will be explored.

The main objectives will be to identify the areas of prime agricultural land, the future land uses and their water requirements and investigate efficiencies of water use for agricultural production.

Lower Mary River. Farm planning for the scheme by local Soil Conservation officers aims at ensuring that soil conservation and irrigation requirements are jointly considered in this new area.

Proserpine River. Over recent years, the QWRC received submissions calling for the construction of a dam on the Proserpine River to mitigate the effects of both flooding and short-falls of water on rural and urban areas. A dam would provide an assured supply for urban and agricultural needs with a spare capacity for possible mining and industrial purposes.

An assessment of the response to irrigation on an annual basis was undertaken. The result showed a small response of between 5 and 8 t per 100 mm of irrigation on average. However, this figure is distorted due to climatic conditions in the period examined. A more recent assessment is that a long-term response to irrigation of 30 t per ha per 100 mm would result. The long term rainfall records indicate that an irrigation requirement of 300 mm a year on 80% of total gross assignment will be required.

The Gap Dam site. The Gap Dam site is located 80 km upstream from Rockhampton on the Fitzroy River. It is envisaged that water from the dam would be used for a new power station, oil shale mining and agriculture.

A reconnaissance investigation found there were a maximum of 30 000 ha of land suitable for irrigation by gravity from the dam site. However, this figure would be substantially reduced if the attitudes and capabilities of the local landholders were taken into account. In addition three separate areas, ranging in size from 1 000 to 4 000 ha, occur in areas separated from the major tract of suitable land. These areas may not be included in any planned scheme.

Regional and catchment planning

The 134 Local Authorities in Queensland are responsible for land use zoning and have a major involvement in planning within their shires. The development of town plans (which also cover rural areas) involves consideration of natural resources. Pressures to develop first class agricultural lands to urban and other purposes are high. Liaison of officers from this section with the Local Authorities enables resource data and Statewide planning experience to be implemented through Town Plans.

Town planning. The Local Authorities in Queensland have been delegated the major responsibility for land use planning. While Local Authorities are aware of the agricultural land within their boundaries, their view is often very parochial. The Branch seeks to present a wider perspective and concern about the loss of prime agricultural land and subdivision in rural land.

During the year, six draft town planning schemes (Peak Downs, Kolan, Chinchilla and Rosalie Shires and Logan and Gold Coast cities) were examined. Two specific surveys for Beaudesert Shire in areas where their town plan was being challenged by subdividers were conducted. Maroochy Shire recently commissioned town planning consultants to prepare new strategic and statutory town plans. These plans have incorporated the results of two land suitability studies.

In addition, officers have been involved with providing guidelines on levels of subdivision north of the Daintree River and in feasibility studies for a new railway line through the Lockyer Valley to avoid unnecessary incursions into prime agricultural lands.

Farm dam survey. A farm dam survey was conducted in the West Moreton and Darling Downs Regions to evaluate the various water harvesting techniques used and identify the best method for intensively farmed areas.

As a rule, the large dams provided the highest return on capital. However, this was due to the fact that water from the larger dams is used on high value crops and these dams have the largest safety

margin in dry years. The builders of these structures were also found to have more capital available and so were able to match the capital cost with better distribution equipment.

A work sheet has been developed to assist farmers in making decisions on construction of such water storages. The work sheet is a simple guide which ensures that a farmer takes into account the characteristics of the proposed site, the reliability of supply and the cost of the irrigation project in terms of the probable return from irrigation.

Cooktown–Daintree. A draft land use classification and map for the Cooktown–Daintree study has been prepared but this will not be finalized until further information on the area is obtained from Forestry.

Bremer–Lockyer. The Bremer and Lockyer Study reports were released in 1979.

It is now the usual practice for advice to farmers on matters such as stocking rate, pasture improvement and fertilizer application to be tailored to the land units. This has led to a more conservative and appropriate level of management on lands now being more intensively developed.

A secondary school student project, based on the Bremer Catchment, has been written for Senior geography students. The project, which is part of the 'Man and his Environment' section of the curriculum, will be made available to schools in the Brisbane and surrounding areas.

Environmental impact assessment

The Branch assesses the agricultural land use aspects of Environmental Impact Studies (EIS) undertaken for major development projects in Queensland. The submissions from Development Planning Branch and from other Branches are collated and forwarded to the Co-Ordinator-General's Department where they are combined with all other submissions, and then presented to the relevant Minister for decision.

Proposals examined during the year included a coal project at Collinsville and an aluminium smelter at Goodwood. At the same time, guidelines for EIS studies were prepared for an oil shale extraction plant near Proserpine and a coking plant in Gladstone.

The manner in which the development organizations are now seeking advice and guidelines at an early stage is particularly pleasing. A number of such mining companies is co-operating fully and these are investigating methods which will leave the land in a more productive stage than it may be at present.

Water supply catchments

Prime sites for major water supply catchments are becoming rare in Australia and there is a need to protect these sites against erosion and pollution.

Land resource and land degradation surveys were conducted over the resumed area for Wivenhoe Dam and recommendations for land ownership and management of this area were made. It was suggested that land other than the present resumed area might be acquired for catchment protection purposes. The interdepartmental committee report incorporating these studies should be published early in 1982.

Land development

Cassava land. The development of markets and the energy crisis has led to increased interest in growing new and exotic crops in the State. The section attempts to locate suitable lands and develop management practices specific to each crop. This is in order to maximize efficiency of production and reduce expansion of cropping onto poor and erodible soils and to manage the lands to minimize degradation.

A private company interested in developing a cassava processing industry has been investigating the potential of various areas in Queensland for cassava growing. So far, this work has concentrated on the reliable 1 000 mm rainfall belt. Experience indicates that the available lands investigated have considerable limitations in soil types.

A large area of suitable soils (14 000 ha) occurs in the Bowen-Broken Rivers Basin. However, this area is in the rain shadow of the Clarke Range, with an average rainfall of about 600 mm, and appears to be too dry for rain-grown cassava production. Major moisture deficiencies occur in the critical spring and early summer period.

A climatic analysis based on weekly rainfall was undertaken to assess the requirements for supplementary irrigation.

Officers also reported on the suitability of land at Torbanlea for cassava production.

Land management conditions. As a result of contact with this Department, the Central Sugar Cane Prices Board has strengthened its policy of not assigning unsuitable land for cane growing. The soil conservation needs of newly assigned land are noted on the assignment conditions. The Land Administration Commission has also included soil conservation conditions on leasehold land where it is being developed for cultivation.

In Ingham, the land adjacent to watercourses has been designated as esplanades which remain under the control of the local authority. This should prevent clearing these ecologically important areas during subsequent cane assignment expansions.

Engineering Services

ENGINEERING Services Section has three principal functions: to provide technical services to those Branches of the Department requiring specialist engineering advice, to undertake research and development, and to provide an extension and advisory service for primary producers who seek guidance in engineering matters.

The Section operates four major work areas:

1. Agricultural Engineering Research and Development, within which research, development and modifications of machinery are carried out so as to meet the needs of Departmental Research officers and farming industry groups;
2. Environmental and Resources Research, within which studies of engineering operations which might minimize the effect of farming practices on the environment are carried out and within which more efficient use of energy resources are studied;
3. Farm Organisation-Operations Management, where studies are made to assist in relatively simple machines and buildings which affect the operations of properties; and
4. Information Services, which provide media and field day support to extension in engineering matters. These subjects of course overlap considerably.

An engineer was appointed during the year to Biloela to service the Dawson-Callide area of central Queensland. The loss of three experienced engineers by resignation has caused some projects to fall behind schedule.

Workshop facilities and activities

The workshop in Toowoomba is now well equipped for its purposes with a wide range of machines and equipment and skilled staff. The appointment of an electronics technician to the workshop group will contribute constructively to the team effort in these days of sophisticated electronic equipment.

Agricultural engineering research

Engineering effort this year has been channelled heavily into the area of farm machinery development and use. Special machinery requests from Departmental research workers have been lower than usual, no doubt because many of the basic needs have been met and funds to develop more sophisticated machinery have not been available.

The tractor-implement matching project is considered to be of great importance in the light of increased cost of machinery, rises in fuel prices, and fears for future fuel availability. Many farm machinery units are ill-matched because information to assist in this important area of decision making is not available. Collection, collation and distribution of this data are therefore important. Collection to date has enabled information on tractive efficiency to be explained to particular farmers and this advice has enabled some of them to improve their particular usage/systems and to reduce fuel consumption up to 20%.

An engineer has been included in a group of officers who will compile a handbook on spray application technology. Wastage of fuel and chemicals, unnecessary water application, uneven chemical distribution, poor control and unnecessary residues all result from incorrect and inefficient spray application. The handbook is at least a first step in studying spray technology and it is expected to provide much useful information for extension officers.

Within this area of spray applications, a machine called a 'Towermister' was fabricated for use in citrus orchards. This unit has been shown to produce superior coverage and is at present being tested in the Gayndah and Mundubbera citrus areas.

Following trials at Biloela further modifications were made to a pea viner being developed for bean seed harvesting before it was used in the Burdekin area. Results have been most satisfactory and high quality commercial seed has been produced. This virtually completes the engineering aspects of the Reserve Bank's Rural Credits funded project.

The modified pea viner has since been sold by tender to a Burdekin bean seed grower. It is hoped, however, to monitor the future performance of this machine. A Victorian company evaluated our work with the pea viner and modified to our specification a similar machine for their bean seed harvesting. They have since reported good production capacity and high seed germination results.

The evaluation of a number of systems and of different materials for use in these various systems formed the major work carried out in a project covering equipment selection and management for grain and feed handling. Use was made of information obtained from farmers' experiences.

As a result of this work, a booklet and extension articles, including design proposals for on-farm storage, have been produced.

A drier was also designed, for use in research into cattle ration protein levels when cassava is included. After modifications to improve airflow and enable better product handling, the chipped cassava drier is now operating efficiently.

Miscellaneous projects included the following—

Further data have been collected on seed metering and delivery equipment and is being incorporated in a technical paper.

Work with the soil conservationists involved with minimum tillage experiments included the addition of unit planters to their planting machines for more accurate sorghum sowing. Precision metering units make planting devices more suitable for both summer and winter planting.

A sheep conveyor has been designed and constructed for use in trial work associated with insecticide spraying and chemical de-fleecing applications. A mobile power unit to provide the power for the conveyor and sprayer has been designed so that the composite equipment can be demonstrated in the field.

A prototype on-farm peanut curing unit, incorporating an electronically operated controller which features energy conservation practices as well as controlling the temperature and humidity of heated air and the moisture uptake, has been constructed for demonstrations at field days as part of the engineering input to a project seeking to develop the north Queensland peanut industry.

A more consistently reliable drawbar dynamometer has been developed for studying the matching of tractor and implement. This development was the result of an upgrading in strain gauge technology which was demonstrated to one of our engineers who attended a workshop in Sydney.

A study has been carried out for Soil Conservation Branch regarding the feasibility of adopting a selective sprayer to detect and spray weeds in stubble. Several selections are available but all are expensive and require major modifications for field use. Such a project will be a long term one.

Work has proceeded in the development of a prototype drop roll sizer aimed at more efficiently sizing and grading fruit of different shapes. Liaison is continuing with commercial suppliers of electronic colour sorters towards the development for future use of their product when incorporated with Drop Roll Sizers.

A prototype bulk bin with capacity greater than 200 kg has been constructed for testing in a revolutionary materials handling approach to fruit and vegetable wholesaling and retailing.

Investigation into minimizing draft requirements for tillage tools while still producing a satisfactory seedbed is in progress.

The design has commenced of the electronic circuitry for use as a recorder in which force readings are related to depth of penetration of a standard cone into soil. The results are stored in a memory bank. This recording cone penetrometer will accurately and reliably gauge soil density.

An hydraulically operated fresh bean picker, similar to a commercial unit but suitable for attachment and operation from a farm tractor, has been designed and constructed for the use of researchers to enable them to evaluate new fresh bean varieties developed for mechanical harvesting.

A blower insect collector was designed for use by Entomology Branch officers.

Engineering advice was given on feed mills and their installation at the new Animal Husbandry Research Farm at Mutdapilly and the new Poultry Research Farm at Redlands.

Environmental and resources research

A greenhouse for ornamental production designed for low cost erection and operation has been constructed at Redlands Horticultural Research Station. The materials used included pipe frame, fibreglass roof sheeting, bubble plastic for walls. A black plastic curtained day-length control chamber has been erected within the greenhouse.

As the greenhouse is now being used, the performance of both the main structure and the control chamber will be monitored during the next year. The design is such that the greenhouse may be extended should growers wish to adopt it commercially.

An hydraulically powered and operated soil sampling machine has completed its trials and although a more diligent approach to safety and stability is required of the operator, the unit's performance is meeting the high specification demands set for it.

Excellent work in housing and waste disposal for intensive animal industries paused because of the resignation of the experienced engineer involved.

Farm organization-operations management

To enable their suitability to be gauged for wider distribution, a set of calibration cards was prepared for a particular spraying machine specifying the nozzle size and spray pressure, the speed over the ground, and the amounts of chemicals and water to be mixed for each spraying activity. Additional information including details of calibration checks, time to empty tank and area covered will provide continuous checks of sprayer performance. The value of this approach is being assessed.

Several items of commercial spraying equipment for use in herbicide application have been examined and their approval for use recommended. The performance of a prototype commercial mister was recorded during trials in two areas.

The following items were also completed: design of a special bolt-on three-point linkage arrangement for a tractor; design of a bean windrower; design of a bean cutter (harvester); design of a trailer re-build, and improvement to seed placement for the plot planter at Biloela Research Station; design of a major modification to a blade plough for experiments in Emerald area; designs for three farm buildings for machinery cover and produce protection; design and manufacture of a plot planter for Agriculture Branch officers at Emerald.

Information services

In its belief that agricultural engineering developments should be documented and information made available for advisory and extension purposes, the Section has published 14 technical papers for distribution. It has also contributed 16 articles for farmer workshops and seminars and 12 extension publications. It has also been heavily involved in two major engineering-oriented field days.

Manufacturers have been advised of data obtained from field and laboratory testing of machinery and of its interpretation.

Drafting Services

THE Drafting Section prepares maps depicting land resources and plans to accompany reports submitted by the Division of Land Utilisation. It also draws farm plans and provides for associated needs for Soil Conservation Branch.

In addition, the Section provides a service, limited by staff and finance available, for other Divisions of the Department with drafting and mapping activities. Agriculture, Botany and Agricultural Chemistry Branches in particular draw on this service.

The resource maps produced by Drafting Section now cover important areas of Queensland and are used intensively throughout the State. There has been good co-operation between Drafting officers and resource surveyors in the production of resource maps so that a range of map types is available to cater for different user needs. This has been made even more useful by the inclusion of map references in resource data files.

Time spent on different areas of work within Drafting Section varies, particularly with the size of some individual projects and the amount of time required to complete them. This year 60% of time was spent on land resource mapping (mostly for Development Planning officers) and 40% on technical services drafting. Last year, about half the time was spent in each area. Some large projects in land resource mapping have been handled, however, during this year.

Technical services drafting work included soil conservation planning; covers, diagrams and figures for reports and technical bulletins; colour proofing, general drafting and photographic work.

Major projects handled in land resource mapping included: sections of the Western Arid Region Land Use Studies; Western Arid Properties; Burnett Resource Assessment—South Burnett Area; Mackay Cane Growing Area; Eastern Darling Downs; Maryborough Strip Lands; Emerald Irrigation Area for Agricultural Chemistry Branch; Broad Resource Assessments for Agriculture Branch; Proserpine Lowlands for Agricultural Chemistry Branch.

Some new computerized equipment for drafting and mapping should assist considerably with the output of the Section once it is fully installed and organized. There is a great and growing interest in land use, including conservation of soil, throughout the community and the Section would like to be able to help more in the production of material which makes this visible and more easily understandable.

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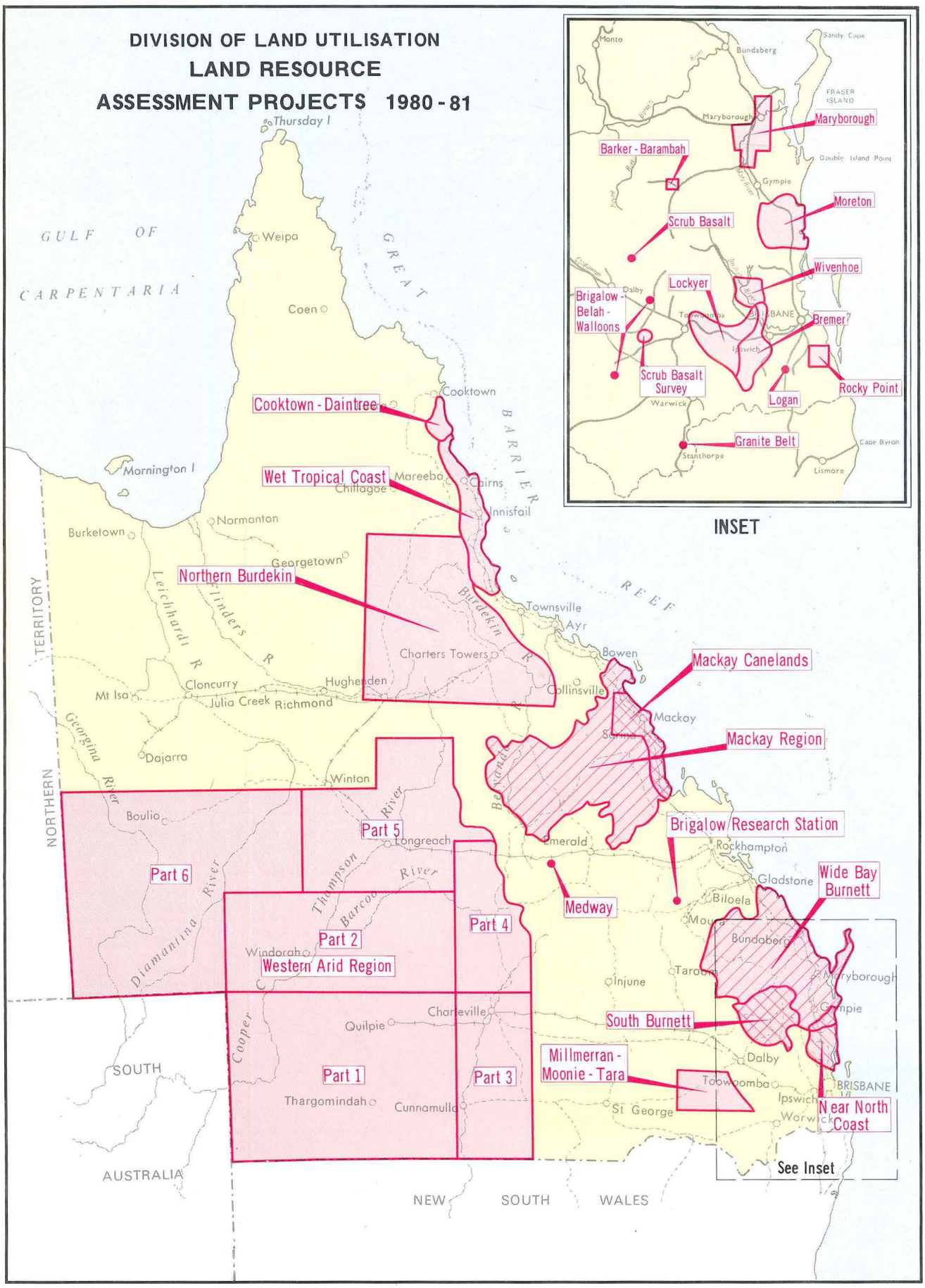
DIVISION OF LAND UTILISATION
LAND RESOURCE
ASSESSMENT PROJECTS 1980 - 81
Thursday I
GULF OF CARPENTARIA
Weipa
Coen
GREAT BARRIER REEF
Cooktown - Daintree
Cooktown
Mornington I
Wet Tropical Coast
Mareeba
Chillagoe
Cairns
Innisfail
Burketown
Normanton
Georgetown
Northern Burdekin
Townsville
Ayr
Bowen
Charters Towers
Collinsville
Mackay Canelands
Mackay
Mackay Region
Cloncurry
Julia Creek
Richmond
Hughenden
Mt Isa
Dajarra
Winton
Boulia
Longreach
Part 5
Part 6
Part 4
Part 2
Western Arid Region
Windorah
Emerald
Brigalow Research Station
Rockhampton
Gladstone
Biloela
Medway
Wide Bay Burnett
Bundaberg
Maryborough
Gympie
Injune
Taroom
Charleville
Quilpie
South Burnett
Dalby
Millmerran - Moonie - Tara
Toowoomba
Ipswich
BRISBANE
Warwick
St George
Near North Coast
Part 1
Part 3
Thargomindah
Cunnamulla
See Inset
NORTHERN TERRITORY
SOUTH AUSTRALIA
NEW SOUTH WALES
Georgina River
Diamantina River
Thompson River
Barcoo
Cooper
Leichhardt R
Flinders R
Burdekin R
Boyne R
INSET
Monto
Bundaberg
Sandy Cape
FRASER ISLAND
Maryborough
Barker - Barambah
Double Island Point
Gympie
Moreton
Scrub Basalt
Wivenhoe
Lockyer
Brigalow - Belah - Walloons
Dalby
Toowoomba
BRISBANE
Bremer
Ipswich
Scrub Basalt Survey
Logan
Rocky Point
Warwick
Granite Belt
Cape Byron
Stanthorpe
Lismore