Gympie

Queensland Department of Primary Industries

ANNUAL REPORT 1975-76

Presented to Parliament by Command

A. 59—1976

Growing enough high quality winter forage is always a challenge to Queensland farmers and graziers. Forage quality is boosted by fertilizing oats with nitrogen after the first grazing.

The winter forage problem is also met, in part, by protein-rich white clover, an important cool-season component of dairy pastures in southern Queensland.

COVER PICTURE.—A group of cows of the new tropical breed, Australian Friesian Sahiwal (A.F.S.), with some of the nucleus Friesians. The A.F.S. is a triumph for Department of Primary Industries breeders who have combined the cattle tick resistance of the Indian breed with the high milk yield of the European Friesian. These cattle are being evaluated on the Kairi Research Station and on Atherton Tableland farms. Portion of Lake Tinaroo is visible in the background.

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Organization of the Department

as at 30 June 1976

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

CENTRAL ADMINISTRATION AND CLERICAL AND GENERAL DIVISION—

Director-General and Under Secretary	J. M. Harvey, D.Sc., F.R.A.C.I., I.S.O.
Deputy Director-General	A. A. Ross, M.Agr.Sc.
Chief Advisory Officer (Administration)	E. O. Burns, B.Com., F.A.S.A.
Assistant Under Secretary	H. J. Evans, A.A.U.Q., A.A.S.A.
Assistant to the Director-General	A. Winterton, B.Sc., Dip.Bus.Admin., Q.D.H.
Accountant	J. D. Reardon, A.A.U.Q., A.A.S.A.
Executive Officer, Research Stations Section	G. H. Allen, Q.D.A.
Executive Officer, Extension Services Board	J. Gibb, B.V.Sc., Dip. Agric. Ext.
General Manager, Agricultural Bank	F. J. Strutton, A.A.S.A., A.C.I.V.
Director, Information and Extension Training Branch	J. L. Groom, B.Sc.Agr., Q.D.A.

DIVISION OF ANIMAL INDUSTRY—

Director of the Division	L. G. Newton, M.V.Sc.
Deputy Directors	J. W. Ryley, B.V.Sc., B. A. Woolcock, B.V.Sc.

Animal Research Institute—

Biochemical Branch	C. W. R. McCray, B.Sc., A.R.A.C.I. (Director)
Husbandry Research Branch	L. Laws, M.V.Sc. (Director)
Pathology Branch	W. T. K. Hall, M.V.Sc. (Director)
Beef Cattle Husbandry Branch	M. R. E. Durand, M.R.C.V.S. (Director)
Veterinary Services Branch	K. M. Grant, B.V.Sc. (Director)
Sheep and Wool Branch	A. T. Bell, B.V.Sc. (Director)
Slaughtering and Meat Inspection Branch	B. Parkinson, B.V.Sc. (Director)
Pig and Poultry Branch	F. N. J. Milne, B.Sc. (Director)

DIVISION OF DAIRYING—

Director of Dairying	G. I. Alexander, B.V.Sc., M.S., Ph.D.
Deputy Director	V. R. Smythe, M.Agr.Sc.
Dairy Cattle Husbandry Branch	I. H. Rayner, B.Econ. (Director)
Field Services Branch	W. D. Mitchell, B.Agr.Sc., Dip.Agric.Ext. (Director)
Research Branch	W. C. T. Major, B.Agr.Sc., A.S.B.M. (Director)

DIVISION OF LAND UTILISATION—

Director	J. E. Ladewig, B.Agr.Sc.
Assistant Director	A. Hegarty, B.Sc., Q.D.A.
Development Planning Branch	A. Hegarty, B.Sc., Q.D.A. (Director)
Soil Conservation Branch	H. W. Pauli, B.Agr.Sc., B.E.(Civil) (Director)

DIVISION OF MARKETING—

Director of Marketing	D. P. Lapidge, B.Com., A.A.U.Q.
Deputy Director of Marketing	A. C. Peel, Dip.Ind.Chem., A.R.A.C.I.
Economic Services Branch	R. B. Bygott, B.Econ., Dip.Agric.Ext. (Director)
Marketing Services Branch	D. R. Lewis, B.Sc. (Econ.) (Director)
Standards Branch	W. V. Mungomery, B.Agr.Sc. (Director)

DIVISION OF PLANT INDUSTRY—

Director of the Division	B. L. Oxenham, B.Agr.Sc.
Deputy Director	N. F. Fox, B.Agr.Sc.
Agriculture Branch	J. K. Leslie, Ph.D., B.Agr.Sc. (Director)
Horticulture Branch	H. M. Groszmann, B.Agr.Sc. (Director)
Agricultural Chemical Laboratory Branch	T. J. Beckmann, M.Sc., F.R.A.C.I., F.C.S. (Director)
Botany Branch	S. L. Everist, B.Sc. (Director)
Entomology Branch	T. Passlow, M.Agr.Sc. (Director)
Plant Pathology Branch	G. S. Purss, M.Agr.Sc. (Director)

Queensland Department of Primary Industries

Annual Report 1975–76

To the Honourable the Minister for Primary Industries.

Sir,

I have the honour to submit the following report on the operations of the Department of Primary Industries for the year ended 30 June 1976.

Yours faithfully,

J. M. HARVEY,
Director-General.

General Comments

QUEENSLAND'S rural sector must view 1975–76 with mixed feelings and, again, the depression in the beef industry cast gloom over the whole rural scene.

Production was subject, as always, to the influence of the weather and, in 1975–76, the full gamut of Queensland's weather pattern was experienced. Unseasonal, dry, autumn weather gave way to good spring conditions. The usual summer rains this year increased to flood proportions which, at one stage, covered a significant proportion of the State's prime agricultural land. These conditions, in turn, gave way to an autumn with much of the grazing lands needing rain to ensure good winter pastures.

Production and incomes seesaw

The production response to these wide variations in weather conditions was equally variable. Coarse grains production, generally, was substantially higher in 1975–76 than in 1974–75, as was dairy output and sugar-cane production. Raw cotton and potato production were lower than in 1974–75. Approximately 450 000 more head of cattle were slaughtered in 1975–76 than in 1974–75, but this increase should not be seen as the outcome of improved prosperity in the industry.

Rural producers found that, in 1975–76, their incomes were just as subject to fluctuations as was their production. Dairy producers who had lifted their production 11% above the 1974–75 level increased their income by only 6%. Grain sorghum producers increased production by 1% while value was about the same as in the previous year. Sugar-cane producers, on the other hand, increased production by 7% but the value of their crop fell by 17%. Cotton producers were more fortunate. Despite a drop in production in 1975–76 of 9% compared with the previous year, the value of the crop rose by 23%.

Gross value disappointing

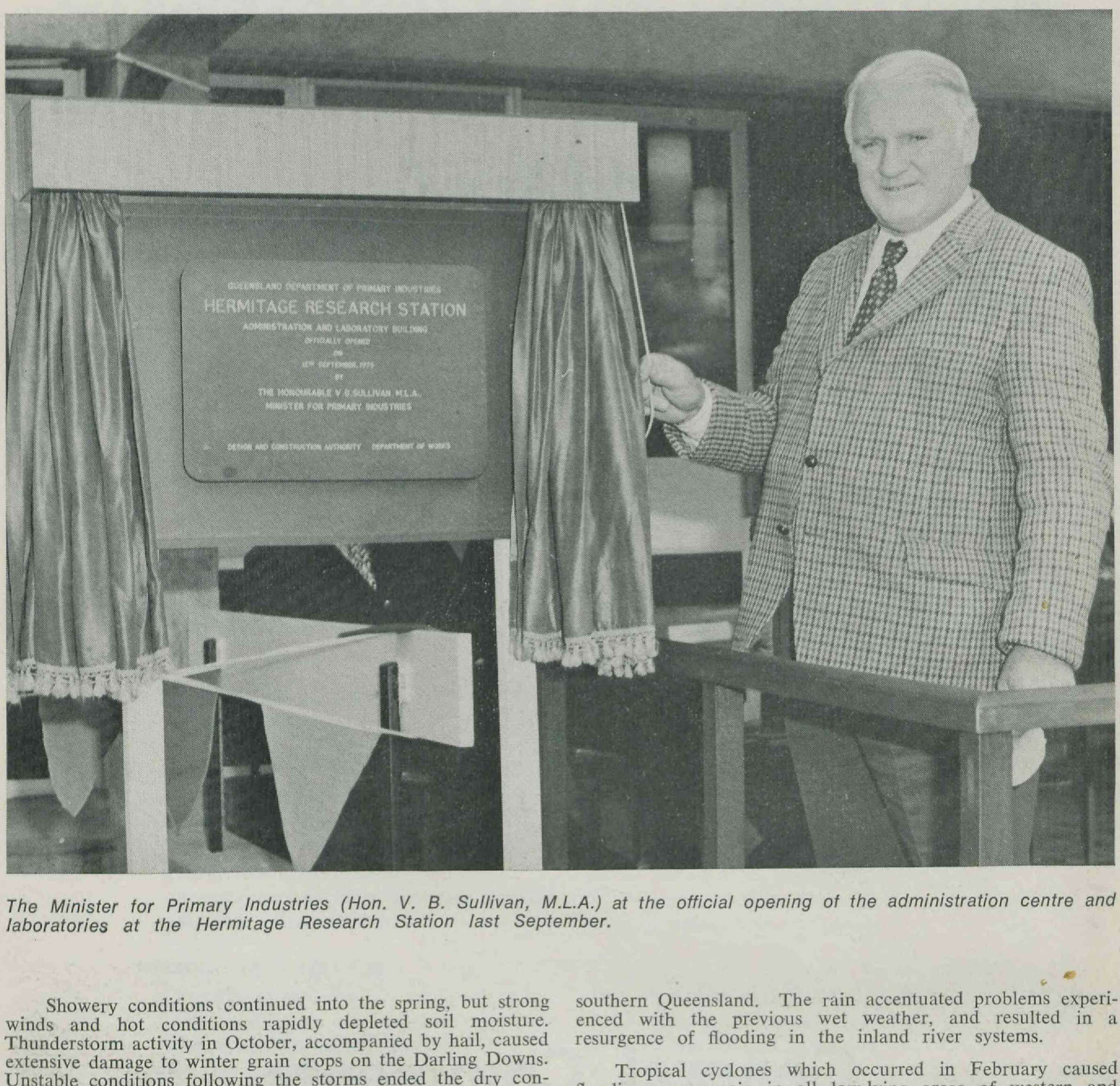
The gross value of rural production in Queensland in 1975–76 is estimated at $1 248 million. This was a marginal increase compared with the previous year's estimated figure of $1 223 million. The increase in gross value does not justly reflect the effort that went into production over the year, nor does it adequately reflect the net financial position of the rural sector.

The increase of 2% in the gross value of rural production was at a lesser rate than the increase in the cost of farm inputs.

It is against this background that the Department continued to serve the rural sector.

The autumn of 1975 in Queensland was predominantly dry and the inland areas in particular reflected the severity of the harsh seasonal conditions. Chilling westerly winds and frosts combined to intensify the drought in sections of the Tara, Waggamba and Balonne Shires. Surface water was in short supply and cattle in parts of the south-west were dying as a result of the dry conditions. Many graziers cleared surplus stock and the cattle market was swamped with plain descriptions unsuited to the trade.

Early, well-distributed rains which followed the dry autumn averted a critical situation in the winter cropping areas of central and southern Queensland. Throughout the winter, periodic rains were sufficient to relieve the dry stress to which winter crops and pastures had been subjected, but the inland still needed run-off to replenish surface water supplies.



The Minister for Primary Industries (Hon. V. B. Sullivan, M.L.A.) at the official opening of the administration centre and laboratories at the Hermitage Research Station last September.

Showery conditions continued into the spring, but strong winds and hot conditions rapidly depleted soil moisture. Thunderstorm activity in October, accompanied by hail, caused extensive damage to winter grain crops on the Darling Downs. Unstable conditions following the storms ended the dry conditions experienced earlier in much of Queensland, and almost continuous rainfall was responsible for severe inundation and localized flooding in the Macintyre River Basin.

Variable weather conditions were experienced during November, with above-normal rainfall being recorded near the coast but generally insufficient rain over the interior. Seasonal conditions worsened with the continuation of the hot weather and partial drought conditions prevailed over the Blackall, Tara, Warroo and Balonne Shires. Water shortage caused concern among graziers and feed also was inadequate in some areas. In contrast, crops and pastures in the eastern half of the State made good progress.

A change to fine weather occurred about the midde of November. After nearly 3 consecutive months of above-normal rainfall, all areas, except the Far North, the South-east and isolated coastal districts, recorded well below normal monthly rainfall.

Major floods again

Heatwave conditions, accompanied by occasional dry electrical storms, were experienced in western districts. A monsoonal trough brought typical wet summer conditions to the State. Almost continuous cloud cover and humid conditions produced thunderstorm activity, and heavy rain was responsible for extensive flooding of rivers and streams in central and north coastal districts. Severe inundation and localized flooding also occurred along inland watercourses. A major flood in the Condamine inundated much of the lower reaches. Major flooding also occurred along the Bulloo River, drowning sheep and destroying fences in the country between Quilpie and Thargomindah.

The outstanding feature of the weather during January was the rain depression associated with cyclone 'David' which brought widespread moderate to heavy rains to central and southern Queensland. The rain accentuated problems experienced with the previous wet weather, and resulted in a resurgence of flooding in the inland river systems.

Tropical cyclones which occurred in February caused flooding once again in all low-lying areas of western and southern Queensland. Major flooding occurred in most streams in the Brisbane Valley, and in the Albert and Logan Rivers, the Macintyre, Moonie and Weir Rivers, the Condamine, Balonne, Bulloo and Paroo Rivers, the Warrego, Thomson, Barcoo Rivers, and Copper Creek, Diamantina, Georgina and Eyre Creek. Heavy run-off maintained the Condamine River at levels equal to those of the record 1893 flood. Inundation and flooding in the Cecil Plains, Yandilla, Tummaville, Leyburn and Pampas regions were the worst on record. The Severn River at Stanthorpe and Mingoola reached record flood levels.

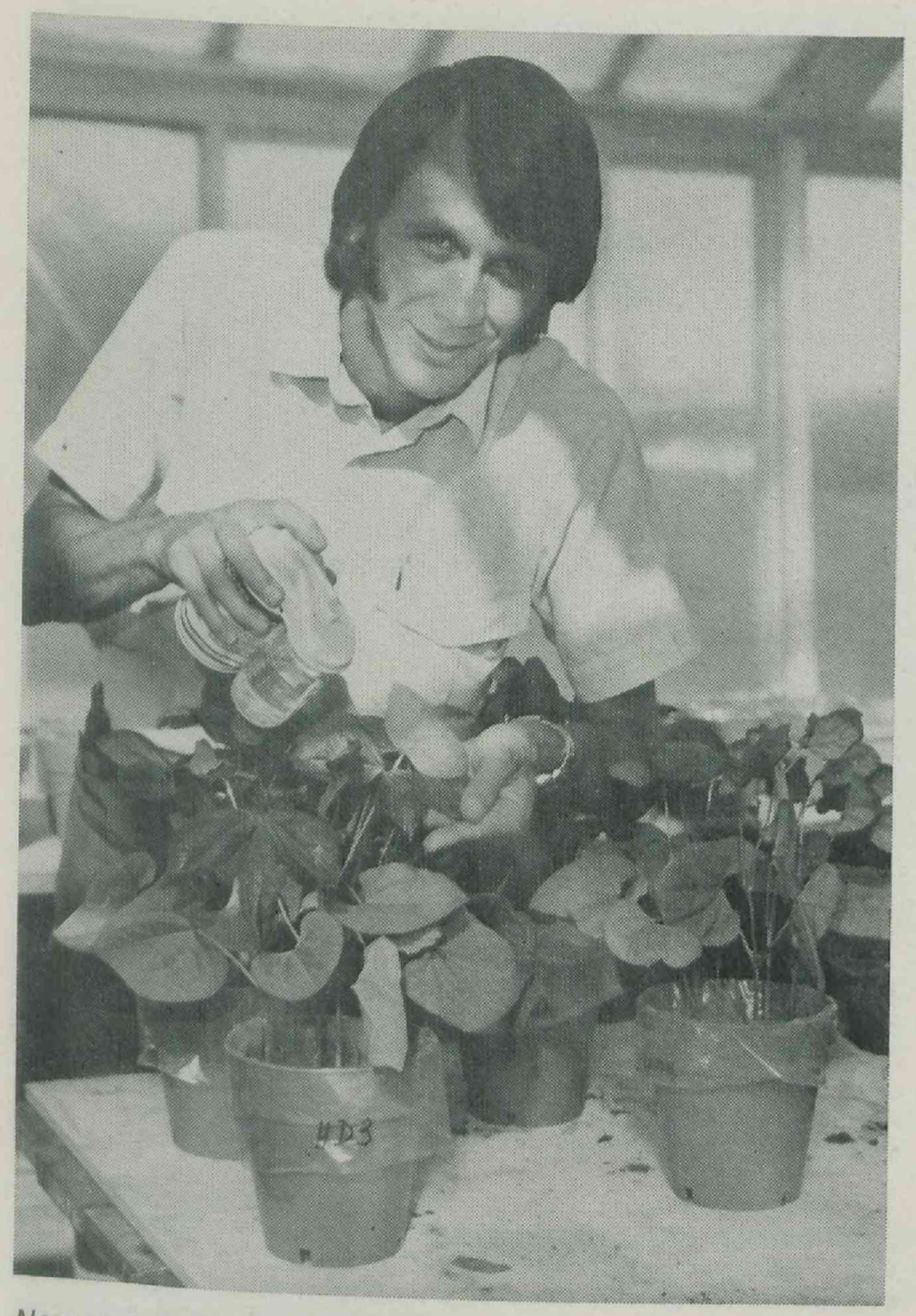
Soil erosion

Further tropical cyclones in March caused sprawling of advanced crops and soil erosion in some coastal districts.

Shower activity was confined to the coast and generally light rain occurred in the adjacent districts. No rainfall was recorded over the south-west quarter of the State. Late in the month, a tropical cyclone moved in a south-westerly direction parallel to the coast and brought heavy rain, accompanied by strong winds, to coastal areas, mainly east of the Ranges.

Fodder crops and pastures

Apart from partial drought in some western districts in November, the State as a whole experienced one of the best summer seasons since the mid 1950s when pastoral conditions were regarded as the best on record. However, heavy rains in early summer devastated pastoral and agricultural regions in southern Queensland. There was also severe soil erosion, particularly in the alluvial soils of the river flats. In the south-west and border country, floodwaters took more than a month to recede fully.



New varieties of French beans are inoculated with rust spores to test the plants' resistance to this serious disease. Breeding disease-resistant lines is a continuing task for the Department's plant-breeders. Work of this sort is carried out at the Department's research stations.

Planting of summer crops was more restricted than usual because of the abundance of pasture supplies. The high cost of fertilizers, combined with the recession in the beef cattle market, also had a detrimental effect on new pasture developments.

Demand for supplementary feed declined appreciably and was confined to dairying centres.

Livestock industries

Beef cattle

Cattle, except those in the drought-affected areas and on some overstocked properties, were maintaining good condition during November. Ephemeral fever was reported and the epidemic worsened in the Biloela, Bundaberg, and Gayndah districts. Blight was also prevalent in the Biloela district.

Store cattle trading was quiet with the approach of the Christmas holiday period. Values of store cattle weakened, reflecting the uncertainty over beef exports to the United States of America, and prices for steers fell by $6 to $8 and for heifers by $2 to $3.

Weather in western areas influenced the market and store prices dropped by a further $10 to $15. Similarly, the market for fat cattle was subdued, and offerings at the Cannon Hill sales included large percentages of unfinished types and boner cows. All descriptions were cheap, and cattle sold lightweight also eased in price.

January saw a return of confidence in the cattle market, stimulated primarily by expectations of increased beef exports to the United States. Fat cattle prices received a boost, but there was only a cautious improvement in the store market, with sellers waiting for the selling season to begin in order to obtain some indication of market trends.

Assured seasonal conditions were also a major influence behind the increasing activity in the store market. Prices of top quality stock had nearly doubled since the pre-Christmas recession in the cattle market.

Early in February, there was a spectacular increase in prices of fattening-age, 2-year-old steers which sold at $80 to $105 a head. Prices of 3-year-old bullocks similarly increased dramatically and were as high as $150 a head.

Tail-tagging is the approved method of identifying cattle so that diseases can be traced back to the property of origin. Identification of cattle will become compulsory from 1 July 1976.

An officer of the Slaughtering and Meat Inspection Branch records the location and extent of bruises on an animal just slaughtered. Bruising studies are a joint project by the Department's Division of Animal Industry, the Australian Meat Board and the C.S.I.R.O.

Many store breeders were selling forward-condition cattle direct to meatworks and, as a consequence, yardings at Cannon Hill included large percentages of females and young cattle. Export bullocks and trade types were in very short supply.

In Queensland, in excess of 1 800 head of stock were estimated to have been lost directly as a result of flooding. Roads made untrafficable by floods prevented movement and transport of stock, resulting in the postponement or cancellation of most cattle sales in the Far West and Southern Border region.

By March, Australia had shipped almost half her 1976 quota entitlement to the United States, leaving only a modest share for Queensland. In late March, the United States confirmed that the quota for 1976 would be 287 000 tonnes, an increase of only 7 000 tonnes on the previous year's allocation.

Conditions in the industry deteriorated from the more optimistic tone of the market earlier. Prices at Cannon Hill in late May weakened to levels generally in the range of 35 to 40c per kg (dressed weight), compared with levels of 50 to 55c per kg earlier in the year.

A number of factors caused the weaker market. First, most markets were heavily oversupplied with cattle. Despite the record slaughterings over the previous 18 months, large numbers of slaughter cattle were still coming forward from the production cycle begun 2 to 3 years previously. Further compounding the oversupply situation were the very dry conditions in the southern States, forcing further surplus numbers onto markets.

A second factor was the restrictions placed on shipments to the U.S.A. by the Australian Meat Board to ensure that Australia's export entitlement to that market was not exceeded. Considerable confusion existed over the current state of shipments to the U.S. and many exporters believed that shipments were still too high. This factor, along with a general weakness of demand from other overseas markets, contributed to weakening of saleyard prices.

Sheep

Rainfall during November was variable, and in the Blackall and Winton districts sheep were deteriorating in condition because of inadequate feed and water. In the other regions of the sheep country, stock were generally good to prime. Lambings throughout the central and western regions were relatively poor.

In the store sheep market, the continuous rise in wool values had the effect of improving demand for young woolgrowers. Few good quality young sheep were available for sale, and graziers were willing to pay $5 to $7 a head, depending on skin values.

Yardings of sheep at Cannon Hill were suitable for all sections of the trade, and offerings of sucker lambs were the best for some time with very few plain types offered. Competition from buyers was reasonably good, but the market weakened with prices of prime descriptions being least affected.

Disastrous losses

Rain late in December ended the dry conditions, but was responsible for severe inundation and localized flooding in the western watercourses. The wet season continued unabated, and flooding was responsible for disastrous losses of about 241 000 sheep. Others in a weakened condition succumbed to the effect of blowfly strike.

In the flood distressed areas, graziers were unable to muster stock, and the delay in crutchings and shearing continued to prevent operations for the control of blowfly strike. In the south-west, shearing was completely disorganized by localized flooding and, in many areas of the mulga country, operations were well behind schedule.

Strong demand continued for replacement sheep, and store sheep prices remained high. Young woolgrowers were selling at up to $7 a head in western districts. Values of sheep fell slightly during the Storemen and Packers' strike, but afterwards recovered rapidly. Stock losses caused by blowfly and preceded by poor lambings last spring maintained heavy demand for woolgrowers.

Dry sheep were fair to good but weaners were losing condition in the grass-seed infested country and in areas where sheep worms were still a problem. Competition for meatworks sheep was keen and quality short-woolled wethers were extremely dear. Prime lambs, however, were relatively cheap.

Higher returns from wool

The number of sheep and lambs shorn in Queensland in 1974–75 increased by 7% and wool produced improved by 3.8% compared with the previous year. However, the value of wool produced declined by 24.3% from the $107·4 million recorded in 1973–74. Preliminary estimates indicate that wool production in Queensland could have decreased marginally in 1975–76 but the total value of Queensland's wool clip is expected to rise by approximately 8%.

World wool production in 1975–76 was expected to increase marginally from 1974–75. World demand for wool improved during 1975–76 from the depressed levels of 1974–75. This was because of the then low level of wool stocks held by the main consuming countries and the likelihood of some general recovery in economic and textile activity in the major western economies.

The 1975–76 wool selling season began in the latter part of August with opening values fully firm on the closing values of the previous season. The normal hesitancy evident at the opening of most seasons was experienced, but there was a firm underlying demand evident among wool consuming countries.

The second half of the selling season opened on a strong note with sales at Melbourne, Sydney, Albury, Canberra and Brisbane attracting good support from all major wool using nations. As sales progressed, it was evident that prices were firming at a level marginally above those recorded in the previous year, but still well below 1973–74 levels.

Wool sales throughout Australia were disrupted during March and April by industrial action by the Storemen and Packers' Union and an estimated 500 000 bales of wool were held up. This delay resulted in a strong demand for Australian Wool Corporation stocks held overseas. When sales re-opened, late in April, demand was quite strong, but towards the end of the year prices tended to stabilize at levels closer to those of a year ago.

Mutton and lamb

The value of sheep and lambs slaughtered in Queensland in 1974–75 declined dramatically to $8·1 million from the $18·3 million recorded in the previous year. A preliminary estimate for 1975–76 indicated the likelihood of a slight increase in value, to $8·5 million.

South Burnett pig farmer Mr. George Kratzmann (left) records the backfat thickness of a live sow using an Ultrasonic tester. He is assisted by a Departmental adviser. The machine enables pig farmers to select lean, well-grown pigs for breeding. This will, in turn, give housewives the leaner bacon they want.

Pigs

There were slight increases in herd numbers in some intensive piggeries and a few small-scale producers re-entered the industry. However, there was little incentive for expansion in pigmeat production.

Net returns for pigs were being eroded under the pressure of rising feed prices, and these were reflected in their influence on capital investment in the industry. Few new piggeries of any significance were constructed during the year, and the trend was still towards additions to and improvements of existing facilities.

Expansion in the industry consisted mainly of slight increases in breeding stock numbers. In some intensive piggeries, there was a tendency away from raising weaners and stores for sale towards marketing pigs as baconers, thus reducing the number of small pigs sold locally.

Dairying

In November, dairy herds in north Queensland were still affected to varying degrees by ephemeral fever but only isolated occurrences of the disease were reported in other areas, and dairy cows were generally in good condition.

The seasonal increase in dairy production, which had progressively improved since the onset of the wet summer season, resulted in all dairy factories operating at capacity. The quality of production was satisfactory and more than 80% of the butter produced was of choice grade.

The ephemeral fever epidemic continued to intensify in some centres, and bloat was responsible for some stock losses on the Darling Downs.

The trend in dairy production became more erratic with output in north Queensland and the Maryborough region tending to reach its peak, whereas in the inland areas production varied considerably between one area and another. The East Moreton district, in particular, recorded increases of up to 17% in some localities while, in others, production declined by as much as 14%, compared with the levels of November.

By the end of January, the general trend radically altered with overall dairy production being maintained at the December level. Production on the Darling Downs reached its peak during the month and was about 8% more than that of the previous year's highest level. Production in the Wide Bay region held basically steady with increased butter output, decreased cheese production and minimal change in powder production.

Throughout February, there was a marked fall-off in volume of dairy production with the overall output of cheese, butter and powder manufacture declining seasonally. Milk supplies for the market milk trade were well maintained.

The normal seasonal decline in dairy production became more pronounced during March. Milk production on the Darling Downs fell by about 32% compared with the level of the previous month.

In the milk quota zones, production was maintained during April, though dairying centres in the South Burnett district needed rain to ensure milk supplies. Winter fodder crops, where planted, made good progress and dairy cows entered the winter in good condition.

The dairying industry continued its steady decline with the number of dairy farmers reduced to about 4 500 during the year. Production, however, showed a slight increase over that of the previous year. Butter production increased to 10 992 tonnes compared with 10 389 tonnes in 1974–75 and cheese production increased to 12 320 tonnes compared with 9 840 tonnes in the previous year. On the other hand, there has been a decline in the amount of milk used for pasteurization, reflecting an apparent per capita decline in milk consumption over the last 3 years.

The depressed state of the world market for dairy products persists and there appears to be little likelihood of any recovery in the immediate future. Total Australian production is still well above domestic requirements, and the low returns on the exportable surplus have had severe effects on the equalized returns to manufacturers in all States. The depressed state of the industry has resulted in pressures for new marketing arrangements for dairy products and schemes have been put forward for industry and government discussion.

Eggs and poultry

The introduction of a supply-demand management scheme in the egg industry has meant that growers are reducing their total flock numbers as part of a deliberate management policy. In January, leviable hens were reported to be reduced to 1·8 million. This was the lowest number for some years and reflects a positive response by growers to overcome the unprofitable over-production situation that has existed for a number of years.

Commercial egg production declined in 1975–76. Recorded domestic consumption may have also declined but, because there appeared to be an increase in non-recorded output, it is difficult to verify the extent, if any, of the decline. The increased activity of 'back-yarders', the main source of non-recorded output, is causing increasing concern to the industry.

Until the first 2 months of 1976, the total volume of eggs and egg products available for export was continuing to grow, with consequent adverse effects on returns to producers. After the beginning of March, however, the intake of eggs by The Egg Marketing Board steadily declined. This decline was attributable almost entirely to the reductions in hen quotas.

A direct result of this situation is that The Egg Marketing Board was able, for the time being, to eliminate certain deductions from growers' returns, thus effecting considerable improvements in net returns. This has been achieved with only a minor arrangement of egg prices. It is unlikely that this situation will continue indefinitely but, in the meantime, the profitability of egg production is assured. The decline in net returns to growers recorded in 1974–75 in south Queensland has now been reversed.

Poultry meat industry

The poultry meat industry continued to face comparatively minor competition as a result of low beef prices. Because of the capacity of the industry to increase stock numbers rapidly, the long-term viability of the industry appears reasonably certain. The value of slaughterings for the year is expected to be about $19·3 million, up significantly on the estimated $17·6 million in 1974–75.

Towards the end of the year, legislation was passed to establish a Chicken Meat Industry Committee. This committee will be concerned with the negotiation of contracts between growers and processors.

Agricultural industries

Agriculture

Soil erosion, local flooding and lodging of crops resulted from almost continuous summer rain in central and southern Queensland, and strong winds associated with cyclonic disturbances, accentuated the farmers' problems. In the flooded country, the damaging effect on crops was not as severe as had been expected, though there were some heavy individual crop and property losses. Many crops matured before the flood rains and, although some grain was discoloured, the yield potential was still good.

Harvesting continued to be interrupted periodically by rain until late March when fine weather allowed field activity to progress rapidly.

Sugar

Weather conditions in the far north improved in late 1975, but heavy rains and strong winds caused lodging and delayed land preparation. Yellow spot disease increased in susceptible cane varieties, and weed control measures were necessary in most localities. Cool conditions slowed crop growth but are expected to produce favourable c.c.s. levels.

In the Mackay–Proserpine region, a record harvest is expected from all 1976 crops despite land preparation and plantings in many areas being disrupted by weather. Concomitant with the weather conditions have been problems caused by vigorous weed growth.

Sugar-cane production in the 1975 season broke all previous records for the quantities of cane crushed and sugar manufactured. The total of 21·07 million tonnes of cane crushed was 1·65 million tonnes higher than the 1974 record crop, while the total of 2·75 million tonnes of 94 n.t. sugar exceeded the 1974 record by 24 000 tonnes.

The latest estimate for the 1976 season indicates an increased harvest of sugar-cane of 24·2 million tonnes and a crop of 3·36 million tonnes of 94 n.t. sugar based on a forecast 14·08 c.c.s. ratio.

Gross industry income from the 1975 season could total $653 million compared with $737 million in 1974. The main reason for this decrease was that the extraordinarily high prices which prevailed on the world free market in 1974 returned to more normal levels in 1975. The No. 1 Pool Price was $232·23 per tonne while the excess sugar price was $277·90 per tonne 94 n.t. The corresponding figures for the 1974 season were $252·66 and $301·10.

Total exports of sugar during 1975 reached 1·85 million tonnes, 137 000 tonnes higher than in the previous year. This increase was related to an increase in overall economic activity in our major markets as well as a marked reduction in sugar prices.

The Australian sugar industry now has agreements covering the supply of sugar to Japan, Malaysia, Singapore, the Republic of Korea and New Zealand. Together with the domestic market, these contracts promise secure outlets and stable prices over the next 4 to 5 years for about 2 million tonnes of sugar a year, or about two-thirds of current productive capacity.

Grain crops

Queensland's summer grain and seed crops had an extended planting and harvesting season because of the excessive wet season and subsequent waterlogged fields. Grain sorghum, maize, sunflowerseed, panicum and white French millet suffered from vigorous weed growth. The wet conditions encouraged disease and the occurrence of insects such as midge, heliothis and head caterpillar. After the February deluge, some fields had large deposits of silt and the wet field conditions made mechanical harvesting difficult.

The winter grain and seed crops, wheat, barley, linseed, canary seed, and safflower, were also affected to varying degrees by excessive rain and waterlogged field conditions in November. Quality in some crops, for example wheat, did deteriorate but not unduly. Barley was severely affected by the wet harvest in both quality and quantity.

WHEAT. The area planted to wheat in 1975–76 was estimated at 595 800 ha and resulted in an estimated production of 886 000 tonnes.

The distribution of receivals at State Wheat Board depots by grades was as follows:

	Percentage
Prime Hard	20
No. 1 Hard	30
No. 2 Hard	14
Australian Standard White	19
General Purpose	16
Seed	1
Total	100

Export prices declined towards the end of the year following a drop in demand, and returns to growers from the 1975–76 crop are expected to be slightly below last season's level of $105 per tonne f.o.b. at port.

Prospects for the 1976–77 wheat crop are good, although estimated plantings, at 610 000 ha, were lower than those of last year.

BARLEY. Early forecasts had put the 1975–76 barley crop in excess of 500 000 tonnes. This figure was gradually reduced with the continuation of the wet harvest conditions and the final production figure appears to be about 421 000 tonnes, well above the previous record of 299 000 in 1966–67. Plantings were a record 210 000 ha. In 1974–75, production was 297 268 tonnes.

Quality was seriously affected with receivals of malting barley being well below the expected levels. However, a record 330 000 tonnes of barley should be available for export. The Barley Marketing Board's intake reflects the low percentage of high quality malting barley:

	Percentage
Malt 1	5
Malt 2	40
Milling	53
Seed 1	1
Seed 2	1
Total	100

Returns to growers are expected to approximate last season's level of $95 per tonne, growers' delivery depot.

GRAIN SORGHUM. As a result of reduced plantings, grain sorghum production in 1974–75 reached only 634 000 tonnes compared with 654 000 tonnes in 1973–74. Plantings for the 1975–76 seasons are estimated at 361 000 ha from which production of 715 000 tonnes has been forecast. In southern Queensland, yields of 2·5 tonnes per ha were common throughout most cropping areas with yields in the Lockyer Valley rising as high as 5 tonnes per ha.

The Queensland Graingrowers' Association expects to export about 230 000 tonnes on behalf of growers in southern Queensland compared with an estimated 200 000 tonnes in 1974–75.

The Central Queensland Grain Sorghum Marketing Board expects to export about 160 000 tonnes in 1976 from a total of about 200 000 tonnes. These figures are substantially up compared with 1975, when 104 000 tonnes of the 106 000 tonne crop were exported.

Export prices during 1975–76 decreased by about $10 per tonne to $80 per tonne f.o.b. at port. However, a firming tendency was becoming apparent.

RICE. The 1975–76 summer harvest yielded 5 775 tonnes of paddy from an area of 1 235 ha. This compares with 8 114 tonnes from 1 475 ha for the 1974–75 summer harvest.

Returns to growers are expected to total $120 per tonne compared with an expected final payment of $107 per tonne for the 1974–75 summer crop.

The 1976 winter crop was hampered by excessive rain in the early growing period and leaf hopper infestations which have combined to reduce yields.

Sunflower is an increasingly important oilseed crop in Queensland. With a price of approximately $175 per tonne, sunflower is one of the few agricultural crops that returned more this year than last.

OILSEEDS. The long-term market situation for oilseeds remains bright but prices for most oilseeds are likely to ease in the immediate future.

Safflower production in 1974–75 reached 27 000 tonnes from 27 575 ha. For the 1975–76 crop it is estimated that plantings will reach 31 000 ha to produce 20 000 tonnes. Returns to growers in 1974–75 reached a record $225 per tonne at farm gate. Because of the poor quality of the crop, returns during 1975–76 will probably decline to $120 per tonne.

From 8 543 ha planted, linseed production in 1974–75 was 10 720 tonnes. However, extended dry conditions and relatively low linseed oil prices reduced plantings in 1975–76 to an estimated 1 400 ha, with an expected production of 2 000 tonnes. Returns to growers during 1975–76 may slip by up to $50 per tonne below last season's level of $240 per tonne, delivered processors' plants.

Sunflower production from the 1974–75 crop reached a record 68 402 tonnes from 105 000 ha. Plantings in 1975–76 were estimated to reach 62 000 ha to give a production of 42 000 tonnes. Prices during 1974–75, approximated the previous season's level of $160 per tonne delivered processors' plants. Prices for 1975–76 are likely to be up to $15 per tonne higher.

MAIZE. Prospects for a record maize crop are good. Dryland crops throughout the State were averaging 2 tonnes to 4 tonnes per ha and irrigated crops were producing between 4 tonnes and 7 tonnes per ha. The area planted was estimated at 29 400 ha which should yield about 77 000 tonnes.

Returns to growers are expected to approximate those of last year. Growers in the area of The Atherton Tableland Maize Marketing Board traditionally receive higher returns than south Queensland growers. The latter should receive about $55 per tonne, farm gate, for this season's crop.

Peanuts

The gradual decline in the area planted to peanuts was halted with the 1976 season when plantings were equal to those of 1975. The main reason for this reversal was the high returns growers are receiving for their crops.

Rust, which first occurred in 1975, reappeared in 1976 in isolated pockets. While the incidence of rust causes concern in the industry, provided that it is carefully monitored and receives the appropriate chemical treatment, it should not cause undue concern.

The first advance growers received for the 1975 crop was equal to the total payment of only 3 years previous. This figure, in turn, was exceeded in 1976 and the total return to growers is expected to be about 33c per kg. Final returns to growers for the 1975 season will be much lower than originally forecast because of the very high proportion of the crop being down-graded because of poor quality.

The Peanut Marketing Board continued to expand its export activities and good quality large size kernels from Queensland are well accepted in overseas markets.

Navy beans

Plantings for the 1975 crop were a low 3 349 ha, the lowest figure for nearly 8 years. Nevertheless, production was a surprisingly high 2 599 tonnes, reflecting the comparatively favourable seasonal conditions.

A selling price of 51·75c per kg was successfully negotiated for the 1976 season, and this should ensure growers a return of about 47·5c per kg. Growers responded to this level of return by nearly doubling plantings to 7 600 ha for the 1976 seasons. While some of the crop in the Inglewood area was affected by the summer floodwaters, production should be about 5 600 tonnes.

Soybean

The area planted to soybeans for the 1976 season was substantially less than the previous year's record 33 000 ha. The planting of 20 000 ha is about the same as that for the 1973 season and is the first time since 1970 that plantings for a new season have not set a new record. Production in 1975 was a record 52 542 tonnes.

The reason for the smaller planting is the poor seasonal conditions experienced in some districts last year. The poor seasonal performance occurred at the same time as a market reversal. Growers who received $200 per tonne two seasons ago averaged only $160 in 1975.

Returns to growers in 1976 are expected to be of the order of $150 per tonne, slightly less than the average result of last year. It is also expected that prices will remain at about the 1976 level for some time because of the competitive prices of meat-and-bone meal, and the generally depressed cattle industry.

Tobacco

Growing conditions for south Queensland growers for the 1975–76 tobacco crop were among the worst on record. Two cyclones in the early part of 1976 were responsible for significant loss of leaf in the Bundaberg and Moreton areas, while the crop grown in south-west Queensland was disastrously affected by flooding in February.

The Australian marketing quota for the 1975 selling season remained unchanged at 15·422 million kg with Queensland's share being constant at 8·304 million kg. The minimum average price was fixed at 336·4c per kg. For Queensland as a whole, a total of 8 298 626 kg was sold at auction for an average price of 331·5c per kg and a total value of $27·5 million.

During the year, there was a marked decline in the consumption of tobacco products brought about by severe increases in Commonwealth excise and the imposition of tobacco taxes in all States except Queensland and Tasmania. This caused the Australian marketing quota to come under threat.

In order to offset these trends, the Australian Tobacco Board agreed to shortsell the 1976 quota by a minimum of 502 000 kg of which Queensland's shortsell will be a minimum of 155 000 kg. This was made possible by the shortfalls in production, particularly in Queensland and New South Wales, through adverse seasonal conditions. As a result of these measures, the Australian Agricultural Council was able to determine the 1977 Australian Marketing quota at the unchanged level of 15·422 million kg.

The 1976 tobacco sales to date have seen a total of 5 581 089 kg of leaf sold out of a State quota of 8 304 300 kg. This has yielded $19·5 million for an average price of 348·5c per kg. The minimum average reserve price for the 1976 sales was determined by the Australian Agricultural Council at 347c per kg, a rise of 10·6c per kg over the 1975 price.

Lesser-known fruits, such as the jackfruit shown here, are being tested as alternative horticultural crops.

Cotton

The 1975 cotton season in Queensland was satisfactory, although irrigated crops on the Darling Downs were generally disappointing as a result of localized flooding and extended waterlogged fields. Aerial spraying of 2,4–D severely affected crops which had survived the wet period, and the severity of 2,4–D damage was unprecedented in the district. Flooding and 2,4–D damage combined to reduce crop yields on the Darling Downs to only 610 kg per ha, compared with 987 kg per ha at St. George and 955 per ha in central Queensland.

The outstanding feature of the season was the increase in plantings at Emerald, and indications are that plantings of cotton in that district will expand significantly when the second stage of the irrigation scheme is completed.

Plantings of cotton in Queensland for the 1975 season were 7 189 ha, including 540 sown to dryland, skip-row cotton. Production of cotton totalled 26 423 running bales, made up of 9 044 at Biloela, 4 964 at Cecil Plains and 12 415 at St. George. The 26 423 running bales produced during the 1975 season were equivalent to 24 426 bales, each of 225 kg of raw cotton, or 5 946 100 kg of raw cotton.

Details of grades and bales are set out in the table below.

Grade	Running Bales	Percentage
Good Middling	87	0·33
Strict Middling	4 132	15·64
Middling Plus	3 494	13·23
Middling	8 191	30·99
Strict Low Middling Plus	4 486	16·98
Strict Low Middling	4 876	18·45
Low Middling	1 110	4·19
Strict Good Ordinary and Good Ordinary	47	0·19
Total	26 423	100·00

Queensland sold 19 823 bales on the local market and exported the remainder. Prices of cotton rose steadily from 81·11c per kg in January 1975 to 113·27c per kg at the end of the year. The main factor behind the marked rise in prices was the economic recovery in the world textile market.

The average return per kg to Queensland growers for their raw cotton for the 1975 crop is expected to be 78c, including 6·92c per kg from oil milling proceeds.

The prevailing average selling price of cotton continues at a high level and the return to cotton growers for the 1976 crop is expected to rise significantly.

Projects on dwarfing apple rootstocks are aimed at reducing the need to use ladders for harvesting.

Ginger

Yields for early harvest ginger from the 1975 crop, at 20·76 tonnes per ha, were the lowest for many years. This was brought about by adverse weather which caused earlier that normal fibrous development. The yield for the second late harvest was particularly high, increasing the overall crop to an estimated 3 888 tonnes.

Overall, sales of the 1975 crop are expected again to finish strongly. The United Kingdom market for crystallized and syruped ginger was somewhat depressed, though sales to other countries helped to offset this particular fall. Sales of other ginger products on the export market remained firm while domestic sales continued at satisfactory levels. Final realizations for the 1976 crop are expected to show some improvement on the previous season's levels which averaged 16·5c per kg for early harvest and 10·29c per kg for late harvest.

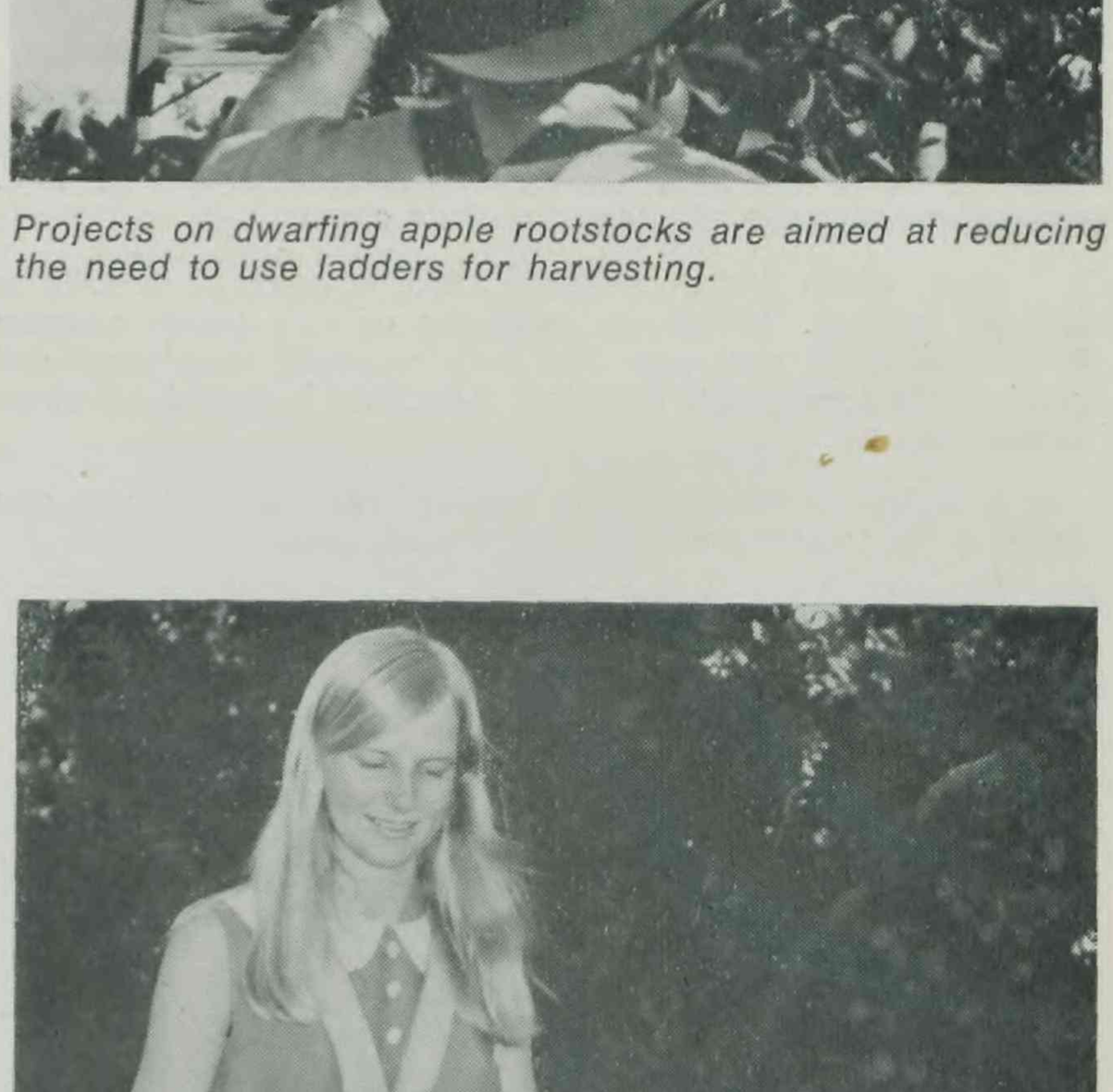
Fruit and vegetables

During January 1976, cyclonic weather caused varying degrees of crop damage in all horticultural districts. Damage was severe in banana plantations around Rockhampton and production of fruit over the next 6 to 12 months will probably decline considerably.

The vegetable growing areas in the south Moreton areas also suffered heavy losses. In the Lockyer Valley and on the Darling Downs, excessively wet conditions prevented horticultural activities and many crops were lost.

Substantial increases in potato prices throughout January 1976 stemmed from the wet conditions in New South Wales. The average price for potatoes sold on the Brisbane Market during this period averaged around $14 per sack, peaking at $25 per sack.

Pineapple production in 1975 was down compared with the previous year because of a slight drop in the area planted, and very poor yields because of adverse weather conditions. The intake of pineapples at the Golden Circle Cannery was only 74 794 tonnes, 25·8% down on the previous year. Record prices have been declared for both Pools.



Harvesting apples on the Granite Belt. High density plantings of apple trees suggest that yields per hectare can be increased tenfold.

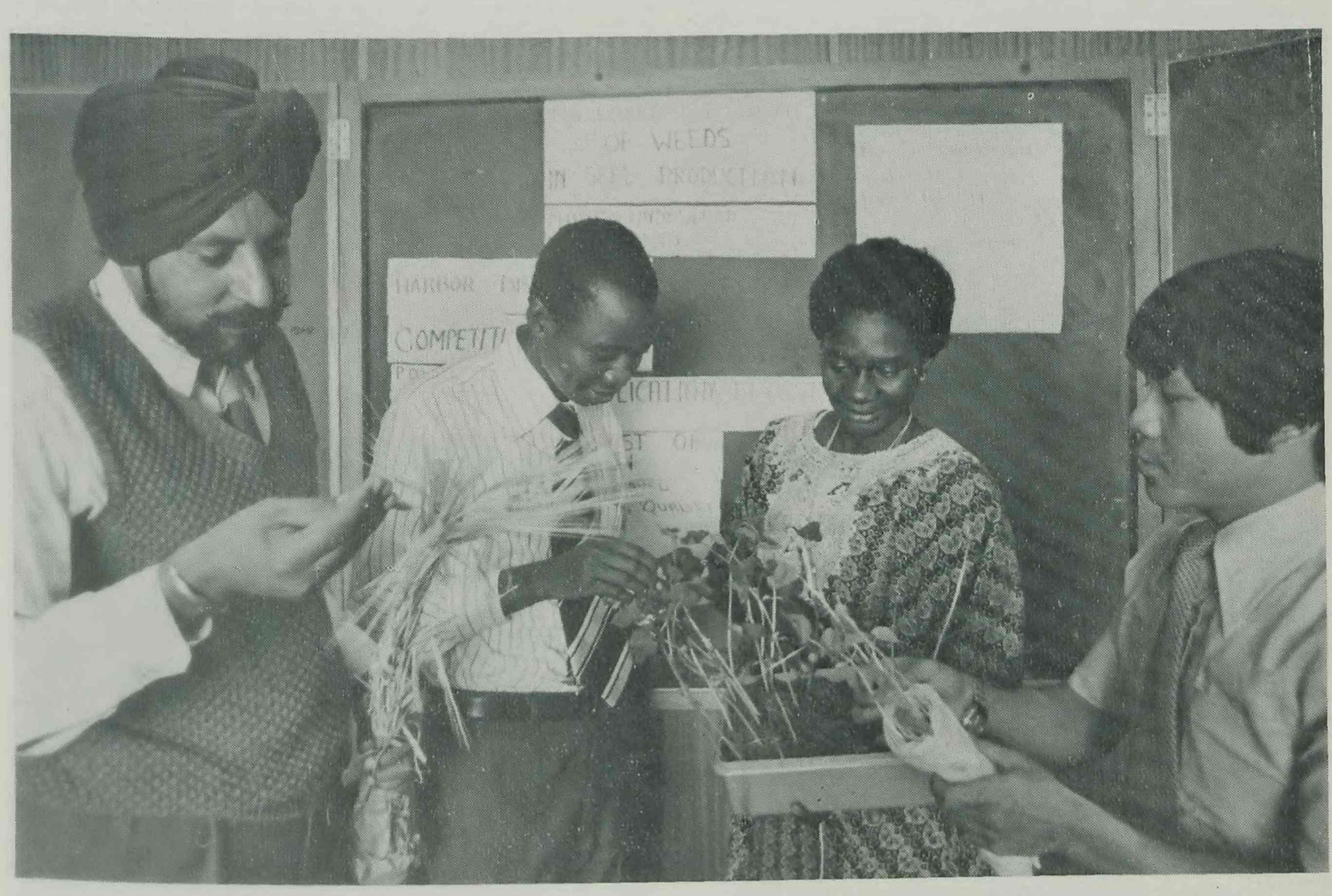
Returns for fruit delivered to the No. 1 and No. 2 Pools were $131.74 per tonne and $79 per tonne respectively. Despite the lower cannery intake, these high returns were attained because the industry has, in recent years, concentrated on servicing the domestic market, thus largely insulating itself from fluctuations in export demand.

The most serious threat to the local fruit and vegetable industries at present stems from the importation of processed horticultural products.

Imports of orange juice increased from 12·3 million litres in 1973–74 to 25·8 million litres in 1974–75. In the last quarter of 1975, imports totalled 10·2 million litres. Frozen potato imports increased from 17 tonnes in 1972–73 to 16 051 tonnes in 1974–75. Similar trends have occurred for other processed vegetables and for passionfruit juice.

In February 1976, evidence was submitted by officers of the Department to the Industries Assistance Commission on the effect of importations of processed potatoes. The submission highlighted the fact that the current tariffs provide little protection for local producers.

During the year it was proposed that a general clearance scheme, covering the major vegetables, including beans and tomatoes, would be introduced into the Brisbane Market. However, because of restrictions in the Trade Practices Act, the introduction of this Scheme has been deferred. An approach has been made by the Committee of Direction of Fruit Marketing to the Commonwealth Department of Primary Industry seeking exemption for the scheme. An exemption has already been granted for the National Banana Marketing Development Scheme.



Agriculturists from Afro-Asian countries receive training in seed improvement and certification under the Australian Development Assistance Agency. Among the 14 students at the Department's training course last September were (from the left) Dr. B. S. Sidhu (India), Mr. C. Okwele (Uganda), Mrs. A. G. Gyasi (Ghana) and Mr. Naratine Sagidon (Malaysia).

General and Clerical

Total clerical staff at 1 July 1975 was 543 officers, 369 in Brisbane and 174 in country centres.

During the year, Public Service Board approval was obtained to increase this total by 14 officers, seven Brisbane and seven country. At 30 June 1976, three positions financed from Commonwealth funds were abolished.

During the year, 114 officers (76 Brisbane and 38 country) resigned or transferred to other Departments. This number includes three classified officers. All have been replaced or will be replaced in the near future.

Three clerks and one stenographer were replaced with clerical assistants. In addition, 70 officers have been transferred to different positions by promotion or to gain further experience.

Study Assistance Scheme

During the 1975 academic year, 318 officers were undertaking approved courses ranging from Senior to Doctor of Philosophy. Of these officers, 84 completed or discontinued their course. During the financial year 1975-76, reimbursement of fees totalling $7 195.50 was made to 117 officers. A total of 103 officers amended their previously approved course.

An additional 77 officers have submitted applications for course approval commencing in the 1976 academic year.

Accommodation

Two major accommodation changes have taken place this year which will result in vastly improved working conditions for most sections of the Department's Head Office staff. The allocation of three floors of Comalco House has provided first-class accommodation for the Ministerial, Executive and Administrative sections.

The transfer of Entomology Branch from William Street to a new laboratory at Indooroopilly has provided that branch with facilities of a very high standard.

The transfer of these sections from the William Street Building has made possible an extensive re-arrangement of accommodation. This will enable several branches such as Biometry, Economic Services, Information and Extension Training and Sheep and Wool, which are now housed in poor accommodation in several separate buildings in the city area, to be rehoused in more adequate accommodation in the William Street building.

Other large projects completed, or nearing completion, include a Brucellosis and Tuberculosis Laboratory at Yeerongpilly, a new Office-Laboratory Building at the Animal Health Station, Oonoonba, and the new Court House Building at Dalby which includes the provision of very good accommodation for Departmental officers.

Major projects in the early construction or advanced planning stages at present are the Swine Research Centre at Wacol, new office-laboratory buildings at Mareeba and Ayr, Biochemistry Building at Yeerongpilly, Resources and Hydrology Building at Indooroopilly and a new Government Offices Building at Bundaberg.

Retirements

A long and distinguished Departmental career ended with the retirement of Mr. A. L. Clay on 20 September 1975. He had served with the Department for 40 years, the last 17 of them as Director, Division of Animal Industry.

Few Australians have given such a wide range of service to the animal industries over such a long time.

Mr. Clay joined this Department in 1935 after having spent 3 years with the New South Wales Department of Agriculture. As a Veterinary Officer in Queensland, he was stationed in Atherton and Townsville before being transferred to Toowoomba as Divisional Veterinary Officer.

In 1949, Mr. Clay became Assistant Director, Division of Animal Industry, and was appointed Director in 1958. As part of his duties, he served on a number of national committees including the Animal Health and Animal Production Committees. He was also Chief Quarantine Officer (Animals) and President of the Veterinary Surgeons' Board.

Mr. Clay always maintained a deep interest in the veterinary profession. He was president of the Queensland Division of the Australian Veterinary Association in 1951, and was elected president of the Federal body in 1957. He was a foundation member of the Australian College of Veterinary Surgeons and was awarded a Fellowship of the College in 1975. He served as a member of the Faculty Board of Veterinary Science at the University of Queensland from 1958 onwards.

Mr. Clay also served on the Meat Industry Authority, the Pastoral Advisory Committee, the Poultry Advisory Board, the Artificial Insemination Advisory Committee, the 'Belmont'—'Brian Pastures' Technical Committee, and many others.

Thirteen other officers who had given many years of loyal service to the Department also retired during the year.

They were: Messrs A. H. Outridge, C. H. Smith, C. A. R. Manning and T. Pope, Pig and Poultry Branch; A. Hutchings and V. A. Wyvill, Dairy Cattle Husbandry Branch; A. W. Jessen, Field Services Branch, Division of Dairying; D. A. Marshall and L. G. Trim, Horticulture Branch; K. C. Guyatt, Marketing Services Branch; G. Hoskin, Animal Research Institute; W. J. Quade, Gatton Research Station; and Miss S. C. Mullan, Division of Animal Industry.

Research Stations Section

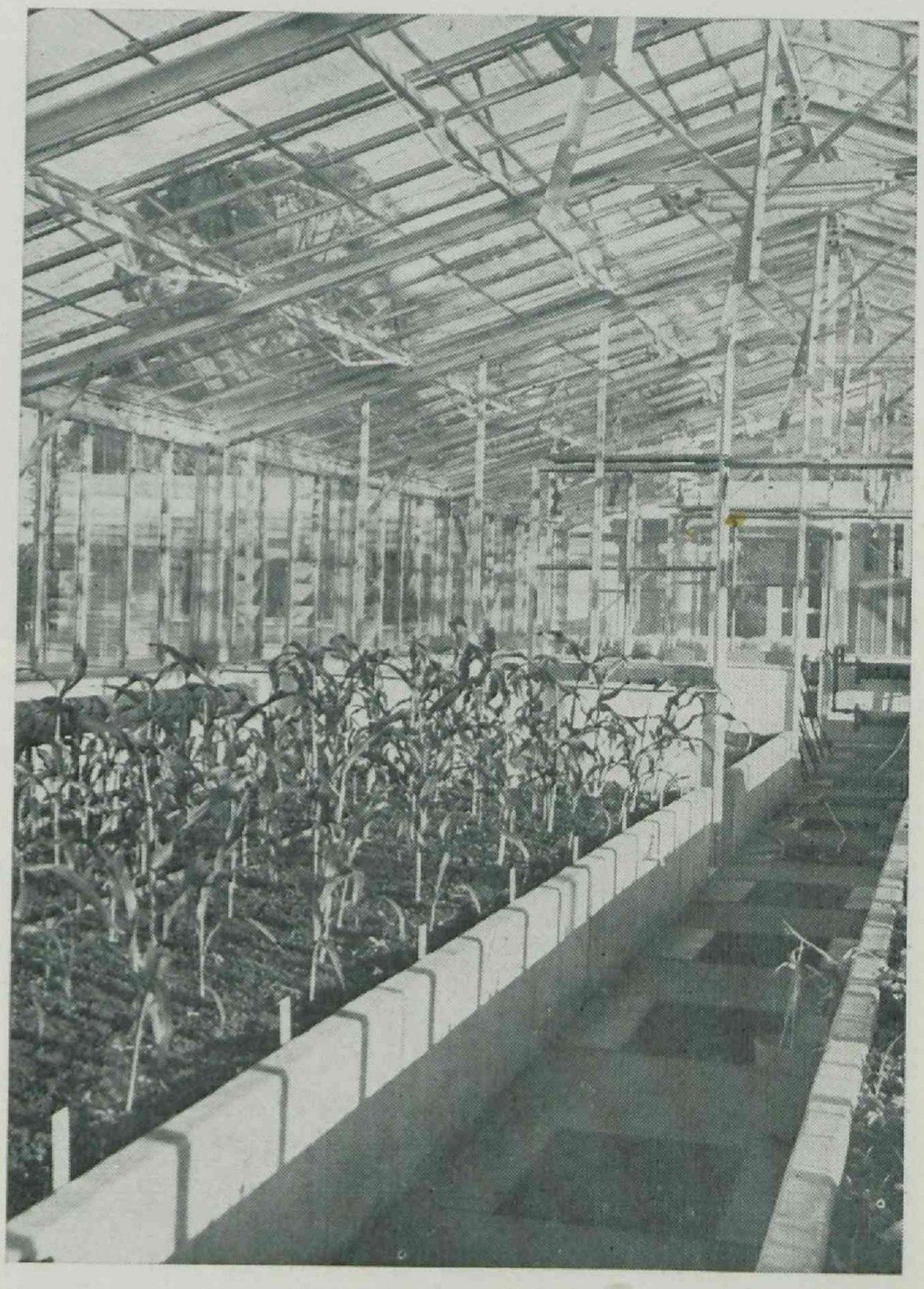
THE Research Stations Section is responsible for the operation and management of 14 properties, and has multi-disciplinary functions and programmes involving all Branches and Divisions of the Department.

Other field centres which provide service or research facilities for a single industry function are administered by the relevant branch.

The technical aspects of research station programmes are reported under the industry or Divisional headings in this report.

Multi-discipline research stations have a major role in project co-ordination and the provision of finance, facilities, machinery, labour and management for the conduct of station and district research programmes approved by the Research Stations Board. This board, consisting of the Deputy Director-General, Directors of each Division, and the Executive Officer of Research Stations Section, met on 10 occasions during the year to consider projects and policies. The board was also represented at all meetings of Industry Consultative groups which advise the stations on industry problems and assist in securing rapid transmission and utilization of results achieved in investigations.

Although the research stations are essentially centres of regional research activities, much progress has been made in the development of mobile specialized plant to extend the range of investigations to district field sites with specific problems. The co-ordination of regional research is also linked to the specialist laboratories, extension centres and services such as biometry being established in the State.



Winter does not halt the sorghum breeding programme at the Biloela Research Station. Plant breeders just transfer their work to the heated glasshouse.

The fleece-shedding characteristic of the Wiltshire Horn breed is being used to breed 'mini-care' sheep. The crossbreeding programme is in progress at the Hermitage Research Station, near Warwick.

The current programmes at research stations involved more than 400 projects directed towards the study of both short and long-term problems of agriculture and animal husbandry. The section has a field staff of 146 and there are 168 research and technical staff of other branches at the stations on a full-time basis. Visiting staff operating part-time research projects total 95.

During the year, the functions of all stations were critically examined for efficiency of operations and industry needs. The new offices and laboratories at Hermitage, near Warwick, were brought into use and expanded regional studies undertaken in

breeding and production of wheat, barley, soybeans and sunflowers—all very significant industries in southern Queensland. The new research complex, the J. Bjelke-Petersen Field Station, near Kingaroy, also came into full operation with emphasis on district investigations in the South Burnett region on soil fertility problems and production of peanuts, maize, soybeans, navy beans and other crops.

A decision has been made to close the Parada Research Station, near Dimbulah, and to continue regional studies in this area of north Queensland on the Walkamin Station, near Mareeba, and on selected private properties.

A project site on the south bank of the Burdekin River development area was established with extensive irrigation facilities for the evaluation of crops and land-use practices relevant to the future expansion of the Burdekin irrigation area.

Joint projects were established at two stations with C.S.I.R.O. for cattle tick research and for assessment of agro-industrial crops, especially fibre sources for paper manufacture.

A series of investigations was initiated by the section at several sites to furnish information on the production of cassava (tapioca) as a stock feed and for industrial purposes such as starch extraction and as an alcohol base. The assessments are related to commercial aspects, harvesting techniques, construction of chipping and washing units and the evaluation of leaf and tuber quality.

The research stations provide land and facilities for other organizations and Departments. This co-operation has continued with the National Parks and Wildlife Service and the Queensland Fisheries Service following transfer of these responsibilities from the Department of Primary Industries.

Officers of the section contribute skilled advice on a wide range of rural topics including specifications for equipment, rural safety training and property management and several stations provide experience and training for overseas students and fellows.

Biometry Branch

A perceptible improvement in the quality of project proposals was observed during 1975–76 as a result of increasing consultative activity by biometricians during project planning.

At the same time, the participants from Biometrics and Research Design Workshops reached numbers sufficient to influence the improvement in experimental designs. These improvements are reducing the number of difficult and intractable analyses to a minimum with the result that research staff are receiving their results more quickly.

Improved computing facilities, additional staff and organization of work patterns along regional lines resulted in the analysis of almost two and a half times the number of sets of data processed during the previous year.

Moves to extend statistical services for Departmental research staff to major regional centres were initiated during the year. Two biometricians and a technical assistant will be transferred to Toowoomba early in 1976-77. Extension of statistical services to Townsville and Rockhampton are proposed for 1977 and 1978 respectively.

Systems development

Biometry Branch continued to assist the development of computer simulation models of biological and economic systems. Additional information from 'Brian Pastures' Pasture Research Station enabled further development of the model of beef cattle grazing for sub-coastal areas of the Burnett region. Soil conservation practices, pasture management and cattle husbandry are being combined to give a range of grazing strategies suitable for long-term production from the area.

Research to integrate results from the Toorak Sheep Field Research Station was initiated as a means of improving management of sheep flocks in the harsh environment of north-western Queensland. Farther south, biometricians combined with C.S.I.R.O. workers to develop a computer model of sheep grazing properties centred on Charleville. This study into arid land deterioration forms part of the international research into problems affecting the environment sponsored by the International Council of Scientific Unions.

Biometrics workshops

During 1975-76, 110 Departmental research officers participated in four biometrics and research design workshops conducted by Biometry Branch. The main purpose of these workshops was to acquaint research officers with basic concepts of experimental design and statistical methodology. A pre-requisite for acceptance at the workshops was a lack of previous formal training in statistics or biometrics.

These basic workshops will continue at least until mid 1977, by which time more than 300 Departmental officers will have received basic training. More advanced follow-up or refresher training on specific topics is being developed for 2 or 3-day short courses. Major topics include design of experiments, regression techniques, multivariate analysis and sampling methods.

Computer services

Purchase of new computing equipment gave the Department direct access to a comprehensive range of statistical programmes developed or maintained by the C.S.I.R.O. Divisions of Computing Research and Mathematics and Statistics.

In the past year, the biometricians wrote several small statistical programmes for the CSIRONET computer to suit particular forms of analysis. One major programme which is particularly suited to statistical analysis of randomized block experiments with single factors is being rewritten in FORTRAN so that it can be transferred readily from the present Treasury computer.

Programme development was sought for a Departmental asset register, the livestock brands registers, dairy cow health records, quality control of dairy produce, and a data bank of meteorological information during 1975-76.

Information and Extension Training Branch

THE objectives of Information and Extension Training Branch are to operate and, where possible, improve—

1. The Department's central information and library services.
2. The central editing, art, photographic and duplicating functions of the Department for mass media and for publications.
3. Training activities for the development of Departmental staff.

Publications

PRINTING. The demand for duplicating services has continued to increase. In the last year, output was a record 6 million sheets (20% up on last year), giving about 10 million printed pages.

About 750 extension publications were produced in the year, and there were 5 800 non extension duplicating jobs.

The Branch also produced the *Queensland Agricultural Journal* and the *Queensland Journal of Agricultural and Animal Sciences*.

PRESS. During the year, one metropolitan and 17 provincial and trade newspapers were served by Regional Information Officers at Rockhampton, Toowoomba and Brisbane. Daily press releases or radio items were made both on the Darling Downs and at Rockhampton. Radio and press coverage of the Gympie and Kingaroy areas was resumed.

In addition, Departmental journalists took part in seven advanced writing workshops, and two extension methods schools.

RADIO. The Department's three Regional Information Officers make heavy use of both the A.B.C. and commercial radio stations, and provide a valuable extension service especially to sparsely populated areas.

The Department also conducts a central radio service, issuing tape recorded interviews to 15 radio stations each week.

CINE AND TELEVISION. Photography section produced five cine films and seven television news items (a total of 45 minutes) during the past year in support of the Department's extension efforts.

To help maintain the benefits of Department's activities to the urban community and consumers generally, news stories about the work of the D.P.I. are used regularly by a Brisbane commercial television station on the 6 p.m. news.

STILL PHOTOGRAPHY. During the year, the section processed 648 black and white and 794 colour films, and made 1 273 black and white sheets of contact prints. Field and studio work amounted to 1 491 black and white exposures and 3 794 colour exposures. The number of enlargements made totalled 13 222.

Photography section staff gave basic and advanced training in photography to field officers at Blackall, Charleville, Cairns, Mareeba and Kairi, as well as at two Extension Methods Schools.

ART. In the last year, 3 000 half-tone pictures and line diagrams were printed. The Art Section, besides handling publications, played a major part in preparing the Department's exhibit at the Royal National Association exhibit. Responsibilities to the R.N.A. exhibit continue to tax severely the manpower resources of the Art Section.

The Art Section also produced graphs and line drawings for publication in the *Queensland Agricultural Journal* and the *Queensland Journal of Agricultural and Animal Sciences.*

Training

The training needs of staff are changing. There is still a demand for basic training in communication skills and in the principles and practice of adult education. But there is an increasing pressure on the trainers to help staff develop skills in planning, decision making, managing time and supervision.

Another change has been the move to make the 'work group' the training unit and the work itself the focus of the training activity. A third major trend has been in response to the request from various regions, branches and divisions for assistance with programmes of planned improvement. Trainers have worked with client groups in the role of third party facilitators in analysing current situations, setting goals and objectives, and planning action.

The Training Section carried out four induction courses, four extension methods schools, two country workshops, four consultations with Regional Extension Leaders on regional management, five management problem analysis workshops, and various other meetings and seminars.

Library

The Departmental library service consists of a central library and smaller libraries at Indooroopilly, Yeerongpilly and Toowoomba.

Demands on the resources of the library continue to increase, in some areas enormously: loans increased 82% to 8 785, reference requests by 72% to 11 333, and photocopying by 79% to 143 971 sheets. There were 1 876 books accessioned (up 16%), 22 new serials (up 16%), 4 553 items catalogued (up 26%), 3 339 inter library loans (up 24%), and 4 685 inter library items borrowed (up 38%).

During the year, six issues of the *Science Digest and Library List* were produced. The value of this publication has been severely reduced by the freezing of the Science Abstractor position in December. 'Trial' input sheets for inclusion in AGRIS, an International Information System for the Agricultural Sciences and Technology, were forwarded to C.S.I.R.O. in March.

Extension Services Section

SOME 500 field officers of 15 Branches are involved in making available to Queenslanders information on all primary industries except sugar-cane, forestry and fisheries. They are located in all major centres throughout the State.

These extension workers are primarily concerned with the technology, economics, marketing and legislative requirements of primary production. A comparatively small, but important, part of their work involves services of direct use to persons engaged in agri-business, consumers, education and training institutions, students and members of the public.

In 1972, an Extension Services Section was created to co-ordinate the activities of extension workers. The new section also assists in providing a more effective problem-oriented extension service, and helps plan and co-ordinate the development and training of staff engaged in extension work.

Teamwork, advisory and extension activities appropriate to the needs of producers in particular districts, a farm business management approach, and the development of co-operative action programmes involving producers, industry organizations and agri-business were seen as desirable features.

To ensure that extension was relevant to the needs of district producers and their associated communities, the State was divided into 30 extension districts within 13 extension regions. Officers responsible for extension activities in each district were asked to ensure that all major extension undertakings, particularly those requiring co-ordination between Branches, were subjected to programme planning. They were also asked to involve producers and industry organizations in all stages of programming their extension activities.

The first district extension programmes were developed and implemented in 1973-74, but it was not until a year later that most districts began programming.

During 1975-76, some 330 district extension projects were developed. More than 80 of these projects involved activities requiring the co-ordination of efforts by officers of more than one Branch. Most of the planned extension activities involved work traditionally conducted by Departmental officers, but there were some exceptions which may not have taken place without the reorganization of the extension service.

Perhaps the most notable of these was the work of Regional Agricultural Economists who organized, with the Queensland Country Women's Association and, at times, producer organizations, a series of property business and office management courses, each of approximately 2 days' duration.

During 1975-76, these courses were offered at 40 centres throughout Queensland. Some 1 200 men and women attended the first day of the course, mainly devoted to office management procedures. In addition, 900 people are known to have attended the second day's programme offered at 20 centres.

Evaluation is recognized as an integral part of extension and, with planning under way in some districts since 1973, a number of officers undertook during 1975-76 to evaluate what some of their planned extension efforts were achieving. The work of evaluation by officers in the Burnett, South Burnett and Near North Coast Regions is producing useful results, but it is now obvious that an evaluation of the impact of much of the routine extension-advisory activities of the Department would be difficult without a considerable staff involvement. Work undertaken without evaluation in mind can mean a heavy drain on time, staff and resources should it be subsequently decided to make a detailed, objective assessment of the usefulness of the work.

In the light of this experience, greater attention will be given in future extension planning to factors which will facilitate evaluation.

An unnamed feed barley variety from South Australia, W.I. 2355, topped the eight varieties tested in 12 regional trials. It yielded 2·5 tonnes per hectare.

Calf rearing by multiple suckling is being studied at the Biloela Research Station. The growth rates being obtained suggest that this method can be used successfully to rear heifer replacements on dairy farms.

Division of Animal Industry

THE Division has a broad area of responsibility for services to the livestock industries and through the products of these industries to the consumer. These services include advisory, extension, research and regulatory functions.

The areas covered are disease control and investigation, animal husbandry and management, public health and product quality.

The Division is made up of eight branches including five field branches. They are—

VETERINARY SERVICES. This branch has responsibility for disease investigation and control, extension of disease prevention, and administration of the *Stock Act* 1915–1976; the *Brands Act* 1915–1975; and animal quarantine services on behalf of the Commonwealth Government.

BEEF CATTLE HUSBANDRY. This branch is responsible for extension of research findings in beef cattle husbandry and management and for carrying out applied research in these fields. It conducts the 'Swan's Lagoon' Cattle Field Research Station and has research functions at Kairi, Brigalow, 'Brian Pastures' and Coolum Research Stations.

SHEEP HUSBANDRY. Extension and advisory services to the sheep and wool industries are the main responsibilities of this branch.

PIG AND POULTRY. This branch comprises two sections which have responsibilities for providing extension and advisory services to these two intensive industries. The Poultry Section also administers the *Poultry Industry Act* 1946–1975.

SLAUGHTERING AND MEAT INSPECTION BRANCH. This branch has a broad area of responsibility in relation to public health. It provides domestic meat inspection services from the point of slaughter to the retail outlet for all meats including poultry and pet foods. It is responsible for the administration of the *Meat Industry Act*. The branch provides information on the incidence and origin of disease in slaughter stock and is responsible for extension of meat quality to the consumer.

The remaining three branches are concerned with research and diagnostic work and the headquarters of all three are at the Animal Research Institute, Yeerongpilly. These branches are—

PATHOLOGY. This branch supplies veterinary diagnostic services to the field branches and the livestock industries. It has an applied research function in the area of livestock diseases and undertakes the preparation and supply of tick fever vaccine. It has a regional laboratory at Oonoonba.

BIOCHEMISTRY. This branch services all Divisional needs in the areas of clinical and nutritional biochemistry and toxicology and it has research functions in these fields. It also services the Division of Dairying and Agriculture Branch in a number of chemical areas and plays an important role in monitoring feedstuffs and products for chemical residues.

HUSBANDRY RESEARCH. Research into animal husbandry problems of all species is the function of this branch. It conducts the Animal Husbandry Research Farm, Rocklea, the Toorak Sheep Field Research Station, Julia Creek, and has research units at the Hermitage and Biloela Research Stations and the Charleville Pastoral Laboratory.

Finance

The Division's operations are funded mainly from the Stock Fund, to which owners of stock make an annual contribution through a stock assessment. This is subsidized by the State Treasury on the basis of $2 to $1. In recent years, droughts and low prices for wool and beef have caused a reduction in assessment collections and made the financing of the Division's operations extremely difficult. The Treasury has had to provide funds over and above the agreed subsidy rate in order to avoid serious curtailment of services to the livestock industries.

The Meat Inspection Services of the Division are funded from slaughtering and meat inspection fees which are paid into the Meat Inspection Account.

The Poultry Section is financed by industry contributions in the form of precepts collected under the *Poultry Industry Act* 1946–1975 endowed with a matching amount from the Treasury together with such additional amounts as are necessary to meet the needs of the services supplied, and paid into the Poultry Industry Fund. The Biochemistry Branch is funded from Consolidated Revenue.

The Division receives financial support from the Commonwealth Extension Services Grant, several Industry Research Trust Funds, the Australian Meat Research Committee, Wool Research Trust Fund, Australian Chicken Meat Research Committee, the Pig Industry Research Committee and other incidental sources. The Commonwealth Government contributes to the costs of the Brucellosis and Tuberculosis Eradication Programme.

Beef Industry Committee

To examine short and long-term assistance to the beef industry, the Beef Industry Committee, consisting of parliamentary, industry and departmental representatives, was formed during the year under the chairmanship of the Minister (Hon. V. B. Sullivan, M.L.A.). A number of recommendations has already been acted upon by the Government, including long-term, low interest loans to producers, freight concessions, acaracide subsidy and restructuring of the Australian Meat Board.

Terms of trade

The producer's terms of trade (ratio of prices received to prices paid) in the pastoral industries have taken a marked downward trend over the last 2 to 3 years, not only because of the downturn in prices received, but more particularly because of sharp rises in the costs of farm inputs, particularly labour.

Extension activity in both the sheep and beef industries has moved towards an emphasis on cost saving practices in management. In the sheep industry, the emphasis has been on labour-saving devices for sheep handling and on alternative shearing and crutching techniques. Beef industry extension officers have concentrated their efforts on minimum-care management and avoiding practices which require substantial money or labour inputs.

Brucellosis and tuberculosis eradication

Eradication of brucellosis and tuberculosis is a major undertaking by the Division involving three branches: Veterinary Services, Slaughtering and Meat Inspection, and Pathology. Eradication is vital to the long-term security of Australia's meat markets. Considerable progress has been made in defining the problem and in identifying infected herds. The latter will be further facilitated by compulsory identification of cattle and traceback, to be introduced on 1 July 1976.

The programme is now entering a new phase of active eradication by regular testing of infected herds. Eradication areas for both diseases have been declared and testing will be concentrated in these areas. The dairy industry is already tuberculosis-free. Infection is restricted to 357 beef herds. Unfortunately, these are mostly large, inaccessible herds in remote areas and progress will be slow.

Brucellosis has a low prevalence in the beef industry with few infected herds. The highest levels of infection are in the far south-west and Brigalow Area 2. While the overall prevalence is higher in dairying areas, it is considered that eradication will be well advanced by 1983.

The economic plight of the beef industry has slowed activity in many areas. Satisfactory arrangements for compensation for brucellosis have been made with the Commonwealth Government and those presently in force in respect of tuberculosis have been slightly modified for the next financial year. Both will come into force on 1 August.

All data relating to the Scheme are computerized. A national computer network has been proposed and agreed to, and should be in operation as a joint State-Commonwealth venture late in 1976-77.

Disease outbreaks

Among the many disease outbreaks investigated during the year were two of unusual significance in cattle.

Johne's disease, which normally does not occur in Queensland, was detected on the Atherton Tableland in dairy cattle introduced from Victoria. This is a chronic contagious disease affecting cattle and occasionally sheep and goats. It is invariably fatal once clinical signs of diarrhoea and wasting develop. Because of the serious nature of the disease, prompt quarantine measures were employed to limit its spread. All exposed animals were tested and infected animals were destroyed. Although the incubation period may be prolonged, indications are that the outbreak is under control.

An outbreak of an acute form of infectious bovine rhinotracheitis (IBR) occurred in the Wandoan area. This virus infection is known to be prevalent throughout the cattle areas of the State, but is seldom manifested as a disease outbreak. In this instance, more than 100 bullocks from a herd of 600 head died over a period of 2 weeks.

Animal quarantine

The Division provides animal quarantine services within Queensland on behalf of the Commonwealth Government. During the year, staffing was increased to meet the demands imposed by the introduction of Boeing 747 (Jumbo) aircraft services and to tighten supervision of parcel post and passengers' baggage and other quarantine services.

During the year, approximately 250 kg of meat and meat products, 20 kg of dairy products and more than 150 eggs were taken from passengers entering Australia through the Brisbane Airport.

The backlog in accommodating dogs and cats imported directly into Australia from Papua New Guinea, Hawaii, Fiji and Norfolk Island has been overcome. Since importations were first permitted in February 1973, 273 dogs and 72 cats entered the Lytton Station, of which 197 dogs and 35 cats were accommodated during the year. This was possible because of the completion of 80 additional kennels. No evidence of the introduction of disease by dogs was apparent. An embargo on the importation of cats due to concern at the possible introduction of the fluke worms *Platynosomum fastosum* was lifted following the implementation of a screening test for this parasite.

Following upon the outbreak of fowl plague in Victoria, Queensland will make its initial financial contribution to the cost of controlling an exotic disease outbreak under the agreement existing between the Commonwealth and States. Serological surveys at the time of the outbreak failed to reveal any evidence of the disease in Queensland flocks. The outbreak in Victoria was eradicated.

An amendment to the *Stock Act*, 1915–1976, paved the way for the imposition of a ban on the feeding of swill to pigs containing food refuse. The prohibition is to become effective from 1 October 1976. It is aimed at preventing outbreaks of foot and mouth and other major exotic diseases which might result from feeding swill containing illegally introduced animal products.

Amendments to Legislation

The *Brands Act* 1915–1975 was amended on 9 October 1975 to permit the use of a distinctive brand on the twist as well as on the cheek of cattle, and the use of a prescribed brand on a prescribed position of stock to indicate the results of testing for disease.

At the same time, provision was made to publish both the Brands Directory and the Sheep Brands and Earmarks Directory every fourth year and to restrict free distribution to such pound-keepers, inspectors and clerks of the court as the Minister may approve.

The regulations under the Brands Act were subsequently amended on 20 March 1976 to provide the necessary machinery for use of the twist as an alternative position for distinctive brands and to provide for the use of prescribed brands for brucellosis and tuberculosis reactors. At the same time, opportunity was taken to delete a series of redundant earmarks formerly used entirely within the ears of cattle.

The Poultry Industry Act was extensively amended by the *Poultry Industry Act Amendment Act* 1975, which commenced by Proclamation from 1 January, 1976.

The principal amendments made provision for reconstitution of the Poultry Advisory Board, restored provisions relating to additional support for the Poultry Industry Fund from Consolidated Revenue and introduced provisions for levying commercial suppliers outside board areas. In addition, the conditions relating to the sexing of day-old chickens including the issue of licences to chicken-sexers were amended and an indemnity provision for the protection of Departmental officers was introduced.

Less important were amendments to repeal provisions in regard to accredited poultry premises and certification of freedom from pullorum disease, and to revise conditons concerning advertising by registered poultry and egg producers accordingly.

Further amendments made provision for separate classifications for started pullet suppliers and poultry dealers, gave greater control over the manufacture of egg pulp and inserted appropriate definitions and amendments where necessary throughout the Act.

Redundant provisions relating to compensation were deleted and the powers of inspectors in regard to disease control and hygiene in places where poultry or eggs are produced or processed were widened. Draft amendments to relevant regulations are still being processed.

The *Stock Act* 1915–1976 was amended on 22 April 1976 to provide for the registration of piggeries, where considered necessary, to control the feeding of swine on food refuse or any other substance, to control the movement and disposal of swine from registered piggeries and to include powers to seize and slaughter swine fed on prohibited foodstuffs. Draft regulations to give effect to these amendments were prepared but had not been gazetted before the end of the year.

The Stock Regulations of 1935 under the Stock Act were amended on 20 December 1975. The accent was on disease control with extended provisions to regulate gatherings of livestock, by provisions to enable the method of moving travelling stock to be laid down by an inspector, and to require stock to be presented for clearing treatments during the hours of daylight. The list of approved dip medicaments was also updated.

Additional provisions were made for identification of cattle tested for disease and to enable the use of new vaccines by owners. The provisions relating to artificial insemination of stock were updated, with provision for special short courses on A.I. to train owners to inseminate their own cattle.

The Identification of Cattle Regulations 1976 under the Stock Act were gazetted on 1 May 1976 to come into force as from 1 July 1976.

They provide for the identification of sale or slaughter cattle by means of approved tail tags or district tail tags or approved ear tags before moving from the property. Exemptions from the identification requirements apply to calves under 3 months of age or suckling and travelling with their mothers; to movements direct from property to property; to cattle consigned to a store or breeder sale approved by a Chief or Divisional Veterinary Officer or to drafts in excess of 20 cattle consigned direct to slaughter and otherwise suitably identifiable to the property of origin to the satisfaction of an inspector.

Machinery is provided for the registration of holdings and the allocation of identification particulars, the keeping of necessary records and the method of supply of approved tags.

The Meat Industry Regulations 1973 were amended on 19 July 1975 to increase inspection fees and were further amended on 29 November 1975 to modify the definition of a Class 3 slaughterhouse situated in a remote area; to tighten hygiene requirements in butchers' shops; to increase registration fees for butchers' shops, meat delivery vehicles, kangaroo depots and pet food shops and to increase inspection fees for certain classes of animals and meat.

Notable events

A major field day was held at the 'Toorak' Sheep Field Research Station, Julia Creek, on 3 October 1975 to enable producers in the north-western areas to hear and see the results of recent research projects. The day was very well attended and appeared to be well received.

To mark the occasion of the opening of the new farming shed and laboratory at the Biloela Research Station piggery, a field day was conducted on 9 March 1976 at which pig production and husbandry were featured. A good representative gathering of producers attended.

Beef Cattle Husbandry Branch was responsible for organizing and conducting the Third Beef Refresher Course held under the aegis of the Standing Committee on Agriculture. The course was on body composition and carcass classification and was held at the Queensland Agricultural College. The Pig Section was also involved in the organization of the Pig Industry Review Conference held at Gatton. This was sponsored by the Standing Committee on Agriculture.

Divisional staff were closely involved in surveying the effects of severe flooding in southern Queensland and in the aerial fodder drop programme supported by the Commonwealth Government and the R.A.A.F.

These Hereford heifers grazing Sugardrip sorghum on Brigalow Research Station are part of a trial designed to compare the effect of nutrition on dystocia in heifers calving at 2 years of age.

Cattle industry

Both the beef and dairy industries have faced a difficult year. Low beef prices continued with some fluctuation including a short-lived rise early in 1976. Producers appear to be reconciled to the situation and the market is over-supplied. Disposal of females has been very difficult even at depressed prices and the percentage of females slaughtered has dropped from the normal 40% to below 30% of the total kill.

With the State cattle populations reaching 11·4 million at 31 March 1976, the oversupply problem is likely to continue. Annual turn-off of more than 3 million head will be necessary to reduce the cattle population unless there is a change in the pattern of favourable seasons which has aided the build-up in numbers and permitted the increased numbers to be carried without major losses.

The depressed economy of the cattle industries has continued to exert a major influence on property and herd management. To date, most producers have been able to contain rising costs in the short-term by heavy retrenchment of labour. However, prospects for further containment of costs are virtually nil.

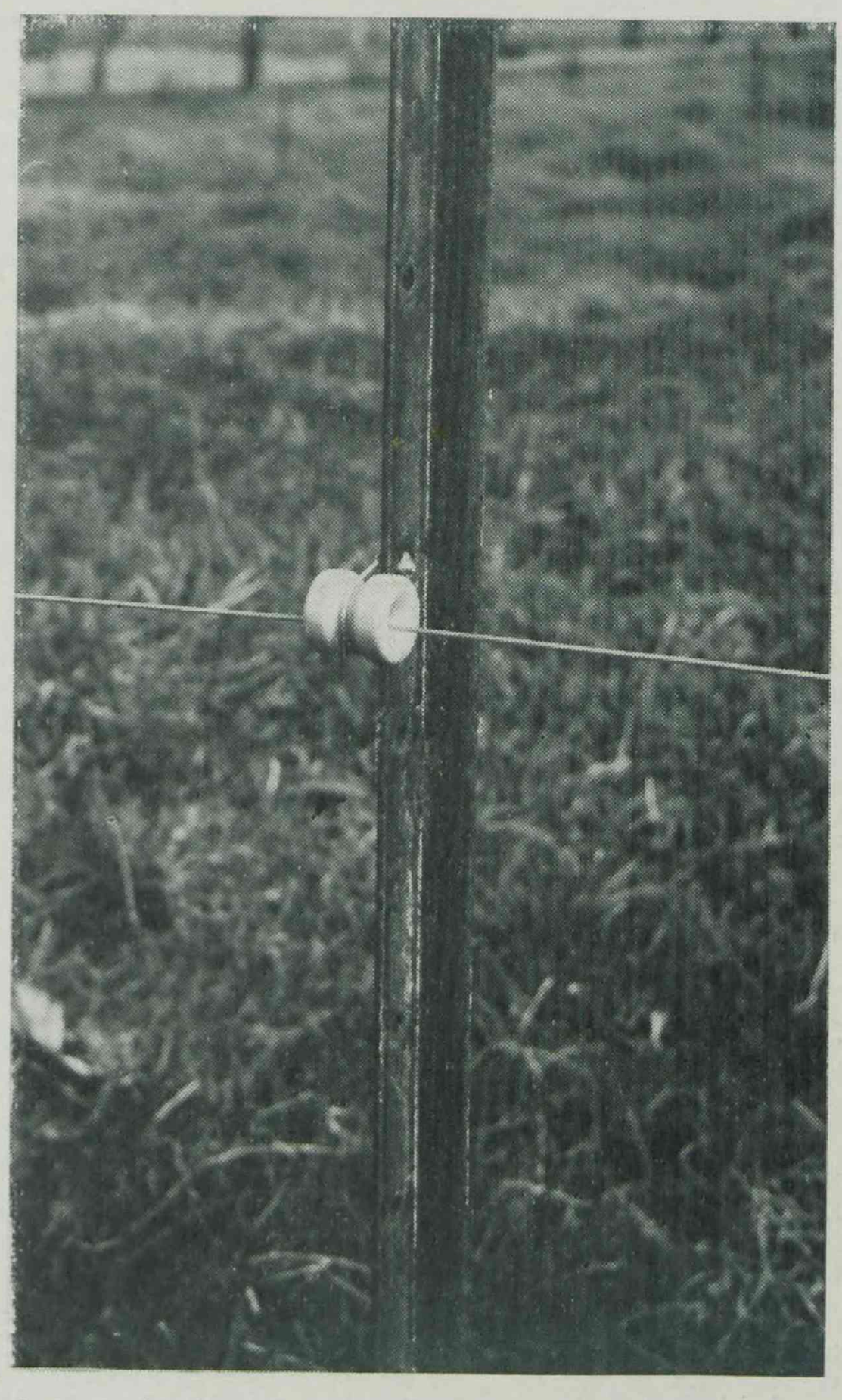
The retrenchment of staff and off-farm employment by owner-managers in many instances have had a serious effect on basic management practices such as weaning and disease control, particularly the control of cattle ticks. The current economic crisis is expected to set the industry back several decades in terms of development, maintenance of improvements and the use of advanced management practices.

Cattle producers in more favoured areas have been able to diversify into alternative enterprises, particularly grain growing. However, diversification is denied the vast majority of beef producers in the more extensive, specialist beef-production areas. Many cane growers have taken advantage of low prices for cattle and cattle lands to enter the industry as a means of diversification.

The Beef Cattle Husbandry Branch, while it retains its broad objective of helping producers to improve the efficiency of their operations, has modified both its extension and research programmes to meet the new challenges posed by the changed economic circumstances of the industry.

The emphasis has been placed on cost saving management practices. One example is a series of projects examining the effects of reduced dipping in *Bos indicus* crossbreds. At the same time, longer-term research projects, for example, supplementation and breed evaluation studies have been continued.

Extensive damage to fencing caused by severe flooding of river systems in southern Queensland during the summer placed a heavy financial burden on property owners to restore these improvements. Permanent electric fences, which have been developed to a high degree of efficiency, offer a much cheaper alternative to conventional and suspension fencing and are being promoted by this branch. To this end, a senior officer of the branch visited Victoria and South Australia, where electric fences are widely used, to study construction methods and practical aspects of their use. This information will be very valuable in promoting the wider use of this comparatively cheap form of fence in Queensland. The concept of electric fences also offers management advantages particularly in respect to better bull control and in weaning practice.



A properly-planned and well-constructed electric fence is cheaper than conventional fencing, equally or more effective, and much more versatile. The need to replace many miles of fencing after the Condamine floods stimulated a special investigation into the value of electric fencing.

The weak demand for female slaughter cattle which has existed over the last 2 years created herd management problems on most breeding properties. The practice of spaying has been widely re-introduced into the industry after more than a decade of non-use and has provided breeding control over surplus cull females and has allowed them to be fattened without the risk of pregnancy, thus converting them into a more readily salable product. The marked reduction in spaying over previous years has created a shortage of professional spayers and the branch has continued organizing spaying schools where groups of cattlemen have been taught the art. These schools have been very well accepted and appreciated by producers and the demand for further schools continues.

Brucellosis-tuberculosis eradication programme

The eradication of these two diseases is a major undertaking by the Department and involves the active co-operation of all cattle producers, livestock agents and beef and dairy processors. Guidelines for eradication procedures are decided by a national committee and these are adapted by a Divisional management committee to meet Queensland legislation and industry conditions. Finance for the campaign is provided by the Commonwealth and State Governments and from 1 July 1976 the cattle industries will contribute towards the cost by way of a Commonwealth slaughter levy of $1 per head, excluding calves, slaughtered. In addition, the Commonwealth Government has agreed to contribute to compensation to the extent of 75% for brucellosis and 50% for tuberculosis of the net compensation costs.

A most important aspect of the eradication programme is the identification at slaughter of the origin of animals which are affected by the two diseases. Traceback of cattle with tuberculosis lesions has been in progress for many years and has enabled the identification of most actively infected herds. However, traceback of saleyards and other mixed drafts of cattle has been difficult. As eradication proceeds, monitoring of incidence in slaughter stock and identifying infected herds becomes more critical. The introduction of compulsory identification of cattle by using tags bearing the property identification number of the herd of origin on 1 July 1976 will facilitate traceback.

The programme entered a new phase during the year with a change in emphasis from definition of area prevalance and identification of infected herds to active eradication in infected herds. Eradication areas have been defined and routine test and slaughter programmes will be concentrated in infected herds within these areas. In addition, eradication testing will be carried out in infected herds in other areas, provided that programmes meet certain conditions.

Veterinary practitioners have played an important role in survey and eradication testing for tuberculosis. Their services are also used for vaccination against brucellosis and will be used to a limited extent in brucellosis eradication testing.

Tuberculosis. Some 925 000 cattle in 3 869 herds have been tuberculin tested with 5 097 or 0·55% reactors. Most of these reactors have been destroyed on the property because of the low cattle values prevailing and high costs of transport and slaughter. Only 132 reactors were slaughtered at meatworks. Apart from reactors, the incidence of tuberculosis lesions in slaughter cattle was 0·14%. This provides an index of the low prevalence of the disease on a State basis and of the progress with eradication. These are, however, 357 infected herds throughout the State though only about half of these are considered to be actively infected. Many are situated in the far western extensive areas where herd size and lack of facilities and labour will slow progress towards eradication.

Despite the severely depressed beef market, owners of infected herds have, in the main, co-operated within the limits of their reduced capacity to muster by virtue of staff retrenchments and the necessity to reduce operating costs. Indications are that the volume of testing will be reduced by about 30%. Testing of dairy herds has been continued at 5-year intervals.

All of the State, with the exception of the Mount Isa, Boulia and Diamantina Shires and those portions of the Barcoo, Quilpie and Bulloo Shires west of the dingo barrier fence, is to be included in a Tuberculosis Eradication Area. This is an important step towards declaration of this area as Provisionally-Free in terms of the Standard Rules and Definitions adopted by the National Committee. Progress to this status will allow freer movement of cattle to interstate destinations, as movement between provisionally free areas is unrestricted except from infected herds. The timing of this declaration will depend on progress with eradication testing, within the eradication area.

This area is to be given Protected Area status under the Stock Act to facilitate control of the introduction of infected cattle to prevent reinfection of herds within the area.

The change from HCSM (synthetic medium) tuberculin to bovine PPD tuberculin has been delayed by production and standardization problems. Trials have suggested that higher concentrations of PPD tuberculin provide greater specificity and sensitivity than the normal strength of 1 mg per ml Further trials are under way to assess PPD tuberculin of various strengths. It has been decided provisionally to use 2 mg per ml PPD in infected beef herds in the north and west of the State when this product becomes freely available. HCSM tuberculin will continue to be used in non-infected herds, in other beef areas and in dairy cattle.

Brucellosis. Field survey testing and monitoring of dairy herds has revealed a very low prevalence of brucellosis in the north-eastern area of the State. As a result, this area has been defined as the initial Eradication Area in Queensland. It comprises the Cook, Mareeba, Etheridge, Dalrymple, Ayr, Bowen and Proserpine Shires and the Atherton, Eacham and coastal shires from Douglas south to Thuringowa Shire. Survey testing using the Rose Bengal Plate Test (RBPT) is continuing to the south and west of this area with a view to extending the Eradication Area as soon as staff and facilities permit the extension of eradication testing beyond the present area. The brucellosis eradication area will also become a Protected Area to prevent the reintroduction of infected stock and to facilitate testing within the area.

Veterinary Services Branch staff, with the co-operation of the Division of Dairying, expanded the milk ring testing programme. All wholemilk suppliers were tested at least three times during the year, and a start was made on the more difficult task of collecting and testing samples from cream suppliers. Progress was made with studies on improvements to the cream ring test. The State average of herds with positive results to the milk ring test was 27%, with the highest incidence in the Brisbane Milk Supply Area at 46%. During 1975-76 an effort was made to do follow-up blood testing in dairy herds with a history of positive milk ring tests. This programme clarified the status of many dairy herds, and revealed a prevalence in infected herds of about 7%.

The costs of mustering and yarding cattle for testing are high as is the cost of testing. The basic strategy of brucellosis eradication is to test and slaughter infected herds to clean status and to monitor the status of these and all other herds through testing of breeding stock slaughtered at meatworks. The Cattle Identification Regulations of 1976 will permit positive traceback of nearly all slaughtered cattle.

During the year, some 100 000 breeding cattle which were identifiable with the property of origin were tested for brucellosis at slaughter. The prevalence of positive reactors was 14% in dairy and 4% in beef cattle. These figures are higher than those detected by survey because the cows sampled are mostly aged and represent a biased sample.

The number of blood samples collected by Slaughtering and Meat Inspection Branch officers at meatworks was nearly double that of the previous year. These officers and their colleagues within the Federal Meat Inspection Service forwarded 999 specimens of suspected tuberculosis lesions for definitive diagnosis by the Pathology Branch. Of these, 669 were histologically positive for tuberculosis. Of the negative lesions, the majority were club-forming (actino) granulomata. A total of 489 was examined bacteriologically and *Mycobacterium bovis* was recovered from 185 but, at the time of reporting, many examinations are incomplete. In addition, three atypical Mycobacteria were isolated. *M. avium* complex type 6 was recovered from a histologically positive mediastinal lymph node and two untyped *M. avium* complex, one from a histologically positive bronchial lymph node and the other from a club-forming granuloma in lung tissue. Mycobacteria were isolated from 17 specimens submitted from reactors with no visible lesions at slaughter.

During the year, there was a further decline in the use of Strain 19 vaccine. Its use was encouraged in dairy herds, but discouraged in beef areas except in infected herds and those exposed to risk of infection. There was also a slight fall in the use of Strain 45/20. This vaccine is used mainly in infected herds in extensive areas where segregation of weaners is practised as part of a two-herd eradication programme. In most instances, simultaneous eradication of tuberculosis and brucellosis is being attempted and this approach is encouraged by veterinary staff.

Stud herds are being encouraged to enter the brucellosis accredited free herd scheme because cattle from stud herds are dispersed widely and it is important that they be free of brucellosis. The scheme requires at least three clean tests at 6-monthly intervals and satisfactory maintenance of quarantine and inventory. Initial testing and scrutiny of inventory and isolation are undertaken by Departmental officers, but further tests are to be carried out by veterinary practitioners on behalf of the Department. There has been an encouraging response from stud breeders in the Rockhampton, Toowoomba and Brisbane Divisions.

Because of difficulties in having brucellosis reactors slaughtered at meatworks, the opportunities for field research on this disease are limited. However, it was possible to

perform cultural and biological tests on material from one group of cattle from an infected property. The results indicated that animals giving a strong reaction to the Rose Bengal Test, but negative to the complement fixation test, may be culturally positive and should therefore be regarded as reactors. Further studies of this aspect are planned.

Comparisons have been made between the individual milk ring and the complement fixation tests. The former is a useful test for detecting chronic carriers of infection in the udder which often yield negative blood tests. An assessment was made of the significance of the 'suspicious' (1+) bulk milk ring test. Most herds with this test result yielded no reactors to blood testing.

Cattle tick

Due primarily to the succession of very favourable years culminating in the present one, there has been a major resurgence of cattle tick (*Boophilus microplus*) infestations in normally free areas, encompassing the Eastern Downs and South Burnett. At present, there are 275 properties under quarantine compared with 227 in 1974-75 and 188 in 1973-74.

There have been increased tick outbreaks in marginal areas such as Wandoan and Alpha, and these have often been associated with outbreaks of tick fever. In north-western Queensland, ticks have progressed up to 70 miles south of the tick line in the Julia Creek-Gilliat area and also into the northern end of Barkly Downs. This encroachment is considered to be due to four interesting factors—1. A succession of good seasons. 2. Cattle replacing sheep in the area. 3. Sheep fences which are not cattle proof. 4. Lack of dipping facilities to control ticks in the area.

During the year, 303 tick samples were tested for resistance to acaricides. Of these, 47 samples were Mt. Alford Strain, 217 Biarra, 2 Mackay and 11 Ridgelands.

It should be noted that only 26 or 8·4% of the samples submitted recorded no resistance. Biarra strain resistance is the dominant type and is widespread throughout the State, but the prevalence of Mt. Alford strain is increasing and it has been recorded from central and northern Queensland as well as south Queensland. A new acaricide, Amitraz (Taktic) was registered for use in dips and increases the range of medicaments available to combat Mt. Alford resistance.

Despite the depression in the cattle industry, graziers have sought the hire of the Department's dip moulds because of their efficiency and low construction cost. During the past year, 60 such dips have been installed. The provision by the Government of an acaricide subsidy was associated with an upsurge in tick treatments.

Except where biological control and/or planned dipping is practised, heavy tick populations on properties have been recorded especially in southern Queensland because of favourable seasonal conditions, and the slump in the beef industry. Graziers have been encouraged to use Zebu (*Bos indicus*) infused cattle as a means of effective biological control of this parasite.

Tick control is costly in labour and acaricides, both of which are in an inflationary spiral. Research has demonstrated that *Bos indicus* infused cattle have a high degree of tick resistance, and there is evidence that, on properties where Zebu crossbred cattle are run, cattle are overdipped.

In southern Queensland, the pest status of the cattle tick has increased because acaricide resistance has led to more frequent dippings and the use of more expensive acaricides. A logical approach to the alleviation of the tick problem and to delay the development of resistance to acaricides, is to use tick-resistant cattle.

Extension programmes have therefore been instituted to demonstrate the advantage of tick-resistant cattle and to make producers more aware of the cost savings which will result from less frequent dipping. Demonstrations are being conducted on properties in southern and central Queensland with the object of demonstrating that mild tick burdens can be tolerated without loss of production.

Immunological principles and techniques being applied in investigations of *Babesia* are being used at the Tick Fever Research Centre in studies on the immunology of tick resistance. The organizing role of a certain type of lymphocyte (T) was established by studies of infestations of sheep from which the thymus had been removed. Current studies suggest that the level of tick resistance attained by individual animals may not be wholly genetically determined, which gives some hope of manipulating the immune response of cattle to the disadvantage of the tick.

Tick fever

FIELD OUTBREAKS. *Babesia argentina, B. bigemina* and *Anaplasma marginale* were diagnosed from smears submitted to the Tick Fever Research Centre on 141, 24 and 35 occasions respectively. Some of the more serious losses due to babesiosis were 25 head at Cloncurry; 60, 50, 19 and 10 at Wandoan; 12 dead and 26 sick at Yandina; 15 dead at Arcadia Valley; and 40 at Kooralgin. In some instances, losses were the result of failure to vaccinate as a means of cost saving.

Some heavy losses were also attributed to anaplasmosis and included 40 dead out of a group of 600 at Richmond and 60 dead at a property north of Cloncurry. In both instances, vaccination and dipping were used to control the outbreak.

VACCINE PRODUCTION. About half the effort of the Tick Fever Research Centre, Wacol, is spent providing a vaccine developed in Queensland and unique in the world. The yearly demand for vaccine has ranged between about 700 000 and 1 400 000 doses in the last 10 years. A decreased demand has occurred over the last 2 years due to depressed economic conditions in the beef industry. A total of 872 842 doses was supplied during the 12 months ending 30 June 1976.

In the past, almost all the babesial vaccine requirements has been for *Babesia argentina,* but, in recent years, there has been an expanded demand for vaccine against anaplasmosis and, more recently, there has been a need to include *B. bigemina* in some batches of vaccine. *B. bigemina* is a parasite with different biological characteristics from *B. argentina* and one for which vaccine production methods are not so clear-cut. Some of the demand for *B. bigemina* vaccine has been for cattle selected from the southern States for export overseas. Safety and effectiveness therefore become even more important than previously as does the need for purity and freedom from extraneous infective agents. As the only source of reliable vaccines of this type in the world, this Department has an unavoidable responsibility to ensure that the best possible results are obtained.

Research

A major programme of research on tick fever is undertaken by the Division. This work receives generous assistance from the Australian Meat Research Committee and most of it is done at the Tick Fever Research Centre, Wacol. Other work is undertaken at the Animal Health Station, Oonoonba, and by field staff in the Veterinary Services Branch.

The first is related to attempting to find rapid solutions to problems that arise during the day-to-day provision of the vaccine service provided by the Tick Fever Research Centre. The second type of research could be termed basic or long-term, but is equally important because it is an attempt to find solutions for problems that do not yield to trouble-shooting approaches. Success in this type of research could lead to sudden large improvements in our methods of dealing with tick-borne diseases in Queensland, perhaps through the application of a previously unknown and unthought of principle or approach.

The goal of providing cheap, effective and safe vaccine seemed to be realized in the mid 1960s, but widespread use and changing needs have provided a steady supply of problems for investigation since then. In the late 1960s vaccination was causing an incidence of deaths in new-born calves because certain cows developed antibodies following vaccination. These antibodies destroyed the calves' blood when colostrum was ingested. This was solved by reducing the antibody-stimulating component of the vaccine to harmless levels. At the present time, vaccination failure in certain groups of cattle is causing some concern.

In regard to vaccination failure, it should be emphasized that cattle in the Queensland tick environment are much better vaccinated than left unvaccinated. Collaborative work between field staff, laboratory staff and a number of producers in south-east Queensland provided the information that almost half the yearling cattle on the properties surveyed were at risk to tick fever and should be vaccinated. Tick fever occurred in vaccinated cattle, but the incidence was about 1% in contrast to an incidence of almost 18% in the unvaccinated controls.

Although instances of vaccination failure have been rare, on occasions they have resulted in severe loss to individual owners. It is now probable that through a combination of factors relating to the initial vaccination and the subsequent field challenge, some groups of cattle suffer more severely than if they had not been vaccinated at all.

Some insight into this problem was gained recently when it was shown that a strain maintained at the laboratory had the capacity to break through immunity conferred by other strains. In fact, this strain had been used as a vaccine strain itself for some time before it suddenly exhibited aberrant behaviour when used for re-vaccinations.

This problem provides a good example of how applied and basic work are undertaken. Following the reports of losses due to re-vaccination, the strain involved was withdrawn immediately, and an investigation was undertaken to incriminate this strain, the strains used at previous vaccinations or the general method of laboratory maintenance of vaccine strains.

Now that it is known that 'break-through' strains exist, these can be avoided for vaccine, and an explanation given for unexpected losses in the field. However, it is necessary to try to reduce distressing losses of this type, and to elucidate mechanisms of immunity of cattle to tick fever parasites so that means to fortify this can be rationally applied.

To this end lymphocytes, key cell types in immunity, have been studied in the laboratory for several years. Considerable immunological information from studies throughout the world on small laboratory animals is now available to guide current research with cattle.

Very satisfactory methods of growing vaccine lymphocytes have been developed, and we may now be able to determine under what circumstances lymphocytes react to lead the host into a susceptible state rather than to protect against parasitic attack.

It was confirmed in an experiment at the Animal Health Station, Oonoonba, that aged cows have a much more severe disease following initial exposure than younger cattle. This finding has a practical implication in that, if herds are being moved from clean to 'ticky' country, more care would be needed with the older animals. In another experiment at this Station, it has been shown that the age at which an animal is vaccinated against *B. argentina* has no effect on the duration of the ensuing immunity. Current work at Oonoonba is being directed towards an evaluation of weight losses resulting from tick fever infections.

The risks of significant contamination appear slight with precautions currently taken during vaccine manufacture. This view is reinforced by the fact that, during 12 years of production, there has been no evidence of untoward results of vaccination, resulting from the inclusion in vaccine of any unwanted agent. Animals before being used for vaccine are now intensively screened by serological, haematological and parasitological means. Nevertheless, there is continuing concern that an unwanted agent could occur because the vaccine is prepared in the tissues of the same species of animal for which the vaccine is to be used. It would be very advantageous if *Babesia* could be grown in the laboratory to provide the ingredients for vaccine.

This is a long term aim of the Tick Fever Research Centre and has not been possible using an empirical approach. It has been necessary to develop a programme of basic research into the physiology of the parasite. A better understanding of its metabolic needs is being gained and this could lead to a rational approach to *in vitro* culture.

Other unconventional approaches to parasite production away from the bovine host include attempts to adapt *Babesia* to mice and the use of tick larvae infected with *B. argentina*. It had been believed essential for ticks to feed to activate infective babesial forms but, very recently, the Centre has shown that this can be achieved in unfed larvae under certain conditions of temperature and humidity. This finding removes a major practical barrier to utilizing babesial stages of the tick as an inoculum.

Investigations of relationships between *Babesia* and its tick vector have led to the interesting finding that if a strain of *B. argentina* is transmitted from animal to animal by infections of blood, and not allowed to undergo a natural passage through ticks, the *Babesia* will eventually lose the ability to infect ticks or be transmitted by them. Several strains have been tested for infectivity for two strains of ticks. At least four laboratory strains of *B. argentina,* three of which are currently used in vaccine, will not infect ticks. Thus, there can now be no risk that vaccination on one property could lead to a tick fever outbreak in a neighbouring herd.

The reasons for the loss of infectivity is not known, but could be related to a change in the enzyme system of the *Babesia*. When the development of the organism is followed after it has been ingested by the tick, normal forms readily invade the body of the tick by piercing the gut wall. Non-infective forms, however, complete a limited cycle within the gut before degenerating. The possible existence of an enzyme necessary for the *Babesia* to digest its way out of the tick's gut is being investigated by biochemical means.

It was observed in 1899 that the virulence of *Babesia* declined when it remained in the one host for any length of time. This principle is being used to overcome the pathogenicity of laboratory-maintained *B. bigemina* so that a safe vaccine can be prepared.

To overcome another probem, that of poor infectivity of blood from carriers given in vaccine-sized doses, calves are splenectomized 2 to 3 months after recovery from a primary infection with *B. bigemina*. The parasites that reappear in appreciable numbers in the blood following this procedure are either used immediately or frozen and used subsequently as vaccine or frozen and used to infect a susceptible splenectomized calf which becomes the donor of vaccine. In all cases, the parasites produce reactions much less severe than those resulting from inoculation with rapidly passaged *B. bigemina*.

A long-term basic study that has produced practical dividends is the viable preservation by freezing of blood parasites in liquid nitrogen. Parasites are frozen and recovered alive in may other laboratories, but close attention has been paid at the Tick Fever Research Centre to defining optimal conditions for freezing, storing and subsequently thawing and using the material.

Babesia have been found to require different conditions from other parasites for maximum recovery. The definition of these conditions has allowed economical storage of strains on which the vaccine is based, some parasites actually used as vaccine, and also numerous strains and species used in experimental work. The pioneering work done has opened the way to providing a bank of frozen vaccine should this ever become necessary.

In work on anaplasmosis at the Animal Research Institute, Yeerongpilly, the close association of the cattle tick (*Boophilus microplus*) with anaplasmosis was confirmed in a statistically designed serological survey. The prevalence of complement fixing antibodies was 42% in the ticky areas and 0·4% in non-ticky areas and was considerably higher in herds exposed to moderate to heavy tick infestation than in those with light tick infestation. Most clinical cases of the disease occurred in the latter group and occurs within a higher frequency in autumn and winter.

In experimental work at Yeerongpilly, the disease could not be transmitted by the New Zealand cattle tick (*Haemaphysalis longicornis*).

Other diseases

Johne's disease is a chronic, incurable disease of cattle associated with scouring and wasting and is caused by *Mycobacterium paratuberculosis*. It does not normally occur in Queensland and there was only one recorded case before this year.

During early 1975, stud Friesian cattle were introduced to a farm at Millaa Millaa from a Victorian property and in June 1975 Johne's disease was confirmed on the property of origin in Victoria.

Investigations showed that the Millaa Millaa farm had, in fact, introduced 13 cattle from Victoria during the previous 2½ years and one animal introduced 2½ years ago from the the same property in Victoria was scouring severely, was emaciated and had acid fast organisms in rectal smears. This cow was autopsied and a diagnosis of Johne's disease was confirmed at the Oonoonba Animal Health Station. The eldest daughter of this cow on the farm at Millaa Millaa was also autopsied and the disease confirmed. In utero infection commonly occurs in infected cows and it is probable that this animal was infected by this means. Specimens were also obtained from a draft of culled cows which included the youngest and only surviving progeny of the original case. All proved negative on histological examinations of sections, although cultural results are still to be received.

All animals sold to other properties have returned negative results on faecal culture, so have all other animals on the property. An atypical mycobacterium resembling *Mycobacterium phlei* was cultured from the faeces of one animal.

At present there is no evidence to suggest that the disease has spread on the property or to other properties. Complement fixation and intradermal Johnin tests will be used on all animals to give an indication of the degree of exposure that may have occurred. Provided these tests are negative, it may be possible to remove restrictions from all contact properties, leaving only the infected farm in quarantine.

The outbreak has involved a considerable amount of laboratory testing at the Oonoonba Animal Health Station and has taxed the bacteriology unit at that laboratory which has been working in temporary accommodation.

During May, a severe loss involving over 100 head out of 600 on a property at Wandoan was investigated. Symptoms included fever, inappetence, depression, salivation and scouring. Affected animals lost condition rapidly, were ataxic and moved slowly. Acutely affected animals had a brick-red muzzle, ocular and nasal discharge, injected sclera and some coughed. Erosions were present on the buccal mucosa and occasionally the tongue of some animals, and gum lesions were covered with a white cheesy material. No vesicular lesions were observed. Several autopsies were performed and specimens obtained for virological, bacteriological and histopathological examinations. Lesions observed included buccal erosions, erosions of the lower part of the oesophagael mucosa, abomasal erosions and catarrhal enteritis.

Infectious bovine rhino tracheitis (IBR) virus was isolated from eight sites (conjunctival nasal and oral swabs, blood, oesophageal ulcers, retropharyngeal lymph nodes) from three out of five animals autopsied on the property. A temperature rise, and ulcers of the gums, tongue, oesophagus and rumen were produced in transmission tests with two of the IBR isolates. There was also severe necrosis of the adrenals in one of the animals, which clinically showed depression and weakness, and less adrenal necrosis in the other.

Restrictions were placed on the infected property and also on adjoining properties and regular inspections maintained. It appears that the disease has ceased on the infected property and lateral spread has not occurred.

Ephemeral fever has been active in some parts of the State since August when it was confirmed at the Animal Health Section, Oonoonba, in a mob of travelling steers at Julia Creek from Normanton. During early August it was also reported in young stock in the Alpha area and from Rockhampton during September-October. Farther south, a few cases were subsequently reported from the Maryborough-Childers area. During the October-November period the disease was sporadic in the Rockhampton division.

An outbreak occurred at Millaa Millaa during mid November and spread to other parts of the Atherton Tableland. It was not until November that the disease was reported from the Maryborough division and reached its peak in the Bundaberg, Maryborough, North and South Burnett areas during late January and early February. It was active in the Brisbane Division from January to March and was widespread on the Darling Downs during this period. Outbreaks were reported from the Maranoa and far south-west.

The disease reappeared in north Queensland, being reported and confirmed in many areas. However, with the onset of autumn, the disease quickly began to fade. It is of interest that the recorded milk supply in a confirmed case at the Ayr Research Station decreased by two-thirds during the clinical course of the disease which was spread over 7 days.

Observations have been made on a variety of developmental abnormalities of young animals.

There is a need to determine the causes of these as there are several possibilities such as in utero virus infection, effect of plant or fungal toxins on the foetus and genetic defects. Akabane virus has been shown to be a cause of some syndromes of defective central nervous system development in New South Wales. This infection is widespread in Queensland.

Two calves from Wandoan were found to be suffering from hydrocephalus and cerebellar hypoplasia. Both calves had positive antibody titres for akabane virus, and both gave negative serological tests for mucosal disease, IBR, and ephemeral fever.

A full-term Santa Gertrudis calf at Toowoomba had severe arthrogryposis. The foetus showed a left thoracic scoliosis, severe cerebellar hypoplasia, and incomplete development of the spinal chord. Akabane virus antibodies were found in both the dam's sera, and the foetal pleural fluid.

In the Flinders River Basin project, which is a joint programme with C.S.I.R.O. Long Pocket Laboratories, there has been a high rate of antibody conversions except at Toorak Research Station. The majority of conversions occurred in the July–September period.

It is of interest to note that while *Culicoides brevitarsus* is the only insect from which akabane virus has been isolated, this insect is very scarce in the dry season. However, serology in this area clearly indicates a dry season spread. Under these circumstances, it is possible that another vector is associated with the transmission of this virus.

A hind leg lameness syndrome in dairy cows was investigated by incidence survey, clinical and pathological examinations and phosphorus supplementation trials. Samples of bone, blood, saliva, faeces, urine and milk were collected from lame and normal cows, some of which had received a phosphorus supplement of 30 g per day.

The disease was diagnosed as an arthropathy affecting either the coxa-femoral or femoro-tibial joints and was present in 30% of herds surveyed. Each owner reported two or three lame cows. The affected cows could not be differentiated from the normal cows on biochemical grounds but were clearly abnormal both clinically and pathologically. Previous nutritional status and methods of production cannot be ignored as predisposing factors of this syndrome.

A diagnosis of malignant catarrhal fever was made in two Banteng cattle. Although common in Victoria, this is the first diagnosis of this disease in Queensland. In Australia, the disease is sheep-associated and these are considered the symptomless carriers. The cause and epidemiology include many unknown factors.

There were some serious losses reported to be due to suspected botulism and, in some instances, this was associated with cost cutting, because graziers were avoiding the expense involved in vaccination.

During the year a survey was undertaken on the efficacy of botulism vaccination. Generally, vaccination of cattle against botulism is regarded as being relatively effective, but it appears that there are a number of vaccination regimes followed by stockowners. Bivalent vaccine is mostly used and the majority of stockowners in the Townsville Division vaccinate every 2 years. However, others vaccinate annually while some wait until losses before undertaking revaccination. This usually takes about 30 months following initial vaccination.

One property in the Ingham area which did not provide mineral supplementation or vaccinate against botulism lost all of 97 cattle in one particular paddock from suspected botulism. Other serious losses included the death of 60 heifers on a Oorindi property, 12 on a Merinda property and 9 each on properties at Childers and Tiaro.

Twenty-four head died overnight on a Wandoan property. Affected animals were observed to stagger and fall over, a flaccid paralysis was evident and feed fell from the mouth of affected animals. The turkey nest dam was filled with rotting vegetation which was regarded as a possible source of toxin, as 24 out of 40 animals in the paddock had died and all others were affected to varying degrees. The owner shifted the cattle immediately and the losses ceased.

Leptospirosis is widespread in Queensland causing calf losses, cow abortions and suspected abortions in mares, while its association with periodic ophthalmia in horses is suspect. The role of feral pigs is probably significant in the spread of this disease, when it is realised that 68% of 72 feral pig bloods obtained from various parts of Queensland in the past year yielded positive serological tests for *L. pomona*.

In experimental leptospirosis undertaken by the Beef Cattle Husbandry Branch, 687 breeders at 'Katandra' were vaccinated with a single dose bivalent *Leptospira hardjo-pomona* vaccine in October 1974. Of the vaccinated heifers, 7·5% failed to rear a calf compared with 11·4% of the heifers not vaccinated. Losses were also lower for vaccinated mature cows at 3·4% compared with 6·0% for unvaccinated cows. In 1973, losses were also lower for both vaccinated heifers and cows when a single dose of only *L. hardjo* was used. In contrast with that year, more vaccinated than unvaccinated first-calf cows failed to rear a calf (7·0% against 2·5%).

During the year, there were nine positive diagnoses of trichomoniasis in various areas of the State. Four of them were recorded in a meatworks survey at four works in southern Queensland in which 670 samples were submitted to the Animal Research Institute.

Twenty unvaccinated calves died from blackleg on a property in the Alpha district. In addition, the disease was reported in a number of areas in the east and west Moreton and the Burnett and it was also suspected on a property in the Julatten area.

Leucosis has become widespread and during the past year was diagnosed in herds at Childers, Gundiah, Wandoan, Drillham, Beaudesert and Gympie. Several herds are attempting eradication of this disease by regular bleeding and culling of suspect animals. Queensland is the only State in which this disease has been diagnosed.

As part of an investigation into bovine enzootic haematuria, a survey of cattle urinary bladders from three meatworks begun in 1974 is continuing. Bladders from cattle more than 4 years old were obtained, selecting particularly those from south-east Queensland. The bladders of 2 840 cattle from 180 properties have been examined and 180 of these from 72 properties have had lesions. Seventy of these were neoplasms of which 58 were fibroma, and three were proliferative lesions. In many of these, there was an associated chronic cystitis.

The past year has again been suitable for propagation and spread of buffalo fly (*Haematobia exigua*). In north-western Queensland, infestations reached as far south as Boulia although the incidence was lower than expected and appeared to be related to the level of activity of dung beetles. Heavy infestations were also reported north of Injune and Mitchell while, in the Charleville area, the fly was prevalent as far south as Wyandra and as far west as Coopers Creek.

On the southern coast, flies reached as far south as Maryborough during March, and became established throughout the Monto Shire and most of the Eidsvold and Mundubbera Shires and into the southern end of the Chinchilla Shire. This was the southernmost extension in coastal districts for many years.

Plague populations of stable flies (*Stomoxys calcitrans*) were reported from the Burnett areas where flies bred in dumped peanut shells during moist, humid weather conditions in February and many cattle were severely affected. Areas of skin especially the legs and shoulders were completely denuded of hair exposing raw flesh, which in some cases developed secondary infections. Dairy herds dropped in production and affected cattle refused to feed and lost condition quickly.

Trials to evaluate anthelmintic treatment of weaners were undertaken at Brigalow and Coolum Research Stations. At Brigalow, anthelmintic treatment was examined as another possible way to improve post weaning performance, but failed to improve substantially the liveweight gains of Hereford weaners on buffel grass. They were drenched at weaning in June and thereafter at 3-week intervals until the seasonal 'break' in October. Between June 1975 and late January 1976 (238 days), the undrenched steers gained 56 kg and the drenched steers 66 kg. Gains for heifers were 53 kg and 57 kg, respectively. Worm egg counts were low throughout and were mostly *Cooperia* sp.

The work at Coolum was undertaken because a survey of the wallum area in 1972 showed that weaner growth was a problem and internal parasitism was a likely cause. The work, which commenced in 1973, failed to show a liveweight response to anthelmintic treatment in any year. Weaners grazed nitrogen fertilized pangola pastures at five to the hectare throughout the winter and spring following weaning. In 1975, treated animals gained 0·61 kg a day and untreated ones 0·62 kg a day from May to December. Worm egg counts were generally low, with a majority being *Cooperia* sp. Steer weaners gained 0·64 kg a day and heifers 0·5 kg a day over this period, representing 598 kg liveweight gain per hectare over the 195 days.

Arsenic and lead were again the most important toxic agents causing stock losses.

At Burpengary, 10 head died and six were affected as a result of topping up an arsenical dip with arsenical weedkiller. The detergent content of the weedkiller increased skin absorption of arsenic. In all, 25 separate arsenic poisonings were confirmed by laboratory analysis. Lead poisoning was confirmed in 20 cases, the source of lead being identified in three instances.

At Emerald, seven head died after dipping in double strength Bercotox following upon treatment with Nexagan S 3 days previously. Six bullocks died at Eumundi after being drenched and dipped with O.P. preparations on the same day. A total of 44 out of 60 cattle died on a tobacco farm at Dimbulah after being sprayed with a mixture containing Nexagan S, gusathion and lanlate. The surviving animals responded to atropine treatment. It appears that, in the tobacco growing areas, gusathion is frequently involved with stock sickness.

Promicide toxicity was reported after cattle were dipped in promicide at Grantham. About 20 minutes after the dipping of 80 head, 12 became recumbent, grunted and were flatulent. The symptoms passed within an hour, and all animals recovered. Later that day, 10 animals out of 20 showed symptoms after being dipped in the same vat. These animals displayed kicking, stretching and groaning. Animals dipped before and after this day have shown no signs of intoxication.

Thirty-six cattle and 10 goats died near Mareeba after gaining access to sodium nitrate, a fertilizer obtained from Chile and used for side-dressings in tobacco growing. Affected animals displayed severe gastro-enteritis and tests supported a diagnosis of nitrite poisoning.

Abscesses were discovered in primal cuts in the boning room at Borthwicks, Murarrie. Specimens were taken and results indicated that the abscesses had been caused by an oil based injection. A classic case of osteohaemochromatosis was discovered after inspection at the Brisbane Abattoir, Cannon Hill. The meat from the carcass was passed fit for human consumption after boning out.

Monitoring for the national contagious pleuro-pneumonia campaign at meatworks ceased on 31 December 1975. Until that date, lung palpation had been carried out on selected drafts of cattle at the works at Townsville, Pentland and Merinda.

Suspicious lung lesions were forwarded to Animal Health Station, Oonoonba, for diagnosis, with negative results.

Bruising

Slaughtering and Meat Inspection Branch staff, in conjunction with Beef Cattle Husbandry Branch, C.S.I.R.O., the Australian Meat Board and co-operating producers and meat companies have continued a study of bruising in slaughter cattle. The aim was to pinpoint the more important causes and developing methods of eliminating these causes. During the year, seven trials were completed and a further seven are planned. Consignments of cattle from various properties under a range of conditions have been studied both in transit and at slaughter.

Effects of age, sex, breed, rail versus road transport, fasting before transport and modification of standard crates and wagons have been studied. Bruising increased with age and was heavier in cows than in steers. Fasting for 24 and 48 hours before transport increased bruising. Modification of standard crates had no effect on bruising though this aspect needs further study. Once again, trials confirmed that less bruising occurs with rail transport than with road transport over comparable distances.

The earlier studies, which confirmed the importance of horns as a cause of bruising, led to a stepping-up of Beef Cattle Husbandry Branch extension programmes on dehorning. Numerous demonstrations were given by advisers on properties and at field days. Through the media, producers were made more aware of the causes of bruising and the loss accruing to the industry as a whole from this source. A film depicting causes of bruising and methods of reducing losses has been planned and some sequences taken.

Slaughtering Branch officers at four centres are undertaking pH testing of beef carcasses to test the relationship between bruising and pH levels. The ictotest was carried out on several slaughter drafts to assess its value in ageing of bruises. No conclusions from these two studies have been reached to date.

Reproduction

Raising reproductive levels has long been recognized as being, for many producers, the easiest and least costly way of improving efficiency. Field investigations carried out in the 1960s showed how this could be done by regulating the time of mating and weaning; practices that can be carried out at an early stage of property development without high capital or recurrent costs. The general management principles are well understood, but in some regions their application needs further study.

Extension programmes relating to controlled mating and weaning were pursued in all regions. In one district, a study was made of the reasons why there has not been greater adoption of these two important practices. The results of an informal survey suggested that most producers would not give attention to improved management until they had achieved a relatively high level of property development.

High levels of dystocia affect branding rates in many herds. Field investigations in southern Queensland and on Brigalow Research Station have tried to sort out the various causes of dystocia. While the investigations are still continuing, the Beef Cattle Husbandry Branch embarked on an extension programme in southern areas to make producers aware of the methods that could be used to reduce their losses.

The major experimental work in reproduction relates to a comparison of the performance of breeders on Townsville stylo and native pastures, the effect of phosphorus supplementation, the effect of leptospiral vaccines on calving rates and studies on dystocia.

Nutrition

Extension programmes on supplementation were suspended as being inappropriate while beef prices are at such low levels. Despite the economic situation, some producers in the Maranoa supplemented or fed cattle during a dry period in 1975. In the Warwick area, a number of producers continued the practice of winter supplementary feeding, favouring the use of true proteins such as meat-and-bone meal and oil seed meals because their cost was favourable in comparison with non-protein nitrogen sources.

Feed lot fattening could be expected to be out of the question with current low beef prices and high grain and labour costs. However, at least five producers on the Darling Downs had cattle in feedlots during the year primarily to ensure turnoff. There are a few lots presently with cattle on feed to fulfil special orders for the Japanese market.

TOWNSVILLE STYLO. Animal performance on fertilized Townsville stylo at 'Swan's Lagoon' Cattle Field Research Station has consistently been greater than on predominately spear grass pastures. In the major reproductive experiment, 86% of lactating Brahman-cross cows grazing Townsville stylo were pregnant in 1973-74, but only 61% on native pastures. In 1974-75 pregnancy rates were 96% and 95% respectively. Total foetal and calf losses, however, have been consistently high on Townsville stylo. Losses on stylo were 16·8% in 1973-74 and 13·1% in 1974-75, compared with 9·6% and 5·5% on native pastures. Pre-natal calf losses among breeders grazing Townsville stylo have been approximately double those for cows on native pasture. Perinatal losses are variable, but post natal losses to date have always been higher on Townsville stylo.

Even at a stocking rate of two cows per ha, double the stocking rate on native pastures, calves reared on Townsville stylo pastures grew faster and so were heavier at weaning. Calves grazing Townsville stylo gained 0·8 to 0·9 kg a day before weaning, whereas those on native pastures gained 0·7 to 0·8 kg a day.

As the percentage of Townsville stylo increased relative to native pasture in the total pasture system, liveweight gains by Brahman-cross steers on stylo increased progressively. While the highest gains have been with 80% Townsville stylo to 20% native pasture (143 kg from May 1975 to April 1976) nevertheless, the inclusion of only 20% Townsville stylo lifted gains to 125 kg, a level approaching 80% Townsville stylo.

Restriction of grazing to the Townsville stylo during the wet season markedly reduced liveweight gains by an average of 23%. This is due to the effect of the increases in stocking rate, with differences in animal performance related to differences in available pasture and not quality.

This work and other work on nutrition at 'Swan's Lagoon' receives generous support from the Australian Meat Research Committee.

NON-PROTEIN NITROGEN. The possibilities of using less than 200 g molasses per head in urea-molasses supplements and the inclusion of extra sulphur are still under investigation at 'Swan's Lagoon'. Reduction of the molasses levels would lower freight, labour and handling costs. For the same reasons, dry lick supplements are being compared in another experiment with urea-molasses fed via drum lickers.

In two out of three years (1973 and 1975) reduction of the molasses level from 220 g to 110 g per head per day in urea-molasses supplements did not lower animal performance. In 1974, dry season liveweight gains by Brahman-cross steers were lower when only 110 g molasses was fed. The addition of sulphur improved animal performance during the dry season with 220 g molasses, but has not always done so with 110 g molasses. From May 1975 to March 1976, steers on native pastures gained 88 kg. Steers gained 97 kg when 220 g molasses were fed and 101 kg with 110 g molasses, and 100 kg and 103 kg, respectively, with the inclusion of 0·7 g sulphur. With 3 g sulphur and 220 g molasses a day, steers gained 110 kg.

During the first year of the dry lick study, considerable difficulty was experienced obtaining a satisfactory intake of salt plus urea and of salt plus urea plus sulphur. At the commencement of feeding in May 1975, salt and urea were fed, but acceptance was very poor until molasses was included. Intake problems continued until supplementation ceased in September following good rains.

Over the past 3 years at 'Brian Pastures' Pasture Research Station urea-molasses supplementation of weaner heifers has improved their performance during the winter following weaning. In 2 years, 1973 and 1975, 56 g urea to 240 g molasses per head per day increased liveweight gains between May and November from 7 kg to 20 kg and from 3 kg to 13 kg respectively. In these years, average weaning weights for all heifers were 165 kg and 163 kg. In 1974, when the heifers were heavier, 196 kg at weaning, and the protein content of their diet lower, unsupplemented heifers lost 22 kg. Supplementation, however, reduced the liveweight loss by 12 kg. Compensatory growth has not occurred in any year. At current beef prices, supplementation is not economic, despite the small liveweight advantage.

Urea supplements have also been used at 'Swan's Lagoon' and 'Brian Pastures' in an endeavour to improve breeding performance. At 'Swan's Lagoon', early rains in September of both 1973 and 1974 reduced the potential response period to dry season supplementation by Brahman-cross cows. As a result, final pregnancy rates for lactating cows were no higher than those for unsupplemented ones. Urea supplements reduced the interval between calvings from 361 to 353 days and to 343 days when phosphorus was included, for 1973 to 1974. However, the calving interval from 1974 to 1975 was reduced only for phosphorus plus urea supplements on native pasture (353 against 360 days). Supplementation did not lead to improved calf growth rates or weaning weights.

At 'Brian Pastures' in each year from 1970 to 1974, a low energy-urea supplement was fed to that year's maiden and first-calf heifers for 8 weeks before mating in an attempt to increase conception rates. Only in 1970 was this successful for maiden heifers, when the mean conception rate increased from 76% with the feeding of 2·26 kg grain sorghum per day. Weaning weights of the calves from the fed heifers were also higher.

In other years, 1972 and 1974, conception rates for fed heifers were 84% and 73%, or 4% and 5% lower than for the unfed ones. In 1971 and 1973, similar energy supplements were fed to first-calf heifers. Conception rates increased only in 1971 when 31% of the unfed heifers conceived, compared with 41% of the heifers fed 2·26 kg sorghum grain per day.

Energy supplements

The use under grazing of molasses at high levels has been under examination for a number of years because it is a cheap energy source for beef producers close to sugar producing areas. In each dry season at 'Swan's Lagoon' from 1972 to 1974, liveweight advantages of 9 kg, 23 kg and 27 kg resulted from *ad lib.* molasses feeding of Brahman-cross steers. Liveweight gains during the wet summer months have generally been similar for fed and unfed animals. Molasses intake is highest during the dry season, with conversion rates of molasses per kg extra liveweight about 25·5 kg. In 1975-76 when urea was included, the liveweight advantage at the end of the dry season was 17 kg, which had, by April, increased to 19 kg. From May 1975 to March 1976, the supplemented steers had gained 143 kg and the unsupplemented ones 124 kg.

At Kairi Research Station, an experiment is under way to study the effects of *ad lib.* molasses feeding on beef production from glycine-green panic pastures. Molasses feeding increased per animal and per hectare gains at each stocking rate of 3·0, 3·75 and 4·5 steers per ha, and it would appear that molasses may help preserve the pasture component at high stocking rates. Liveweight gains per hectare from May 1975 to March 1976 were 765 kg per ha for fed steers stocked at 4·5 per ha, while unfed steers at 3·0 per ha gained 495 kg per ha on basaltic soils. The corresponding gains were much lower on granitic soils at 693 kg per ha and 411 kg per ha respectively.

An energy supplement of molasses and 56 g urea per head per day fed to mature cows for 6 weeks before or after mating commenced, or both, has consistently failed to improve pregnancy rates at 'Brian Pastures'. Supplementation slightly shortened the conception to calving interval and also the intercalving interval.

For a number of years the Departmental 'home brew' has been recommended as a survival supplement, particularly for pregnant breeders in north Queensland. Pen studies were carried out at 'Swan's Lagoon' to see whether the cost could be reduced without reducing the effect. In a study with Brahman-cross weaners, urea and energy (sorghum grain plus molasses) gave the greatest improvement in animal performance when fed with native pasture hay.

Of the other ingredients, meat-and-bone meal and phosphorus appeared to contribute little. Salt acted only as an intake regulator. The practical significance of phosphorus must depend on the class of cattle being fed—whether breeders or not. These studies will now examine the possibilities of replacing grain with molasses and the use of higher molasses levels.

A series of experiments conducted by Husbandry Research Branch at the Hermitage Research Station, Warwick, has examined the efficiency with which supplementary grain is utilized by roughage-fed cattle. These experiments suggested that grain utilization by grazing cattle would be comparable with that of lot-fed cattle. In testing this hypothesis, steers were either fed a range of levels of forage-harvested oats in yards or grazed oats at a range of stocking rates. All except two control groups were supplemented with hammer-milled sorghum grain.

Carcass growth rates ranged from 0·23 to 0·86 kg a day for grazing steers and from 0·46 to 0·84 for yard-fed steers. Conversion of grain dry-matter to carcass gain was 0·080 kg carcass per kg grain (12·5 kg grain per kg carcass) for yard-fed steers and 0·086 kg carcass per kg grain (11·6 kg grain per kg carcass) for grazing steers. There is little doubt that grain utilization by cattle grazing oats is comparable with that by yard-fed cattle.

The implications of these results are—

1. Grain available for feeding to cattle can be utilized as efficiently by cattle grazing good quality pasture as by lot-fed cattle. However, the grazing system requires much less capital outlay and has much greater flexibility of operation.
2. The efficiency of grain utilization is independent of the level of grain feeding, provided overall feed intake is not restricted and pasture is not wasted.
3. The level of substitution of grain for forage demonstrated here (approximately 60%) indicates that supplementary grain can also play an important role in manipulating the grazing pressure on the pasture. It can be used as an aid to maximizing productivity of good quality pastures.

Dairy x beef animals are a potential source of additional income to both beef and dairy cattlemen, especially if reared and sold as prime yearlings. The use of grain supplements to ensure turn off of such yearlings is being studied on irrigated temperate grass-legume pastures at the Gatton Research Station. Sorghum grain supplements fed at 1 kg and 2 kg per 100 kg liveweight improved gains, carcass weight and fat cover of dairy beef calves. Conversion ratios of grain per kg extra liveweight gained were 9 kg and 11·6 kg respectively. The unfed animals lacked sufficient fat cover (2·5 mm) and weight (135 kg) to meet local trade requirements of 3 to 6 mm fat at 160 to 190 kg carcass weight. The high grain fed animals dressed 179 kg with 7 mm fat cover, with some tending to be overfat and should have been turned off earlier if under commercial conditions. Those fed 1 kg grain per 100 lb. liveweight dressed 165 kg with 4·8 mm fat.

In more basic work on energy evaluation of feedstuffs for ruminants, the Biochemistry Branch has shown that there are characteristics of food that can be chemically determined and which explain a large part of the variation in energy value between foods.

A biological method for determining the unexplained variation has now been developed. It relies on the interpretation of fermentation gas production patterns when food is fermented in rumen fluid.

MINERALS. The use of a rib biopsy technique for measuring changes in the phosphorus status of cattle was investigated by the Husbandry Research Branch. A series of three experiments involving growing heifers and steers and mature non-pregnant, non-lactating cows fed diets either adequate or deficient in phosphorus was conducted to elucidate the sources of variaton and the value of the technique for experimental and diagnostic purposes.

It was found that the position of the sampling site on the twelfth rib and the frequency of sampling, if less than once every 2 months, were factors to be considered when comparing serial biopsy values. There were no differences in rib values between heifers and steers fed a diet deficient in phosphorus. Phosphorus was found to be more easily removed from the twelfth and thirteenth ribs than from the eleventh.

There was poor agreement between duplicate biopsy samples. A component of variance analyses revealed that the number of samples was the only factor affecting the precision as no distinction could be made between the number of ribs sampled and the number of samples per rib on the basis of variance.

For a complete description of the bone samples, it was necessary to express the calcium or phosphorus in the following terms: weight either per volume (mg per ml) or fresh weight (g per 100 g FW); weight per fat free dry weight (g per 100 g FFDW); weight per ash weight (g per 100 g ash).

Whole bone samples which comprised cortical and cancellous bone were found to be less sensitive in reflecting dietary change in mature cows than the cortical samples, from which the cancellous bone had been pared. This cancellous bone may be useful but further information is required.

This technique offers a sensitive method for detecting changes in rib bone mineralization caused by alterations in dietary phosphorus levels.

As phosphorus deficiency is known to be widespread in parts of south-western Queensland, observations were continued at 'Moombidary', south-west of Cunnamulla. Final 1975 pregnancy rates were 93% for supplemented cows and 94% for replacement heifers after 5 months' mating, while pregnancy rates were 88% for the unsupplemented ones. For the third successive year, 5% more supplemented than unsupplemented breeders were pregnant, with a difference of 2% in 1972.

In previous years, pregnancy rates for the unsupplemented breeders were 79% (1974), 91% (1973) and 91% (1972). Because of the good seasonal conditions, 75% of all lactating cows were unable to maintain forward store body condition or better to September. Not only did the final pregnancy rate favour the supplemented breeders but, by the end of the fourth month (April), 58% were pregnant compared with 51% of unsupplemented breeders.

Except for 1974, weaning weights did not differ between calves weaned from supplemented and unsupplemented breeders. Their respective 1975 weaning weights were 198 kg and 202 kg, at an estimated mean age of 260 days. For the years 1972 to 1975, the estimated weight gain per day of age was 0·85 kg and weaning weight averaged 180 kg.

Availability of surface water greatly influenced phosphorus intake. Intakes increased as surface waters dried up, and cattle depended more on the watering point dispensing the phosphorus supplement.

The Biochemistry and Beef Cattle Husbandry Branches have collaborated in a survey of pasture and water sodium levels in southern and central Queensland districts. This is part of an on-going survey of likely incidence of sodium stress in beef cattle. Of particular interest has been the recording of low sodium levels in surface water from seven properties in the brigalow belt south and west of Miles. Values ranged from 10 to 70 p.p.m. sodium (Brisbane water has 40 to 60 p.p.m. sodium).

Genetic improvement and breed evaluation

Most measures taken to improve efficiency involve an annual recurrent cost. Genetic improvement of livestock represents a permanent 'gain' with no annual input. Consequently a major objective of the Beef Cattle Husbandry Branch is to get producers to understand and apply the principles of objective selection of cattle, at a level appropriate for their enterprise, so that ultimately there will be a permanent lift in total herd productivity. Cross-breeding is also a technique used to achieve the same objective.

Despite a depressed state of the beef industry, new enrolments in the National Beef Recording Scheme continued at a low level. Queensland has now 68 herds enrolled with the NBRS 'basic unit'. In addition to those, several herds are performance recording in the Simmental and Limousin 'performance-pedigree' system which is a companion to the 'basic unit'. There are also a number of properties involved in various forms of 'do-it-yourself' performance recording under the guidance of branch field staff.

At the national level, it has been estimated that 5% of all bull-selling units are now enrolled in performance recording schemes of various forms. It is expected that this percentage will increase markedly with the development of the 'performance—pedigree' system.

These schemes provide breeders of stud stock with an option to record performance data when making the normal registration. It considerably reduces the amount of work involved in performance recording among stud breeders. Several breed societies are already providing this service to members.

At present, the NBRS 'basic unit' is being re-programmed and updated. Extension staff and producers in all States have been consulted on alterations to the programme which is expected to be operational early in 1977.

In the central performance test at the Animal Husbandry Research Farm, Rocklea, 24 Poll Herefore bulls were tested and the two best selected as semen donors for the Artificial Insemination Centre, Wacol. Over the liveweight range of 250 to 400 kg, the selected bulls grew 0·2 kg a day better than average and had a feed conversion ratio 1·2 better than average.

A long-term programme of work on breed evaluation continued. It would be impossible for the Division to examine all the breed combinations likely to be adopted in Queensland and the programme has had to concentrate on a few selected breeds. Co-operation by several breeders in central coastal Queensland ensured a continuing comparison of various *Bos indicus* crosses, including the Belmont Red, Droughtmaster, and Brahman x Hereford.

Work continued on a study of Sahiwal and its crosses, and Simmental-Hereford crosses, and a programme to study the Belmont Red was begun. The objective of all this work is to find out whether there is any significant difference between breeds in relation to fertility and weight gain, and whether there are any environment-breed interactions so that the extension staff will be in a position to help producers choose the breeding programme most appropriate to their own situation.

In the large-scale Simmental evaluation programme at Brigalow Research Station, the first of the F_1 Simmental x Hereford progeny were mated in October 1975. Simmental-cross bulls were mated to both yearling and 2-year-old Hereford heifers, with 95% of heifers of both ages pregnant. Similarly, Hereford bulls were mated to both yearling and 2-year-old Simmental-cross heifers, with 85% and 95% of heifers pregnant, respectively. These heifers are due to calve in July 1976.

Although dystocia was not a problem in 1975 compared with previous years, the influence of the larger Simmental breed was again most evident. For the third year, first-cross Simmental calves experienced more calving difficulty than straight bred Herefords (3·6% against nil). The incidence of stillbirth was low and similar in each breed, being 0·9% for Simmentals and 0·7% Herefords. Heifer deaths of 1·8% were higher for heifers in calf to Simmental sires, in contrast to 0·7% for Herefords. The post-weaning growth of F_1 Simmental x Hereford and Hereford steers is being compared on improved brigalow pastures.

The resistance to ticks of Hereford and Simmental x Hereford yearlings was compared following two artificial infestations of ticks. Over the 44-day experimental period, Simmental crosses grew faster despite their heavier tick burdens. Mean tick counts per side was 345 for Simmental-cross steers and 221 for Herefords after the first infestation. Mean count for Simmental-cross heifers was 493 and 428 for Herefords. Counts were much lower following the second infestation.

Growth and carcass characteristics of Simmental-Hereford (S x H) cross steers were compared with those of Hereford steers on a high plane of nutrition (high grain diet) from a mean weight of 218·2 kg to slaughter at either 420, 460 or 500 kg liveweight at the Husbandry Research Farm, Rocklea. The average daily gain of the S x H was 1·20 and significantly higher than the Hereford (1·06 ± 0·41 kg a day). Although the S x H had a greater dry matter intake (8·34 v. 6·75 ± 0·30 kg a day) for the steers slaughtered at 500 kg, this difference was not consistent for the other slaughter groups. The feed conversion ratios were not significantly different (6·63 v. 6·95 ± 0·187).

At each slaughter weight, the S x H were significantly leaner than the Hereford resulting in a greater percentage yield of salable meat (70·4 v. 66·5 ± 0·44). With some trimming, S x H slaughtered at 420 and 460 kg liveweight met the requirements for the local market, whereas the Hereford and the 500 kg S x H were overfat at all slaughter weights.

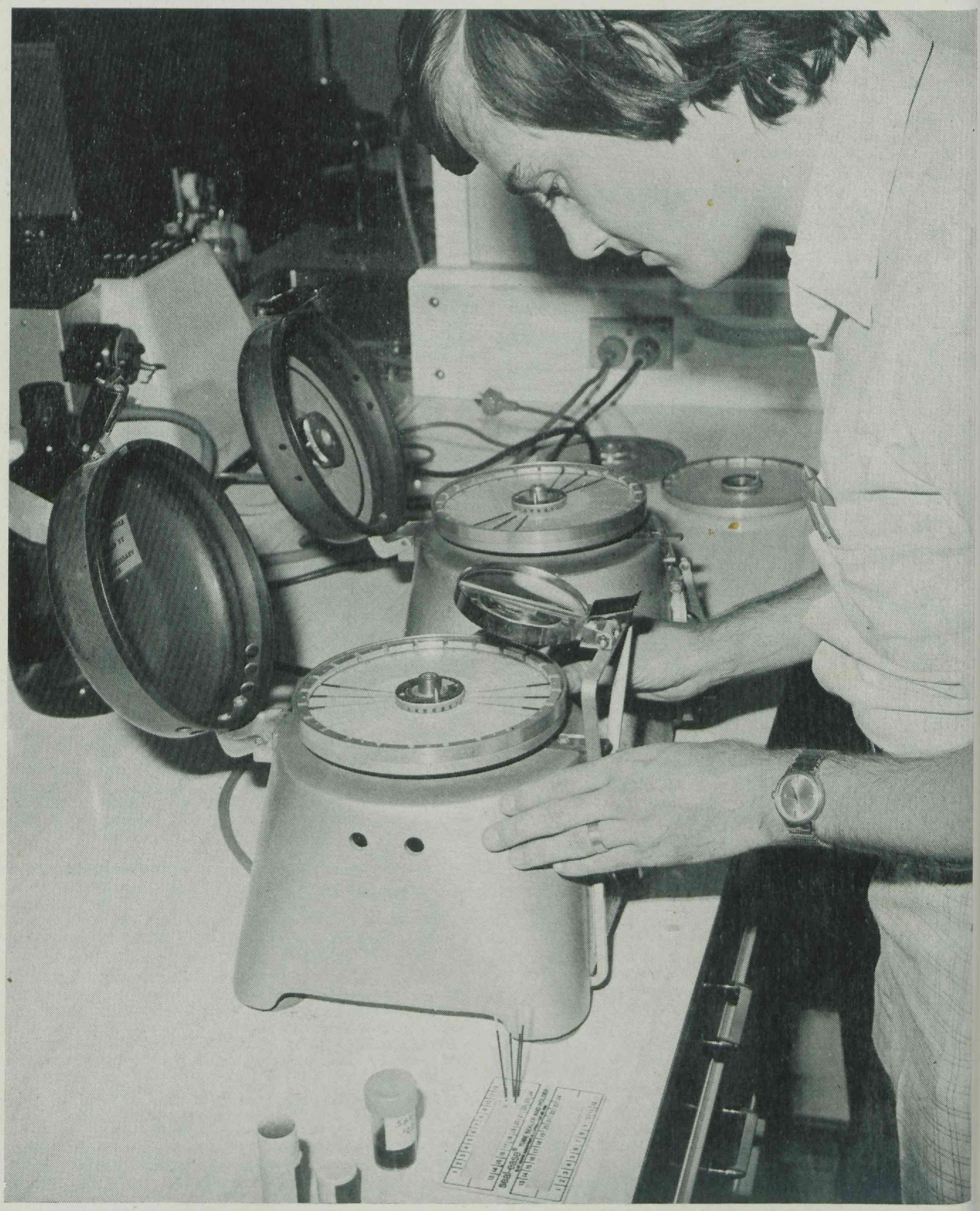
The grading-up programme to pure Sahiwal continues at 'Swan's Lagoon'. The first seven-eighths Sahiwal calves were born in 1975 and pure Sahiwal (fifteen-sixteenths) calves are expected in 1978. The performance of F_1 Sahiwal x Shorthorn and F_1 Brahman x Shorthorn continues to be similar, except for higher foetal and calf losses for the Sahiwals. For example, in 1974-75, total losses from pregnancy diagnosis to weaning were 12·0% for Sahiwal and 8·2% for Brahmans. For 1975–76, pre and perinatal losses are 7·1% and 5·2% respectively.

From 1972 to 1975, 377 three-quarters Brahman calves and 184 three-quarters Sahiwal calves have been born. The three-quarters Brahman calves are heavier at birth averaging 33 as against 29 kg for Sahiwals. This advantage increased during the pre-weaning period to the extent that three-quarters Brahman calves averaged 181 kg and three-quarters Sahiwal calves 173 kg, when liveweights are corrected to 180 days.

A new major project at the Brigalow Research Station was started during the year to evaluate the performance of F_1 Africander x Hereford crosses against Herefords. Stage 1 (1975–1980) of this project involves three matings of Africander and Hereford sires to Hereford cows. The pre-weaning and post weaning growth of all progeny will be compared, plus the reproductive performance of the heifers and carcasses of the steers.

Stage 2 (1977–1982) includes monitoring the performance of Africander x Herefords when grading up to a Belmont Red herd. Again, the performance of the Belmont Red progeny will be compared with that of Herefords run under the same conditions.

The interest in the Australian Friesian Sahiwal (AFS) is increasing because of its greater resistance to ticks than the Friesian. The growth and carcass characteristics at 500 kg and 600 kg liveweight turn-off of the AFS and Friesian steers are now being studied at Kairi Research Station. Friesian and AFS steers will graze glycine-green panic pastures at a stocking rate of 2 steers to the ha. The previous experiment demonstrated the superior growth of the larger Friesian breed over Brahman and Shorthorn steers. The carcasses of Friesians, however, lacked finish unless taken to at least



Measuring the concentration of blood cells in blood at the Tick Fever Research Centre, Wacol. Because tick fever causes destruction of blood cells, monitoring their concentration is important in a number of experiments relating to this disease.

500 kg liveweight. The earlier-maturing Shorthorn and Brahman provided better finished carcasses when turn-off was at 450 kg liveweight.

Among the breeds being evaluated in co-operative work with producers are the Africander, Belmont Red, Sahiwal and tropical breeds, Droughtmaster and Braford. The Brahman-cross and Hereford are usually the base breed used for comparison. Experiments are being conducted on properties in north-west Queensland, in the brigalow belt and forest country of central Queensland and in the wet tropics. Results from earlier trials are already being used extensively by extension officers.

At 'Mt. Eugene', near Jambin, cows mated to Brahman bulls have generally had lower pregnancy rates than those mated to either Hereford or Belmont Red bulls. Belmont Reds have been highest in most years. In 1974-75, pregnancy rates for cows mated to Belmont Red bulls were 86%, Herefords 86%, Droughtmasters 75%, and Brahmans 76%. Liveweight gains before weaning tend slightly to favour Brahman-sired calves over Herefords, with Belmont Red and Droughtmaster calves intermediate. At 2½ years, Brahman steers born in 1973-74 weighed 474 kg, Droughtmasters 473 kg, Belmont Red and Herefords both 468 kg.

Final pregnancy rates for 1974-75 were again very satisfactory for Droughtmaster breeders grazing Mitchell grass downs country at 'Katandra', south-west of Hughenden. After a 3-month mating period beginning in February, 86·7% heifers were pregnant, 92·5% first-calf cows and 95·4% mature cows. The herd averaged 94·5%. In the previous 2 years, the herd average was 92·2% (1973-74) and 88·2% (1972-73). Most conceptions occurred within the first month of mating in 1974-75 and 80·3% were pregnant at the end of February.

Furthermore, 91·8% of lactating first-calf cows were pregnant. This year's lower pregnancy rate for maiden heifers in comparison with 1973-74 was attributed to the presence of a higher number than usual of immature animals. Breeders again maintained forward store condition through the dry season.

Management

This year has again been a difficult one from the point of view of extension. Programmes leading to increased production are inappropriate with the continuing low beef prices and over-supply of cattle.

Emphasis has therefore been placed on management aspects that will help to reduce the cost of production but will, at the same time, maintain a high level of production efficiency.

Retrenchment of staff on cattle properties has thrown a severe strain on property and herd management. Extension staff are actively encouraging producers to continue to use proven, low-cost management practices with a view to maintaining production efficiency. High among these is breeding herd management where controlled mating and strategic weaning programmes are important factors in achieving production efficiency. While their influence may not be so great under good seasonal conditions, they will be important safeguards in the event of the inevitable return to unfavourable seasonal conditions.

The current high cost of feedstuffs in relation to cattle values will inhibit the implementation of survival feeding programmes in the event of drought. The emphasis has been placed on the cost saving aspect of these practices rather than the long term objective of raising production.

One major activity has been to pass on from one producer to another, novel, cost saving ideas and techniques. At the same time, a start was made on more detailed investigations into cost structures and optimum use of labour.

Beef extension officers have promoted spaying of surplus female cattle as a management tool which not only limits further over-production, but also reduces drought risk and helps to ensure marketing of these surplus cattle. Several officers were actively engaged in demonstrating spaying techniques and, as a result, large numbers of cows and heifers have been spayed during the last 2 years.

A survey of the beef industry, with the prime objective of finding out what effect the recession has had on management, and what might be the most effective form of assistance, was started in early May. Preliminary results are expected in August. A total of 600 producers was interviewed with the help of officers from a number of branches.

One objective of extension staff is to be able to answer requests for written information on all aspects of beef cattle husbandry. District officers have developed a collection of handouts while progress has been made on compilation of a comprehensive manual of beef production for Queensland.

Sheep industry

While the Sheep and Wool Branch's broad objective of helping producers to be better able to make their decisions remains unchanged, variations in the industry require frequent changes in emphasis. In recent times, labour and material costs have increased while prices for the industries' products have failed to increase sufficiently to maintain comparable profitability.

As a result of this cost-price squeeze, the industry is tentative and uncertain and a number of management and social changes have occurred. Labour is difficult to obtain and is costly. A 30% reduction in the male work force is recorded for the shires in the pastoral sheep areas. More of the younger generation are leaving and the average age of the rural population is increasing. This change helps to accelerate the present lack of amenities and as such the pastoral zone holds little or no attraction to young people.

To combat these developments, a number of changes are being introduced into the industry. Mechanical devices have been developed to reduce the labour requirement and expense of many sheep operations and, of economic necessity, sheep handling operations have been reduced to those which are absolutely necessary.

Marketing changes have been introduced. Wool is now sold by objective measurement at a guaranteed price. The price paid is based on the 21 mμ wool at 250c per kg clean. This price is discounted for yield, grass seed contamination, tenderness, dust and thicker diameter. One estimate shows that the wool producer actually receives only 40 to 50% of this indicated price on a net basis.

Along with the floor price scheme, an alternative system of classing has been introduced. This scheme is designed to lessen the fragmentation of the wool clip and help prevent rapid escalation of marketing costs.

The number of sheep on the coastal plains is increasing. British breeds and their crosses predominate in these areas. At present, these are supplying localized prime lamb markets. With the continued low beef prices, enquiries on this enterprise have been increasing.

Alternative industries are being investigated. The mohair industry is one such industry. Though numerous enquiries are received, there has been little expansion in the western sheep areas.

Within this atmosphere of uncertainty and economic pressure, the Sheep and Wool Branch has developed programmes which are designed to assist the producers in alleviating some of these problems.

These include the investigation and promotion of devices and techniques which will reduce labour requirements for necessary sheep operation, promotion of objective clip preparation and sale by samples, investigation of the potential of Angora goats, and examination of new methods of wool harvesting.

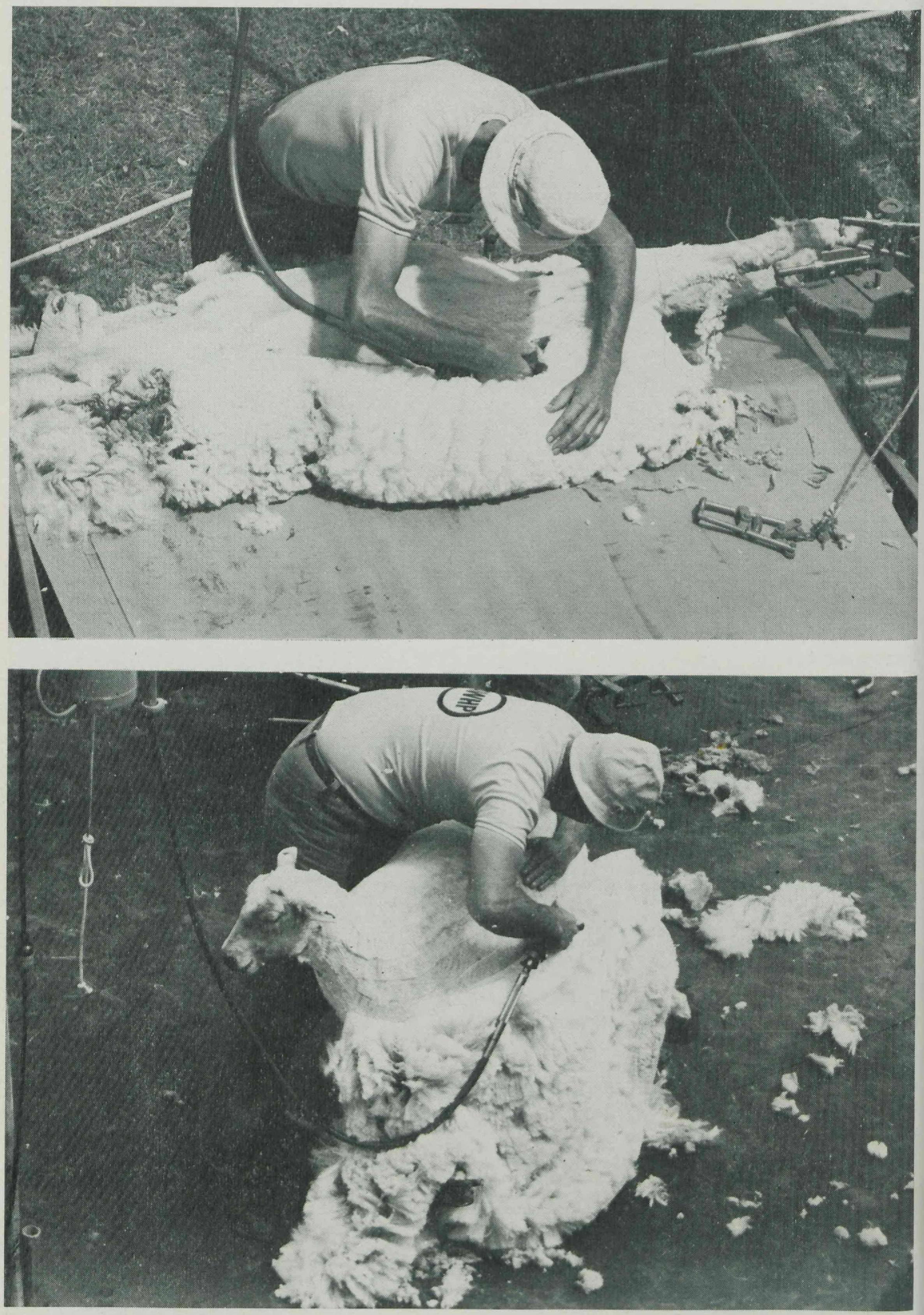
Sheep research, which is undertaken by the Husbandry Research Branch at Toorak Sheep Field Research Station, Julia Creek, and Charleville Pastoral Laboratory has concentrated on factors limiting reproduction, lactation and productivity, the development of innovations to harvest wool, methods of control against blowfly strike and factors affecting utilization of mulga (*Acacia aneura*).

Studies with mulga

In previous work, supplementation of penned sheep with 50 g dry matter molasses resulted in an increased consumption of mulga. Since molasses is expensive to transport to areas in Queensland where mulga grows, studies were undertaken this year to determine the nutrients in the molasses responsible for the increased intake. The ash from a similar amount of molasses produced an identical response, indicating that the mineral content of molasses was responsible rather than the increased energy supplied by it.

In an experiment this year using funds granted by the Wool Research Trust Fund, molasses increased the intake of mulga over that of control sheep by 59·3% over an 8-week period where drenching with sodium sulphate and calcium sulphate increased intake by 46·7% and 40·1% respectively. This was associated with a weight loss of 3·6 kg in the control sheep and a weight gain of 4·6, 2·3 and 1·4 kg in sheep receiving molasses, sodium sulphate and calcium sulphate respectively. Wool growth was increased by 21·4%, 39·6% and 38·5% by molasses, sodium sulphate and calcium sulphate respectively. Thus at least part of the response from molasses is attributable to sulphur.

Further evidence for the possible benefit of sulphur supplementation was obtained from analyses of a number of constituents of mulga, including tannin.



Emphasis on labour-saving devices is being given in the extension programme of Sheep and Wool Branch. The top picture shows shearing the first side using the 'Pederick' shearing table and the lower one shows shearing the second side using the 'Moore' efficient shearing system. These experimental devices are being tested under the auspices of the Australian Wool Corporation.

Percentages of tannic acid equivalent were high and ranged from 5·2 to 7·3% in different samples of the plant. As high levels of tannins form complexes with protein and as sulphur is present as sulphur-containing amino acids in the protein fraction, a significant portion of the sulphur in mulga is unavailable to sheep thus aggravating the apparently marginal level of sulphur (0·12 to 0·15%) present in mulga.

Current investigations are examining practical and economic methods of supplying sulphur to sheep under field conditions. Blocks and dry licks containing sulphur will be used in this phase of the investigation.

Labour saving devices and techniques

Sheep handling is labour-intensive and much attention has been given to the reduction of labour inputs. During 1975, a number of devices became commercially available and a series of nine field days financially supported by the Australian Wool Corporation was held in the sheep areas in October-November 1975 at which a range of labour saving devices was exhibited. Crutching machines predominated in these displays which some 2 000 producers attended.

Officers have investigated Queensland-designed races and a number of devices are currently being assessed, including a commercially available jetting race.

The major sheep-handling site is the sheep yard. Officers are investigating the requirements for a good set of yards and how these principles can be economically incorporated in existing yards to improve their efficiency for one man operation.

Investigations into work aggregation and man management are being conducted by officers from Sheep and Wool, Economic Services, Agriculture, and Beef Cattle Husbandry Branches.

Objective clip preparation and sale by sample

This project is conducted in association with the Australian Wool Corporation and the Wool Brokers' Association. Nearly 70% of Queensland's wool is now sold by sample. This system of selling assists in containing marketing costs. Objective clip preparation is a system of fleece classing which complements sale by sample. This system precludes the fragmentation of the clip experienced with traditional classing and assists with containing costs. Officers conducted field days in the Roma and Quilpie districts to demonstrate objective clip preparation.

Parasites

The control of and the prevention of parasite infestation is a continuing programme. Labour shortages make this task more difficult. The blowfly is still the major parasite in Queensland and seasonal conditions have assisted its activities. Most areas report good control of crutch strike by mulesing sheep, and some 40% of producers in southern Queensland have now adopted this practice, which is being actively promoted by the Sheep and Wool Branch.

Body strike in all sheep and pizzle strike in wethers was a major problem this year. Weather conditions and floods prevented treatment in some areas and up to 25% losses were reported.

Research at Toorak supported by Wool Research Trust Funds is examining methods of permanently defleecing those areas of sheep which are prediction sites for blowfly strike. The use of freezing, irritant, fixative and protein denaturizing agents is being studied.

Many chemicals were tried and rejected because of being either non-effective or too irritant. The treatment showing most promise in the experimental work is phenol; 15 to 30 ml of either 40% phenol or a mixture of 20% phenol and 50% orthocresol. A thick, non-purulent, encrustation of wool and cutaneous tissue formed within 10 days of treatment. This subsequently fell off leaving a bare area of healthy skin on the breech or belly regions of lambs and weaners 4 to 6 weeks after treatment.

The low incidence (8%) of wool regrowth on the belly of male lambs and weaners suggests that this method may be of value in controlling blowfly strike in these animals. A high incidence of wool regrowth (26%) on the breech region would be a limitation to its use in female sheep. Current research is directed towards simpler methods of application and field trials have been initiated.

Another approach to the control of sheep blowfly being evaluated by staff in the Pathology and Biochemistry Branches at the Animal Research Institute, Yeerongpilly is the possible use of fungal extracts to protect sheep. The rationale for this approach is based on the fact that many of the antibiotics in use today for controlling bacterial diseases of man and animals are fungal extracts.

Fungi isolated from animals, feedstuffs and other sources at the Animal Research Institute are being screened for their activity against the larvae of the blowfly. Approximately 50 extracts have shown some activity against the larvae and 16 have sufficient activity to warrant further study. In addition to testing the crude extract for toxicity to larvae, chemical studies are being made to partition the extract by differential solvent extraction. These portions will be retested to try to isolate and identify the active ingredients produced by the fungi.

A trial at the Animal Research Institute, Yeerongpilly to determine the residual characteristics of three organophosphorus insecticides on the fleece of sheep was carried out as part of the investigations supported by Wool Research Trust Funds. Groups of 10 sheep were jetted with a 0·05% emulsion of diazinon, fenthion ethyl or chlorfenvinphos. Implants with three strains of blowfly larvae were effected 2 weeks after jetting and weekly thereafter. Periods for 50% of each group to show one strike and two strikes were recorded.

Insecticide residues were determined in fleece taken at fortnightly intervals. Chlorfenvinphos showed best protection, particularly against the highly resistant RI strain of blowflies. This was at least partly due to greater persistence of chlorfenvinphos on the fleece compared with diazinon and fenthion ethyl.

Officers co-operated with commercial companies on four properties in the testing of experimental insecticides.

Treatment for the body louse (*Damalinia ovis*) is another practice which is affected by the labour shortage. Officers promote control programmes in which there is no necessity for a special muster for lice treatment. A trial conducted at Blackall demonstrated that dipped shorn sheep became reinfested when kept in contact with lousy sheep.

Internal parasites have been a problem this year and outbreaks have been reported in all of the sheep areas. The barber's pole (*Haemonchus contortus*) is the main worm reported but infestations of black scour worm (*Trichostrongylus* spp.) and nodule (*Oesophagostomum columbianum*) have been reported.

Breeding

The continuing increase in labour costs is a matter of considerable concern to the long-term viability of the wool industry and as part of the Division's programme on blowfly control measures, the feasibility of incorporating fleece shedding from the head, neck, belly and breech areas to provide a 'mini-care' sheep into a predominately Merino strain is being examined. This work which involves the use of the Wiltshire Horn breed is being undertaken at the Hermitage Research Station, Warwick, by officers of the Husbandry Research Branch.

The Wiltshire Horn sheds its entire fleece annually but there are few animals of this breed in Australia. Arrangements were made to obtain on loan a ram from the small flock in Victoria for an insemination programme. Crossbred progeny from the 1974 and 1975 lambing in this project have now been evaluated. The percentage of sheep from the 1974 lambing exhibiting appreciable shedding by 4 to 5 months of age was 79% for the head region, 44% for the neck and 59% for the belly. The figures for the 1975 lambing were similar for the head but considerably lower for the neck (13%) and belly (20%).

Before shearing as two-tooths, the 1974 crossbred rams and ewes were scored for degree of shedding. With the rams, 100% showed appreciable shedding from the head region, 89% from the neck, 100% from the belly and 89% from the breech. The corresponding figures from the ewes were 96%, 84%, 89% and 91%.

Crutch and pizzle strike have been almost non-existent in the Wiltshire Horn x Merino sheep, while a considerable degree of crutch strike has been experienced in the non-mulesed Merinos.

In the next phase of the project, Wiltshire Horn–Merino ewes have been mated with both Wiltshire Horn–Merino and Merino rams to assess the degree to which shedding can be retained at the same time as producing an acceptable Merino-type fleece.

Sheep flocks in north-west Queensland consist of adapted and non-adapted animals. Work carried out at Toorak Sheep Field Research Station, Julia Creek, has indicated that adapted animals, classified into this category on the basis of rectal temperatures under conditions of heat stress, have better production (body-weight 39 kg against 34·5 kg for non-adapted) and reproductive performance (pregnancy rate 70% against 51% for non-adapted and lamb birth weight 3·7 kg against 2·7 kg) in this environment.

On the basis of these results, a small control flock and a similar one selected for adaptation on the basis of rectal temperature under conditions of heat stress will be established at Toorak. This will enable the effect of selection for adaptation on a number of fleece, body and reproductive traits to be examined in further detail.

Officers have developed and are assisting with a number of ram breeding projects in all districts. These programmes are assisted by the fleece testing services of the Wool Laboratory. The laboratory measured 4 369 samples in the past year. Fifteen studs and 42 ram breeders supplied most of the samples. The remainder, including 394 dyeband and 203 skin samples, were processed for experimental purposes.

Officers of the Sheep and Wool Branch provide a ewe classing service and many producers continue to use their services. These services are designed to assist the producer to increase his wool cuts.

Sheep management

The breeding of sheep adapted to the environment in north-west Queensland is a long-term project and, in the interim, work is proceeding at the Toorak Sheep Field Research Station to modify the environment of the sheep in an endeavour to obtain increased productivity.

Following physiological studies on the water metabolism of shorn and unshorn tropical Merino ewes, in which it was shown that water loss through the skin (sweating) is five times greater than respiratory water loss, an experiment to promote adaptation by shearing in November and running sheep in a shady paddock for 2 to 3 days to prevent sunburn was undertaken. These sheep were compared with similar sheep shorn at the flock shearing in June.

Death rates over a 3-year period were 46% in the winter-shorn animals and only 23% in the summer-shorn animals. Of these losses, 26% of the winter-shorn ewes died in the 1974 wet season compared with 5% of the November-shorn animals. This suggests that sheep with short wool resist blowfly strike and continuous wet weather during summer better than those with long wool. The summer-shorn animals also cut more wool at their first two shearings. Work is being continued in this field.

Reproduction

Reports of low lamb markings in 1975 have been received from the sheep areas throughout Queensland. An investigation of these losses indicated that lamb marking percentages in the central west were markedly lower than average and some properties had lamb marking figures of less than 10%. Lamb marking figures also were lower in the north and south-west.

As this is a major concern of the sheep industry, a joint investigation involving five branches in this Division and Agriculture Branch in the Division of Plant Industry has begun. The project will involve six producer co-operators; three where spring lambing is practised and three with autumn lambing. The work involves the serological testing of blood samples at joining, before lambing commences and after lambing; examination of rams before mating and pregnancy testing of ewes.

Observations will be made at lambing and, if these indicate that a high percentage of new-born lambs are lost, pathological examinations will be made. The role of predators will be examined by enclosing a proportion of ewes during the lambing period inside electric fences to compare their lambing performance with ewes not protected in this way.

The influence of nutrition will be examined assessing the botanical composition and nutritive value of the diet selected by sheep using fistulated and cannulated wethers on the pastures grazed by the ewes. The part played by nutrition will be further studied by supplementation of a group of ewes before and during lambing.

In work already carried out in the Charleville district, an increase of up to 50% in lambs marked has occurred on some properties which conducted a predator programme this year but not last year.

Studies in the animal house at Toorak have shown that heat stress of ewes during the first week after mating reduces pregnancy rates by 40 to 60% whereas similar stress during the second and third weeks after mating has no effect. This finding, together with work indicating that iodine supplementation marginally improved pregnancy rate, suggested that the provision of shade and iodine supplementation may improve the fertility of ewes joined during the spring.

One group of ewes was provided with shade and supplemented with iodine while the control ewes received no shade or iodine supplementation. Ewes were removed from the shaded paddocks 7 to 10 days after service. Iodine, for the purposes of the experiment, was given as a drench providing 20 mg of iodine a week. In both experiments, one in October and the other November-December, the pregnancy rate was markedly improved in the shaded, iodine-treated groups. The benefit appeared to be greater in the November-December joining when heat stress was most severe (17 of the 24 days mating being when maximum temperature exceeded 38°C).

As shade at strategic times such as joining and lambing is likely to increase lamb-marking percentages, and as there is a lack of native shade trees in many areas of the north-west, the methods of establishing small glens of shade are under study. To date athel, jacaranda, pepperina and poinciana trees appear the most promising of those being examined.

Work on the provision of sufficient water for establishment and maintenance in the form of mini-shallow water storage will be undertaken next year.

The work on reproduction at Toorak is being followed up conjointly by Toorak and Sheep and Wool Branch staff in developing techniques to improve reproductive performance in the tropics. Trials are at present being undertaken at Morella, Barcaldine and Longreach, and a survey to determine the time of greatest reproductive wastage in the tropics is being undertaken.

Wool harvesting programmes

One of the major costs in the wool industry is shearing. Because of this, a major effort in a number of institutions throughout Australia is directed towards developing labour saving devices to handle sheep at shearing time and on methods of shearing sheep. Staff at Toorak are contributing to the wool harvesting programme, supported by Wool Research Trust Funds, by evaluating a number of drugs for their potential to cause a break in the wool of sheep.

Twenty-two drugs have been screened and others with potential as judged by their pharmacological properties will be evaluated as they become available. One drug, a preparation of mephalen, has shown promise in preliminary screening, and much of the more recent work has been concentrated on this drug.

Studies to date have involved dose rate studies and the effects on the fleece, body systems and on body-weight. Much further work requires to be done before its practical potential as a defleecing agent can be properly evaluated.

Included in the work necessary is the effect on sheep of different nutritional status and body condition, effect on the pregnant ewe at different stages of pregnancy, effect on ram fertility, whether its action can be improved and whether it has any effect on future wool growth and lifetime performance.

The finding of a drug that is efficient and has a wide margin of safety will be a major step forward, but other problems will need to be solved before chemical shearing is a practical possibility. Ways will have to be found to keep the fleece intact until it can be removed and to protect the recently-defleeced sheep. Methods of removal with low labour inputs are also required. Although facilities are limited, a programme involving the co-operation of commercial companies is under way to examine a number of possible approaches to these problems.

In the wool harvesting programme by Sheep and Wool Branch field officers, the main activity has been to co-operate with the Australian Wool Corporation in testing sheep rugs. These field trials are being continued in association with the C.S.I.R.O. and a commercial firm on three properties in the Barcaldine district testing coats which hold the fleece on and protect the sheep after it had been chemically defleeced.

New types of coats are continually being assessed. These coats keep the fleece clean and this may result in a higher price for fleece wools. Assessment of their usefulness and economic value continues.

Pig industry

The year was an unusually stable one for the pig industry. This stability encouraged many enquiries from prospective producers, particularly those seeking an alternative enterprise to dairying or beef production. The heavy capital costs required and high interest rates deterred the majority. There was some expansion by established producers, but this was limited by concern over rising costs and the threat of over-production.

Officers of the Pig Section maintain close liaison with the industry through the Queensland Pig Industry Producers' Association, as well as with individual producers. These close links have enabled the section to be well aware of industry problems and to develop extension programmes which are relevant and well accepted. While current programmes relate to a wide range of industry problems, there has been an increased emphasis on programmes related to genetic improvement, particularly on-farm performance testing.

Disease

Salmonellosis has always been an important disease of pigs in Queensland and numerous diagnoses were made again this year. However, one spectacular loss attributed to salmonellosis should be recorded. It involved the death of 23 baconers, 11 sows, three boars and more than 100 suckling piglets, while 36 sows aborted in this 195 sow piggery.

The clinical picture was that of pyrexia, anorexia, vomiting, salivation and purplish discoloration in the skin. It is considered that the source of infection was a recently delivered and heavily contaminated supply of meat-and-bone meal. This was fed in the ration on the Monday evening and Tuesday morning and symptoms developed on Wednesday morning. A fortnight after the onset of the outbreak, approximately 95% of affected pigs had recovered and pneumonia was the most obvious clinical symptom in the remainder.

Swine dysentry continues to be a disease of major economic importance in those piggeries to which it is introduced. Organic arsenicals play an important role in its control and, in some instances, excessive dose rates cause an arsenilic acid toxicity. Recently, it has been found that Emtryl (dimetridazole) is particularly efficient in controlling outbreaks of this disease.

Pathogenic strains of *E. coli* caused severe losses in both suckling piglets and weaners. A particularly severe piglet mortality occurred in a piggery at Warwick and was finally diagnosed as hyper-acute *E. coli* septicaemia—toxaemia. Initially affected litters started to die at 3 days of age and no lesions were observed on post mortem. Affected litters generally contained more piglets born alive (10.6 on average) and were not the progeny of any particular age group of sows. However, the condition was seen more frequently in litters from sows with the gestation period exceeding 115 days. A regime of oral dosing of the piglets within a few hours of birth and again 24 hours later with neomycin was successful in controlling the condition.

A condition associated with fracture of the head of the femur (epiphysiolysis) which mostly affects gilts has been diagnosed on at least six piggeries during the past year. The condition does not have a clear genetic basis, but is seen in rapidly growing pigs. Diets have not been deficient in calcium, phosphorus or protein. Management of affected individuals is important and early cases should be removed from crowded growing pens and ideally off concrete.

Another bone condition occurred in piggeries where whale-meat or whale-solubles was being fed as the major source of protein, and where no extra calcium or phosphorus was added to the ration. In such piggeries, spontaneous fractures often occurred. This most commonly occurred in the vertebrae and resulted in a sudden complete posterior paralysis.

Parakeratosis has been reported more frequently than usual and has been precipitated by the fact that, on occasions, meat-and-bone meal has been approximately the same price as grain. The addition of zinc to the ration ensures a complete recovery within 2 weeks of all affected pigs.

Haemorrhagic bowel syndrome which was reported for the first time in Queensland last year results in rapid death associated with free blood throughout the intestines. Although the incidence was low, it was again recorded this year.

Porcine parvovirus was confirmed as the cause of mummification and still-births in a Gayndah piggery. It was also suspected to be implicated in metritis and returns to service in a Walkamin piggery.

The main research programme on disease is related to examination of a number of aspects of arthritis, a major source of production loss to the pig industry. This project, supported by the Pig Industry Research Committee, is carried out mainly by Pathology Branch at the Animal Research Institute, Yeerongpilly. Approximately 4 100 arthritic joints originating from 200 farms have now been examined in the project and *Erysipelothrix rhusiopathiae* has been isolated 23% of the joints representing 33% of the properties from which joints have been examined.

Twenty-three strains of *E. rhusiopathiae* of known type were obtained from Hungary to prepare antisera in rabbits for serotyping of the strains isolated in Queensland. Several methods of isolating *E. rhusiopathiae* were examined. In general, the changes made did not improve the isolation rate, but storing joint fluid in nutrient broth at 4°C resulted in an improved rate of isolation. Agglutination tests on joint fluids have shown a good correlation between high antibody titre and presence of the organism as indicated by culture. The possible role of mycoplasma in those properties with arthritis and a low or nil isolation rate of *E. rhusiopathiae* is being examined.

A survey was also conducted by Veterinary Services and Pathology Branches to determine what variations there were in the management practices of piggeries with a low incidence of arthritis condemnation at slaughter and those with a high incidence. Of 70 piggery owners and/or managers interviewed, 17 properties were classed as having a 'high' incidence (more than double the State average figure) and nine had a low incidence (nil or less than half of the State average).

The significant findings were that 24% of high incidence piggeries brought in stores while no low incidence piggeries brought in stores. Hygiene in the high group was assessed as poor in one unit, moderate in 64% and good in 29%. In comparison, 75% of the 'low incidence' group was assessed to have good hygiene and none was assessed as poor.

Swine vesicular disease, a virus disease, which occurred for the first time in the United Kingdom in late 1972, causes a disease in pigs which cannot be distinguished clinically from foot-and-mouth disease. It has not been recorded in Australia. As the disease stimulates antibodies to Coxpackie B5 virus, which occurs in humans, this provides a means of monitoring for the presence of the disease in Australia without involving the introduction of the swine vesicular disease virus for testing purposes. A survey has been commenced on pig sera submitted to the Animal Research Institute, Yeerongpilly for other purposes. To date, 400 sera have been tested with negative results.

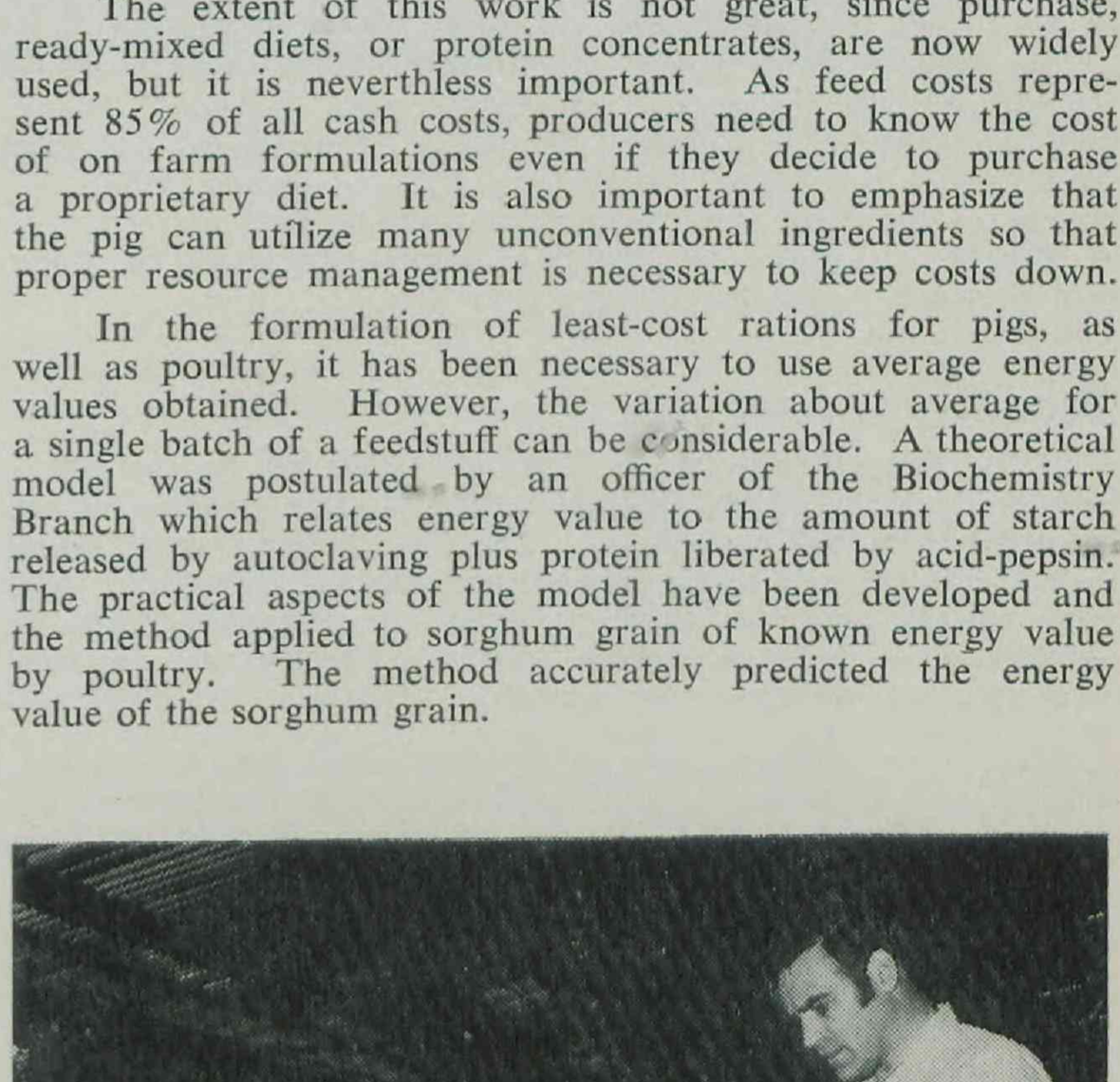
Veterinary Services Branch officers examined the effectiveness of organo-phosphorus compounds for mange control units where owners stated that their use was inefficient. It was found that mange was effectively controlled in all units by the two products tested when adequate procedures were followed. There was no evidence of insecticide resistance by sarcoptic mange mites.

Nutrition

To assist district officers and to enable their advice on ration formulation to be objective, computer calculations of diets which will supply known requirements at least cost are made by the Pig Section as required. In addition, on a fee for service basis, calculations are also made for individual producers and feed compounders.

The extent of this work is not great, since purchase, ready-mixed diets, or protein concentrates, are now widely used, but it is neverthless important. As feed costs represent 85% of all cash costs, producers need to know the cost of on farm formulations even if they decide to purchase a proprietary diet. It is also important to emphasize that the pig can utilize many unconventional ingredients so that proper resource management is necessary to keep costs down.

In the formulation of least-cost rations for pigs, as well as poultry, it has been necessary to use average energy values obtained. However, the variation about average for a single batch of a feedstuff can be considerable. A theoretical model was postulated by an officer of the Biochemistry Branch which relates energy value to the amount of starch released by autoclaving plus protein liberated by acid-pepsin. The practical aspects of the model have been developed and the method applied to sorghum grain of known energy value by poultry. The method accurately predicted the energy value of the sorghum grain.



A district adviser from the Pig Section demonstrates a creep feed hopper attached to the pen gate. Officers are often able to pass on ideas which save labour or improve efficiency of production.

On the heavy flood plain soils of the Burdekin Delta, feed grade rice yields 8 to 10 tonnes per hectare which is a little more than twice the yield of sorghum and about twice the yield of maize on those soil types. Because of this higher production, a series of trials has been started to assess the nutritional value of feed grade rice (IRRI224). Results to date show the rice to be inferior to both wheat and sorghum. The reason for this is the high fibre content (10%) as the grain is fed with the husk on.

Both dry matter and energy digestibility values were below those of wheat and sorghum (down to about 70%). The crude protein digestibility of about 80% is equivalent to wheat and sorghum indicating that, even though the crude protein content of rice was low (8%), it was reasonably digested.

In a practical pig grower-diet, up to 50% of sorghum can be replaced by rice. At higher levels of substitution, performance declines and, on an all rice-soybean diet, growth rates are 0·5% kg a week lower than on ail sorghum-soybean diet. Current investigation involve methods of physically or chemically treating rice to improve its digestibility.

Experiments designed to determine to what degree protein supplementation of cereal-based diets can be reduced at various stages of pig growth have been undertaken by the Husbandry Research Branch at the Animal Research Institute, Yeerongpilly, and Biloela Research Station. Results have shown that the finisher-diet can be compounded of grain only provided an 18% crude protein diet is fed to 50 kg liveweight and provided the grain has 10 to 12% crude protein and a small amount of lysine is added.

Vitamin A appeared to be associated with losses in two piggeries, in one case as a deficiency and in the other as an excess. In a 25-sow piggery, some of the baconers were dying after showing nervous signs. In two cases autopsied by the Pathology Branch officers, there was gross thickening of the flat bones of the skull and consequent compression of the brain and spinal cord. The liver vitamin A levels were low.

In another large piggery where six times the recommended amount of vitamin-mineral supplement was included in the diet, an infertility problem was being experienced because sows would not stand for service. It was evident that the weight of the boar was causing considerable pain and vitamin A excess is known to interfere with ossification of bone and produce a painful lameness in pigs.

Breeding

The Boar Performance Testing Station at Animal Husbandry Research Farm, Rocklea, evaluated the breeding values of more than 200 stud boars. The best 25% of these boars judged on growth rate, feed conversion efficiency and carcass quality will be used as sires in a small group of influential herds co-operating with the Department in running efficient breeding programmes.

On-farm performance testing has continued to expand. With the provision of additional ultrasonic equipment for measuring fat thickness in live animals, all field staff in the Pig Section are involved. In some districts, the programme dominates pig extension work with up to a third of farm visits being associated with the work. The programme is already showing considerable spin off benefit in the management area.

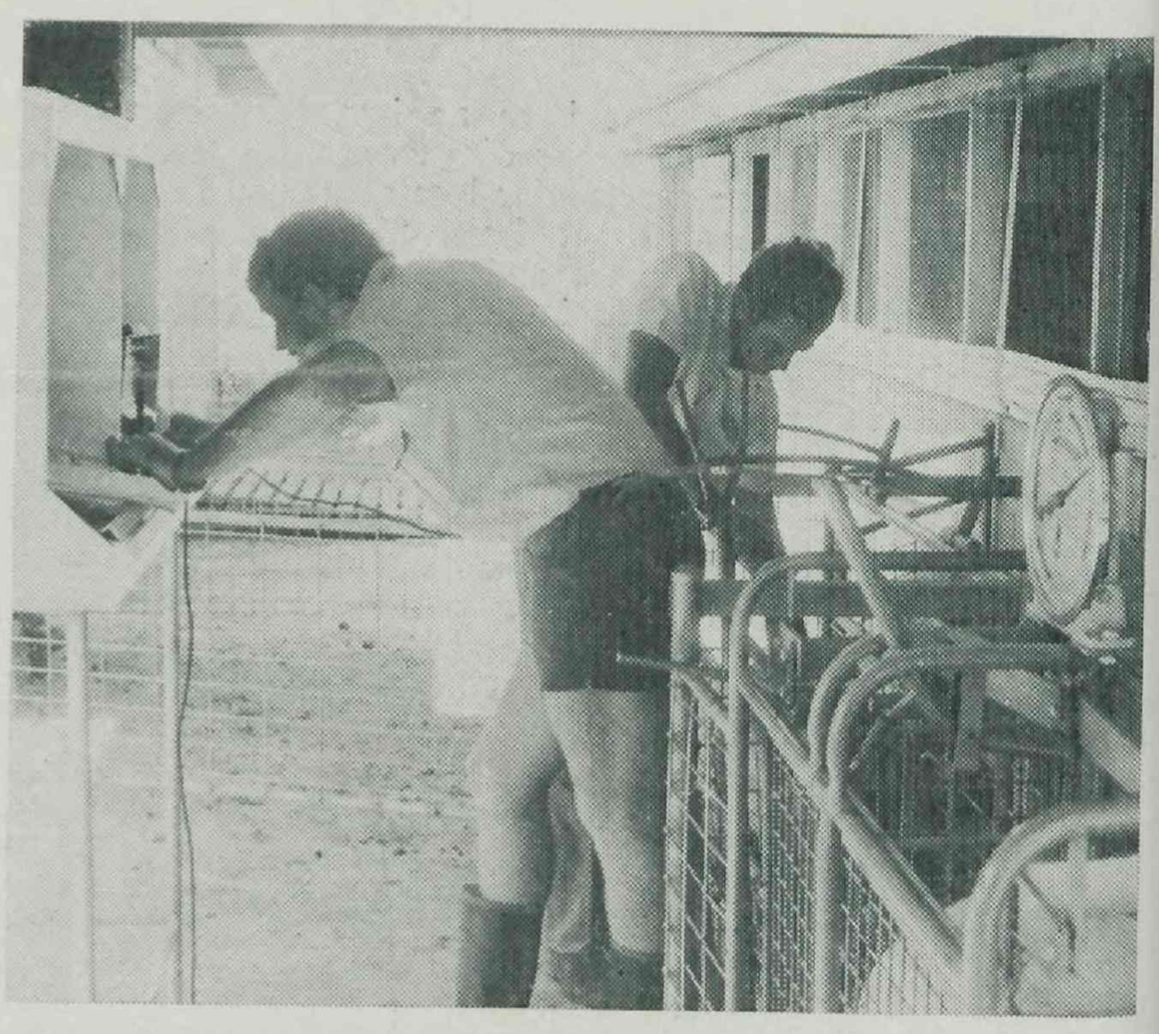
In the pilot scheme for on-farm testing, begun in 1973 and supported by funds from the Pig Industry Research Committee, about 1 900 boars and 2 000 gilts were tested during the year. The superiority of selected replacements has continued to improve. It ranges from 93 to 204 g in daily gain and from 1·5 to 2·7 mm in fat thickness. Selection intensity ranges from 1 in 8·8 to 1 in 46·2.

Data accumulated during the first 3 years of the project are currently being used to evaluate the efficiency of the programme. Areas of weakness revealed by the analysis are the under-utilization of best performing animals and inaccuracies in the back fat estimation. Measures are being taken to correct these inadequacies.

The herd of mixed breed origin at the Hermitage Research Station has now been selectively improved for economically important traits over four generations. A comparison with control pigs indicates an improvement in the selected herd of 0·05 kg a day growth rate, 0·16 feed conversion ratio and 1·5 mm back fat depth.

Pig farm management and housing

The pig farm management and housing programme embraces a number of district extension projects as well as technical advice on a wide range of subjects relevant to efficient management.



A Husbandry Officer and farmer weighing potential breeding stock, and measuring depth of back fat with an ultrasonic instrument. This on-farm service enables farmers to select breeding stock on performance figures, not appearance, and has been very well received.

Groups in most districts were maintained as a means of encouraging producers to keep records as a basis to make decisions regarding the performance and management of breeding stock. Periodic reports by supervising officers and personal contacts with the producers point out factors requiring remedial measures.

As with other projects the aim is to teach producers to keep and use records intelligently, then introduce new members in their place as they become capable of self-help.

Analysis of data recorded from the 55 herds participating in 1974-75 showed that the number of live piglets born per sow in that year averaged 20·6 with an average of 9·53 piglets born alive in each litter and 8·25 weaned at an average age of 34 days. It is considered that these results are representative of those being obtained under good management conditions in Queensland.

To assist an increasing number of producers to determine profitability of their enterprises, several district officers supervised groups keeping pertinent records. At intervals, records were analysed on a group and individual basis and discussed with producers. These groups are proving to be valuable aids in determining weaknesses in management and other factors affecting profitability. Officers of the Pig Section have had to limit the number of participants to that which can be serviced adequately.

Although not part of any formal project, assistance with budgeting is a routine service provided by the Pig Section, particularly for those producers contemplating expansion or establishment. A major publication entitled 'Consider the Alternatives—A Guide to Profitable Pig Farming' was written by officers from Economic Services and Pig and Poultry Branches and issued during the year.

Assistance with the design of accommodation for pigs has always been a major activity for district staff. While part of this work is now undertaken by an Agricultural Engineer a considerable amount will remain in the Pig Section. For example, in central Queensland, enquiries regarding the subject accounted for a third of all enquiries during the year.

Poultry industry

Changing role of Poultry Section

The role of the Poultry Section in the past has been to provide a general advisory service covering management and disease control and to carry out certain regulatory work under the Poultry Industry Act.

Ten years ago, there were nearly 1 200 suppliers to the Egg Marketing Boards. There was a heavy staff commitment in continuous pullorum disease testing and the broiler industry, through its total involvement in vertical integration, felt that it was self-sufficient in technical competence.

It was difficult to plan long-term projects in extension or even to develop short-term projects of immediate application because of the heavy staff involvement in disease control and the attitude of the broiler companies towards departmental services.

Poultry Section officers and Egg Board quality control staff checking albumen height and yolk colour in a co-operative survey of the quality of eggs sold in shops in the Brisbane metropolitan area.

The evolutionary changes in the commercial egg industry saw a massive reduction in the number of egg producers but a significant increase in the size and complexity of farms. Similar changes took place in the broiler industry.

These changes have meant a shift in section policy from general advisory work with a commitment in disease control as a major function to one involving special project work in the fields of nutrition, housing and environment, co-operative studies on egg quality, farm accounting and surveys designed to highlight industry needs. In addition, there have been changes in the application of legislation to the poultry industry.

The basic tenets of the *Poultry Industry Act* to provide guidelines for communication between the industry and the Department (The Poultry Advisory Board), the means by which the industry makes a financial contribution towards the provision of extension, regulatory and research services and the conditions governing the hatching, sexing and sale of day old chickens, remain unchanged. However, there has been a change in emphasis in the implementation of regulations designed to promote consumer protection and confidence in the methods of grading, handling and processing eggs and egg products.

Research liaison

The research programmes in poultry health and production result, at least in part, from considerations by Poultry Liaison Groups involving representatives of the commercial industry and extension and research workers in the Department. Representation by industry is designed to ensure that research work is devoted to practical problems.

Most of the research work on poultry nutrition, breeding and management is undertaken by the Husbandry Research Branch at the Poultry Section of the Husbandry Research Farm at Rocklea.

Interesting developments

COMMERCIAL EGG INDUSTRY. To reduce the amount of labour in packing and handling eggs, both at the farm and at the Egg Marketing Board floor, mobile trolley systems for bulk handling of eggs have now been introduced to the Darling Downs area. More than half of the eggs now consigned to the board's floor at Toowoomba from outlying farms on the Darling Downs are bulk handled. In southern Queensland, 30% of eggs are now handled in this way.

Because of the depressed state of the industry during the early part of the year under review, the Egg Marketing Board Suppliers' Organisation decided to form a committee comprising representation of their organization, the Poultry Section and Economic Services Branch of this Department to endeavour to estimate current costs of production. This information was presented to the board as a case for improving the net price paid to the producer. As at October 1975, costs of production of 56·64c per dozen and 60·01c per dozen were established for the Darling Downs and Brisbane areas respectively.

BROILER INDUSTRY. A survey of the industry to determine the various costs and their relative importance was carried out during October and November 1974 by the Poultry Section and Economic Services Branch.

On the basis of the data collected, a cost structure of the industry as at 1 January 1975 was established. It was calculated that growers should be receiving 15·22c per bird to make a reasonable return on investment. Since then costs have risen but the growers, at the start of this financial year, were only receiving 14c per bird. At the end of May 1976, they were receiving 14·7c per bird.

The Broiler Growers' Association throughout the year has been pressing for legislation to be introduced to oversee contracts between broiler growers and processors and to provide a legal basis for the price negotiations.

Broiler growers welcomed the passing of the *Chicken Meat Industry Committee Act* 1976 in April 1976. By this means, a considerable degree of stability has been added to the broiler growing industry. Similar legislation in other States has either been proclaimed or is under way.

Disease

The occurrence of mild fowl plague (avian influenza) in Victoria interrupted interstate and export trade during January 1976. The testing of flocks in Queensland and in other States resulted in a heavy short-term work load for staff of State Departments, but this work, together with eradication procedures in Victoria, allowed a rapid declaration of Australia's freedom from the disease to be made and normal trade to resume.

In Queensland, more than 5 000 sera were collected by field staff and examined at the Animal Research Institute for antibodies to the disease. Selected birds were also examined for the virus. No evidence of the disease was found in this State.

The Marek's disease—lymphoid leucosis complex was reported on a number of occasions. Some reports within this group related to haemangioma, a form of lymphoid leucosis which is characterized by bleeding points from many tissues, including skin surfaces. In one flock, this caused the death of 200 of 1 800 pullets aged 8 months.

On another egg-producing property, layers developed haemorrhagic ulcerated nodules over various parts of the skin and only 7 200 birds were left out of 10 000 at 26 weeks. The number of Marek's disease diagnoses were more numerous than has been the case in recent years and may indicate that maternal antibody in Marek's disease vaccinated hens is interfering with vaccine virus inoculated into day old chickens.

A wasting disease characterized by inflammation of the glandular stomach (proventriculitis) has been seen in several States although it is not common. In Queensland, only eight farms have been affected but on each it has been of considerable economic consequence as losses due to deaths and culling have been as high as 20%. The birds rapidly lose weight but continue to eat. The age incidence of 5 to 9 weeks seems very consistent and pullet replacements on new litter are affected. The proventriculus is enlarged and the mucosal surface is oedematous to haemorrhagic. Microscopically, there is some invasion of lymphocytes and a few heterophiles but the most conspicuous change is hyperplasia and columnar metaplasia of the glandular epithelium.

There is no evidence of fowl plague or Newcastle Disease. Treatment has not been effective and so far the aetiology is not known. The Pathology Branch at Yeerongpilly has isolated 13 agents from three affected birds, but it is unlikely that any is responsible for the disease.

Salmonella pullorum (variant type) was isolated at the Animal Health Station, Oonoonba, from a reactor from a large hatchery in the Cairns area. Subsequently, birds showing fine reactions from this farm were sent to the laboratory for examination, but no further isolations of the causal organism were made. Titres to the tube agglutination test varied from 1:25 to 1:100, all of which were to the variant strain. One out of three litter samples yielded *S. typhimurium*. There have been no field outbreaks of disease in young chickens originating from this hatchery.

Two outbreaks of infectious laryngo-tracheitis were seen in vaccinated flocks in the Redland Bay-Mt. Cotton area. The virus was recovered from a 12-week-old flock that had been vaccinated at 6 and 10 weeks. The second 'break' occurred in 4-week-old chickens vaccinated at 3 weeks through the drinking water.

Severe outbreaks of fowl cholera were confirmed at Woongoolba in Australorp pullets and in turkey pullets at Bonjeen.

Deaths in parrots, particularly rainbow lorikeets (*Trichoglossus haematodus*) in south-east Queensland, received considerable publicity in the media and were first brought to the attention of the Department in early October 1975. When feeding the parrots, people had noticed that the birds were ill with symptoms of fluffed up appearance and diarrhoea. They usually died within a few days a first being seen sick.

In all 25 birds examined at the Animal Research Institute, Yeerongpilly, there was an ulcerative enteritis, particularly of the duodenum. In some birds, yellow diphtheritic membranes adhere to the mucosal surface of the small intestine. About half the birds have had a chronic peritonitis, which appeared to have originated from rupture of the intestinal ulcers and, in one-third of the birds, the livers were enlarged, mottled and yellowish. Microscopic examination confirmed the gross findings and showed that the ulcers had a variety of bacteria in them.

Tests on the intestinal contents have been negative for the common organochlorine and organophosphorous pesticides. No virus has been isolated by inoculation onto the allantois of chicken embryos. Inoculation onto VERO cell culture has not been successful and chicken fibroblast cultures were also used. Haemagglutination tests on allantoic fluid from embryos inoculated with intestinal contents and liver have been negative. Independent investigations at the University Veterinary School have also failed to isolate virus.

Thus, no infectious cause for the disease was established. It is believed, however, that it may be associated with unnatural feed. These birds normally feed on nectar and possibly, when populations increase, this supply declines and birds feed on and/or are given alternative feedstuffs. This possibly allows changes in the intestinal tract contents permiting organisms normally present, for example, clostridial bacteria, to multiply and produce disease.

Nutrition

LEAST COST RATION FORMULATION. With the introduction of a computer programme to handle the laborious calculations involved, Poultry Section officers have been able to increase the volume of nutritional advice given. Altogether, 150 diets were checked and reformulated during the year for 35 different producers. Two producers and one feed miller made extensive use of the formulation service, for which a charge is made to cover computer costs.

Contact through this service with farmers indicates that there is a need for a special extension effort directed towards developing an understanding of the basic principles of poultry nutrition.

It is proposed that further emphasis on the value of least cost feed formulation be made to home-mix feeders, in particular to the larger producers and that the scheme be given greater publicity next year. This will help in two ways—(1) by improving the efficiency in feed utilization on the farms, and (2) by assisting in the forward buying of ingredients.

Research

A series of layer experiments in recent years has examined the effects on egg production of restricting the feed intake of both the replacement pullet and the laying hen. Several levels of feed restriction have been investigated and practical restriction programmes have been developed which have significantly improved the efficiency of egg production.

For example, denying the birds access to feed for 40 hours in 72 during the growing period reduced the feed required to produce 1 kg of egg from 2·71 kg for the full-fed birds to 2·54 kg. Denying the birds access to feed for 8 hours per day in the laying period following the growing period restriction further reduced the feed required to 2·45 kg.

This work has been summarized and made available to the industry in an article in 'Quill', the quarterly information bulletin published by the Poultry Section. Because the work has an important part to play in the economics of egg production a 16 mm film has been prepared to inform producers about the value of the practice and the management procedures involved. Workshops for producers which will include a showing of the film will be held in the various poultry areas of Queensland.

In studies on nutrient density of broiler rations, diets ranging from 2 800 kcal per kg to 3 100 kcal per kg with amino acids held strictly in proportion to energy had no effect on weight gain of broilers from 0 to 8 weeks (meat 1·94 kg), but showed a significant improvement in feed efficiency at higher energy levels from 2·28 to 2·04.

Over the same range of nutrient densities, gains improved significantly from 1·88 to 2·01 kg as energy increased. This was associated with a significant improvement in feed efficiency from 2·30 to 2·05 when amino acids apart from lysine were allowed to exceed their requirements in proportion to energy.

Cottonseed meal and low protein sunflower meal were included in broiler diets at levels of up to 15% with no harmful effect on gain or feed efficiency compared with the performance of chickens on a commercial control ration.

Inter-relationships of the amino acids, isoleucine, valine and leucine in practical starter diets were studied in broiler chickens from 7 to 28 days old. Percentages of isoleucine, valine and leucine ranged from 0·57 to 0·87, 0·63 to 1·08 and 1·18 to 1·98, respectively. Gains were significantly poorer on the lowest valine level, but there were no consistent interactions between any of these amino acids. This work was carried out with funds provided by the Australian Chicken Meat Research Committee.

Following a report in the North American literature and a request by the Broiler Growers' Association, some preliminary work was undertaken at Rocklea on the effect of restriction of time of feed access for broilers from 6 to 8 weeks of age on performance. Cockerels, but not pullets, tended to eat more and grow more rapidly on mild restriction (8 hours feed denial per day). Cockerels ate less, but weighed about the same on a skip a day feeding programme while pullets were significantly lighter in weight when severely restricted and they ate less.

Although feed efficiency tended to be better when cockerels were restricted, the fat content of the dressed carcass was not significantly influenced by feed restrictions. While these results are preliminary, they are sufficiently promising to warrant further work.

Egg quality investigations

The consumption of any animal product by the public is likely to be maximized when the quality of that product reaching the consumer is consistently high. A survey conducted by the Poultry Section in 1967 disclosed that the quality of eggs at the retail outlets was comparatively low. Since the survey, the Egg Marketing and Grading Regulations under the *Poultry Industry Act* were introduced in 1971 with the aim of improving the quality of eggs sold to consumers in Queensland.

A survey has been undertaken this year by the Poultry Section, the Marketing Services Branch and the South Queensland Egg Marketing Board to establish the current position with regard to egg quality in the retail stores.

Results from the survey carried out during the cooler months (July–August) showed that there appeared to be no improvement in the internal quality of eggs in the retail stores in the intervening years; the mean Haugh Unit value, a measure of internal quality, for 60 g eggs being 56·6; for 55 g eggs 57·3 and for 50 g eggs 63·1. Since a minimum value of at least 60 is desirable for 60 g and 55 g grades, improvement needs to be made in internal quality.

It was noted that many of the eggs sold at the retail outlet were over 7 days old. This lengthy period of storage often under less than ideal conditions would have a significant influence on internal quality. An improvement was noted in the presentation of eggs as far as external quality was concerned. Very few eggs were dirty or stained, and shell quality and egg marking were of an acceptable standard.

The survey during the hotter months has been completed, but results are still being collated.

Arising out of this survey and the proposed implementation by Egg Marketing Boards of an egg quality scheme, based on Haugh Unit measurement of albumen, Poultry Section staff, with assistance of the Quality Control officers of the board, have held two egg quality workshops on the Darling Downs and further workshops have been sought by the industry.

Egg shell strength is a problem in Queensland in the summer, and particularly if older birds are used for egg production. In an experiment to evaluate the role that selection can play in improving egg shell quality, significant improvement has resulted by the second generation. The work is continuing.

Another investigation into egg quality was aimed at establishing the cause, and providing a solution, to an 'apricot' yolk problem which caused the down grading of eggs from a number of producers in south Queensland. A commercial product consisting of a blend of yellow and red pigments in a ratio of 1.28:1.00 was shown to produce the unacceptable hue when fed in diets not rich in natural sources of pigment.

When a comparable product was fed at a level of 21 g per tonne, more than 90% of the yolks produced were 'apricot'. A blend of the yellow and red pigments of approximately 3:1 fed at a level of 20 g per tonne was shown to produce yolk hues and intensities acceptable to the industry.

Miscellaneous

LAYER REPLACEMENT SURVEY. A sub-committee of the Poultry Advisory Board was set up early in 1975 to investigate ways and means of reducing the number of surplus fertile eggs being consigned to the Egg Marketing Board. This Committee considered various procedures for devitalizing fertile eggs but found that no satisfactory method was available which could be used on a commercial scale.

The Committee's enquiries also showed that the number of surplus fertile eggs could be reduced substantially if hatcherymen were able to predict chicken demand more accurately. Examination of monthly pullet chicken hatchings over the last 7 years shows that there is no set pattern of hatchings and that it would be impossible for hatcherymen to predict chicken requirements with any degree of accuracy.

A survey of producers designed to determine the proportion of replacements which are purchased according to a set plan; and to identify factors which affect producer's purchases of replacements has been undertaken. Farms of 5 000 or more hens were included in the survey. There were 106 farms in this category and these account for an estimated 74% of the total number of layers in the State. Results are expected to be available in the near future.

BROILER PROCESSING. The management, collection and slaughtering arrangements for broilers result in variable times between removal of food and water and processing. There is little known on the effects of these treatments on weight and carcass characteristics. In a preliminary study by the Husbandry Research Branch, feed was withdrawn from broiler chickens before slaughter for periods ranging from 4 to 26 hours and each of these periods was associated with water being denied for either 4 or 8 hours.

Birds lost significantly more weight when water was withdrawn for 8 hours than for 4 hours. A loss of about 112 g in weight resulted from withdrawal of both feed and water for 8 hours. This represented a loss of about 4c a bird. Longer feed withdrawal times could amount to a loss of 6c gross income per bird. Dressing percentage was not significantly affected by treatment.

EGG WASHING TECHNIQUES. A preliminary investigation has been made into the operation and efficiency of egg washing machines and the results have enabled the development of an interim practice for the cleaning, sanitation and operation of egg washers. Further studies on the effectiveness of various sanitizers, sanitizer rates and water temperatures are planned for next year.

Horses

The upsurge in interest in horses for stock work, recreation, and breeding as an alternative enterprise on grazing properties, continues. In consequence, the market value of horses has increased substantially. There is a growing demand for advice on horse husbandry, particularly in nutrition and prevention of common diseases and parasites. This demand is met mainly by Beef Cattle Husbandry and Veterinary Services Branches.

A well-attended Seminar on 'Horse Care and Handling' sponsored by the Queensland All Breeds Horse Association was held at Rockhampton in September.

Two conditions of horses, equine infectious anaemia and osteodystrophia fibrosa, have an effect on the use of horses in the cattle and sheep industries and warrant special mention in this report.

The prevalence of equine infectious anaemia in Queensland varies with location and waxes and wanes according to seasonal conditions. The last few years have experienced heavy wet seasons, so that the disease has been more commonly reported in areas where vectors abound in large numbers following suitable environmental conditions. Such areas include the Fitzroy and other river systems of central and northern Queensland and the Channel Country in western Queensland.

Occasional cases are diagnosed in areas such as south-eastern Queensland where the disease is uncommon. However, these cases are usually associated with horses introduced from endemic areas and there appears to be little lateral spread to the neighbouring and mostly susceptible horse population.

The gel-diffusion precipitin test for this disease reported in the U.S.A. was introduced at the Animal Research Institute, Yeerongpilly, and used on blood samples collected by Veterinary Services staff to survey the serological incidence of the disease in central and southern Queensland. To date, 358 horses from 185 properties have been tested with 10 reactors (2·8%) being found on eight properties. The reactors were located in four shires, namely Broadsound, Belyando, Murweh and Taroom, of which two are adjoining, Broadsound and Belyando.

Osteodystrophia fibrosa (ODF) in horses is a disease causing a shifting lameness, ill-thrift and, in some animals, swellings of the bones of the head. The classical disease occurs in horses fed high levels of cereals or cereal products and results from an abnormal calcium-phosphorus ratio resulting from the high phosphorus levels in cereals. The disease in grazing horses was first reported in the spring of 1973 from the brigalow areas of the Fitzroy Basin in Queensland and has since been reported on a number of properties usually associated with buffel grass (*Cenchus ciliaris*) or other improved species.

Investigations have shown that calcium and phosphorus levels of pasture on the affected properties were normal, but all the pasture species involved contained oxalates. It has been postulated that these may interfere with calcium absorption by forming insoluble complexes of calcium oxalate in the intestinal tract.

A small pilot trial to examine the possible role of oxalate was undertaken by Pathology and Biochemistry Branches at Yeerongpilly with one horse fed a ration containing 3% soluble oxalate. The trial was terminated after 12 months without producing symptoms of ODF, but a greatly increased faecal calcium resulted which is consistent with field cases of the disease.

Officers of Biochemistry and Agriculture Branches commenced a programme to screen buffel cultivars for oxalate content by chemical means. Seasonal variation in oxalate concentration in buffel grass, effect of soil type and stage of growth on oxalic acid build up and the relative levels of oxalate accumulation in commercially-available buffel cultivars (Biloela, Nunbank, Molopo, Tareninnabar, American and Gayndah) will be determined.

An officer of Slaughtering and Meat Inspection Branch applying the blue ribbon brand. The 'Ys' indicate yearling beef, the 'Os' 1 to 3 mm of fat over the rib eye.

Meat inspection services

The Slaughtering and Meat Inspection Branch has the responsibility for State or domestic meat inspection services from the point of slaughter to delivery to the consumer. It also provides a wide range of allied services including poultry slaughtering, slaughter of prohibited animals for pet food, and meat quality aspects including meat classification and grading.

The branch inspection services complement those provided by the Commonwealth Government at export meatworks. Rationalization of the two services has been investigated by the Federal Administrative Review (Bland) Committee and was the subject of several State–Federal and Interstate discussions during the year. Within Queensland, relations between the two services have been harmonious, and duplication of services has been avoided.

Slaughtering facilities

The construction of the new Metropolitan Public Abattoir at Cannon Hill was virtually completed in January 1976 when preliminary trials began. Many problems, mostly mechanical, were experienced, particularly on the beef floor.

The construction of a new sheep floor at the Ipswich Public Abattoir was completed in March 1976. The new layout allows inspection of sheep carcasses and viscera to be carried out more efficiently and in accordance with modern approved practice. A new meat cannery was constructed and opened at J. C. Hutton Pty. Ltd., Oxley, to replace the old cannery which was burnt down. A new abattoir at Killarney was completed and began operations on the 26 November 1975. A full time inspection service involving two inspectors was provided.

From the 1 January 1976, the Metropolitan Public Abattoir Area was extended to include, in addition to the City of Brisbane, the City of Gold Coast, the City of Redcliffe, the Shire of Albert, the Shire of Pine Rivers and the Shire of Redland. Full-time inspection was provided at a Class 2 slaughterhouse at Tugun to permit operations to continue with Queensland Meat Industry Authority consent.

During the year, continuing advice and assistance has been given by officers to licensees of country slaughterhouses concerning the interpretation of the requirements of the Meat Industry Regulations 1973.

Although considerable progress has been made towards compliance with the standards specified in the *Meat Industry Act,* there are still a few slaughterhouse licensees who have as yet either not made a decision to upgrade or surrender their licence and obtain meat supplies from some other source.

Amendments to the Meat Industry Regulations were gazetted on 29 November 1975. These provided for an increase in the permitted capacity of Class 3 slaughterhouse from 10 cattle units to 20 cattle units in any period of 7 days (three to four cattle units in any day). The amendments also provided for the licensing by the Queensland Meat Industry Authority of certain Class 3 slaughterhouses in isolated areas with a limited kill provided certain prescribed conditions apply and the slaughterhouse is constructed to standards deemed adequate in the circumstances by the Authority.

In accordance with the provisions of section 102 of the *Meat Industry Act* 1965–1973, action was taken on the certification of interstate premises supplying meat into Queensland. Certification was issued, on application, to those premises which have an export registration with approval to send products to the U.S.A. In other circumstances, abattoirs and meat processing establishments must meet the standards specified in the Meat Industry Regulations 1973. The Director, Slaughtering and Meat Inspection Branch, carried out inspections at four interstate premises during the year.

Poultry

The Australian Agricultural Council has agreed to the phasing in of poultry inspection services by all States over an agreed period. Queensland is well advanced in reaching this standard. Poultry slaughterhouses have now been largely brought up to the standards specified in the Meat Industry Regulations 1973. A new Class 2 slaughterhouse has been constructed at Aspley.

Weight gain tests were carried out during the year at the larger poultry slaughtering establishments using spin chilling equipment. One result over 8%, the legal limit, was obtained but a repeat test produced a satisfactory result.

Butchers' shops and smallgoods establishments

The insistence on high standards of construction and appliances in new butchers' shops and smallgoods establishments has been maintained during the year. Detailed plans are submitted for approval before construction commences. Excellent co-operation has been forthcoming and some premises of a very high standard have been constructed, mainly associated with supermarkets.

Reasonable standards in older premises are being maintained. Many of these older premises with unsatisfactory timber floors have had them replaced with concrete floors properly graded and drained. Most butchers have co-operated well in meeting the requirements of Meat Industry Regulations, 1973.

The elimination of sawdust from the floors of butchers' shops has created some problems on the grounds of safety in a minority of instances. The regulations have been amended to ensure that smooth floors must be consistent with safety.

Consultations were held with the Meat and Allied Trades Federation before guidelines were drawn for the use of decorative meat tray dividers and plastic fruit.

More specialized and regular inspection is now being given to Class 2 butchers' shops (smallgoods factories) because of their high volume of throughput. A high hygiene standard at these premises is essential.

Meat quality

The promotion of tenderstretch by Branch officers continued. Some difficulty has been encountered in obtaining media coverage since it is no longer considered newsworthy. The amount of beef treated by the process at the Metropolitan Public Abattoir fell slightly during the year. Positive identification of tenderstretch meat is essential to its promotion and

widespread adoption. Preliminary trials and discussions have been held on the possible use for this purpose of the gelatine transfer process recently published by the C.S.I.R.O.

Slaughtering and Meat Inspection Branch Officers have again given numerous talks on meat quality and care of meat generally to housewives and other organizations. These are coupled with showings of the three films purchased from the Australian Meat Board. Audience response as judged by length of interest in discussion has been excellent. This is highlighted as being an important extension activity of the branch.

The Pathology Branch is undertaking an investigation to determine the numbers of salmonellas and various points of transfer of salmonellas from the animal to the meat during processing. The first part of this project has shown that knives used for operations where contact with the hide is possible have a greater chance of being contaminated and also the actual numbers of salmonellas are greater than on knives where hide contact does not normally occur. Furthermore, it was shown that dipping of knives in water at 82·2°C is ineffective in killing salmonellas unless they are dipped for at least 8 seconds.

The quantitative study of salmonellas on other items of equipment that come into direct contact with the carcass has commenced. This includes the examination of air knives, leg cutters, hooks and tables. The results of this project should show which transfer points should be given priority in controlling the spread of salmonellas in meatworks.

Sales of vacuum-packaged beef cuts on the local market have become more common during the year. Many butchers are totally unaware of the way the process works and are thus unable to handle or merchandise it to best advantage. These aspects of the introduction of vacuum-packaged meat are considered unfortunate as they may bring a reliable technological advance into disrepute on the local market.

Officers have appraised carcasses for competitions for country and provincial shows as well as organizing the Department's bone-out competition at the Royal National Show.

At an Australian Meat Board Carcass Classification workshop in Adelaide, systems of carcass classification for pigs, lambs and beef were presented. Considerable enthusiasm for their voluntary adoption and feedback of carcass data was expressed by producers representatives. Scientists and Departmental representatives generally supported adoption with some reservations on two of the parameters measured.

Resistance to adoption was evident from meat trade representatives, particularly the processors. Among other things, they question the cost benefits. Unfortunately, the only information offered on this at the workshop was theoretical in nature. The Australian Meat Board now wishes to see at least one large-scale, long-term trial in each State. Negotiations are proceeding in an attempt to introduce such a trial at the Brisbane Abattoir under supervision of the Slaughtering and Meat Inspection Branch.

Changes were brought about in the voluntary blue ribbon grading service at Cannon Hill. Under the previous specifications, the amount of fat on carcasses (finish) was required to be reasonable. It has been shown that measurement of fat at one point in the carcass is a reasonable estimate of total carcass fat. From this, it was decided to define acceptable limits of finish by measurement. In addition, there is a valid world-wide trend away from grading and names of grades which imply superior eating quality towards classification. For these reasons, it was decided not to continue with the names 'prime' and 'choice' for grades. These are replaced by symbols, which relate to fat measurements, within the Yearling and Beef Grades.

The changes introduced bring blue ribbon grading closer to a classification system. The Slaughtering and Meat Inspection Branch favours adoption of the Australian Meat Board classification system. No difficulty would occur in continuing the blue ribbon system if this happened. Grading beef would be determined by selecting among the classes described under the Australian Meat Board system.

The rise in number of carcasses voluntarily offered for grading represents a gratifying acceptance by the trade of the modified specifications for grading.

Poisonous plants and mycotoxicoses

Poisonous plants

LOSSES IN STOCK. A wide range of toxic plants was associated with losses and sickness. Some of the more important losses are detailed below—

Suspected wild jute (*Corchorus olitorius*) poisoning occurred on a property in the Boonah area. After harvesting soybeans, the owner screened out all foreign seeds and cracked soybeans, and about 20 bags of this material was left near a shed. Cattle began eating some of these screenings before the bags were removed and 36 hours after access to the screenings, one cow was found dead and a further 11 became sick. A total of eight eventually died. The initial symptoms of lethargy progressed in 24 hours to ataxia and excitability.

On post mortem, the lungs were haemorrhagic, congested and collapsed. There were numerous heart haemorrhages and the kidneys were soft, friable and nephritic. Jute seed was very obvious in the abomasum. Feeding trials at the Animal Research Institute confirmed the toxicity of the material. A 130 kg steer, which was fed 6 kg of the mixture containing 1·3 kg jute seed, died approximately 72 hours later. Cattle fed the separated jute seed and soybean at similar dose rates suffered only transitory effects.

While pimelea poisoning (St. George Disease) was reported in cattle in the Maranoa during early spring, predictions that the disease was likely to be a serious problem in the summer ahead proved false and this was probably associated with the abundant season which developed. Another species of pimelea, *Pimelea altior*, has been shown by feeding tests at the Animal Research Institute to produce St. George Disease.

For some years now, some serious losses of cattle have occurred on a number of properties in central western Queensland and they are usually associated with a severe toxic hepatitis. Symptoms include scouring, depression and weakness and post mortem findings are an enlarged hard liver with some jaundice. Feeding trials with water and *Crotalaria* sp. have both yielded negative results to date.

There were several severe losses associated with eating lush pig weed (*Portulaca oleracea*), usually linked with semi-starvation and/or transportation. Losses included 34 mixed breeders and stores at Julia Creek; 25 cattle at Roma; 25 cattle at Charleville; 65 ewes and 15 lambs at Blackall; and 50 sheep at Charleville.

Mother of millions (*Bryophyllum tubiflorum*) caused death in seven of 100 head at Goondiwindi. Symptoms included salivation, photosensitization, dysentery and ataxia. Post mortem examination revealed gastro-intestinal haemorrhage and sub-cutaneous ecchymosis.

Hoya vine (*Hoya australis*) caused the loss of six cattle on a property at Yarraman and nine deaths with seven other cattle missing on a Cadarga property.

Research

Fluoroacetate is the toxic principle of *Acacia georginae* and *Gastrolobium grandiflorum*, shrubs which are present over large areas of grazing land in Queensland. Metabolism studies elsewhere suggested that increased protein intake may protect the ruminant against fluoroacetate toxicity. To test this hypothesis, officers of Husbandry Research, Biochemistry and Pathology Branches at the Animal Research Institute fed sheep a basal diet of poor quality roughage (6% crude protein) plus molasses and supplemented this diet with either 50 g gluten, 14 g urea 73 g meat-and-bone meal or 146 g meat-and-bone meal for 3 weeks when the sheep were given sodium fluoroacetate at 6, 4 or 2 mg per head per day. These doses were calculated as the possible level of sodium fluoroacetate in 1 kg of leaves or pods of *A. georginae*.

The results indicated that protein supplementation would be of no practical value in protecting against fluoroacetate toxicity as deaths occurred in all treatment groups. Exercise played a significant role in the onset of poisoning.

Cheilanthes seiberi (rock fern or mulga fern) has the same ability as bracken fern to cause an acute haemorrhagic syndrome in cattle which is often fatal. It is suspected as a possible cause of tumours in the bladder resulting in the condition of cattle known as enzootic haematuria. Low levels (20 g per day) of the plant have been fed to two cattle throughout the year. No clinical signs of the disease have been seen to date.

Chemical studies relating to the toxic principles of *Helicia youngiana, Wedelia asperrima* and *Lophyrotoma interrupta* (sawfly larvae) are proceeding in the Biochemistry Branch.

Following acute illness in a man at Atherton after eating half a fruit of *Helicia youngiana* and following feeding tests to show that the kernel was toxic to some laboratory animals and sheep, studies were undertaken to identify the toxic principle. Extensive chromatographic examination of extracts of whole fruit has produced a collection of conflicting data.

Results are consistent with the hypothesis that the original toxic principle or principles break down during processing to produce fragments which retain the original physiological activity. However, treatment with dilute hydrochloric acid or dilute sodium hydroxide at 100°C for 15 minutes causes a considerable reduction in activity. It appears that fragmentation with retention of activity occurs only under very mild conditions.

Current efforts with *Wedelia asperrima* (sunflower daisy) are directed at preparation of 100 mg of the purified major toxic component for C13 nuclear magnetic resonance spectroscopy. It is believed that the use of this technique will clarify structural details which are at present difficult to interpret. The compound is a diterpene acid with a small nitrogen-containing group attached. Removal of this group destroys toxicity.

Sawfly (*Lophyrotoma interrupta*) larvae prefer to feed on the silver-leaf ironbark, which is not known to be toxic itself, but cattle eat the larvae when they accumulate at the base of the trees, often with fatal results.

Work undertaken by the Biochemistry Branch has resulted in isolation of a toxin from the larvae and studies on its structure, in collaboration with the Australian National University in Canberra, are virtually complete.

Mycotoxicosis

Thirty young cattle died and others were sick 96 hours after 700 of them were weaned into a feedlot in central-western Queensland. Losses ceased after removal from the feedlot. Clinical signs included hindquarter stiffness, lateral recumbency, salivation and scouring. Several fungi were isolated from the feed and the fact that the deaths ceased upon removal to open paddock feed, gave presumptive support for a diagnosis of mycotoxicosis.

Mouldy corn was also suspected to be the cause of ruminal stasis, nasal and rectal haemorrhage and haematuria in three cows which died on a Toowoomba property. Three species of *Fusarium* and one *Penicillium* were isolated from the mouldy corn.

Also a Fusarium mycotoxin was held responsible for the death of 24 out of 47 3-month-old pigs at Nobby when 20 males haemorrhaged to death following castration and four females after ear notching. The pigs were being fed on smutty sorghum from which *Fusarium* sp. was isolated.

The Biochemistry and Pathology Branches at the Animal Research Institute have examined a number of strains of *Aspergillus flavus* and *Aspergillus ochraceus* for their potential as toxin producers. Of 172 strains of *A. flavus* examined 89 had no detectable aflatoxin B_1 (<0·02 p.p.m.) while 10 strains produced more than 100 p.p.m. Of the 172 strains, 15 produced detectable aflatoxin B_1. Of the 22 strains of *A. ochraceus,* three produced more than 1 000 p.p.m. ochratoxin A, while 11 had no detectable ochratoxin A. Six strains produced detectable ochratoxins B or C.

The effects on productivity of broiler chickens of low levels (1 p.p.m.) of aflatoxins and ochratoxins in the feed was studied during the year. In the initial experiment, chickens initially 1 week old were fed the contaminated rations for 5 weeks. Toxicological, biochemical and histological studies are being made.

Chemical residues in animal products

Considerable resources of the Biochemistry Branch are devoted to continuing surveys, investigation and research into residues of pesticides in the environment and in animal products. This work allows possible sources of residues to be determined, permits the effect of treatment schedules on potential residues to be evaluated, and provides some monitoring data on the environmental effects of chemicals used in agriculture.

The results obtained allow more effective extension on correct usage of pesticides and other chemicals. The work is undertaken with other branches of the Division, the Division of Dairying and the Queensland Fisheries Service.

H.C.B. was banned nationally as a seed treatment for cereal grains in 1972. As there was evidence of unsatisfactory residues in the meat of some animals, it was agreed at Standing Committee on Agriculture that a number of aspects be examined. This Department examined the possible role of the previous use of treated seed on sheep grazing old wheat lands. Regular biopsy samples of subcutaneous fat from wethers grazing a wheat cultivation in which H.C.B. treated seed had been used for 13 years before the ban, indicate that such lands are not a potential source of H.C.B. residues in grazing animals. Soil and herbage-stubble samples from the cultivation showed very low levels of H.C.B., varying from 0·001 to 0·004 p.p.m. H.C.B.

Studies on ethion residues in beef and dairy cattle were also undertaken. In the case of beef cattle, samples of fat were obtained at slaughter from various classes of cattle with a known dipping history. Dip concentration (within normal variations), breed, sex and condition appeared to have little bearing on residual ethion levels. Hair length had a minor effect. Although the group means for animals sampled 3 days after dipping were generally below the maximum residue limit, individual animals exceeded this limit. From 5 to 14 days after dipping the mean fat residue was 1·2 p.p.m. and no values exceeded the maximum residue limit.

Residual ethion characteristics are also being studied in the tissues of cattle dipped in newly charged and in aged ethion vats. An attempt will be made to correlate residues occurring in the fat of treated cattle with hair loading figures and with physical or chemical characteristics of the dipping vat fluid, for example, age, and degree of silting. This work is in progress.

Work with dairy cows assessed the persistence of ethion residues in the milk of sprayed or dipped cows. Results of the trial indicate that both methods of application lead to ethion residues in the milk in excess of 1·5 p.p.m. (based on the fat fraction) in the 2 days following treatment. Highest excretion level was 4·5 p.p.m. ethion. There was no evidence to suggest that repetitive treatments at 10-day intervals present a cumulative problem as far as ethion excretion is concerned. Dipping generally resulted in higher ethion residues in milk than spraying.

Ethion levels should not cause a problem with beef levels for slaughter following relaxation during the year of the requirements for tick control treatment of cattle moving for slaughter. In milk, marketing methods which result in the bulking of milk from a number of farms before sale should ensure that levels are below the maximum residual level unless synchronized tick control measures took place in a supply area.

Further work aimed at investigating potential problems of pesticide residues in dairy produce is continuing. This involves examining pasture and soil samples for dieldrin and other organochlorine pesticides from mixed dairy farms where sugar-cane is grown. Some of the levels of dieldrin found in dairy pasture and soils could be a source of residues for dairy producers.

Residues of chlordane (0·7 and 1·0 p.p.m.) were detected in the U.S.A. from two samples of meat from Queensland establishments. Preliminary investigations suggested one possible source deriving from ant control in pineapples as the ants promote the mealy bug, thought in the industry to be a vector of a wilt.

A survey of the levels in the fat of cull dairy cows from four dairies feeding pineapple waste and in butterfat from 17 dairies using industrial wastes (pineapple waste, brewery grain, cottonseed hulls, bread and small crop waste) was undertaken.

The data on the cull cows suggest some residue potential with dieldrin and chlordane, but the investigation did not establish whether waste was the sole source of pesticide. In the survey of dairy products, chlordane, heptachlor, endrin and endosulphan were not detected but low levels of DDT and its metabolites were found.

Samples of feed materials were taken by Veterinary Services personnel from properties from which 'above-tolerance' organochlorine residues have been found in cattle by Commonwealth survey. Few trace-backs produce positive findings. In one, DDT residues were found in sorghum stubble which had been treated for grasshopper control. Progressive sampling from cattle from this property continued. DDT residue levels were negligible.

Following adverse publicity in New South Wales concerning alleged ingredients in sausages and additional non-specific publicity concerning pesticides in sausages, a limited survey on pig fat of mixed origin was undertaken in collaboration with a manufacturer. Although there were detectable levels of DDT and its metabolites present, the maximum levels found were far below the residue limits permitted.

Tissues from pigs fed a ration containing 2·5% whale solubles were analysed for total mercury content. Mean liver level was 0·06 p.p.m. total mercury and mean kidney level, 0·11 p.p.m. total mercury.

Samples of 'meat-and-bone' meals derived as 25% to 90% of their weight from pig offal were analysed for total mercury content. Mercury levels ranged from 0·014 p.p.m. to 0·11 p.p.m. total mercury and, generally, correlated with the percentage of pig offal in the meal.

Samples of whale feed products from Cheynes Beach, Western Australia, contained 9·6 p.p.m. total mercury and whale 'solubles' contained 3·0 p.p.m. mercury.

In collaboration with the Queensland Fisheries Service, a survey of heavy metals in fish was undertaken at two sites in the Brisbane River. Juvenile mullet from a site at Esk, the extreme range of mullet migration, and commercial mullet from Luggage Point were examined for cadmium, chromium, copper, mercury, nickel and zinc.

With the possible exception of copper, levels in liver and edible muscle in juvenile fish were low. There was little difference between heavy metal concentrates in natural waters and sediments from the two sites. Pesticide analyses will also be undertaken on the same material.

Disposal of animal waste

Treatment of effluent from intensive animal units to allow discharge into water is too costly so that, for the foreseeable future, wastes from these units will be disposed on land either before or after some form of treatment.

For Queensland conditions, there is little information on the beneficial use of these wastes as fertilizers and on their pollutant potential. During the year, a comprehensive study, supported in part by the Environment Control Council and involving a number of Branches of the Department, was commenced at the Animal Husbandry Research Farm, Rocklea, with beef cattle manure to examine these aspects.

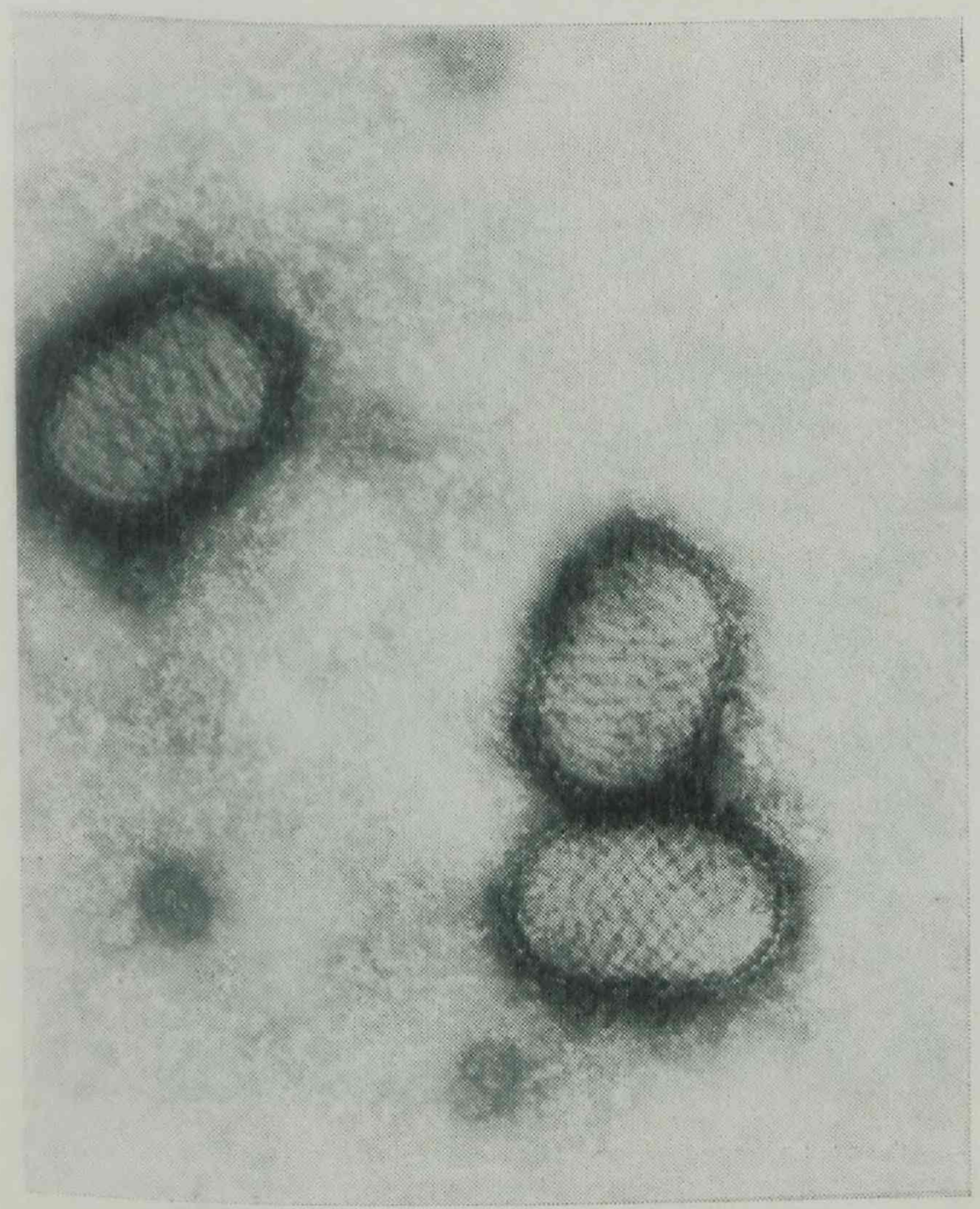
Manure is deposited on a mixed grass-legume pasture at rates of 0 and 120 tonnes per hectare per year at 1-monthly and 6-monthly frequencies. Studies are undertaken on the chemical composition of the manure, soil chemistry, pasture yield and the composition and levels of organic, inorganic and microbiological pollution in the run-off.

Manure application began in August 1975 and results to date are—

The manure varied in dry matter content from 18 to 59% and had an average content of the following elements: nitrogen 2·0%; phosphorus 0·56%; potassium 1·67%; copper 28 p.p.m.; zinc 163 p.p.m.; manganese 183 p.p.m.; sulphur, 0·30%. To date, there has been no difference in hay yield, build up of nitrate in pasture, or botanical composition.

Bacterial counts in the run-off and ground water were similar and high for all paddocks with the exception of salmonella serotypes recovered from water from the control paddocks. The salmonella serotypes recovered from the control paddocks were those commonly found in reptilia. Samples in treated paddocks were collected a few yards from where manure was deposited.

In all paddocks, the B.O.D.$_5$ in continuity samples, run-off and ground water was low with maximum from any sample of 12 mg per litre. Nutrient levels were not alarming. Nitrates and nitrites predominated in ground water (maximum of 2·8 mg per litre) while NH_3–N predominated in run-off samples (maximum of 0·84 mg per litre). The C.O.D. levels were high in all sample types from all paddocks (maximum 386 mg per litre). The maximum organic P level was 6·4 mg per litre. The C.O.D. results are puzzling and require further examination. No odour pollution has occurred nor has there been fly breeding.



An electron microscope photography of contagious ecthyma (scabby mouth) virus magnified 120 000 times in scab material from a sheep. Sophisticated equipment allows the more rapid laboratory diagnosis of animal diseases.

Laboratory services

Specimens examined

One of the areas of the Division's activities that is sometimes overlooked in the reporting of achievements is the services provided by laboratories direct to the producer and in support of extension and research officers servicing the livestock industries.

During the year, a record 15 700 batches of pathological specimens were submitted to the laboratories at the Animal Research Institute, Yeerongpilly. More than 6 000 of these were associated with the campaign for eradication of tuberculosis and brucellosis from cattle.

An examination of the origin of specimens submitted to the Yeerongpilly laboratory for the calendar year 1975 showed that approximately 88% were from cattle, 1·5% from sheep, 6·5% from pigs and 4% from fowls. Limited numbers were received from horses and other animals or birds.

Most of the specimens were submitted by Departmental officers (79%) with 17·1% from private veterinarians, 1·6% by Commonwealth officers and less than 1% by the University and direct by owners.

There has been an increasing requirement for various tests in connection with the export of live animals, mainly cattle. More than 50 000 serological tests have been done for this purpose during the year.

Interesting findings sometimes result from non-farm animals that are examined from time to time because they might have disease of public health significance or because they are laboratory animals used in providing the diagnostic service. Two such examples are reported this year. One was the finding of *Salmonella typhi murium* in two snakes that had nodules throughout their livers. This is a diagnostic feature of salmonellosis in a wide range of warm-blooded animals. The other was the recording of fluorosis in guinea pigs at the laboratory in common with similar findings at a number of other biological laboratories throughout Australia.

As part of its chemical service, the Biochemistry Branch analysed 1 317 samples for a great variety of toxic substances, including heavy metals, other inorganic and organic substances, including pesticides. Included in the wide range of tissues and feedstuffs analysed were a considerable number of wildlife specimens. A total of 1 582 diagnostic specimens, including a sharp rise to 400 equine samples, were processed as part of the clinical diagnostic service.

In servicing Departmental research projects, a total of 2 479 samples were analysed for nutritional and clinical parameters. A further service is provided to Department field officers, who submitted 850 samples for nutritional determination as an aid in farmer advisory services. The determination of the amino acid content of grains and stock feeds, using the Beckman 120 C amino acid analyser, has been allied to specific projects involved in either pig or poultry nutrition.

Blood inorganic phosphate analyses related to continuing observations on phosphorus supplementation of fattening steers and sulphur determinations are part of a continuing data gathering project, which will be used to establish blood sulphur levels in fattening steers.

The laboratory provides an analytical service for all proprietary cattle dipping fluids. A total of 2 780 samples from cattle dips was analysed. Chemical analyses of a service nature were carried out for several private companies in situations where chemicals presented potential hazards to free marketing of products. These included assay of the blood from cattle dipped in an equi mixture of bromophos ethyl (0·1%) and its di-bromo derivative (0·1%) for cholinesterase activity and examination of 58 batches of aflatoxin to provide certificates for export shipments.

Method development

In the provision of these services, methods have to be continually developed, modified or adapted as scientific discoveries increase, technology changes and requirements of industry dictate. The following chemical procedures were introduced during the year—

1. Total and soluble oxalic acid in ruminal contents, faeces and plant material using the Moir Filtrex equipment.
2. Determination of citric acid in tissues as an index of 1080 poisoning.
3. Determination of heavy metals in natural waters and sediments.
4. Determination of thallium as a dithizone complex.
5. Detection of metaldehyde in baits using Schiff's reaction.

6. Determination of cyanide in plant material using a selective ion electrode.

7. Measurement of thiocyanae in blood and urine as an index of cyanide poisoning.

8. Determination of chlordane in meat and milk by EC/GLC.

9. Determination of fenthion ethyl and chlorfenvinphos in wool by AFID/GLC.

10. Measurement of hydrocarbon volatiles in fish by infra red spectroscopy.

11. Detection and estimation of anionic surfactants in waters and sediments by a methylene blue reaction.

12. Improvements in the separation of ochratoxins from plant and feed materials and detection by TLC.

13. Piezoelectric detector output modification to provide 1mV sensitivity for measurement of hydrocarbons.

14. Progress in the development of a suitable screening method for 1080 in post mortem material.

The construction of a 10-unit Co-sweep Distillator is in an advanced stage of construction at the Animal Research Institute. A prototype four-unit model has been used in the laboratory to test gas flow rates, condensation traps, column packing, and other physical parameters in the Co-sweep process. An alternative method to conventional techniques (dry or wet ashing) for preparing pasture samples for mineral analyses has been conceived and partially developed. The process involves acid hydrolysis in a commercial filter device (Filtrex).

Results indicate equivalent and, for certain metals, superior performance to classical techniques. More importantly, the method overcomes a severe pollution problem associated with wet ashing (that is, nitric, perchloric, sulphuric acids) and also allows for large-scale batching which is not feasible with muffle furnace ashing.

An additional assay for monitoring hepatic damage has been successfully adapted from human to veterinary use. The enzyme gamma glutamyl transpeptidone should increase the precision of diagnosis of hepatic damage, particularly in cattle.

In the technique evaluation in the microbiological field, 297 cultures were used to assess the performance of the A.P.I. system (a commercially available rapid semi-micro identification kit for Enterobacteriacea). The results showed an identification level of 93%, with the major reasons for mis-identification being the citrate and orthonitrophenyl galactoadose (DNPG) tests.

A technique was also developed to allow more effective examination of eggs in the work to evaluate egg washing procedures. This involves removing the contents from the egg aseptically and filling the egg with bacteriological agar containing an indicator to stain areas where bacteria multiply. This allows an accurate assessment of degree of bacterial penetration in eggs subjected to various treatments.

Other methods introduced were the Coggins-gel diffusion test for equine infectious anemia and the Coxsackie B5 virus serum neutralization test using monkey embryo kidney cell monolayers for surveying for swine vescular disease.

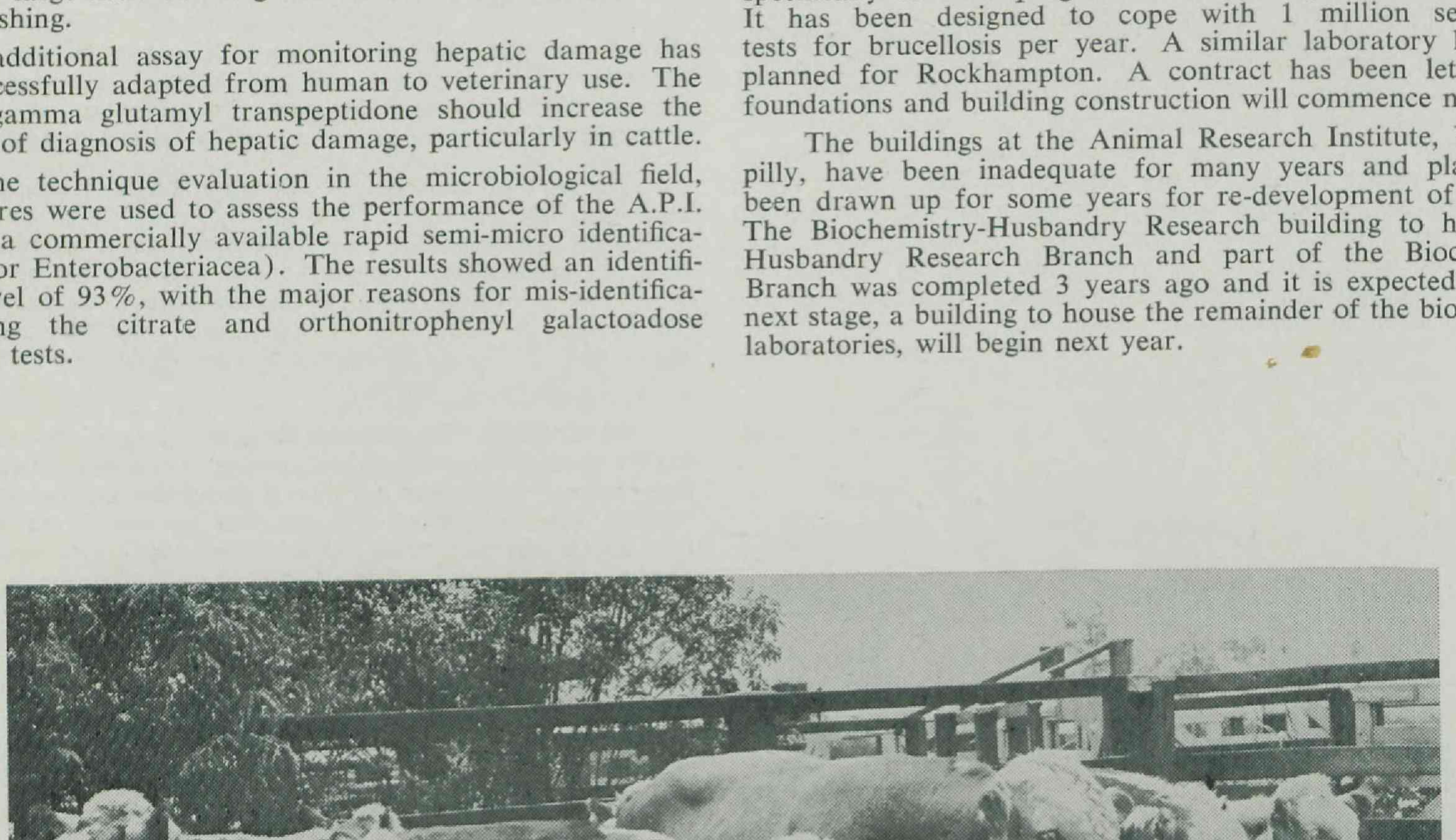
Methods for isolation of *Erysipelothrix rhusiopathiae* and *Campylobacter fetus* were compared and different methods for gel diffusion testing for *Corynebacterium ovis* and for microtitre tests for ephemeral fever, infectious bovine rhino tracheitis and mucosal disease were evaluated. Three isolations of *Pseudomonas pseudomallei,* the cause of meliodosis, were made from soil at the Animal Health Station, Oonoonba, and studies are continuing on the survival of the organism in soil.

Building programme

The main laboratory building at the Animal Health Station, Oonoonba, built in 1914, was destroyed by fire in July 1972. Since that time, the service from that Station has been provided from temporary accommodation in one of the large residences and in a semi-detached portion of the main building which was saved. The virologist is using facilities at the James Cook University of North Queensland. The new laboratory is expected to be completed in the spring of 1976 and will provide modern facilities to service north Queensland.

The national brucellosis-tuberculosis eradication programme will rely more heavily on laboratory support as the scheme progresses. A laboratory at Yeerongpilly designed specifically for the programme was occupied in June 1976. It has been designed to cope with 1 million serological tests for brucellosis per year. A similar laboratory has been planned for Rockhampton. A contract has been let for the foundations and building construction will commence next year.

The buildings at the Animal Research Institute, Yeerongpilly, have been inadequate for many years and plans have been drawn up for some years for re-development of the site. The Biochemistry-Husbandry Research building to house the Husbandry Research Branch and part of the Biochemistry Branch was completed 3 years ago and it is expected that the next stage, a building to house the remainder of the biochemical laboratories, will begin next year.



Overseas reports suggest that the Simmental-Hereford cross possesses the best traits of both breeds. This is being examined at the Brigalow Research Station. The purebred Hereford heifers pictured here are with the half-bred Simmental-Heretord sire.

Division of Plant Industry

THE Division of Plant Industry is concerned with improvements in crop and pasture production. Its broad objectives are yield increase, quality improvement, conservation and cost containment in agricultural production. It has a role in seeking for and testing new crops that would add to the diversity of agricultural production in the State.

Two major production branches, Agriculture Branch and Horticulture Branch are supported by specialist research groups organized into Entomology, Plant Pathology, Agricultural Chemistry and Botany Branches.

The Director of Horticulture is also Chief Plant Quarantine officer in Queensland and, as agent for the Commonwealth Department of Health, administers Plant Quarantine in this State.

Officers in the Division provide a service to other State Departments and to home gardeners, to the private sector servicing agriculture and to users of agricultural products.

The Division's functions are principally research and extension or advisory. It is, however, involved in the administration of regulations concerned with plant and crop protection.

The Division of Plant Industry is responsible for the administration of three research units supported by Industry or Commonwealth Industry Funds.

THE QUEENSLAND WHEAT RESEARCH INSTITUTE, Toowooma, is financed by contributions from the Australian Wheat Research Council and the Queensland Wheat Research Committee. The State Government provided $42 000 towards operating costs in 1975-76 and pays most of the salaries. The Institute is the centre for a vital wheat breeding programme. The popular variety Oxley was released from that centre. Plant protection, soil fertility and wheat quality studies are also being undertaken.

'BRIAN PASTURES' PASTURE RESEARCH STATION, Gayndah, is an Australian Meat Board research centre. Its objective is improved beef production through the development of improved nutrition and husbandry practices.

The Australian Meat Board contributes an agreed sum each year. Staff salaries and running costs are met by the Queensland Government.

SOUTHEDGE TOBACCO RESEARCH STATION, Mareeba, is financed by the Tobacco Industry Trust Account. Some salary commitments are met by the State Government. Research priorities are the development of disease resistant varieties, plant protection techniques which will reduce dependence on chemicals, and management practices which will result in cost savings.

Varietal improvement is one of the most significant advances being made in technical agriculture.

Eighteen new fruit and vegetable varieties and nine new field crop varieties were released to growers during the past year. These releases will lead to higher yields and some reduction in production costs.

A major cause of deterioration of lucerne stands has been identified. Strains of Hunter River lucerne resistant to both crown rot and root rot have been selected and are under test. This outstanding piece of scientific investigation should result in increased life of lucerne stands and return lucerne to its premier position as the outstanding forage legume for central and southern Queensland.

During the year, peanut rust attacked crops in southern Queensland for the first time. Treatments evolved by officers of Plant Pathology Branch in north Queensland enabled Burnett district farmers to take immediate protective action.

An entomologist in the Division leads Australian scientists in a programme to develop alternative grain protectants. This work has been successful. This officer will put the case for the approved use of new and effective grain protectants at an international conference in the U.S.A. later in 1976. His work will help ensure that Australia is able to continue to meet world market demands for weevil-free grains.

Advances in the biological control of insect pests have been spectacular. A natural enemy of circular black scale of citrus has been increased at the entomology laboratory at Nambour. The tiny parasite has been released at 60 orchard sites in Queensland, and has been so successful that black scale is no longer a significant pest in these citrus orchards.

By harmonizing biological and chemical control practices successful pest management systems are being evolved in Queensland. Fruit and vegetable quality has not deteriorated. Fewer pesticide sprays have been needed and there has been a saving in costs and minimal environmental contamination.

While technical advances have been highlighted it would be unrealistic not to refer to the work of the extension services. Vibra packing in the citrus industry has been successfully introduced. The market extension service has improved presentation and reduced wastage and costs in the horticulture industries. Hygiene on grain farms has improved. Technical and managerial skills continue to rise and efficiency particularly on crop production farms is of a high order.

Agriculture Branch

IN broad terms, Agriculture Branch seeks to improve the productivity and stability of field crop, forage crop and pasture production in Queensland through a combined research and extension programme.

The extraordinary diversity of Queensland's agricultural environment necessitates major plant breeding efforts in wheat, barley, sorghum, maize, sunflower, soybeans, tobacco and cotton to seek superior local adaptation and disease resistance. Significant selection programmes are also applied to varietal improvement in forage oats, linseed, safflower, peanuts, rice, navy and mung beans, potatoes, sweet potatoes and onions. Exploratory work is assessing the potential for such new crops as gram (*Cicer arietinum*), sesame, lupins and cassava.

Soil fertility and weed problems are also diverse and Branch research encompasses tillage practice, plant nutrition, fertilizer technology, crop and pasture rotation systems and weed control. Irrigation developments require specialized technical servicing.

The pasture research programme seeks principles to guide balanced use of our natural grazing lands with emphasis on the mulga, Mitchell grass, blue grass and bunch spear grass communities. Improvement of animal production from natural grasslands is pursued through legume selection and introduction to extensive grazing lands in the humid eastern sector of the State. For intensively developed areas, forage crops and sown pastures are researched for superior species, grazing management, optimum fertilizer strategies, seed production and establishment methods.

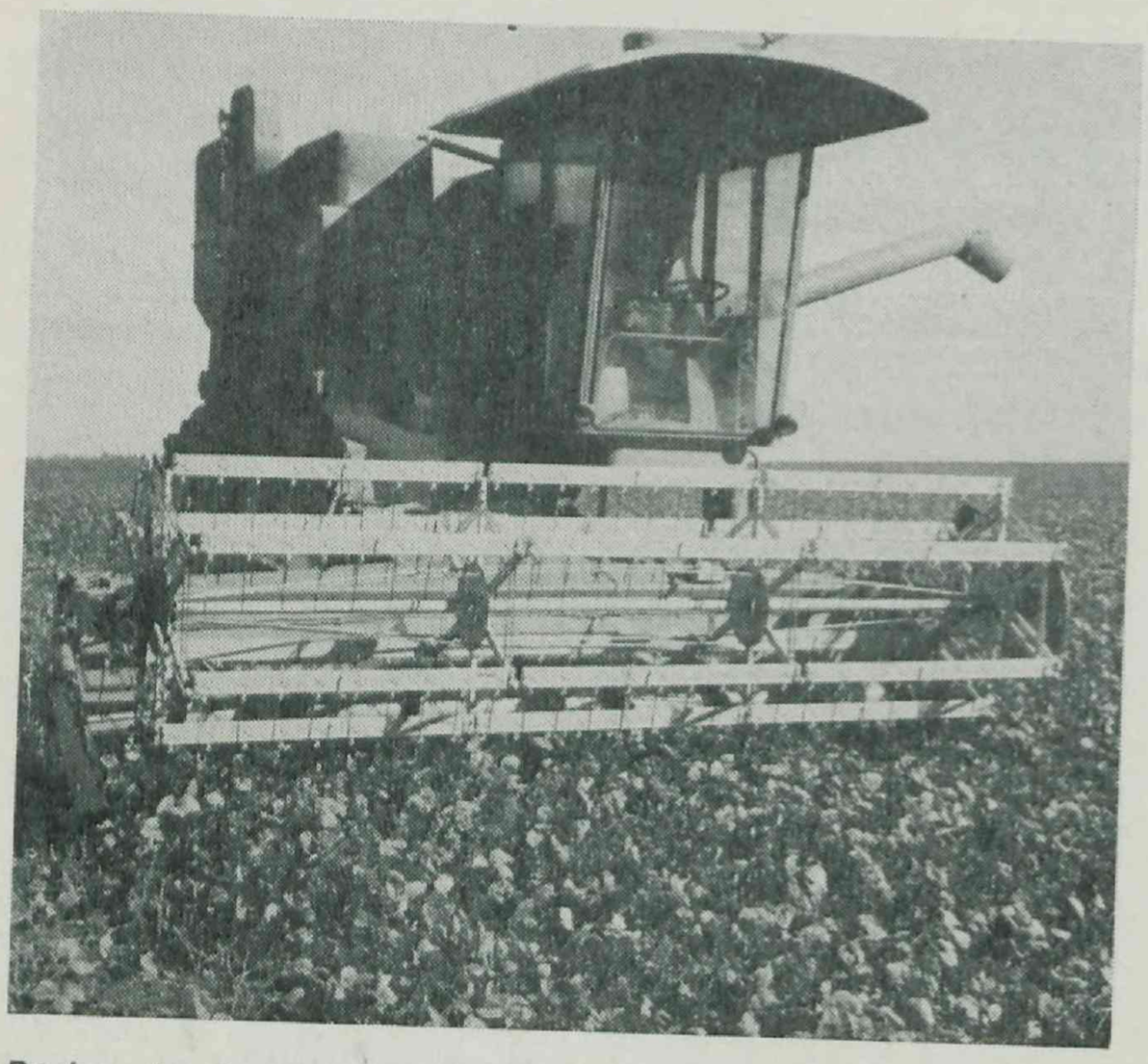
Branch research relies heavily on support and collaboration from other Branches of the Department, and particular effort is directed at linking the Branch's practically oriented research with the important but more basic studies undertaken by C.S.I.R.O. and Universities.

To provide a continuity of service to industries, communities and farmers, the Branch maintains a widely-deployed extension staff skilled in promoting the application of crop and pasture technology to commercial enterprises. This is a particularly demanding activity which has to blend profit motives with a conservative treatment of natural resources. Extension services maintain effective liaison with all agricultural industries and, in this way, identify problems to ensure a proper orientation for research activities.

Pasture research

Seed production studies

The seed production studies investigate the factors affecting seed production and seed viability on a range of the major pasture species and cultivars, especially the grasses.



Berken is the name of a new mung bean variety released during the year. This large-seeded type promises to be superior in the production of bean sprouts.

Records of the efficiency of recovery of grass seed by header harvesting show that this is low (average 40%) with smaller seeded grasses (cultivars of *Panicum maximum, Setaria anceps, Paspalum plicatulum*), but higher (60%) for the larger seeded *Brachiaria decumbens.*

High levels of immature caryopses may explain the variable quality of seed of Petrie green panic (*Panicum maximum* var *trichoglume*) compared with other *P. maximum* cultivars.

A study on the effects of post harvest handling on grass seed quality indicates that the highest quality is achieved if the seed is held at high moisture content but without restriction of gaseous exchange with ambient air for about 3 days before being dried. Restriction of gas exchange over this period is harmful.

Dry tropics pastures

Further progress has been made with the evaluation and development of selected *Stylosanthes* accessions while a new range of legume material has been brought into the preliminary evaluation phase. These have involved material emerging from Mr. I. B. Staples' 1970 collection and the recent collections of Dr. R. L. Burt from C.S.I.R.O. Townsville.

Studies of the nutrient status of soils at the major dry tropics' experimental sites are being intensified and the specific requirements of the most promising species are being assessed. Sulphur is a major requirement on basaltic soils and, in early years, pelleting of seed with elemental sulphur or gypsum has proved useful. Sulphur fertilized plots have also been preferentially grazed by cattle.

Surface sowing of a range of *Stylosanthes* species has given excellent establishment and *S. guyanensis* CPI 40255 has produced up to 6 800 kg per ha dry matter on presentation in the second year and supported 0.5 to 1.0 weaners per ha. All lines were grazed during their active growth, but acceptance by stock following frosts was low and weight losses occurred in stylo paddocks. Weight of cattle on the native pastures outside the trial area was maintained in the same period.

On the native pastures of the Balbirini Land System, significant declines were shown for protein levels in *Astrebla elymoides, Dichanthium fecundum* and *Iseilema* spp. during the dry season. *Iseilema* spp. (Flinders grasses) were the only components to show significant decline in phosphorous contents.

Pasture studies, central Queensland

The study of *Stylosanthes* species showing so much promise in the northern dry tropics has been extended to a range of situations in central Queensland. The *S. scabra* lines in particular show productivity after the establishment period and some frost tolerance.

A grazing trial south of Mackay has examined the effects of stocking rate on legume content of sown pasture and of the legume on animal performance. Legume dominance has been a fluctuating and cyclic feature throughout 4 years of stocking. This has been the result of nitrogen inputs into the pasture system affecting competition from Kazungula setaria. The effects of stocking rate on herbage yield have been very pronounced. For Siratro, the critical stocking rate was marked and above 1.7 steers per ha the Siratro yield was negligible. At medium stocking rates stylo (cv. Schofield) has increased and now contributes greater than 50% of legume at 2.5 steers per ha. Siratro is not readily eaten in spring and summer months. In dry periods, however, it can exceed 45% of the diet on a pasture where it only makes up 8 to 10% of the dry matter.

Pasture studies, 'Brian Pastures' and Isis

At the Isis Experimental Site, where factors affecting cattle performance on northern wallum pastures are being studied, a 94% calving was obtained between November 1974 and January 1975. By weaning in late May, 84% conception had again been achieved in the breeders and a mean weight gain of 27 kg per head recorded for them.

At 'Brian Pastures', the value of leucaena as a supplement to a native pasture over the winter has again been demonstrated. With a pasture dry matter yield of 4 000 to 5 000 kg per ha and a leucaena yield of 550 kg per ha, animals gained 20 kg a head from May to October with a weekly rotation on the leucaena. A loss of 7 kg a head was recorded when 1 kg of crushed lablab grain per head per day was available in lieu of the leucaena and a loss of 31 kg per head was sustained on unsupplemented native pastures.

Lucerne studies

Attempts to define the factors affecting the persistence of lucerne in the subtropics are continuing at Biloela and Brigalow Research Stations. Close monitoring of stands has shown when plant deaths are occurring and when disease infection is present. Sixteen months after planting at Biloela, 19% of the initial Hunter River, 48% of the Siro Peruvian and 46% of the combined creeper plants had died. Most deaths occurred when weekly maximum soil temperature exceeded 30°C and the soil was wet for relatively long periods. Infection with the fungus *Colletotrichum trifolii* only became evident subsequently and was most prevalent on Siro Peruvian. This work is now being expanded to a range of soil types on Brigalow Research Station.

Under grazing at both centres, two C.S.I.R.O. creeping-rooted lucerne lines, ECRS 1 and Combined, have shown no better persistence than Siro Peruvian and Hunter River. Most losses occurred in 1974-75 summer. The performance of 36 progeny of crosses made by C.S.I.R.O. under rain-grown conditions and 24 under irrigation is also to be assessed at Biloela. A local selection of Siro Peruvian has shown 60% persistence under irrigation in the first year against 74% for a Phytophthora-resistant line and 44% for commercial material while its yield (c. 8 000 kg per ha) was equivalent to the commercial line.

Brigalow soil nitrogen studies

Examination of the nitrogen fertility of brigalow-Dawson gum soils with various periods of development has shown responses to applied nitrogen on field plots with efficiency decreasing from approximately 30 to 38 kg dry matter per kg N to 7 to 10 kg per kg N applied. Yield and nitrogen uptake of buffel grass plants grown in soils from 20 sites with a range of total soil N from 0.165 to 0.016% N was positively related to total soil nitrogen.

Pastures studies, wet tropics

Major work on the wet coast now revolves around management and fertilizer maintenance studies. From a monitoring of commercial fertilizer programmes, it would appear that 300 kg superphosphate per ha every second year is sufficient on most soils to maintain soil phosphorus levels and that little change in potassium status is occurring.

At Utchee Creek, the best unit in the guinea grass-centro grazing trial produced 508 kg per ha liveweight gain over 192 days from January to July 1975. This is a common guinea-Belalto centro pasture with 25% of its area pure Basilisk signal grass receiving nitrogen fertilizer.

Productivity and stability of semi-arid grazing lands

Grazing management of the semi-arid grazing lands requires a sound knowledge of the effects of grazing on the persistence and rehabilitation of desirable range plants. These effects are studied by monitoring changes in the vegetation over a time and with various management treatments.

In south-western Queensland, there are 64 km of recorded transects on two mulga properties, 17 permanent exclosures covering all major soil types and 36 benchmark sites on a variety of types of country in well preserved condition. In addition, differentially grazed paddocks of Mitchell grass are examined to identify climatic effects as opposed to management influences.

During the year, 16 km of transects, 15 exclosures and 4 benchmark sites were botanically surveyed for comparison with previous records. The overall trends indicate a general improvement in cover and the proportion of desirable fodder plants, as a result of recent favourable seasons.

Protected Mitchell grass sites showed an increase in the proportion of Mitchell grass from 11·8% in 1972 to 54% in 1975. The plant cover on gidyea country rose from 0·2% in 1972 to 1·2% in 1975. Comparable increases for the mulga site were 0·6% to 2·6% and for a rocky plateau site were 0·8% to 2·0%. In paddocks with histories of light, medium or heavy stocking with sheep, heavily-stocked Mitchell grass has exhibited a decrease in size of clones which was only partly offset by an increase in clone number. A noticeable feature was the absence of the weed grass *Aristida latifolia* in the heavily grazed paddock.

For 5 consecutive years, an area of Mitchell grass at Toorak, Julia Creek, has been heavily grazed by cattle over the dormant period (winter-spring). After the third year, both population and basal area of Mitchell grass plants had declined significantly. However, since 1974, Mitchell grass has continued to show a slight decline in basal area compared with a leniently grazed area adjacent. A main feature has been the almost complete disappearance of *Aristida latifolia* in the heavily grazed paddock. Removal of *Aristida* by this strategy could be a useful technique in wool country.

Because of rainfall variability, a constant stocking rate results in under-utilization of the pasture in good seasons and gross over-utilization (with eventual deterioration) in low rainfall years. At the beginning of 1975, work was begun to investigate flexible stocking rates on Mitchell grass country near Charleville. Stocking pressures have been adopted to remove 10%, 20%, 30%, 50% and 80% of the feed available at the end of summer. This resulted in stocking rates ranging from one sheep to 2·9 ha to one sheep to 0·4 ha for 1975-76.

Pasture and animal responses of wethers grazing a buffel grass pasture near Blackall have now been measured for 8 years. Results in 1975 established that productive buffel grass pastures in cleared gidyea scrubland are under-utilized when continuously grazed at a rate of 1·25 sheep to the ha. This is approximately double the recommended stocking rate on native Mitchell grass pastures in the central west. Doubling the stocking rate on buffel grass to 2·5 sheep per ha while reducing forage availability has maintained animal production and has not yet resulted in any pasture deterioration. At 5·0 sheep per ha, wool production per animal was maintained and wool production per ha was greatly increased. However, this stocking rate does not allow a build up of sufficient fodder reserves for sheep to survive drought periods without supplementary feeding.

Intake and nutritive value studies of sheep diets

The grazing industry of south-west Queensland is almost totally dependent upon the native pastures for forage. Analyses of forage samples from these pastures suggest that they are often deficient in protein and phosphorus. However, it is well documented from other areas that the diet selected by animals can be of much higher quality than would be indicated by analysis of pasture samples.

An investigation of sheep diet quality and quantity using oesophageal fistulated sheep has been undertaken on a mulga property near Charleville. The gross energy values of diets were rarely different from those of whole pasture samples, but these were often below the accepted requirements. This suggests that low intake of energy may be limiting production in these areas. Small areas of high energy, introduced plant species may overcome this problem at a low cost.

Plant introduction and pasture species evaluation

Deficiencies in yield, palatability and nutritive value of many of the native pastures in western Queensland have turned attention to the evaluation of alternative forage sources. Selected species must be capable of establishing, persisting, spreading and producing under the harsh climatic conditions experienced and must be able to grow on low fertility soils which frequently possess poor physical characateristics.

The work is concentrated in the mulga zone but district evaluation sites are located throughout western Queensland. Sward evaluation and comparisons with native species have continued at Charleville. Production from the introductions has been higher than from the native species. Natural spread of some of the introductions has continued, particularly *Eragrostis curvula, Schmidtia bulbosa* and the legume *Stylosanthes mucronata*. *S. mucronata* shows promise in the mulga zone.

Seedling establishment

Long-term stability of native pastures is essential if present pastoral production is to be continued economically. During periodic droughts, severe reductions occur in the cover of living plants, especially the more palatable species. Within the constraints of the semi-arid environment, pasture management should allow the lost plants to be replaced by normal cycles of regeneration. This programme has as its objectives the definition of factors influencing establishment of native and some introduced species on mulga soils of south-west Queensland.

The work has highlighted the importance of some form of surface cover, whether by dead or living vegetation, on species emergence and survival. It has shown that there is sufficient seed available in the mulga ecosystem for adequate regeneration of degraded pastures. Episodic occurrences of abnormally wet seasons will continue to provide the main impetus to widespread regeneration in the region, but occasional seedling recruitment at other times is essential if long-term stability is to be maintained in these grazing lands.

On the Darling Downs, the problem of establishing pastures on the self mulching black clay soils remains. It has, in fact, become more acute with the increased need for pastures in the various soil conservation programmes and several studies have been in progress.

Bothriochloa insculpta has shown some improvement in establishment ability over standard grasses, *Panicum coloratum* and Rhodes grass, while a new species *Setaria porphyrantha* has shown a considerable and consistent improvement. This grass has performed well on similar soils at Inverell in New South Wales.

Irrigated grain and forage production, Mitchell grass country

This work was carried out at Richmond between 1969 and 1976. Its aim was to examine the feasibility of using water stored in shallow dams to irrigate annual summer and winter grain and forage crops to provide alternative and supplementary sources of feed for north-western Queensland sheep flocks.

The 1975 cropping season received abnormally high rainfall (714 mm from December 1974 to April 1975) and consequently was one of the few years in which summer grain crops could be grown without irrigation.

Gamut wheat planted in April returned the highest water use efficiency when irrigated once, 28 days after planting. Although multiple irrigation strategies increased yield to 2 100 kg per ha, this was not sufficient to offset the reduction in the potential area of land which could be irrigated from the storage and consequently water use efficiency fell.

Considerable information has now been accumulated on the agronomics of crop production. The field programme has been terminated and interpretation of data has begun. The project also includes studies of run-off characteristics from the Mitchell grass catchment feeding the shallow storage dam.

Studies on annual medics

The aim of these studies is to assess the role of annual medics as pasture legumes in the southern agricultural regions. Although dependent on winter rain, they have potential to provide winter protein and add nitrogen to the soil.

Maximum dry matter yields of up to 10 000 kg per ha have been achieved from June and July plantings with useful growth possible from plantings between February and August. Growth has been poor from midsummer sowings.

A strong seasonal pattern in flowering is evident. Three control mechanisms involving day length, low temperatures and high temperatures have been determined. These enable the flowering patterns in the field to be understood as an aid to selection of more suitable varieties.

Temperate species

A major deficiency of tropical pastures is the poor quality of forage available over the cooler months of the year. This problem becomes more important as production intensifies in the dairying and cropping areas. In southern Queensland, winter rainfall enables useful cool season production to be achieved from adapted species.

A range of temperate pasture species has been under study in attempts to find the best adapted to local conditions and to fit these into the farming systems. In particular, white clover cultivars have been grown at several centres while the tropical clover *Trifolium semipilosum* cv. Safari has also been under test. Ladino white clover and Safari produce best in summer while Haifa, Louisana and Grasslands Huia perform better in winter and spring. Cultivation of pangola grass pastures at Coolum has led to strong year-round growth of white clover.

Some irrigation is required for maximum benefit from the temperate grasses. Rust can be troublesome with the ryegrasses, although Ariki and Kangaroo Valley have been less affected. The technique of oversowing pastures with ryegrass combined with irrigation and heavy nitrogen fertilization has been evaluated. Very high seeding rates of ryegrass are unnecessary with adequate seedbed preparation. Oats have generally given a higher winter yield but ryegrass growth continues better into the spring and early summer.

Alta and Demeter fescues have also performed well at Gatton while Sirocco and Siro 1146 phalaris show superior performance to Australian phalaris under irrigation.

Plant nutrition

In 1971-72, a series of trials was planted throughout south-east Queensland in co-operation with C.S.I.R.O. to study the residual effects of molybdenum fertilizer. A range of legumes has been used as indicators. Tinaroo glycine has proved the most sensitive to molybdenum deficiency and Lotononis has been the least responsive legume.

Attemps to correlate phosphorus and potassium responses to soil and plant criteria have been inconclusive. Dry matter yields have rarely been responsive, but mineral concentrations in the plant materials have shown responses to nutrient application.

In the West Moreton, soils low in available phosphorus have failed to show any responses to phosphorus fertilizer and plant material has remained above the critical phosphorus level. Low rainfall which reduced growth is suspected of being responsible for the lack of responses at the site.

On the Darling Downs and as far west as Surat, a series of experiments was established in 1969 to study the effect of fertilizer nitrogen on a range of pure grass pastures. The objective of these plantings was to gain an understanding of the influence of environmental factors on responses to nitrogen.

There was an obvious trend in species suitability to environment based on production and ability to minimize weed invasion. The increasing order of suitability to lower rainfall was kikuyu, Rhodes, Makarikari, green panic and buffel grasses. At any one location, adjacent species in this ranking seemed to produce equally well, although species differences occurred in seasonal productivity and responses to increasing N fertilizer rates. Makarikari panic was not superior in any situation and appears to have its sole niche on heavy clay soils.

The mean apparent recovery of applied fertilizer nitrogen in plants tops ranged from — 13% to + 63% depending on site, species, and nitrogen application rate. In general, the species best adapted to each particular site were also the most efficient in recovering applied fertilizer nitrogen.

For species such as Rhodes and Makarikari grasses, which are marginally suited to a semi-arid environment, increasing levels of nitrogen fertilizer induced a lesser degree of persistence.

Agronomy research

Wheat

The wheat variety Oxley performed well in the second year of commercial production. Yields on the Central Darling Downs were estimated to be 20 to 25% above the older commercial varieties and it also yielded well in other areas. It remained resistant to stem rust in the field and showed a useful partial resistance to leaf rust.

A crossbred developed at the Queensland Wheat Research Institute is of similar midseason maturity to Oxley and has broader resistance to stem rust. In 1975, its yield was equal to Oxley's. In some quality characteristics, it was inferior to Oxley and more testing is required.

Release of a superior, quick-maturing variety is of high priority. A quick-maturing crossbred developed at the Institute has performed well. It yielded 1·93 t per ha over 20 sites and compared well with commercial entries Gatcher (1·89 t per ha), Timgalen (1·79 t per ha), Songlen (1·77 t), Spica (1·77 t), Condor (1·77 t) and Mendos (1·70 t).

Queensland Wheat Research Institute, local Departmental officers and Consolidated Fertilizer Sales Pty. Ltd. personnel have combined to extend to the Western Darling Downs a large nutrition programme to complement that commenced on the Central Queensland Highlands in 1974. The aim of both programmes is to rationalize the commercial use of fertilizer in these areas where variable climatic conditions prevail.

On the Western Darling Downs, yield gains from phosphatic fertilizer were obtained at 10 of 18 sites harvested. The yield response to 28 kg P per ha varied between sites from an increase of 67% to a decrease of 9%. There were no yield responses to additions of nitrogenous fertilizer although good seasonal conditions prevailed.

Press-wheel seeders are a major development in crop and pasture establishment.

On the Central Queensland Highlands, increases in yield due to phosphatic fertiliers were obtained in five rain-grown trials out of eight and in two out of three irrigated trials. Responses to nitrogenous fertilizer were obtained in two of eight rain-grown trials and in all three irrigated trials. These results followed those of 1974 where a yield response to phosphatic fertilizer was obtained in only three of 17 trials. In the same series, a yield response to nitrogenous fertilizer was obtained in eight out of 17 trials.

'Decision Making for Wheat Growers in Queensland' is the title of a bulletin published in 1975 which summarizes for Extension Officer and farmer use, information from several hundred wheat trials conducted over the past 25 years. In the bulletin, factors known at planting, such as depth of wet soil, time of sowing and cultivation history, provide a yield expectancy table. This can be used as a decision tool by the farmer in selecting fertilizer treatment, wheat variety and cropping practice. Application of the principles outlined will provide a more flexible and better integrated set of production guidelines than those previously available for wheat culture in Queensland.

Barley

The unnamed feed barley variety W.I. 2355 (2·50 t per ha) produced the highest yield of eight varieties tested in 12 regional trials conducted over the State's grain belt. By comparison, Clipper, the commercial malting variety, yielded 2·04 t per ha. In 42 trials conducted over the past 5 years, W.I. 2355 (bred at the Waite Agricultural Research Institute) has outyielded Clipper by 19%. An application has been made for the registration of W.I. 2355 with a view to commercial release in Queensland.

Results from the barley strain trials indicate that large increases in yields over current varieties can be expected in the future. Clipper was the lowest yielding variety of the 26 varieties tested at nine sites in 1974 and 1975. Of the 162 lines tested in third generation breeding trials only seven had lower absolute yield than Clipper while 62 selections were equal to or greater than W.I. 2355.

Sorghum

Breeding programmes are conducted at Hermitage and Biloela Research Stations with the primary objective of releasing useful parental material to commercial breeders. A new restorer line, QL5, was released. This produces hybrids which combine the high yields of Texas 626 under moderate to good conditions with the superior yield of Q5161 under poor to moderate conditions.

In addition to improving yield, the breeding programmes aim at improving resistance to lodging; to incorporate the Krish type resistance to sugarcane mosaic virus; and to incorporate resistance to midge.

It has been difficult to transfer the Krish resistance as there is an apparent close genetic linkage between the virus resistance and head smut susceptibility. Lines from one backcross not only have both resistances but also possess rust resistance. Pollen production by these lines was marginal and further selection for this character is now being undertaken.

Tests have shown that certain introduced lines possess true midge resistance. This resistance was tested in segregating populations derived from crosses between these lines and susceptible lines. A high level of resistance was apparent in some of these populations grown in a high midge situation. This resistance is now being incorporated into three lines widely used in Queensland to produce hybrids.

The regional varietal testing programme was continued in the 1975–76 season with trials at 19 sites throughout the State. Trials were also conducted to determine the tolerance of sorghum cultivars to the herbicides 2,4–D and Tordon 50–D. Some cultivars were unaffected by either of the herbicides, while others were affected by one or both of them.

In irrigation trials at Emerald it was shown that sorghum grown in 18 cm rows produced 59% more grain per unit area than the same populations grown in 81 cm rows. The higher production of the more evenly spaced plants in the narrow rows was attributed to more efficient use of incoming radiation. Where furrows are required for irrigation, the rows adjoining the furrow cannot compensate fully for the loss of furrow area, so it is impossible to maintain the full yield advantage.

Maize

The maize breeding programme is centred at Kairi Research Station and aims primarily at producing hybrids suited to north Queensland maize producing areas. Secondary aims are to produce hybrids suited to southern Queensland, and to produce sweet corn and high-lysine varieties.

During the year, a new hybrid, QK487, was released for commercial production in north Queensland. This hybrid possesses excellent resistance to head smut (*Sphacelotheca reiliana*) which can be severe in crops planted early which experience moisture stress.

For the first time at Kairi Research Station, a maize line yielded in excess of 8 t per ha. This compares favourably with 6·4 t per ha from the commercial hybrid QK 217. The experimental hybrid, KTW447, has multi-coloured grain which may not be acceptable to the trade. However, its performance indicates further accessible yield horizons.

Testing of sweet corn hybrids has shown that the Kairi single cross KSC467 has extremely good resistance to maize dwarf mosaic virus. Its agronomic and kernel quality characteristics are satisfactory and consideration is being given to its release.

In the spring of 1975, a programme to breed high-lysine maize was initiated. Eight high-lysine composites have also been introduced from Mexico.

The value of growing maize in rotation with pasture is amply demonstrated by two trials at Kairi Research Station. In one study, the 6-year average yield for maize grown in the first year after pasture was 4·9 t per ha while the averages for the second, third and fourth years after pasture were 4·9, 4·5 and 4·1 t per ha respectively. Continuous maize yielded only 2·6 t per ha. In another study where continuous maize was compared with maize grown after 2, 3, 4, 5 and 6 years pasture, it was shown that the effects of 2 years pasture disappeared in the sixth year of maize. Where the pasture phase had been longer, the effects persist for longer periods.

Fertilizer trials which have been conducted in north Queensland for 4 years showed that nitrogen applications of 67 kg per ha induced profitable yield increases; but further applications produced small additional yield increases which were uneconomic. Application of phosphorus in the form of Biosuper gave no increase in yield. When applied in the form of superphosphate, di-ammonium phosphate or mono-ammonium phosphate, phosphorus produced yield increases. However, the costs of obtaining these yield increases were higher than the returns.

Thorough weed control contributes greatly to the success of maize crops on the Atherton Tableland. The importance of clean cultivation is being demonstrated to growers.

Soybean

The major aim of the soybean breeding programme is to produce superior commercial varieties. Yield, disease resistance, maturity and general agronomic characteristics are considered. The best performing lines are placed in three maturity groups and are tested in strain trials the following year. Strain trials with early and mid maturing lines are conducted at Kingaroy, Brookstead, Gatton and Hermitage. Late maturing lines are tested at Biloela, Emerald, Ayr and Walkamin. Lines which show superior performance in the strain trials are tested in the Department's regional varietal testing programme the following year.

The regional varietal testing programme consists of trials at upwards of 20 sites throughout the State. Superior lines from the Department's and the University of Queensland's breeding programmes are compared with the commercial varieties and introductions from overseas in a range of environments.

Two lines from the Department's breeding programme, H.R.I. and 70/50, were named Collee and Flegler respectively and released for commercial production during the year. Collee is an early maturing variety with higher protein content and better resistance to lodging and shattering than the variety Hill. Flegler is a mid–late maturing variety with high yield and good resistance to lodging and shattering.

Research into broadleaf weed control with 2,4–DB, which is cheaper than bentazon, has given variable results. It appears that soybean varieties have varying tolerance to this herbicide. Visual indications are that Flegler and Wills are less susceptible than Bragg, Davis, Hill and Collee.

A continuing study of agronomic practices in the Granite Belt suggests that best yields of soybeans will be obtained with plant populations of 200 000 to 400 000 per hectare in 35 cm rows provided good weed control is obtained.

Sunflower

The sunflower breeding programme is centred at Hermitage Research Station. Strain trials suggest that future yields may be considerably higher than those obtained to date.

In variety trials over the past season, new hybrids produced higher yields than open-pollinated varieties. Over six trials, Suncross 51, Suncross 52, and Hysun 10 gave the highest mean yields. Suncross 51 and Suncross 52 are not fully rust resistant but the level of infection is much lower than in the open-pollinated varieties. The single gene resistance to rust in Hysun hybrids is still effective contrary to some reports. Any rust occurrence in these hybrids has been on off-types and male sterile types resulting from faulty seed production techniques.

Leaf spot, caused by the fungus *Alternaria helianthi,* is increasing in all areas. In the Lower Burdekin, the hybrids have suffered more than the open-pollinated varieties, though the reverse is true in other sunflower growing districts.

Pollination studies have been continued and it has been found that sunflower seed set on the Darling Downs is not improved by introducing beehives. The level of seed set averages 87% irrespective of site, cultivar, flowering date or area of crop. A survey has shown an average level of 59 bees per 100 flowering heads during mid morning on a warm day. This is considerably higher than the 25 bees per 100 flowering heads reported as being necessary for proper pollination under these conditions. Prolonged periods of rain result in reduced seed set and wind appears to be an ineffective agent in pollination. Nocturnal insects, mainly moths, have been shown to make a small, but significant, contribution to pollination of sunflowers.

Field work directed at the computer simulation of yield and oil quality in sunflowers has been completed, and the data are being processed. The sunflower variety Sunfola 68-2 and the hybrid Hysun-30 were used in the trials. There was variation in rates of development between the two lines due to different responses to day length. The response to day length was a short day one in Sunfola 68-2 and a long day one in Hysun-30. An index calculated for the flowering period enables yield prediction from available soil moisture.

Peanut

Lines reputed to be rust resistant were imported and are currently being increased and tested in north Queensland. These lines consist of three varieties and 11 crossbred lines which are still segregating. Of the three varieties, the testa colours of two are not acceptable to the trade. The third variety, of the Spanish type, meets trade requirements, appears to yield well, is resistant to rust and has some tolerance to Cercospora leaf spot.

Fertilizer experiments conducted in the South Burnett indicate that the best strategy for phosphorus fertilization of peanuts is to apply superphosphate to other crops in the rotation and allow the peanut crop to use what remains.

A post-emergence herbicide trial in peanuts in north Queensland showed dinoseb to be slightly less toxic to the crop and to control non-leguminous weeds better than phenoxybutyric acid herbicides. Bentazon generally provided good weed control, but this herbicide may be related to increased incidence of Cercospora leaf spot.

The possibilities for growing peanuts in other areas are being explored. In the preliminary study of rain-grown production on Dalrymple soils in the Burdekin, the crop has grown well. On wallum soil at Beerburrum, Red Spanish peanuts were superior to Virginia Bunch giving an average yield of 1 142 kg per ha. In this trial, broadleaf weeds, waterlogging and wet weather at harvest were serious problems.

Potatoes

The standard commercial variety, Sebago, while well suited to Queensland conditions, has shortcomings. It sets few small tubers and so is unsuitable for the canning trade.

A range of 234 lines from Tasmania, Victoria and New South Wales has been tested under the co-operative potato evaluation programme which is now in its sixth year.

The varieties Tasman, B 5132-3, Wauseon and Suttons' Foremost show particular promise.

The pilot scheme for producing disease-free seed potatoes has reached the sixth of the eight necessary stages. There are strong indications that good quality seed potatoes can be grown in certain areas of Queensland. The local production of such seed could, by eliminating transport costs from southern seed producing areas, be of extreme importance to the Queensland potato industry.

Standard potato production methods are based on wide row spacings with inter-row cultivations to control weeds. The rows are also hilled to maintain quality in the tubers and assist with weed control. These operations cause some damage to the plants and, because the total field area is not used for production, the yields may not be maximum. The question of improving yields by varying plant density and planting depth is under investigation. A necessary preliminary to these investigations is to determine chemical methods for weed control.

Tobacco

The tobacco research programme undertaken by the Department involves four broad fields of work. These are plant breeding, production cost containment, crop and land management, and plant protection.

Within the plant breeding programme, research has continued towards developing acceptable tobacco varieties incorporating resistance to the main tobacco disease. One breeding line (63/73/7) with blue mould tolerance was evaluated in 14 on-farm tests throughout Queensland during the 1975-76 season. Further management studies with 63/73/7 will be conducted during the following season and the variety may be released for commercial use in 2 years' time. Other studies are in progress using locally-developed breeding lines as well as introduced varieties for breeding new varieties with acceptable agronomic characteristics.

Studies of mechanical harvesting have shown the importance of sucker control. Departmental officers, together with grower and leaf manufacturing representatives, have been evaluating a systematic chemical, maleic hydrazide, for controlling sucker growth as part of the mechanical harvesting programme. This chemical when used in association with a 'contact' desuckering agent effectively controls suckers. Maleic hydrazide does have effects on the physical and chemical characteristics of cured tobacco leaf and these are being considered in further work.

Nutritional studies have shown that savings in fertilizer costs can be achieved by using cheaper forms of nitrogen than nitrate of soda where nitrogen side-dressings are required. In addition, using single or straight fertilizers instead of the present compound mixtures can result in a considerable saving in fertilzer costs.

Navy beans

The work done by the Department has had an influence on the establishment and stabilization of the navy bean industry in the Inglewood area and on the Darling Downs. In the Inglewood area, the production of irrigated navy beans has become a stable industry. On the eastern Darling Downs an increased area was planted to navy beans this year.

At Hermitage Research Station, resistance to peanut mottle virus is being introduced into navy beans by crossing with the resistant red kidney bean. These crosses have been advanced to the fifth generation and are being heavily selected for resistance. The main selection programme is based at Kingaroy. Two lines from an Actopan x Sanilac cross are being released for commercial production as Actolac and Actosan. Both the new varieties exhibit more tolerance to peanut mottle virus than the current commercial varieties Kerman and Gallaroy.

Some varieties of navy beans are particularly susceptible to zinc deficiency. Foliar applications of zinc have been found more effective than soil-applied zinc.

Cotton

In the cotton breeding programme, emphasis is being placed on the development of host plant resistance to insects, particularly to *Heliothis* spp.

The effect of the plant's glabrous and nectariless characters on field populations of *Heliothis* is not yet clear in Queensland, though U.S. workers have found that these characters interfere with normal insect development patterns.

However, it has been established that a high level of bud gossypol is linked with reduced growth of *Heliothis* larvae. In one trial, the 10-day larval weights ranged from 18·6 mg per larva for the high gossypol line Pima S1 (1·85% gossypol) to 157·6 mg per larva for the low gossypol line, Rex glandless okra-leaf (0·03% gossypol). A selection from the introduced high gossypol line HG 247-1 has had a much greater effect on larvae than Pima S1. The possibility of breeding a high-yielding, high-gossypol line is encouraging because a high gossypol content does not reduce lint yields.

Miscellaneous crops

SAFFLOWER. A widespread outbreak of *Alternaria carthami* caused serious yield losses in commercial crops. This fungus was reported in trial plots in 1974, but its widespread occurrence in 1975 suggests that low levels of undetected infection had occurred in commercial crops also in 1974. Several introduced lines show a degree of tolerance to the disease, and further varieties with resistance will be introduced.

LINSEEED. The linseed breeding programme aims at developing high-yielding varieties with adequate oil content and to identify and incorporate resistance to Pasmo disease (*Mycospherella linorum*).

Strain and variety trials are conducted at Hermitage Research Station, Dalby and Emerald. At Hermitage, several strains have shown better yielding ability than Bonnydoon and Glenelg. In an irrigated trial at Emerald, some varieties from the Americas and India gave higher yields (Dunes 2 656; Zona Buenos Aires 2 477; T11, 2 432 kg per ha) than Glenelg (2 091 kg per ha) and Bonnydoon (1 969 kg per ha). The yield of Glenelg, however, increased to a similar level (2 595 kg per ha) to these varieties when the plant population was doubled.

In another irrigated trial at Emerald, a late April planting gave a much higher mean yield (1 898 kg per ha) than one in early June (1 596 kg per ha) and a mid July planting gave the lowest yield (962 kg per ha).

ONION. Variety, planting time and plant density studies have confirmed earlier findings that onions can be planted at high rates of 4 kg per ha in 20 cm rows if planted in late February or March. In later plantings, lower planting rates (2 kg per ha) in 36 cm rows are desirable to permit spraying programmes unless varieties with resistance to downy mildew (*Peronospora destructor*) are grown.

Following claims that locally-produced seed was superior to commercial seed of the Early Lockyer Brown variety, trials were conducted to evaluate seed sources. In an early March planting, the average yield from local strains was 67% higher than from commercial seed. In a late March planting, the yield advantage from local strains was reduced to 26%. In an April planting, the local strain had no yield advantage over the commercial strain but the local strains produced more seed stems. By selection, growers have isolated a distinct variety which is suited to early plantings (February-March).

MUNG BEAN. The mung bean testing programme culminated during the year with the release of the variety Berken for commercial production. Berken was introduced from the U.S.A. It is more resistant to lodging and shattering than Celera and has much larger seed. The yield of Berken is similar to that of Celera.

CHICK PEA. The Department has co-operated with C.S.I.R.O. in a varietal testing programme. Trials were sited at Biloela, Emerald, Gatton and Toowoomba. Only one line performed well at all sites. This line, which originated in Iran, was introduced from the U.S.A. and produced a mean yield of 1 994 kg per ha. The crop has considerable potential as a winter grain legume for southern Queensland, but will require further genetic improvement.

Irrigation

BURDEKIN. The agronomy team is evaluating crop performance and soil behaviour on land which, while not presently being irrigated, requires cost-benefit data to allow evaluation of future water storage proposals for the Burdekin basin. Irrigated cropping commenced in 1975 and will extend for an initial 3-year period. Erosion is a major impediment to using the sloping red earth soils for row-crop production. Downslope seepage also occurs with a tendency for salinity to develop on bottom lands.

Interest in rice is still high despite some reversion of land to sugar-cane. Current work is concentrating on variety evaluation and weed control on rice contour banks. Several lines from Columbia, the U.S.A. and the International Rice Research Institute have been introduced for the variety evaluation programme. So far, only Starbonnet has shown promise in that it yields well and has better standability than the commercial variety Bluebonnet. There are, however, quality and marketing problems which could prevent general release of Starbonnet to Queensland's growers. Bromacil, diuron and karbutilate were effective in weed control tests on the contour banks. Each chemical was relatively non mobile and it appears that the effects could last up to two rice crops.

Irrigation frequency studies have begun to define the basic soil–water–plant relations of the flood plain soils. The dry season trial in 1975 showed a positive and very rapid decline in maize yield if irrigation schedules were allowed to extend beyond 50 mm of evaporation from the class A pan.

Kenaf and cassava are two new crops under investigation in the region. Yields of up to 6 t per ha dry matter have been obtained in kenaf variety trials. Some cassava lines grew prolifically on friable soils where internal drainage is good. On the heavy, poorly-drained soils, growth was severely retarded. As the better class friable soils are likely to be used for high value sugar and horticultural crops, a cassava-based industry may not be feasible in the Lower Burdekin.

Weed control

Wild oats present a continuing problem for winter cereal growers in many areas. Barban is the only post-emergence herbicide available for wild oat control, but it cannot be used on Clipper barley.

The new chemicals, difenzoquat, WL 29761 and HOE 23408, gave encouraging control of wild oats in wheat in recent trials. Yield increases of wheat about twofold resulted when the chemicals were applied before the four to five-leaf stage of wild oats. In barley, difenzoquat, and HOE 23408 gave almost complete wild oat control and twofold yield increases. WL 29761 retarded growth of barley for approximately 1 month after spraying.

In the trial to compare the tolerance of wheat varieties to the herbicides, HOE 23408 produced no phytotoxic effects. Difenzoquat caused leaf tip chlorosis of both wheat and barley but yield was not affected. WL 29761 caused tiller shortening in Kite, Timgalen and Gamut but only leaf tip chlorosis of other varieties. Grain yields were not affected by WL 29761 except in the variety Kite.

Parthenium weed (*Parthenium hysterophorus*) has been the subject of considerable concern in the past year. As yet, only isolated infestations have occurred in cultivations. Present knowledge of its germination and dormacy characteristics indicates that normal cultural operations are likely to provide satisfactory control in crops. Infestations in pastures seriously reduce pasture productivity. Joint research with the Department of Lands and C.S.I.R.O. is tackling control problems on crops and pastures.

Herbicides which will control most weed situations in soybeans are now available. Trifluralin applied pre-emergence controls annual grasses and some broadleaf weeds. Bentazon applied post-emergence controls broadleaf weeds, which are not controlled by trifluralin, including thornapples (*Datura* spp.) Noogoora burr (*Xanthium pungens*) and bell-vine (*Ipomoea plebeia*). The effectiveness and persistance of trifluralin is being studied in crops of peanuts, soybeans and navy beans. At some sites, susceptible weeds have reappeared within 30 to 40 days of application of the herbicide.

Work on Johnson grass control on roadsides has produced mixed results. Glyphosate removed the Johnson grass which subsequently regenerated from seed. It also removed the desirable replacement grass species *Paspalum dilatatum*. Other desirable grasses proved difficult to establish in areas cleared by glyphosate. Periodic mowing is showing promise in that *Paspalum dilatatum* is becoming dominant. However, reversion to Johnson grass dominance may occur if mowing treatment is stopped.

Agricultural extension

Farmers, primary producer organizations and local authorities require technical information and managerial advice on crop and pasture production, soil and farm management. Agri-business firms and their representatives are also making increasing demands for assistance of this type. The extension service exists to meet these needs.

The extension officer's role is to link industry with developing technology and to temper this with consideration and concern for the stability of our soil and water resources. With this role, extension officers undertake specific projects emphasizing new problems or techniques, they engage in routine dissemination of information, and they are frequently involved themselves in technical training.

Branch extension

Extension officers in all districts of Queensland maintained a vigorous programme on the control of insect pests in stored grain. Emphasis was placed on hygiene in farm machinery and on-farm storage facilities which are major sources of infestation on farms. While there has been a significant improvement in the hygiene standards on farms, the programme will continue for many years because of the chronic nature of the problem.

There has been a significant increase in the number of grain driers installed on grain growing properties. An estimated 5% of grain farms now have some on-farm drying facilities. This has been a byproduct of the insect control programme, although the main impetus has been the financially rewarding aspects of grain drying. Driers enable greater flexibility at harvest, thereby reducing the influence of the weather and enabling better use of harvesting machinery. The installation of grain driers on farms is expected to accelerate in the immediate future in all grain growing districts of the State.

The Branch provides recommendations of the best crop varieties to plant in each district. This service covers wheat, oats, barley, grain sorghum, maize and soybeans. Recommendations on herbicides for weed control in both winter and summer crops are also updated and published each year.

Field days and whole-farm planning are important activities aimed at improving farm productivity and practice.

Irrigated agriculture is assuming greater importance each year. In recognition of this development, the main inservice training activities during the year were two irrigated agronomy workshops: one in Ayr for north Queensland officers and one in Toowoomba for central and southern Queensland staff. Recent advances in the agronomy of all irrigated crops were reviewed at these workshops and will be translated into farmer advice.

As farming becomes more complex, more technically based and more management oriented, the role of extension officers will continue to expand particularly into areas not serviced by other governmental instrumentalities.

The depressed state of the beef industry has been a major factor influencing extension operations during the year. Almost all extension activities planned for the beef industry are oriented towards diversification or towards management practices designed to cut costs or to reduce labour requirements. Beef producers, where possible, have diversified into grain production. This diversification has taken place against a background of limited plant equipment and capital. These limitations have severely tested the resourcefulness and ingenuity of both property owners and extension officers in implementing diversification programmes.

In those districts which do not lend themselves to diversification, property development is virtually at a standstill. Considerable effort has been devoted to maintaining existing sown pastures with minimal fertilizer and other management inputs.

In the few situations where sown pasture development has been possible, 'low key' pasture development has been encouraged. In this 'low key' approach, a legume is introduced into native pasture, and land preparation, if any, is kept to a minimum. Legumes of the genus *Stylosanthes* lend themselves particularly to this type of development.

Extension officers have worked closely with both research workers and graziers to ascertain these minimum input levels.

North Queensland

A 3-year extension project on the Atherton Tableland on chemical weed control in maize has resulted in almost complete acceptance of the practice by Tableland maize growers. The adoption of these and other improved crop husbandry practices have contributed to the likely record crop being harvested at present.

The first commercial crops of burley tobacco were produced at Mareeba. Some 14 ha were grown successfully this year and the area may be extended to 40 ha next season. An extension project to introduce solid set irrigation systems into the tobacco industry has been completed with the adoption of the practice by most growers.

Extension officers assisted growers at Mareeba in the first commercial rice crops outside the Burdekin. These crops produced yields of 5 t per ha and further expansion is expected. The extent of this expansion will depend on the availability of soils and these are being ascertained at present.

Rice quality studies were undertaken together with the Rice Marketing Board. The studies have provided the Board with guidelines on which to base crop quality determinations.

The recently released *Stylosanthes* species have been sown in a number of sites to evaluate their potential for the region. These species have generated considerable interest among graziers because of their low cost of establishment.

Capricornia

A major extension project has been to control the rate of spread of parthenium weed. A poster enabling landholders to identify the weed has been forwarded to every property owner in the Central Highlands and widely distributed throughout the rest of the region.

Officers have also addressed most primary producer organizations in the region, assisted local authorities in their spray campaigns on roadsides and provided technical advice to landholders on the control of the weed.

Officers in all districts of the region have urged landholders to participate in the feral pig baiting campaign. Damage to crops from feral pigs has been significantly reduced and property owners in Area 2 and Area 3 of the Brigalow Scheme have renewed confidence in their ability to produce commercial grain crops.

An extension project in both the Dawson-Callide and the Central Highlands has concentrated on assisting beef producers diversify into grain production. Significant areas of sown pasture and some newly cleared land have been prepared and sown to grain sorghum in particular. This project was extended to Area 3 of the Brigalow Scheme where grain production has begun on properties accessible to the railway.

Locust control activities in the region have been much reduced on those of previous years. A few swarms have been located and sprayed but crop and pasture damage has been insignificant.

Burnett and South Burnett

An extension project to develop skills in production of crops not well established in the Central and Upper Burnett was continued. Emphasis during 1975-76 was given to soybeans, navy beans and sunflowers. This project will enable grain growers to diversify effectively as economic conditions change.

A co-operative project involving Agriculture, Horticulture and Soil Conservation Branches aimed at minimizing the effect of wind erosion and sand blast on tobacco and horticultural crops was continued in the Bundaberg area. This problem has been aggravated by the expansion of sugar-cane in the district which has forced tobacco and horticultural crops onto less suitable soil types. Some agronomic changes already taking place include using existing sugar-cane blocks as wind-breaks, more judicious irrigation and ridging before planting.

In both coastal and sub coastal areas, the use of high density ryegrass, together with nitrogen and irrigation, has been accepted as boosting dairy production in winter and spring months. Adoption of the practice by dairy farmers is restricted to wholemilk suppliers but is almost universally adopted by these dairymen.

A series of summer crop seminars was held in September at Kingaroy, Murgon and Wondai. More than 100 farmers attended these seminars and the papers prepared for the seminar received wide distribution. The seminars discussed each summer crop suited to South Burnett conditions so that farmers would be better informed on which crops best suit their situation.

Near North Coast and Moreton

An extension project between Agriculture and Dairy Field Services Branches on dairy cow nutrition has been continued. This project has been conducted for 5 years and each year has achieved a 10% increase in milk production per farm per year. The collaboration has been extended further to develop the role of rain-grown and irrigated pastures in dairying systems.

A project on the control of lantana was initiated. More than 50 farmers attended a field day in the Gatton district to discuss the treatments and to inspect results of the range of techniques used to control the weed.

Promotion of the newly-released sweet potato, Centennial, has been too successful in some respects. There has been ready consumer acceptance and demand has exceeded supply. Increased areas will be sown to meet the demand, particularly as the new variety is attracting a premium over local varieties.

Darling Downs and Near South-west

With Glenlyon Dam nearing completion, a survey of current and future land development patterns along the Dumaresq River was conducted. The information obtained from this survey will be a base for future extension activities when irrigation water becomes available.

For some years, irrigators at Inglewood have been urged to produce bean crops. These crops have performed well in trials in the district and offer attractive economic returns. The area under navy beans, soybeans and dwarf French beans has increased from 60 ha in 1972 to 806 ha in 1976.

An extension project aimed at fostering the development of farming systems in the Crow's Nest–Haden areas of the Darling Downs was continued. It involves the integration of sown pastures and forage crops into new feeding systems. This project has already had an impact on farm production and it is expected that the evolution of these systems will gradually extend to other properties in adjacent areas.

The spray drift control programme on the Downs has not been very successful. Some 467 ha of cotton was moderately or severely damaged by spray drift during November and December 1975. Herbicide spraying was widespread at that time as spring rains and subsequent weed growth were heavier than usual.

The programme will be continued despite the extent of the damage in 1975–76. As long as cotton and grain sorghum are grown in adjoining paddocks, the problem will persist and will require caution in herbicide usage.

The use of the contour furrow and press wheel pasture planting technique has been successfully demonstrated on the basaltic uplands. The technique has been used commercially and is attracting considerable interest among the dairy farmers on the eastern Darling Downs.

A project to increase the area of sown pasture in the Waggamba Shire was completed. During the 3 years of this project, the area under sown pasture increased from 4 500 to 34 400 ha.

Extension projects at Miles and Roma have emphasized the crop husbandry aspects of summer grain production. These areas are becoming more reliable producers of grain sorghum and sunflowers as more attention is given to planting techniques and plant populations, varietal selection, and weed control.

Horticulture Branch

RESPONSIBILITY for horticultural research and extension rests mainly with Horticulture Branch, which is concerned with production, post harvest handling and processing of fruits and vegetables.

Activities of the Branch cover also the field of ornamentals including commercial production of cut flowers and nursery stock, and the requirements of landscaping and the home garden.

Cultural research is centred at five horticultural research stations at Applethorpe (Granite Belt), Ormiston (Redlands), Nambour (Maroochy), Cairns (Kamerunga) and Bowen (Delta), supplemented by field trials in the main producing districts.

Post harvest and processing research is carried out at the Sandy Trout Food Preservation Research Laboratory.

The Branch provides extension services in all fruit and vegetable growing districts. These services are integrated on a regional basis under the Extension Services Section. In recent years, Horticulture Branch has collaborated with the Marketing Division in paying increasing attention to post harvest extension commencing with the grower and continuing through the market chain right to the consumer. This aims at minimizing the losses in quality that can occur at every stage of handling.

Liaison with industry is maintained through six horticultural advisory committees, covering six major crops or groups of crops. These committees are composed of grower and Departmental members, each committee meeting twice during the year. Within the Branch, informed research-extension committees are responsible for defining problems in production and handling, and assist in co-ordinating research and extension activities.

The Branch also has a substantial regulatory function. It is responsible for administering the Diseases in Plants Act, which aims to control the incidence and limit the spread of pests and diseases of plants within the State, and to prevent 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 any weeds which might be a hazard to primary production.

A further function of the Branch is to supervise the gardens at Government House, the Museum Gardens, Queen's Park and the State Migration Office.

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

Marketing Services, Economic Services and Standards Branches are concerned with marketing, economic surveys, farm management accounting and seed certification.

The Engineering Section now provides some service towards the varied engineering needs of the producers of fruits, vegetables and ornamentals.

Research

The research programme of the Branch is developed in association with the representatives of the fruit and vegetable industries and has, as a major aim, service to practical industry problems. As increasing production costs are a major problem facing producers, particular emphasis has been given to areas where labour and cost savings can be made. Improved nutrition and varieties, many aspects of mechanization, transport and storage are major investigational areas.

Developments in mechanization

A prototype pick-up passionfruit harvester has been developed at the Maroochy Horticultural Research Station. As harvesting is the greatest single cost in producing passionfruit, it is expected that this development will be of great benefit to the industry.

The unit is based on a beater-inclined plane principle and will pick up fruit on variable terrain with less than 5% damage to fruit even under wet conditions. This is a level of damage quite acceptable for the fresh market and is equal to or less than the damage caused with hand harvesting. This unit is now being incorporated into a complete harvester capable of servicing 4 ha plantations.

Mechanical harvesting may require some trellis modifications and studies are in progress to develop trellis systems to facilitate mechanical harvesting and give improved cropping.

An automatic irrigation control mechanism known as 'auto irrigator' has been developed in association with work to demonstrate the benefits of trickle irrigation in apple orchards. It is a weather-controlled system based on losses from an evaporation pan. The unit takes into account soil water storage, crop ground cover and rainfall. Although it was developed specifically for trickle irrigation, it can be readily adopted for spray irrigation systems.

An improved fertilizer distributor for banding fertilizers has been developed in a project with the Agricultural Engineering Section. The unit allows straight N, P and K fertilizers to be used rather than mixtures. This not only gives considerable savings in fertilzer costs as mixtures are more expensive, but also allows growers more choice in selecting forms to suit soils or crops. It also permits more flexibility in designing fertilizer programmes to meet their individual needs as indicated by leaf and soil analyses. Although the unit was designed for trial work, it is hoped that it can be simplified for general commercial use.

The locally-selected macadamia variety 'Own Choice' is continuing to bear more heavily than the top Hawaiian varieties under test. It is also preferred because of its processing qualities. However, a problem that it does have is that it does not drop the nuts readily. Investigations have shown that Ethrel sprays can be used to promote abscission of nuts. As harvesting is the greatest cost in macadamia production, this technique is being further investigated with the aim of developing a system of mechanical harvesting.

Another part of this programme has involved an assessment of the effect of the stage of nut maturity on processing quality. The results have shown that harvesting nuts before they fall does not reduce quality and may even improve it.

Broccoli varieties are field-tested before release to commercial growers.

Improvements in plant nutrition

Citrus nutrition trials continue to provide information to enable the standards for optimum leaf nutrient levels to be modified to suit local conditions. As many growers are using soil and leaf analyses as a guide to improving fertilizer practices, these results are being readily put into practice by the industry.

The soil fertility programme to improve the accuracy of fertilizer predictions for vegetable crops based on soil and leaf analyses is proving very useful in providing technical information and as a basis for extension activities. Field work has involved test strips in which fertilizer applications based on soil and leaf analyses information are compared with the growers' standard practice. These tests continue to reveal problem areas and add to the accuracy of the prediction system.

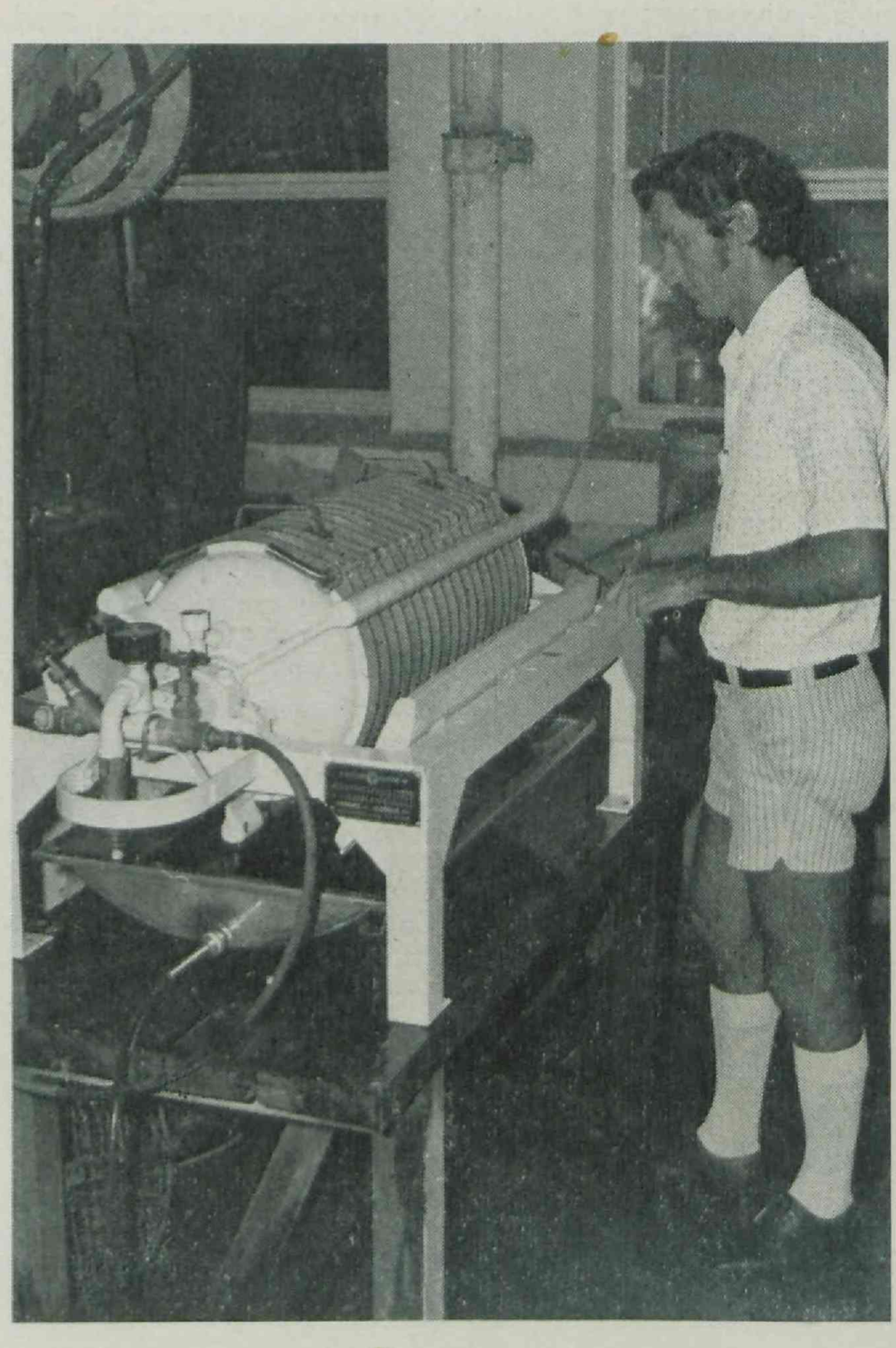
This work also includes a series of pot omission experiments in which the nutritional characteristics of the major horticultural soils are being examined. The aim is to improve the accuracy of fertilizer production systems. One series of these trials has shown that sulphur deficiency appears to be widespread in the alluvial soils along the inland river systems of southern Queensland. This area shows promise for the production of processing vegetables.

Zinc deficiency is a major problem in processing bean crops in the Lockyer Valley. Pot trials have indicated that pH and phosphorus levels in the soils are strongly linked with the deficiency. Field trials to investigate methods of control have shown that zinc sulphate monohydrate, which is not readily available, is superior to zinc oxide at correcting the deficiency.

Hydrophonic techniques have been used to study the effect of trace element deficiency on trifluralin damage in cauliflowers. The results have shown that, when plants are deficient in molybdenus or boron, they are most susceptible to damage. These results explain the damage that has been occurring in some Brassica crops.

Promising new varieties

Early-maturing yellow-fleshed peaches and nectarines introduced from the United States have been an outstanding success in Granite Belt orchards and at the markets. The varieties were introduced and tested as part of a stone fruit improvement programme. Future stone fruit improvement work will be concentrated on the continued breeding of plums and further introduction of promising new overseas peach and nectarine varieties.



Queensland's small wine industry is on the move. A research worker uses a miniature press to make wine from new grape varieties under test.

Improvements in the mango industry can be expected following the release of five new varieties. Mango production is limited to a 6 to 8 week period as the total production depends on one variety, Kensington. As the new varieties crop at different times, it is expected that the season will be extended to 12 weeks. More than 40 varieties have been introduced from overseas and the five that have been released have shown considerable promise in the preliminary testing.

Broccoli is a vegetable that has become popular in recent years. Many good varieties have been developed overseas and a wide range of these has been introduced and tested under Queensland conditions. At least five of these have been found to perform well under a wide range of conditions and are now being grown by the industry.

Studies have continued with grapes for both fresh fruit and wine production. Introduced table grape varieties are showing promise. The early maturing black cultivars Ribier and Barlinka are both of excellent quality and the white variety Italia is showing promise as a possible replacement for Waltham Cross.

The production of baby carrots for processing is an important industry located in the Lockyer and Fassifern Valleys. Varieties and plant density are two major industry problems which have been under investigation.

A wide range of varieties has been tested at several sites and they have been assessed for processing suitability. In all of these trials the new variety Bunny Bite has been an outstanding success and is being taken up by the industry.

In a study of plant density effects, it was found that yield could be increased and roots held to a more acceptable size when density was increased. The way plants were arranged in rows was found to be very important. Best yields were obtained where seed was placed in four sub rows 1 cm apart within the main plant row. This arrangement gives the most favourable spacing while still permitting top lift mechanical harvesting.

Many of the native citrus species occur almost exclusively in Queensland. These species will all hybridize with citrus and they possess several important qualities required in citrus root-stocks such as tolerance to Phytophthora, nematodes, drought, salt and cold. Many of these species are becoming rare and a further collection was made to add to the existing arboretum and also to send to citrus plant breeders in U.S.A.

Meristem culture techniques have been used to improve strawberry planting material. By growing plants using this technique, it has been possible to eliminate the strawberry mild yellow edge virus. The resultant plants are being field tested before being introduced into the Strawberry Runner Approval Scheme for multiplication and distribution to the industry.

New industries

Red table wines from Stanthorpe have won gold medals at the Brisbane Exhibition and at the Stanthorpe Show. This is an important step in the development of the Queensland wine industry and confirms the prediction that high class table wines can be produced on the Granite Belt.

Although many attempts have been made to start a tomato processing industry in Queensland, they have largely been unsuccessful. A programme to foster the development of this potentially valuable industry was begun by investigating the environmental requirements of the crop and surveying possible growing areas.

Trial sites were selected at Chinchilla, Oakey and Inglewood and a range of varieties was introduced and tested for cultural and processing qualities at each site. The most successful trial was at Inglewood where several varieties were found to perform satisfactorily. The knowledge of techniques for handling the crop has increased considerably and the plantings to be made next season will benefit from this experience.

Bananas

Although bananas are grown in high rainfall areas in north Queensland, studies have shown that dry periods can severely reduce plant yields. When plants were watered regularly, bunches produced more hands and were heavier. Trickle irrigation was found to be a suitable method of watering the crop. The best yields were obtained when irrigation at the rate of 0·9 pan evaporation was applied three times a week.

Interest in producing tomatoes for processing is growing in Queensland. The picture is of a harvest scene on a Darling Downs farm.

Increasing plant density in bananas has been found to result in increased yields per hectare. However, these density increases are also associated with reduced bunch weights and longer time to maturity. Under high-density planting, sucker development was adequate and leaf spot could be adequately controlled. However, for high density planting to be successful, particular attention must be paid to soil preparation, selection of planting material and irrigation.

Transport and storage

A new carton has been designed for the citrus export trade. It is 30-litre capacity and will replace the 4/5 bushel carton. The new carton can be packed 768 per shipping container compared with 660 of the old carton. As freight is now paid on a container basis, this new carton will provide a considerable saving in freight.

Many years of development work have now reached fruition with the manufacture and release of a returnable plastic crate suitable for fruit and vegetables. The crate has a number of design changes from the earlier prototypes. They are being tested for a wide range of crops and handling conditions and give every indication of being highly successful. Some further work is in progress to develop systems for fixing the crates on pallets.

Many of the crates are in use in close circuit operations such as supermarkets and food distributors. However, now that the technical performance of the crate has been proven, the problem is to encourage the establishment of a national crate hire exchange pool to facilitate the movement of crates between states.

A report on the design criteria for a new bulk bin for fruit and vegetables has been prepared in conjunction with the University of Queensland (Mechanical Engineering), and Committee of Direction of Fruit Marketing. The fruit and vegetable industry is moving rapidly towards bulk handling in distribution and in the field. The report provides a basis for the evaluation of bins above 200 kg capacity and establishes guide lines for constructing such bins. Industry needs of bin size and function, transport and storage requirements and economic criteria have also been considered.

Pineapples have a short shelf life and this restricts their fresh market potential, particularly on distant markets. Investigations have shown that the shelf life can be extended from 10 days to 20 days by dipping the fruit in growth regulator solutions at harvest time. By including a fungicide in the dipping solution, ripe fruit rots were also reduced. This technique shows great promise for improving the marketing potential of fresh pineapples.

Gibberellin sprays have been found to have a beneficial effect in delaying ageing of the rind of Ellendale mandarins. This will be of benefit in the exporting and the late season marketing of Ellendales. The best treatment from the point of effectiveness in relation to cost is a 10 p.p.m. Gibberellic acid spray in late March, before the rind colours.

The effect of using gibberellin sprays to delay the ageing of the rind of mandarins is tested in field trials under commercial conditions.

Extension

Seasonal conditions

The main features of the weather pattern in horticultural areas during the year under review were a milder and generally drier than average late autumn-winter period with minimal frost damage; prolonged cold conditions accompanied by extensive periods of strong winds in spring and early summer, and two cyclonic periods in summer which resulted in a lengthy rainfall period and extensive flooding in most districts.

The generally very favourable growing conditions in the late autumn-winter-spring-early summer periods resulted in an over supply of some vegetables, while the almost continuous rains during summer, particularly in the coastal areas, produced waterlogged soils which delayed plantings of annual crops and caused heavy losses in those already established.

The milder than usual winter did not provide sufficient chilling for deciduous tree crops, while the cloudy and showery weather at pollination time made conditions unfavourable for fruit setting in apples, resulting in a lighter than average crop. On the other hand, the incidence of hail in the Granite Belt was the lowest for many years.

Extension activities

The major extension activities in all districts has again been directed towards the defining and solving of industry and individual grower problems. Because of the relatively high value of horticultural crops and the intensive production methods employed, the problems which growers encounter usually require urgent and more or less personal attention. Wherever possible, mass media techniques have been used in an endeavour to reduce the time commitment to a minimum but, even so, direct grower contacts comprise a very considerable and essential part of the activities of horticultural extension officers.

The development of new areas for the production of horticultural crops, and the assessment of the cropping potentials of new properties or of existing properties where new crops are proposed have also made heavy demands on the local staffs. Reduced farm incomes from other enterprises have induced many growers to look to horticultural crops in an effort to improve their financial situation. Considerable expansion in horticultural production has occurred already in the Lockyer and Kingaroy areas.

One of the major extension projects in the Granite Belt has been directed towards developing the wine industry. Pure yeast cultures have been supplied by the Sandy Trout Food Preservation Research Laboratory, and officers have tested commercial wines and provided advice to local vintners both by direct contact and through mass media. Testing a range of introduced wine grape varieties is proceeding.

With the objective of demonstrating the effect of close plantings of apples in reducing the cost of production, demonstration plots were laid down on five grower properties in the Granite Belt 3 years ago. The standard district spacing of 260 trees per hectare is being compared with densities as high as 1 350 trees per hectare. Although the trees are too young to produce appreciable yields, the early indications are very promising and tend to support the findings from similar plots on the Granite Belt Horticultural Research Station which have produced yields up to 75 tonnes per hectare compared with the district average of 7·5 to 10 tonnes per hectare. Many growers have already accepted the new technique and so far more than 40 hectares have been planted using this system.

In coastal districts, an extension drive to encourage banana growers to use hot water treatment of planting material to control nematodes has been highly successful. It is not possible to make an accurate assessment of the losses which these pests have been inflicting on the industry but they are accepted as being very considerable. The necessary equipment was purchased with C.E.S.G. funds and set up in the major producing districts, supported by appropriate demonstrations and publicity. The numbers of growers adopting this technique vary between districts from 50% in some cases to almost 100% in others.

The continuing development of the cut flower industry in the North and South Moreton districts is adding considerably to the overall income from horticultural production in those areas. However, these are high-priced crops which are involving extension staff in increased servicing commitments. The main emphasis is directed towards gladioli, carnations, chrysanthemums, asters and roses. A very substantial export trade in gladioli is being developed in New Zealand as well as interstate.

The extension project begun at Gayndah to introduce vibra-packing of citrus has been highly successful. During 1975, this practice became a commercial reality with 15 packing sheds using the new technique. Those growers who used it are agreed that it achieved savings of up to 50% in packing labour, and resulted in good out-turns and market acceptance. Vibra-packing for citrus has been very actively promoted through a series of demonstrations and extension articles as well as personal contacts. During the year, one officer visited interstate citrus districts and markets to assess market response and to encourage interstate packers to use the new technique also. Field days and demonstrations have also been organized in other citrus districts within the State

to indicate to growers how easily their packing sheds can be converted, and to provide them with an opportunity to benefit from the experience of those who have introduced vibra-packing. The indications are that more sheds will be converted before the next season.

During the past year, publication of the district extension newsletters has been continued in the North Moreton, South Moreton and Granite Belt districts. In all, more than 5 000 copies have been produced averaging 19 pages each, with a content of about 13 articles. The 'Citrus Bulletin' produced in the Burnett District is designed specifically for the publication of the latest information on citrus and, for that reason, it is distributed to every grower of this crop within the State. In addition, booklets have been produced setting out the latest recommendations for the control of pests and diseases in deciduous crops and citrus. The distribution of these to every grower of the particular crop has involved printing more than 2 000 copies.

Marketing extension service

The efforts of extension staff over many years to encourage growers to improve their handling and packing methods have achieved some results. However, the inability to cite specific instances of faulty handling to the particular grower involved has markedly reduced the impact of the advice transmitted through normal extension channels. The objective has been to enable growers to obtain better market returns by giving more attention to relatively small defects which, while not being sufficient to warrant regulatory action, can nevertheless result in appreciable financial loss.

In an endeavour to improve this situation a service has been set up at the Brisbane Markets whereby daily oversighting of fruit and vegetable consignments is carried out to identify these quality defects. An appropriate notification is transmitted, usually by telephone, to the extension officer in the district of origin of the produce. He is then in a position to discuss the matter with the grower and to provide appropriate advice.

So far, the service appears to be functioning satisfactorily, and growers are most appreciative of the fact that they receive advice promptly, thereby enabling them to take corrective action in the next consignments. During the past year, 658 notifications have been handled in this way, and almost one quarter of these have involved tomatoes. The most common defects noted have been mixed maturity, poor presentation and incorrect packaging.

Servicing activities

Citrus Budwood and Seed Distribution Scheme. The primary aim of this Scheme, which has been in operation since 1931, is to bring about the supply to the citrus industry of trees propagated from selections with highly desirable commercial characteristics. This means that selections should be true-to-type, yield well and produce good quality fruit. The second aim is to ensure that the selected parent trees, and the trees propagated from them, are vigorous and reasonably free from disease.

There is little doubt that the Scheme has resulted in a very marked improvement in the quality of citrus trees when compared with the situation some 30 years ago. Tree performance has been raised appreciably and disease incidence reduced. The virus disease psorosis which used to account for widespread losses is virtually non-existent in present-day plantings. Other virus diseases have been reduced to the point where they no longer cause serious losses.

The operation of this Scheme involves a fairly heavy commitment on the part of some extension officers, particularly those stationed at Gayndah.

During the past year, a total of 114 225 citrus buds were supplied to 14 Queensland nurserymen, representing an increase of about 15% on the number supplied the previous year. This budwood was obtained from 11 orchard properties. In addition, 73 kg of citrus seed were supplied for the raising of rootstocks.

Strawberry Runner Scheme. This Scheme, in its present form, was introduced in 1963. Its main purpose has been to supply to commercial strawberry growers each year high quality true-to-type planting material as free from the major virus and other diseases and pests as possible. The more important virus diseases in strawberries before the start of the Scheme were yellow edge, crinkle and mottle.

A nucleus of virus indexed mother plants provided by the Plant Pathology Branch is multiplied under controlled conditions in screenhouses at Nambour each year, and the runners from these are multiplied subsequently in the field. The multiplication is carried out on the properties of approved contract growers under the close supervision of the appropriate extension officers.

The success of the Scheme is evident from the fact that the demand for approved runners has increased to the point where annual sales now average between 1 and 1¼ million. There has been a very marked improvement in the overall standard of commercial plantings as a result.

The main variety is Redlands Crimson, but there was a fair demand this year for the recently-released new variety Earlisweet. Both these varieties were bred at the Redlands Horticultural Research Station.

Bean Seed Scheme. This Scheme has grown considerably since its introduction some 25 years ago when its main objective was to provide a reliable source of disease-free French bean seed for sowing by the fresh market bean growers in Queensland. Production for the past 15 years has been centred mainly in the dry tropics where the usually dry winter conditions and availability of suitable land and irrigation facilities are conducive to good yields of quality seed.

By 1975, production was sufficient to satisfy not only the total requirement of Queensland bean growers but also most of the French bean seed requirement for the whole of Australia. In addition, a quantity was produced for export.

The total area under crop in the dry tropics last year was 1 071 hectares, from which an estimated 1 155 000 kg of clean seed were produced. Individual crop yields up to 2 000 kg per hectare were obtained in the Burdekin, although the overall average is below this figure. It is estimated that the industry is worth approximately $\$\frac{3}{4}$ million to growers in the Burdekin each year.

Supervision of and inspectional duties associated with the operation of this Scheme occupy virtually the whole of the time of the extension staff at Ayr for the greater part of the year. In addition, staff from other districts are sometimes called in to assist; and the employment of supplementary female casual labour has become necessary.

Regulatory

Plant quarantine

Administration of the Commonwealth Quarantine Act in this State is a substantial Horticulture Branch commitment, involving two somewhat distinct operations.

One is the surveillance of passengers and cargo entering the State from overseas by sea and by air and the other is the supervision of plant introduction. The main purpose of this surveillance is to minimize the risk of some serious pest or disease of plants or plant products or any serious weed species from entering the country. It necessitates inspectional services at all points of entry, the main ones being Brisbane, Townsville, Cairns, Gladstone and Port Alma.

The following summary will indicate the range and quantity of traffic under supervision during the year—

Number of overseas cargo vessels arriving at the Port of Brisbane	616
Number of overseas passenger vessels arriving at the Port of Brisbane	53
Number of passengers disembarking at the Port of Brisbane	6 780
Number of special inspections made by appointment	3 543
Number of overseas aircraft inspected at Brisbane Airport	2 074
Number of overseas aircraft inspected at Cairns Airport	671
Number of overseas aircraft inspected at Townsville Airport	128
Military aircraft cleared at Amberley	53
Number of passengers disembarking at Brisbane Airport	154 549
Number of passengers disembarking at Cairns Airport	8 624
Number of passengers disembarking at Townsville Airport	2 593

The number of passengers coming in by air is growing rapidly every year.

Timber, with its risks of bringing in forest pests, is the largest single commodity under inspection. After a comparative slump last year, imports have again rapidly increased almost to peak level. Of sawn timber imported in 39 941 bundles measuring 65 627 m^3 (28 022 729 superficial feet), 18 741 bundles measuring 21 460 m^3 had to be fumigated.

Of 2 808 logs measuring 7 329 m^3, all were fumigated.

There were also some 7 000 crates of plywoods and veneers.

Of 3 593 vehicles and implements imported subject to lodgement of application form QP26, 361 were steam cleaned and grain was removed from 1 853.

In the surveillance of material coming in through Parcels Post in Brisbane, 2 897 parcels were inspected in the course of 152 visits. Of these parcels, 170 were returned to the sender, 126 were fumigated and 124 heat treated.

In the course of inspection for the Department of Administration Services at Cannon Hill, 14 133 cases of effects required fumigation.

A major development in recent years and one which complicates Plant Quarantine operations is containerization. This is increasing rapidly, and is involving more than 20 000 containers a year.

The second operation mentioned at the beginning of this Plant Quarantine report is the supervision of plant introduction to ensure that the risk of bringing in serious crop species parasites is minimized. Most introductions within important crop species take place through official Plant Quarantine houses at Brisbane and Cairns and through other official quarantine facilities providing special isolation. However, appreciable introductions in this category are made also through approved commercial quarantine facilities under the supervision of Plant Quarantine Officers. Most ornamental species are brought in through approved private quarantine facilities also under the supervision of Plant Quarantine Officers.

In this way, some 200 consignments of plants entered Plant Quarantine during the year, and some 160 were released.

A special feature of the year's operations has been the increased monitoring of the Torres Strait and Cape York areas for exotic fruit fly species. The oriental fruit fly and the melon fly existing to the north of Australia are of particular concern as serious potential threats to many crops grown in this country.

Monitoring of these areas has been intensified so that any southward movement may be detected in time to stop it. When oriental fruit flies were detected in the Northern Territory during the midsummer months of this period, Plant Quarantine staff from this State were made available to help in assessing this emergency. This situation is under continuing close examination by a working party composed of entomologists and Plant Quarantine Officers of the several States and the Commonwealth.

Steps are also being taken to develop machinery for dealing quickly with any outbreak of a new exotic pest or disease of plants or plant products.

General horticulture

TREATMENT OF FRUIT FOR INTERSTATE MOVEMENT. There are requirements by other States that Queensland fruit must receive appropriate treatment before interstate movement to ensure freedom from specified pests. These have resulted in a sizeable commitment for extension officers who are required to supervise the treatments and issue the relevant certificates. The staff at Gayndah have been taxed to the limit during the past year supervising the ethylene dibromide fumigation of citrus at Mundubbera; and the position is expected to become even worse following the completion of a second fumigation chamber at Gayndah in the near future.

In several districts, there is grower interest in establishing treatment facilities for other fruits and vegetables consigned interstate. If staff are required to service these operations, this would result in an appreciable reduction in overall extension activities.

TREATMENT OF PLANTS FOR INTERSTATE MOVEMENT. Under the terms of an agreement with the other States, Queensland nurseries which conform to certain specified requirements may be classified as Export Nurseries, Group A or Group B, as the case may be. The operators of these nurseries are charged with the responsibility of treating their own plants and issuing the appropriate certificates in accordance with the requirements of the State to which they are exporting. At present there are 47 classified Export Nurseries in operation, an increase of 15 during the past year.

Unfortunately, there is still a large number which do not qualify for this classification and on these properties plant treatment is supervised by extension officers, who then issue the appropriate certificates. This is a servicing commitment which reduces the extension activities of officers in practically all districts.

BANANA INDUSTRY PROTECTION BOARD. Administrative and field inspectional duties associated with the functioning of this Board have occupied varying proportions of the time of extension officers depending on the particular district in which they are located. In the worst bunchy top areas, some officers have been required to spend up to 90% of their time on banana inspectional duties. Major attention has been focused during the past year on the control and eradication of bunchy top infection.

It is evident that, in spite of the efforts made to contain Panama disease over many years, it is continuing to spread and, as a result, there was an acute shortage of 'clean' Lady Finger planting material this year. Action has now been initiated, in collaboration with industry, to establish multiplication areas in isolation in an endeavour to improve the situation in the future.

The total number of banana growers now stands at 1 128 and the area under crop is 2 848 hectares. These figures are virtually the same as for the previous year. Bunchy top infection is still confined mainly to the Southern Banana Quarantine Area which extends from Nambour to the New South Wales border and contains approximately 78% of the growers and 61% of the total banana area. The Northern Banana Quarantine Area remains apparently free of the disease.

During the year, bunchy top has been found in the Caboolture and Southport Banana Districts which were previously classified as being free of this disease. This means that there are now only four Bunchy Top Free Districts remaining.

To effect economies in inspectional costs, action has been taken to reduce the frequency of plantation inspections. This has placed a greater responsibility on growers to find and eradicate bunchy top diseased plants. Unfortunately, this procedure is not practicable where bananas are grown in residential areas and, because of the relatively high incidence of the disease in the Brisbane metropolitan area, one inspector has been engaged almost full-time during the past year in inspections of residential plantings. The position has now improved considerably.

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.

To provide research and services on a decentralized basis from the branch headquarters at Indooroopilly, six field stations in southern Queensland (including one specializing only in beekeeping problems) and three each in central and north Queensland.

Major issues

Locusts

During the years 1973 to 1976, Queensland experienced a major locust plague with infestations of the migratory locust (*Locusta migratoria*) and spur throated locust (*Austracris guttulosa*) occurring in virtually all grain producing areas of the State. In response to grower representations, the Queensland Government subsidized control operations in 1974-75 and 1975-76 with additional subsidies being received from the Commonwealth Government during 1974-75. Entomology Branch was responsible for the administration of the subsidy scheme which was of considerable financial benefit to Queensland producers and to the State's rural production. The action taken was effective. There have been no major problems with locusts during the 1975-76 year.

Until infestations extended into northern New South Wales during the latter stages of the plague, the two species of locust concerned were regarded primarily as pests only in Queensland. For this reason, responsibility for the basic, biological studies on the pests fell almost entirely on Entomology Branch. Research undertaken by branch staff has contributed substantially to improved understanding of the insects and, particularly during the later stages of the outbreak, resulted in more critically and effectively applied control measures.

Grain storage pests

As a result of the continued development of insecticide resistance among storage pests, together with a demand for export grain having a nil tolerance for live insect infestations, research on storage pests is a major requirement. During past seasons, maldison resistance in the rice weevil (*Sitophilus oryzae*) has become widespread while resistance is now apparent in the rust red flour beetle (*Tribolium castaneum*) and the lesser grain borer (*Rhyzopertha dominica*). In consequence, maldison no longer can be relied on for protection of stored grain from insect attack.

Branch staff have been in the forefront of a co-operative research programme involving interstate and Commonwealth entomologists as well as entomologists from chemical manufacturing firms, aimed at developing and evaluating alternative grain protectants. Australia-wide pilot trials have established that the insecticide mixtures, fenitrothion-bioresmethrin and pirimphos methyl-bioresmethrin each provide effective control for the duration of the storage period.

Fruit flies

In late 1975, the oriental fruit fly (*Dacus dorsalis*) was recorded from the Northern Territory, the critical identification being made by an officer of Entomology Branch who is the Australian authority in this field of research.

Oriental fruit fly is a major threat to Australia's horticultural industries in both trade and production. Should it spread into Queensland, considerable difficulties could be experienced in interstate marketing of fruit and vegetable products. Queensland entomologists, together with Commonwealth and Northern Territory staff, have been engaged in studying the situation and monitoring the dispersal and activity of the oriental fruit fly in the region.

The collection of fruit fly specimens by survey teams and their identification by branch staff at Indooroopilly provide the scientific basis of the monitoring programme. To date, oriental fruit fly has not been found in Queensland.

Other fruit fly studies are concerned with a continuing search for better methods of controlling Queensland fruit fly (*Dacus tryoni*). Field trials conducted in the Nambour district on passionfruit showed that, under normal conditions, good control could be achieved with protein hydrolysate bait sprays. However, when subjected to heavy population pressure during rainy weather, they did not provide adequate protection from fruit fly attack.

The unreliability of bait sprays under these conditions may be related to the high immigration rate of gravid female flies into treatment blocks from surrounding scrub. It is probable that better control with bait sprays could be achieved with treatment of larger areas.

Research

Fresh fruits distinfestation projects

The projects are designed to facilitate trade in tropical fruits with other States and overseas countries which have quarantine restrictions on the import of fruit to prevent entry of the Queensland fruit fly (*Dacus tryoni*).

Fumigation with 20 gm^{-3} ethylene dibromide (EDB) has been found effective against eggs and mature larvae of the Queensland fruit fly in mangoes and has been accepted on a national scale. This development has given Queensland mango growers access to southern markets that previously were denied to them.

Other disinfestation projects include studies on the technology of fumigation. For a particular fruit commodity at a specified temperature, there will be a minimum concentration x time (C x T) product that will be effective against infestations of fruit fly. Monitoring of EDB gas concentrations in experimental fumigations has already been undertaken for commodities such as capsicums, citrus and passionfruit in an attempt to determine appropriate, minimum concentration x time products. By ensuring that only the minimum C x T product required for effective fumigation is used, the risk of accumulation of undesirable bromide residues will be minimized.

Integrated control of citrus pests

Field trials at Gayndah, Grantham, Howard and Palmwoods are investigating systems of integrated pest control in citrus orchards. Some pests, particularly the hard scales such as red scale (*Aonidiella aurantii*) and circular black scale (*Chrysomphalus ficus*), are controlled by natural enemies which have been reared in the laboratory and released in the orchards. Other pest species, such as citrus rust mites (*Tegolophus australis*), are kept in check by the careful, discriminating use of chemical pesticides. The chemicals used have been carefully selected in laboratory screening tests for their ability to control the target pest species without being unduly harmful to the beneficial wasp parasites controlling the scale pests.

Early results indicate that the harmonizing of the two forms of control into an integrated pest management system will be successful. Fruit quality has not deteriorated and fewer pesticide sprays have been needed, resulting in a saving in production costs and less environmental contamination.

In the field of biological control of citrus pests, the reduction of populations of circular black scale by the introduced wasp parasite, *Aphytis holoxanthus*, has been spectacular. The wasp has been bred successfully in the laboratory and has been released at approximately 60 sites throughout Queensland where it has quickly become established. It has been so successful in suppressing infestations of circular black scale that the scale is no longer a significant pest.

A similar situation exists with white wax scale (*Gascardia destructor*) which is being brought under control by the action of two, minute parasitic wasps, *Paraceraptrocerus nyasicus* and *Anicetus communis*.

The success of these biocontrol efforts has stimulated an examination of other citrus pests that may be amenable to control by natural enemies and it is planned to introduce another wasp parasite *Anicetus beneficus*, from Japan to control pink wax scale (*Ceroplastes rubens*).

Integrated mite control on deciduous fruit

Investigations in the Granite Belt district are exploring the feasibility of controlling mite pests on deciduous fruit by means of the combined action of a mite predator (*Typhlodromus occidentalis*) and applications of suitable acaricides. The predacious mite was first released in the Stanthorpe area during the summer of 1973.

During the season just past, three acaricide applications were required for mite control on trees on which the predator had not been liberated compared with one spray application in the experimental area. On a district basis, the saving in cost of spray materials alone would amount to approximately $75 000.

The application of the acaricide spray, usually in early December, is an important feature of the control strategy. The spray has little effect on the predator but reduces two-spotted mite populations to a level at which the pest is easily kept in check by the predator. Unfortunately, the European red mite (*Panonychus ulmi*) is not controlled by the *Typhlodromus* predator.

Complete integrated control of spider mites on deciduous fruits will require careful selection of acaricides for this pest that are not harmful to the two-spotted mite predator. Alternatively, the introduction of a suitable natural enemy for European red mite may be advantageous.

Heliothis control in cotton

To reduce the dependence of cotton growers on extensive insecticide spray programmes, alternative methods of controlling the major pests are needed. The use of egg parasites to reduce *Heliothis* spp. numbers had shown promise in preliminary trials and was investigated further in an experimental area at Cecil Plains.

Adults of the egg parasite *Trichogramma* sp. were released at approximately 40 000 per hectare on each of 16 occasions in a test area of 8 ha of unsprayed cotton. Parasitism of eggs varied between 40% and 80% during the season. Although relatively high, this level was insufficient to keep *Heliothis* populations below economically damaging numbers and damage ranged from 0 to 10%.

Although the *Trichogramma* egg parasites alone were unable to control *Heliothis*, there is every indication that they could form a valuable component of an integrated pest management system using a number of control methods.

Heliothis in navy bean and peanuts

Despite an expansion of research on biocontrol, it is apparent that chemical insecticides will continue to play an important part in minimizing crop damage by pests. Experimental work on the determination of economic thresholds for corn ear worm (*Heliothis armigera*) on navy beans and for native budworm (*Heliothis punctigera*) on peanuts has begun at Kingaroy. Spraying for corn ear worm control in navy beans can be delayed until late flowering and one spray at this time is usually sufficient to prevent economic losses.

The native budworm frequently causes noticeable damage to peanut plants at the pre-flowering stage. However, studies have shown that peanuts have a high degree of tolerance of defoliation and a provisional estimate of 12 budworm larvae per metre of row appears to be the infestation level at which treatment is warranted.

Tobacco pest studies

Research during the year has shown that a pest management system based on the use of non-residual insecticides and economic injury levels has a definite potential in north Queensland. Benefits include lower production costs and reduced insecticide usage with consequent minimization of chemical residues on cured leaf.

Highlights of the programme cover the replacement of chlorinated hydrocarbon insecticides by short-term residual chemicals such as methomyl; the definition of the distribution of the immature stages of major pests on field plants; a quantification of the responses of tobacco plants to damage caused by two of the major pest species; and clarification of the deficiencies in spraying equipment presently in use.

Green vegetable bug in soybeans

The green vegetable bug (*Nezara viridula*) is a serious pest of soybeans, and insecticides are necessary to maintain yields and high quality. At present, the timing of spray applications is not attuned to the main period of bug activity. Data from experiments carried out at Emerald show that the maximum number of bugs rest on the surface of the canopy of the soybean plants between 8.00 a.m. and 10.00 a.m. After this, they descend to feed. Since greater numbers are exposed and, therefore, vulnerable during this period, insecticide sprays applied at this time should achieve better control.

Taxonomic projects

The Branch's expanding programme of research on the integrated pest management approach to pest control has emphasized the importance of parasites and predators. In all entomological work it is important to be able to identify the species involved. The taxonomic position of many of the major groups of parasites and predators is confused so studies on the classification of these have been initiated.

Projects include a study of the larval stages of predacious coccinellid beetles. These ladybird beetles prey on a wide range of pests and are considered to exert significant control on pest numbers. As most species in the group are very similar in appearance, it is essential that a detailed study be made available before any reliable identifications can be provided.

Other projects are concerned with grasshopper and locust parasites. Parasites at present under study are scelionid wasps, which parasitize the egg stage, and sarcophagid flies, which attack the body musculature of mature grasshoppers and locusts. Such studies are necessary for future biological work to assess the possible exploitation of the parasites for locust control.

Services

Insect identification service

It is well established that the first step in scientific pest control is the accurate identification of pest species. The determination of the identity of the pest provides a key to all published information on its life history and ecology and to other data important in the development of sound control measures.

During the past year, 3 000 insect determinations were provided through examination of almost 10 000 specimens for Departmental officers, primary producers, householders, quarantine authorities and workers of other institutions. More than 1 300 of these specimens were identified for Quarantine authorities.

Cotton pest activity monitoring service

The aim of the cotton pest activity monitoring service is to provide cotton growers in central Queensland and the St. George district with details of seasonal activity by the major cotton pests so that they can plan appropriate control programmes. Primary interest centres on the relative abundance and activity of the two species of bollworm (*Heliothis armigera* and *Heliothis punctigera*). Information on which species is active at any particular time is of considerable relevance because *H. armigera* has developed resistance to DDT in some areas while *H. punctigera* may still be satisfactorily controlled by this chemical. Consequently, the relative abundance of the two species will influence the grower's choice of insecticide.

Bollworm activity is monitored by continuous operation of light traps. Moth catches are examined daily and the growers advised of the need for control action and the appropriate insecticide to use.

Tobacco pest prediction service

The service has been in operation in north Queensland for the past 7 years. Branch officers monitor the incidence of eggs and young larvae of the major pest species and, from the information obtained, calculate the need and timing for any insecticide treatment required to prevent damage to district crops.

Beekeeping

A major basis for honey production during the year consisted of eucalyptus honey flows on the Darling Downs. Extensive wet weather during January 1976 resulted in poor production during the second half of the year. Production in south-west Queensland was much lower than in recent years.

Mechanization within the honey house has been a major extension activity and continued emphasis has been given to disease control and inspection.

Plant Pathology Branch

THE main objective of the Plant Pathology Branch is to develop and incorporate into field practice more effective and economical methods of reducing losses from diseases caused by fungi, bacteria, nematodes and viruses in crops other than sugar-cane.

This involves the accurate diagnosis of diseases; studies of pathogens and studies on the factors affecting their severity; disease control by chemical, cultural and biological methods, including cultivar resistance; and dissemination of disease control information.

To do this, the Branch has to maintain a record of all plant diseases found in Queensland, other than those in sugar-cane, with reference specimens stored in a herbarium and also a collection of plant pathogens, particularly fungi and nematodes.

Another important function of the Branch is to develop more effective strains of rhizobia for legumes, particularly tropical pasture legumes, and to improve their performance in the field. This often involves an investigation of nodulation failure in the field.

Research

Field crops

PASTURE. Anthracnose (*Colletotrichum gloeosporioides*) has again seriously attacked various species of the very important *Stylosanthes* group. Seed production crops of Townsville stylo in north Queensland have been the worst hit, but grazing stands all along the coast have been affected. A screening of various species and cultivars of *Stylosanthes* with the common pathogenic strain of the causal fungus has shown that a wide range of reactions to the disease exists. The cultivar Cook of *S. guyanensis* and line 40292 of *S. scabra* for instance appear resistant. Screening of lines against the disease is continuing and a co-operative breeding programme with C.S.I.R.O. has been commenced.

Considerable progress can be reported in the incorporation of resistance to both anthracnose (*Colletotrichum trifolii*) and root rot (*Phytophthora megasperma*) in lucerne. This again is co-operative work with C.S.I.R.O. and is aimed at improving the commercial cultivar Hunter River.

Rugose leaf curl is only a minor disease in several legumes but is important in *Trifolium semipilosium* in which it may affect seedling establishment. In glasshouse trials, treatment with the antibiotic penicillin enabled affected plants to produce healthy new growth. This evidence, together with electron microscopy studies, suggests that the causal agent belongs to a new group of bacterium-like organisms, some of which cause very serious diseases such as citrus greening and Pierce's disease of grapevines.

WHEAT. Although the commercial cultivars Timgalen, Gatcher, Oxley and Kite remained free of virulent strains of stem rust (*Puccinia graminis tritici*), this disease continues as a major threat to production. Some crops of Gamut, for example, were severely affected. Leaf rust (*Puccinia recondita tritici*) is undoubtedly the most common disease and was severe this last season on crops of Mendos and Spica. Research work has clearly shown that cultivars fall into particular groups according to their field reaction to these diseases. This finding is a major advance in the search for a more stable type of resistance.

Moist conditions favour such diseases as yellow spot (*Pyrenophora tritici-repentis*) and black point (*Alternaria* spp.), and consequently last season was a bad one for both. Some serious thought needs to be given to the present grading standards with regard to the latter disease.

Crown rot (*Gibberella zeae*) was more severe than it has been for many years with instances of 30 to 40% diseased plants in some crops. Head scab caused by the same organism was found frequently, again reflecting the moist weather conditions. A hybridization programme investigating the heritability of resistance to crown rot is now well advanced and results to date show considerable promise.

Grain sorghum. A disease which devastated sorghum crops in the U.S.A. for many years was found in Australia for the first time in November 1975. It occurred on the Darling Downs. Known as 'milo' disease, it is caused by the fungus *Periconia circinata*. Its wide distribution obviously means it has been here for many years. Modern hybrids obviously have a degree of resistance and the severe above-ground symptoms recorded overseas have not been found. It could nonetheless be an important factor affecting yields.

Sugarcane mosaic virus (SCMV) resistance studies is a major commitment of the plant virology section. The co-operative work with Agriculture Branch on the incorporation of resistance into commercial hybrids is now approaching the final selection and evaluation stage.

Maize. Stalk rots (*Gibberella zeae* and *G. fujikuroi*) continue to interfere with harvesting operations in north Queensland. In south Queensland, detailed research has shown that the organisms associated with these disorders vary between districts. In the Lockyer Valley, for example, *Fusarium monifilforme* and *F. graminearum* predmominate, while at Kingaroy *Diplodia maydis* is more common.

Co-operative work between plant pathologists and plant breeders has resulted in the decline of the importance of maize dwarf mosaic. Most hybrids now in wide use possess adequate resistance, but field evaluation of all commercial and experimental hybrids for resistance continues each year.

Soybeans. Rust (*Phakopsora pachyrhizi*) was reported in most soybean growing areas including the St. George irrigation area. It was severe, however, only in isolated crops in the Boonah area, around Kingaroy and in the Lockyer Valley. Studies on the environmental requirements for optimum disease development are continuing. Work to date indicates that the present rust population may not be a problem in inland growing areas during most summer seasons.

Sunflowers. Both rust (*Puccinia helianthi*) and Alternaria blight (*Alternaria helianthi*) continue to be problems and screening of cultivars for resistance continues. Marked differences were evident in reaction to the latter disease in a collection of cultivars at Warwick.

Peanuts. This crop has always been plagued with severe disease problems. The 1975-76 season showed another serious change with rust (*Puccinia arachidis*) previously recorded only on the Atherton Tableland in Queensland, appearing throughout central and southern areas. Recordings were made at Biloela, Rockhampton and Bundaberg as well as in the North and South Burnett. Some small areas were totally destroyed but most crops suffered moderate or slight loss. There was considerable expenditure on fungicides, particularly on the late-planted crops. The exceedingly wet conditions during the latter part of the season undoubtedly increased the hazard with this disease and its true significance in southern areas will not be determined until observations are made over a number of seasons. However, the spraying strategies, already under review because of the possible resistance of the leaf spot organism (*Cercosporidium personatum*) to benzimidazole fungicides, may have to be further modified. Research to this end has already been initiated. It is interesting to report that, in trials in north Queensland, yield increases of up to 60% were achieved when leaf spot and rust were effectively controlled with either chlorothalonil or fentin. Further studies of introduced cultivars in north Queensland confirmed the presence of resistance to rust and tolerance to leaf spot in some material. A breeding programme will be needed, however, to incorporate these attributes into commercial lines.

Stem, peg and pod rot (*Sclerotium rolfsii*) was very widespread in all peanut areas. A research programme has been started to investigate these disorders. During 1975-76 an intensive survey of peanut areas was conducted to form a basis for future work.

Tobacco. Blue mould (*Peronospora hyoscyami*) was severe in both seedbed and field crops up until the end of August. Ideal conditions prevailed for the screening of two new chemicals against this disease. Both were highly effective with a systemic mode of action. Further work on these is planned as they offer a viable alternative to benzol vapour for control of blue mould in the seedbed.

A total of 25 lines was screened for resistance to blue mould, black shank (*Phytophthora nicotianae* var. *nicotianae*) and bacterial wilt (*Pseudomonas solanacearum*). These constitute an important component of the Departmental tobacco breeding programme and testing ensures that no highly susceptible line will be released.

Navy Beans. Cowpea aphid-borne mosaic is a virus disease of cowpea which has been detected in north Queensland. It is seed-transmitted in cowpeas, but its importance in that host is minimal. However, the navy bean cultivars Gallaroy, Kerman and Selection 39 (Actopan x Sanilac) are severely affected. The disease therefore presents another hazard to bean seed production in north Queensland and its occurrence will need to be carefully watched.

Safflower. Alternaria blight (*Alternaria carthami*) caused very serious yield depression last season. Research during the year proved conclusively that it is seed-borne and that chmical seed treatments at present available are not effective in controlling it. Other seed treatments are now under investigation.

Fruit diseases

Avocado. The management programme involving the increase of the levels of organic matter, calcium and nitrogen in the soil is continuing to be effective in controlling Phytophthora root rot at Mt. Tamborine. The pathogen, *Phytophthora cinnamomi*, cannot now be isolated from such treated soils in which it was previously at a high level.

The use of pathogen-free stock is a prerequisite for the successful propagation of this crop, and the number of avocado nurseries infested with the causal fungus continues to cause concern.

Deciduous fruit. Some years of intensive experimental work is now being reflected in improved control of apple scab (*Venturia inequalis*). Despite above-average rainfall throughout the 1975-76 season, which favoured disease outbreaks, the disease was kept under control. This was due to regular spraying by growers using protectants according to the Departmental schedule and strategic spraying with eradicants according to apple scab warnings. It is hoped that this approach to control will avoid the resistance problem to benzimidazole eradicant type fungicides reported with this disease organism in other parts of Australia.

The same success cannot be reported with brown rot (*Sclerotinia fructicola*) control in stone fruits. The extremely wet conditions near harvest in late maturing peaches and nectarines interrupted spraying schedules. A promising new fungicide, RH 6019, came to light in further post-harvest dip tests.

A ginger Fusarium rhizome rot trial. The devastated plot in the foreground was untreated and the healthy plot in the background was treated with benomyl.

Virus diseases of woody perennials are best controlled by providing virus-free propagating material. Eight locally-grown apple cultivars and two plums have now been heat-treated where required and indexed and will be submitted for inclusion in the national repository. Mother trees will be made up for supply to local nurseries.

CITRUS. Benomyl plus white oil applied as an eradicant spray 20 weeks after the half to three-quarter petal fall copper spray was very effective in controlling black spot on Late Valencia oranges. Before such a procedure is adopted by the industry, very careful consideration will have to be given to the effect of field sprays of the benomyl type on the build-up of resistance in the green and blue mould organisms (*Penicillium* spp.).

GINGER. The use of mercury 'seed' dips has long been unacceptable to the industry. Field tests this year have shown that fungicides of the benzimidazole type when used as pre-plant dips for as short a period as 1 minute give effective control of the main seed-borne problem, *Fusarium oxysporum* f. sp. *zingiberi*. Late infection from soil-borne inoculum did not occur for approximately 20 weeks.

The incidence of root-knot nematode in early harvest ginger was reduced following treatment with EDB and phenamiphos.

MANGO. Anthracnose (*Colletotrichum gloeosporoides* var. *minor*) has been a serious problem in mangoes for many years. Severe breakdown occurs in the market-place with consequent downgrading of fruit and losses to the producer. Trials during this last season have shown that a combination of field and post harvest treatment has reduced wastage. At the same time, the field sprays have increased fruit yield substantially by controlling anthracnose during flowering and early fruit set. The promising field sprays include benomyl, mancozeb and copper oxychloride, while the best post harvest treatment is a 5-minute dip in hot water (52°C) containing 500 ug to the ml benomyl.

PASSIONFRUIT. The hybrid passionfruit widely used in the industry had a distinct advantage in being tolerant of most passionfruit woodiness virus strains. Experimental work has now confirmed the occurrence of a transmissible agent, probably a virus, which causes severe woodiness in such hybrids. While the new disease does not spread rapidly in the field, it is present in several locations from Nambour to Redlands.

PINEAPPLE. Soil dressings with sulphur have continued to give good control of root and heart rot (*Phytophthora cinnamomi*). Research indicates that this control is probably due to a combination of factors including a change in the mineral ion concentration, inactivation of organisms which stimulate spore production in the pathogen, an effect on nitrification and a reduction in nematode populations.

The fungicide ethazol combined with frequent side-dressings with sulphate of ammonia has also shown promise for the control of these disorders. Captafol continues to be effective. The possibility of combining sulphur with fungicide treatments is now being investigated because, under some conditions, sulphur in the quantities needed has some harmful side effects.

An outbreak of root rot in a commercial pineapple plantation.

STRAWBERRY. With the inclusion of meristem propagated Redlands Crimson strawberries into the Runner Approval Scheme, strawberry viruses should be virtually eliminated from Queensland over the next few years.

Some of the problems encountered over the years with the control of black spot of strawberry fruit (*Colletotrichum acutatum*) can now be better understood with the research finding that infection can be carried with the runners. The fungus remains dormant in the leaf tissue and sporulates when the leaf senesces.

The nematode disease of strawberry, 'crimp' (*Aphelenchoides besseyi*), remains a major problem. Studies during the year have shown that the early yield up to the end of August is reduced by 50% in infested plants but the yield over the whole season is similar to that of non-infested plants.

Vegetable diseases

CUCURBITS. Watermelon mosaic remains a major problem with the appearance of the type 1 strain. Recently, 30 cultivars of watermelon were subjected to high infection pressure to this virus disease and none was able to produce an acceptable crop.

Screening of watermelon cultivars for resistance to the new strain of wilt (*Fusarium oxysporum* f. sp. *niveum*) virulent on Calhoun Grey indicates that Warpaint, Charleston Grey, Florida Giant and Smokylee have some level of resistance.

Detailed studies of the brown etch disease of butternut pumpkins have indicated that a number of organisms including *Ascochyta cucumis, Fusarium roseum* and *Fusarium oxysporum* may cause this disorder.

The pumpkin crop, particularly in the Lockyer Valley, was seriously affected again by bacterial spot (*Xanthomonas cucurbitae*). This spot leaves open cracks which are easily invaded by rotting organisms. Farmers who market such fruit have faced heavy losses at the market place. The disease was shown this year to be seed-borne and growers are being encouraged to plant only seed obtained from healthy fruit. Seed treatments are being investigated and a hot water treatment and an acid treatment have shown promise. Frequent applications of copper oxychloride at weekly intervals failed to give any worth-while control of the spot in the field.

FRENCH BEANS. Sclerotinia rot (*Sclerotinia sclerotiorum*) was a major problem in the seed bean crops in the Burdekin area last year. This year, a major investigation has been mounted into control with fungicides and management practices. During 1975, a total of 154 collections of bean rust (*Uromyces appendiculatus*) were typed with strain H again being the predominant type.

A new virus disease causing leaf, stem and pod necrosis occurred in 1975 in French bean cv. Climbing Blue and navy bean cv. Kerman in the Burdekin area. The cause is a strain of the passionfruit woodiness virus and a principal alternative host, *Passiflora foetidia,* is a common weed in the area. Glasshouse tests have shown that other bean cultivators are susceptible. In the field, its symptoms are easily confused with those of common and bean yellow mosaic. Indications are that seed transmission is of an extremely low order.

TOMATOES. Bacterial wilt is one of the most serious diseases of this crop. It is interesting to record therefore that, in a trial at Nambour, five breeding lines, including two from the Philippines, were highly resistant to this disorder. Meanwhile at Bowen, the cultivar Walter, resistant to Fusarium wilt (*Fusarium oxysporum*), went down to a foot rot (*Fusarium solani*). A breeding line H2990 from the U.S.A. showed a high level of field resistance to bacterial canker (*Corynebacterium michiganense*) when tested at Stanthorpe.

DISEASES OF ORNAMENTALS. More emphasis has been put on this area of work in recent years. Carnations have been plagued with both wilt (*F. oxysporum* f. sp. *dianthi*) and collar rot (*Rhizoctonia solani* and *Sclerotium rolfsii*) for many years. Recent trial work has shown that a pre-plant soil treatment with chloropicrin was very effective in controlling these disorders, particularly if combined with a post-plant treatment with fungicides such as benomyl and quintozene.

In experimental work with carnation rust (*Uromyces dianthi*) the fungicide oxycarboxin proved highly effective and has now been registered. Chlorothalonil and folpet were also promising.

Two viruses not previously known to occur in Australia have been found in Queensland orchids. One of these is orchid fleck virus which is widespread in *Cymbidium* species but can also infect other genera. It is suspected this virus has been present for a long time but has only been detected now following the use of a new electron microscopy technique.

Miscellaneous diseases

NOOGOORA BURR RUST. Since its first appearance in south-eastern Queensland in February 1975, this rust (*Puccinia xanthii*) has spread to the Burdekin in the north, west of Barcaldine in central Queensland and south of Mitchell. A field recording was made on one parental line of a sunflower hybrid in plant breeders' plots at Biloela. Glasshouse tests have been commenced to screen a range of sunflower lines for susceptibility.

Extension

Every plant pathologist in the branch carried out extension activities during the year. These included attendance at growers meetings, field days and radio interviews. The major extension activity of the branch remains the preparation of colour profiles, five series of which were published in the *Queensland Agricultural Journal* during the year. Material, including colour illustrations, is being collected and prepared for use in the publication of a handbook of plant diseases when funds become available.

Diagnostic services

The extension pathologist at Indooroopilly alone handled more than 1 000 enquiries requiring disease diagnosis. At field stations, the number of diagnoses which were accessioned again exceeded 2 000. These represent only a fraction of specimens actually handled by plant pathologists in their day-to-day activities.

The specialist bacteriologist handled 250 accessions, many of which required detailed laboratory checking. The specialist nematologist processed 650 plant and soil samples. In the virology section, more than 500 specimens were examined with the electron microscope. Another 240 required indexing in the glasshouse for diagnostic purposes.

The specialist mycologist confirmed many new records during the year. Those of possible economic significance included *Synchytrium* sp. on *Glycine clandestina*; *Peronospora manshurica* on *Glycine tomentella*; and *Puccinia menthae* on *Mentha* sp. (mint).

Legume bacteriology

The legume bacteriology specialist continued to supply cultures of rhizobia to agrostologists in the Department. A total of 38 such cultures for 12 different legumes, for which there are no commercial cultures, were involved. He continued to sample commercial inoculants available at retail outlets and the quality continued to be good. He also assisted field officers in their examination of problems associated with legume nodulation.

Agricultural Chemistry Branch

THE Agricultural Chemistry Branch functions as a chemical service laboratory for the Division of Plant Industry and the Division of Land Utilization, and as a chemical regulatory laboratory for the Standards Branch of Division of Marketing.

In addition to analytical service work, the Branch undertakes independent or co-operative investigations in a number of fields. These are laboratory oriented studies in plant chemistry, soil chemistry, cereal science, soil physics and soil survey. The cognate disciplines with which it works are animal science, entomology, plant pathology, agronomy, agrostology and land use planning.

The primary objectives of the branch are to provide efficient chemical and allied services and advice; to contribute data towards the quantification of particular facets of biological and agricultural systems and resource assessment; and to develop improved interpretation and understanding of such data.

Staff are located at six regional centres in addition to the main laboratory at Indooroopilly.

Research

Chemical residue studies

Surveys have been carried out for a number of commodities to assess residue levels from known spray programmes and also to determine whether spray programmes other than those recommended by the Department are in use commercially. This work is of value in providing information for Departmental officers and farmer organizations in particular industries so that farmers may be advised on economic and effective spray programmes compatible with acceptable residue levels.

Commodities sampled include fruit, vegetables and tobacco. In most cases, residues have been well within acceptable limits and, where higher values have been detected, steps have been taken to advise farmers and industry organizations of the potential problems.

In the registration of ethylene dibromide (EDB) as a fumigant, residual concentrations of bromide resulting from fumigation were determined for a number of commodities.

The changing concentration of active constitutents in post harvest fruit dips may result in either ineffective treatment or excessive residues. As well as service monitoring of some commercial citrus dips, the changes in concentration of dimethoate and carbendazim have been studied for a new dip at Rocklea.

Plant chemistry

A more detailed knowledge of some plant chemical constitutents and factors controlling their development is required for a number of projects. Such constituents may relate to quality factors in a commodity or may be of biological significance.

An attempt is being made to isolate and identify the phytotoxin produced by the fungus *Marasmius saccharii* var. *hawaiiensis* which infects maize plants. A sensitive bioassay technique has been developed to monitor the progressive isolation steps.

Work is continuing on the isolation and characterization of compounds present in the oil of *Eucalyptus caleyi* and related species which predispose animals such as sheep to unpredictable reactions to therapeutic compounds administered to them.

As part of an inter-branch study of host plant resistance to insect pests, the gossypol content of cotton plants is being determined. There is a strong negative correlation between larval weight (*Heliothis* spp.) and gossypol content of cotton squares which ranged from 1·85% to 0·03% in the samples evaluated.

Small amounts of selenium are required in poultry feeds, but a content in excess of a few mg per kg is undesirable. A study of the selenium content of broiler feeds and their raw materials is in progress. Several varieties of wheat, sorghum and soybeans have been analysed from major feed-producing areas. Values range from 0·02 mg per kg Se to 1 mg per kg with differences related more to areas of production than to varieties. This work has been financed by a grant from the Australian Chicken Meat Research Committee.

The determination of oil quantity and quality is an important part of the overall Departmental research programme into oil seeds. Changes in oil yield and quality through the later stages of crop development have been studied for various planting times of sunflower cultivars.

This study confirms previous indications that the crop is ready for harvest when moisture drops to approximately 20%. Results from mature samples indicate that Hysun 30 produces a higher oil content than Sunfola 68-2 for all plantings, while Sunfola 68-2 produces a higher level of linoleic acid.

The linoleic acid content is an important quality factor but actual determination is costly in time and equipment. A predictive relationship has been developed between the more readily measured Refractive Index and iodine value or linoleic acid content.

Cereal chemistry

The main function of the cereal chemistry section at the Queensland Wheat Research Institute is to evaluate and to advise on the quality of wheat and barley grown in Queensland.

Research is undertaken into the method of evaluating quality to provide efficient and thorough quality testing of all the samples received by the section.

Samples originate from the Queensland breeders' programmes and the Regional Variety Testing programme, the latter evaluates the performance of crossbreds in the 2 years before their commercial release. Approximately 2 000 samples a year are tested.

Silo samples are also analysed.

For the variety trials, the qualities of UQ7401, Songlen and Condor were within the range of the Prime Hard varieties presently recommended for Queensland. UQ7410 lacked dough extensibility in the four samples tested. This cultivar will be re-tested over a much wider range of environments during the coming year. The dough resistance of Timson was lower than that of the Prime Hard varieties. This is not a major quality fault and a decision on the classification of this variety will be a topic for the agenda of the next Queensland Wheat Variety Committee.

In general, the samples of Egret did not exhibit true soft wheat quality. The testing also established that Kite was significantly more resistant to post harvest weather damage than the other recommended varieties.

Data from the silo survey for 1974-75 are given in Table 1.

TABLE 1

PRODUCTION, QUALITY AND YIELD OF COMMERCIAL WHEAT CROPS 1974–75

Region	Total Production (000 tonnes)	% Total Production*	% Prime Hard†	Mean Protein for Area (%)†	Yield (t/ha)*
Dalby	174·08	26·3	10·2	12·1	2·00
Western Downs	161·36	24·4	25·5	13·7	1·28
Central Downs	81·31	12·3	6·2	12·5	1·98
South-western Downs	68·42	10·3	65·0	12·9	1·02
Dawson–Callide	45·72	6·8	V.L.	13·9	1·34
Central Highlands	44·93	6·8	0·9	12·1	1·44
Northern Downs	41·35	6·3	2·2	11·9	2·00
Maranoa	22·19	3·4	47·7	13·2	1·15
Southern Downs	12·20	1·8	V.L.	n.a.	1·81

n.a. Not analysed.
V.L. Very low.

* Based on State Wheat Board statistics.
† Approximate; based on major depots only.

The pentosan content of a range of wheat and flour samples has been measured and an attempt made to relate pentosan content of flours to the physical characteristics of their doughs. Whole flour total pentosan content ranged from 4·89 to 7·44% while that of white flour ranged from 1·27 to 2·08%.

Samples from 10 regional barley variety trials were analysed for grain nitrogen content and nitrogen analyses were also undertaken on a number of samples from the plant breeding programme. Further analyses will be conducted to assess malting quality.

Regional soil fertility assessment

Projects are in progress in various parts of the State to define soil nutrient status and to examine methods of correcting deficiencies.

FACTORS AFFECTING THE SUPPLY OF NITROGEN TO WHEAT. Many Queensland wheat-growing soils are nitrogen deficient. This deficiency can be corrected by applying nitrogen fertilizer or by using pasture legume leys. However, whatever the form of supply, the nitrogen undergoes many different transformations in the soil, and these critically influence its availability to crops.

A research programme has therefore been developed to examine the factors influencing the importance and rates of these various transformations. So far, the programme has been aimed at gathering information on the effects of soil moisture and temperature conditions on nitrogen mineralization (from soil and legume residues), on nitrogen immobilization (through the influence of wheat stubble in the soil) and on loss of nitrogen through bacterial denitrification (under waterlogged conditions).

Since stubble mulching is being practised widely in the wheat belt, the rate of stubble decomposition in the field has also been studied using a stubble bag technique.

Recent results, confirm that denitrification losses occur only when the plough-layer soil contains free water. While such losses are rapid in soil at 30°C, losses are relatively insignificant at 10°C, and slow at 20°C. Since most waterlogged field soils are rarely warmer than 20°C, even in summer, the economic significance of denitrification losses is open to question.

NUTRIENT SCREENING OF QUEENSLAND CEREAL-GROWING SOILS. In a co-operative programme with Dr. N. J. Grundon, Agriculture Branch, field experiments have been conducted to test for deficiencies of elements found lacking in glasshouse pot trials and to test for residual effects of fertilizers applied in 1974.

NITROGEN STATUS OF SOILS OF THE BRIGALOW REGION. In an attempt to investigate the extent of depletion of soil nitrogen following clearing, a number of sites has been intensively sampled. More than 40% of sites show depletion for the 0 to 10 cm horizon. This depletion is related to land development categories but there does not appear to be a clear trend of depletion related to age of development.

FERTILITY SURVEY OF CENTRAL QUEENSLAND SOILS. Laboratory and glasshouse assessments previously done for the cracking clay soils of the region have now been extended to the texture contrast soils of the Callide and Dawson Valleys and in the Central Highlands.

FERTILITY OF PASTURE SOILS OF THE WET TROPICS. Pastures on the wet tropical coast are being monitored to determine rates of change in soil phosphorus and potassium resulting from commercial fertilizer programmes. Combinations of soil type, rainfall amount, soil fertility and pasture type are being considered.

A major problem in this study is the variation in soil chemical analyses in any one paddock. Errors in fertilizer application were responsible for some extreme variations, but the general problem of variability in grazed, fertilized pastures is highlighted. Significant changes in soil phosphorus, but not in exchangeable potassium, have been measured during a 2-year period.

Soil and plant diagnostic criteria

A number of projects has the objective of establishing correlations between soil or plant analytical values and plant response to fertilizers.

SOIL TEST CALIBRATIONS, GRASS-LEGUME PASTURES. Data have been obtained from more than 20 sites in south-east Queensland. Promising relationships have been established between soil phosphorus test values and yield response, though in general tropical-legume-based pastures were not responsive to applied fertilizer. A tentative critical value for % P in white clover tops has been established.

SOIL TEST CALIBRATIONS, SOUTH BURNETT. In association with Agriculture Branch, work on soybeans has shown response to phosphorus on a number of sites. Work is continuing to develop the relationship between soil test value and plant response but leaf analysis has been found to be poorly related to crop response or applied fertilizer.

NITROGEN AND PHOSPHORUS FERTILIZER TRIALS. In a co-operative project with other officers at the Queensland Wheat Research Institute, a series of fertilizer trials is being conducted to test and develop soil tests for nitrogen and phosphorus requirements of wheat on the Western Downs and Central Highlands.

In the Central Highlands, vegetative and grain response to phosphorus were recorded on sites having less than 20 p.p.m. bicarbonate extractable P. Plant phosphorus content at late tillering was related to soil phosphorus level. Responses to nitrogen fertilizer were not necessarily linked with low soil nitrate contents.

Crop nutrition and nutrient interactions

Various projects are aimed at more clearly defining specific nutrient requirements of certain crops and the native nutrient and fertilizer interactions associated with particular soil types.

PHOSPHORUS IN ATHERTON TABLELAND SOILS. The phosphorus fertilizer requirements of *Desmodium intortum* have been determined for several soils. Related studies assess the ability of soils of the area to sorb P in a form unavailable to plants. This sorption has been found to be related to parent material in the order basaltic >granitic> metamorphic.

Increasing annual precipitation from 1 100 to 3 000 mm increased the P sorption of soils derived from Atherton basalt. Previous P fertilization caused a decrease in P sorption ability, while soil erosion caused an increase in P sorption.

RICE NITROGEN NUTRITION. The effects of irrigation treatment and previous cropping history on nitrogen reduction under rice have been studied in the Burdekin irrigation area. As expected, the 'permanently moist' irrigation treatment produced conditions most conducive to N reduction. Also, N reduction was favoured if rice were grown after pasture, particularly if the pasture were fertilized. There is little evidence that denitrification is causing reductions in grain yield.

The use of aqua-ammonia was also studied. Grain yields in bays treated with aqua-ammonia were highly variable due to differences in water and N penetration within the bay. It was concluded that aqua-ammonia can be used satisfactorily if mixing with the water is thorough and the bays are carefully levelled so that the depth of water ponding is approximately constant.

MANGANESE AND NITROGEN EFFECTS ON KIKUYU. The suitability of the DTPA test in predicting manganese toxicity on krasnozem soils and the effect of high soil manganese on nitrogen response were studied. Results suggest that DTPA extractable Mn below 100 p.p.m. does not inhibit the response of kikuyu to nitrogen.

PHOSPHORUS RESPONSE OF PEANUTS. In association with Agriculture Branch, experiments showed no response of peanuts to freshly applied phosphorus but significant yield increases resulted from phosphorus applied more than 12 months previously.

Soil physical properties

Laboratory and field experiments have been undertaken to characterize the physical properties of soils and to study the effects of management on various physical properties.

LABORATORY STUDIES ON SOIL STRUCTURE. An attempt has been made to develop general explanations of the structural behaviour of soils following studies on 110 samples chosen to represent a range of Queensland soil types. Clay content was found to be the major factor determining aggregate porosity.

Statistical techniques suggested that minimum porosity is obtained in soils containing 40 to 50% clay. The capacity of soils to regain porosity after puddling was also related to clay percentage. The ability of soils with more than 50% clay to re-organize after puddling is much greater. The work suggests that, in further studies, loss of porosity on puddling and subsequent porosity gain with wetting and drying could be used for soil comparison.

EFFECT OF SOIL MANAGEMENT ON SOIL PHYSICAL PROPERTIES. Management systems studied have included pasture rotations and different fallow treatments.

The effects of pasture rotations on soil physical and chemical properties have been studied on heavy clay soils and sandy loam soils on the Darling Downs. On the clay soil, there is no evidence that grass-legume or pure legume pastures increase the organic matter content or soil structural stability. On the sandy loam soil, however, significant increases in soil organic matter content were measured in both Rhodes grass and lucerne treatments. Only in the Rhodes grass plots was an increase in soil structural stability measured. This is possibly due to soil binding associated with the fibrous grass root system.

In a fallow treatment trial at Hermitage Research Station near Warwick, stubble-retained and nil-cultivation treatments were compared with stubble burning and weed control by cultivation. Large increases in fallow moisture accumulation were measured in uncultivated and stubble retained treatments. The increase in the stubble-retained treatments appeared to be associated with reduced evaporation and the protective effect of stubble under rainfall.

The nil-cultivation treatment altered the soil chemical properties of the surface layer. Exchangeable sodium percentages were lower and the paraquat used for weed control altered the charge characteristics of the clay. Laboratory measurements showed that soil structural stability was higher in the uncultivated plots and this was due to the lower exchangeable sodium. Gypsum has been added to the trial area to lower exchangeable sodium levels and to determine whether or not laboratory measured stability differences are resulting in differences in moisture accumulation in the field.

Assessment of soils for irrigation

Major studies have been undertaken at Emerald, now completed, and in the Lower Burdekin Valley. The objective has been to rank soils on their ability to take in water under irrigation, to store water, and subsequently to supply water to plants.

On a range of soils, small isolated plots of two types have been established: 5 m x 5 m bays with walls sunk to 1 m to minimize lateral water losses, and 1 m diameter steel rings sunk to 10 cm to allow ponding of water on the soil surface. In the larger bays, quantitative information on irrigation intake and water use was obtained. In the smaller rings, approximate information on depth of water penetration and water use can be rapidly and economically obtained.

Rooting depth was variable in the range of soils studied, being as shallow as 30 cm in dispersive duplex and clay soils, and more than 80 cm in some clay soils. In clay soils the amount of water available to plants was related more to rooting depth than to available water per unit soil depth. The depth of the active root zone can be closely estimated from the laboratory analysis profiles for chloride.

Measurements of plant water status have been used to define the degree of plant stress. One problem with isolated plots is that the rate of water use is nearly twice that measured in commercial areas.

Environmental studies

Various management practices may have a harmful effect on soil properties and a number of projects has been undertaken to monitor possible effects of such practices.

DISPOSAL OF ANIMAL WASTE. The effects on soils and pastures of the disposal of fowl manure at rates up to 240 tonnes per ha per annum are being studied in association with the Queensland Agricultural College. Changes in the composition of soils and plants are being measured for a number of elements, with particular emphasis on soil mineral nitrogen status.

Soil NH_4–N levels (0 to 10 cm) up to 500 p.p.m. N have been recorded 2 weeks after manure application. This is followed by a rapid decrease in NH_4–N and a corresponding increase of NO_3–N up to 80 p.p.m. N in ensuing weeks. There has been relatively little movement of mineral nitrogen into subsoil layers in this experiment to date.

A similar experiment on the disposal of cow manure undertaken by the Animal Research Institute is also being monitored for soil and plant effects.

SOIL SALINITY STUDIES. On sloping areas in the Burdekin Valley, clearing and irrigation of soils at the top of the slope have resulted in water seepage and salt damage to crops near the base of the slope. This problem has been studied on commercial farms and measurements have commenced at the 'Fort' site, a commercial cropping feasibility area on the right bank of the Burdekin River. Soil sampling has been used to monitor soil salinity and piezometers have been installed to measure the height and salinity of ground water tables.

Major accumulations of salt are occurring in the productive Koberinga soils and drainage schemes have been implemented to minimize soil damage. Care may be required in the clearing and irrigation of upper slopes in this area.

Soil and land use surveys

Soil surveys are being undertaken to provide the information required for feasibility studies and project planning of irrigation development. Soil surveys have also been carried out in relation to specific crops and a programme of detailed reference area surveys has been commenced.

1:100 000 SOIL SURVEY OF RIGHT BANK LOWER BURDEKIN VALLEY. A total of 81 000 ha was mapped at the semi-detailed reconnaissance scale of 1:100 000 to provide data on the distribution of the major soil groups. In addition, selected reference areas have been mapped at a semi-detailed scale (1:25 000) to provide data for use in assessing potential for irrigation at the farm level.

EMERALD IRRIGATION AREA (RIGHT BANK) DETAILED SOIL SURVEY. A grid method is being used to survey the soils of the right bank from the Nogoa River to Winton Creek in detail adequate for farm design.

SOILS OF THE MAJOR PINEAPPLE GROWING REGIONS OF QUEENSLAND. The morphological and chemical characteristics of the soils growing pineapples in Caboolture, Nambour, Gympie and Yeppoon districts have been defined. The soils have been grouped into soil profile classes and their distribution for each district has been assessed.

SOIL SURVEY OF THE GRANITE BELT VINEYARDS, SOUTH-EAST QUEENSLAND. The morphological and chemical properties of Granite Belt vineyard soils have been defined and their distribution indicated. Most of the soils were found to be developed on Stanthorpe Adamellite and are generally of a gritty nature.

DETAILED SOIL SURVEY OF BURDEKIN RURAL EDUCATION CENTRE LANDS. A soil survey of the centre is being carried out for use in farm planning and to act as a reference area for the mapping of land north and north-east between the centre and the main northern railway.

Method development

There is a continuing programme of method development in the various groups of the Branch.

A number of methods based on gas chromatography has been developed to meet the requirements of the pesticide formulations and residue analyses. New methods have been applied to the analyses of Tordon formulations, the detection of trace quantities of HCB in pesticides, and the identification of 2,4-D and 2,4,5-T ester residues in crops. Gas chromatography has also been evaluated for the determination of nicotine in tobacco.

Other method development work has been in the application of automated techniques for reducing sugars in tobacco, soil sulphate sulphur; and, at Queensland Wheat Research Institute, soil nitrate and ammonium nitrogen.

The determination of arsenic by atomic absorption using gas generation has been investigated. The absolute sensitivity of the method in 1 ng As and the optimum working range is 25 to 700 ng As per 20 ml aliquot.

Services

The Indooroopilly laboratory provides analytical services for research and extension activities of other branches, particularly those of Division of Plant Industry and Division of Land Utilisation.

Materials analysed consist mainly of stock and irrigation waters, plants and soil, but a range of miscellaneous samples is also analysed. Most plant samples are from research projects. Soils include those submitted by farmers through extension officers, samples from soil surveys, and samples from research projects.

Samples analysed were:

Plant samples	17 000	
Oil seeds	2 500	
Soils	13 500	(4 000 farmers, 3 000 soil survey, 6 500 research projects)
Waters	1 050	

Special analyses have also been carried out on 223 miscellaneous samples submitted by other branches and by organizations working in related fields. These analyses include total elemental determinations (S, P, K, Cu, Zn, Mn, Fe, Pb, Br and Cl) by X-ray Fluorescence, and the determination of mass spectra.

Other extension and service work included diagnosis of nutrient deficiency symptoms, analytical service and advice on soil physical problems, and soil classification.

The laboratory at Mareeba serves tobacco research and funds are provided from the Tobacco Industry Trust Account.

The laboratory at the Queensland Wheat Research Institute, Toowoomba, serves the research programme of that organization.

Approximately 10 000 plant samples and 5 000 soil samples were analysed, usually for two or more elements.

Regulatory

Regulatory analyses are carried out in relation to the Agricultural Standards Act and the Agricultural Chemicals Distribution Control Act.

Arising from alleged damage to crops by spray drift, 56 samples of plant material were analysed for various herbicide residues including (2,4-D, 2,4,5-T, picloram, MCPA, atrazine, diuron, bromacil, paraquat, diquat and amitrole).

In ensuring the compliance of various products with agricultural requirements, 173 pesticide formulations, 26 veterinary medicines, 1 000 stock foods and 120 limes and fertilizers were analysed. In addition, protein was determined on 300 export grain or referee wheat samples.

Botany Branch

THE primary objective of Botany Branch is to acquire and store knowledge on the vegetation and flora of Queensland and to provide a service to other Branches of the Department of Primary Industries, other State and Commonwealth organizations and the public by providing information and expert assistance on these subjects.

Efficient service depends on adequate staff and facilities and needs to be backed by relevant research. Three groups operate within the Branch, a taxonomy group which deals with questions on individual species growing in Queensland, an ecology group which studies the vegetation of the State, and a supporting services group which provides assistance to the other groups and maintains the Queensland Herbarium.

Research

Taxonomy

Sound, applied botanical research in such diverse fields as phytochemistry, range management, agrostology, and ecology depends on competent taxonomic research and correct identification. A major objective of the taxonomy group is the description and correct naming of all native vascular plants in Queensland.

During the year, a comprehensive taxonomic study of the 225 species of *Acacia* growing in Queensland was completed. This group of plants is extremely important as indicators of land capability and includes such important trees as mulga, brigalow, gidyea, blackwood and lancewood. More than 20 species are being described for the first time.

Two groups of plants, *Cordyline* spp. and *Dianella* spp., have been found to contain chemicals with interesting pharacological properties. Because of the close relationship between natural plant chemistry and taxonomy, taxonomic studies of both groups are being undertaken. Once taxonomic categories have been established, they are then used by chemists to provide a more predictive and structured base for future pharacological studies.

Other groups of plants which were intensely studied during the year include *Atylosia*, a group of tropical legumes, *Verticordia* and *Homoranthus*.

A co-operative project, with an officer of the Queensland Wheat Research Institute (Toowoomba), was begun to study the taxonomy of wild oats, the most serious weed of winter crops in Queensland. More than 50 characters were recorded from 600 plants grown from seed collected mainly from the Queensland wheat belt. These data are now being analysed in an attempt to relate important agricultural characteristics such as dormancy status and susceptibility to herbicides with taxonomic groupings or morphological characters.

A preliminary check list of the vascular plants of Queensland has now been completed and, in addition, a preliminary listing of all species of Australian grasses was compiled. Besides providing an up-to-date inventory of all species of

plants recorded from each of the pastoral districts of Queensland, the check list forms a base from which to prepare regional accounts of the flora.

Pressure from numerous workers in the field of applied botany such as ecologists, agriculturists and teachers for the preparation of regional floras of Queensland has increased.

Substantial progress has been made on the first of these floras and it is hoped a 3-volume handbook of the flora of south-eastern Queensland will be completed by 1981. It is more than 70 years since work of this magnitude has been undertaken in Queensland. Accounts of 66 families have been completed and, at the present rate of output, the first volume could be ready for publication by the end of 1977.

Preparations for the publication of a handbook on the ferns of Queensland are well advanced and it is expected the final manuscript will be completed by the end of this calendar year.

Ecology

Officers of the ecology group are deeply involved in a number of interdisciplinary projects with other State Government officers. Three botanists are employed on the Western Arid Region Land Use Study, being co-ordinated by Development Planning Branch, which aims at producing an inventory of the natural resources and land use practices of south-western Queensland. Such an inventory is required to plan the long-term, wise use of the lands of arid and semi-arid Queensland.

A vegetation account is being prepared for Part 2 of the study area, which extends from Adavale in the south to Blackall-Isisford in the north and west almost as far as Betoota. A map of the predominant vegetation types has been completed.

Field work on Part 4, which lies to the east of Part 2, was completed during the year and draft descriptions for the 90 land units have been prepared.

Two botanists have recently begun field work, one on Part 3, east and south of Charleville, and the other on Part 5, north of Part 2. Both of these studies will take approximately 2 years to complete.

A co-operative project with the Queensland Fisheries Service is also in progress. This involves mapping and describing the mangrove communities of Queensland. Such information is used to help establish priorities for future fisheries reserves and management policies. During the year, the field work and mapping of the tidal wetlands of the Gladstone area was completed. This leaves only the Wide Bay area to complete the study from Tannum Sands to the New South Wales border.

A map and account of the vegetation of the traprock and granite country in the Inglewood-Stanthorpe area were finished. They were prepared as part of a land-use survey of the region carried out by members of the Development Planning Branch and other officers of the Department.

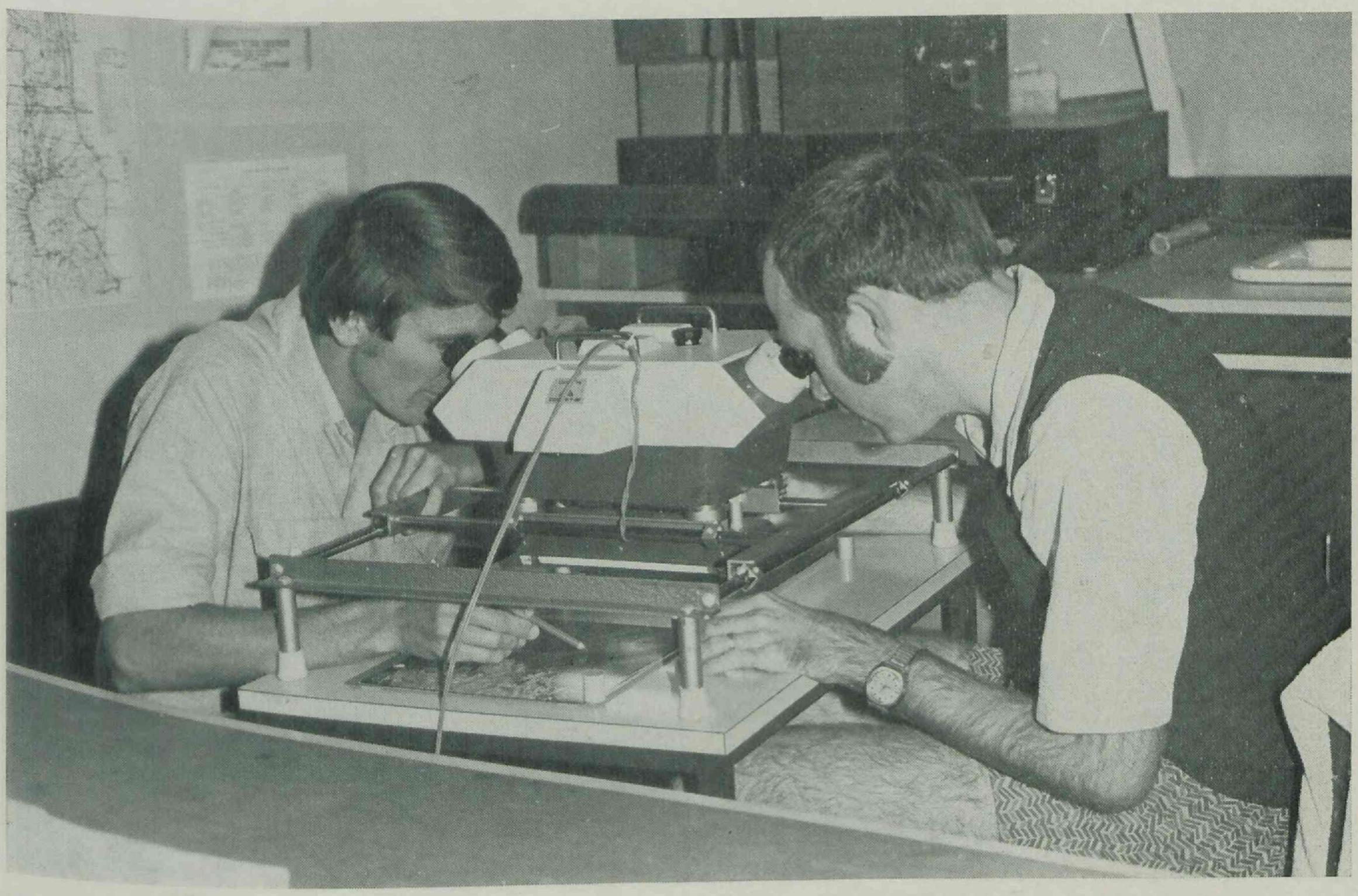
In co-operation with the Queensland Beach Protection Authority, studies were continued into the ecology of coastal sand dunes. This work provides basic data for use in the management and stabilization of the sandy coastal areas of Queensland. A comprehensive report on a trial, aimed at studying the establishment of hairy spinifex on bare sand dunes, was completed. Four split applications of N and P fertilizers totalling up to 610 kg per ha of N and 230 kg per ha of P produced striking increases in percentage ground cover. This improved ground cover has persisted even though the fertilizer applications ceased in 1972.

Assistance was given to officers of the Commonwealth Department of Northern Australia in the compilation of an account of the vegetation of the Burdekin Basin. This was required as input to the Burdekin Basin Appraisal being undertaken by the Commonwealth Government.

A G.C.S. 2100 data entry terminal has recently been installed with access to the computer facilities in E.D.P. Centre, Treasury Department. Because of the much closer liaison now between the encoding staff and the data input operator, problems of inaccurate punching and verification have been virtually eliminated.

Even now, the data bank is of sufficient size to create a demand for the retrieval of information and 15 requests for retrieval were processed during the year. The Queensland Herbarium contains more than 300 000 incorporated specimens and information from this historic herbarium collection, which dates back to the voyages of Captain Cook, is now being made available to projects such as the Western Arid Region Land Use Study and regional flora projects.

The Inventory Project will result in the preparation of structural and floristic descriptions of plant communities and associated vegetation maps covering the Moreton Region. The Brisbane sheet has been completed and is now being printed, while field work is in progress on the Murwillumbah and Beenleigh sheets. Assistance on this project is being provided by National Parks and Wildlife Service. These maps will provide a sound basis for the development of regional land use plans, for selecting areas for conservation purposes, and in assessing the environmental impact of land development projects.



Air photo interpretation of vegetation patterns by officers of Botany Branch and National Parks and Wildlife Service (Inventory Project).

Service and Extension

The Branch has two major service functions. The taxonomic group is responsible for maintaining a plant identification and advisory service while the ecology group assists in the preparation and examination of Environmental Impact Statements.

During the year, about 13 000 specimens were identified for members of the public, other branches and other Departments and organizations. In most cases, advice was given on the properties of the plants, their distribution and sometimes their control.

A total of 133 samples of stomach contents was examined for the suspected presence of poisonous plant material while 42 samples of roots taken from blocked drains or sewage pipes were examined microscopically and in most cases identified.

The identification of *Cannabis sativa* continues to make heavy demands on the staff and three botanists were called upon to handle 561 cases involving 786 hours in laboratory work and in court attendances. Over the past 3 years the time involved in this work has more than doubled.

Assistance was also given to the Animal Research Institute in their attempt to trace the cause of outbreaks of liver disease in cattle in south-western Queensland. There is a strong possibility that plant poisoning is involved, and an officer carried out a botanical survey on three affected properties in the Winton–Longreach–Yaraka areas. From a short list of common species, grey rattlepod (*Crotalaria dissitiflora*) appeared a likely suspect.

The Branch continues to monitor the introduction and distribution of alien plants that have potential as weeds of major importance in Queensland. Contributions were made towards a better understanding of the real nature of the present outbreak of Parthenium weed (*Parthenium hysterophorus*) in the Central Highlands and in the development of a programme to contain this weed. Assistance was also given to Mount Isa Mines Ltd. in assessing the potential hazard of Salvinia weed (*Salvinia molesta*) on Lake Moondarra on the Leichhardt River and in the development of a plan for its control.

The ecology group continued to act as an advisory body to the State Government, suggesting guidelines for the preparation of Environmental Impact Statements, examining prepared Statements and providing critical comment on their botanical sections and preparing botanical sections of Statements for other Government organizations. Studies of the impact of nine development projects including open-cut mining, canal estate, dam building and freeway developments were carried out during the year.

The importance of sound botanical data upon which to assess likely impact on the environment of major engineering projects is well recognized. To enable the Branch to cope with the increasing demands for this type of assistance, a botanist was appointed to the staff to handle environmental impact studies.

An account of the vegetation of Moreton Island and an associated vegetation map were used in preparing an environmental impact study and strategic plan for the island by private consultants. This vegetation account and map is, at present, being prepared for publication.

An officer of the Branch again represented the Department on inspections of revegetation on sand mining leases in Queensland. He reported that most companies continue to make a conscientious effort with their revegetation work.

Introductory chapters and descriptions of 193 species for a new book on the weeds of Queensland have been written and it is expected the entire manuscript covering descriptions and illustrations of about 350 species will be completed by the end of 1976.

Another four articles on the wildflowers of south-eastern Queensland were published in the *Queensland Agricultural Journal* and material for a book on the articles published before 1976 has been submitted for publication.

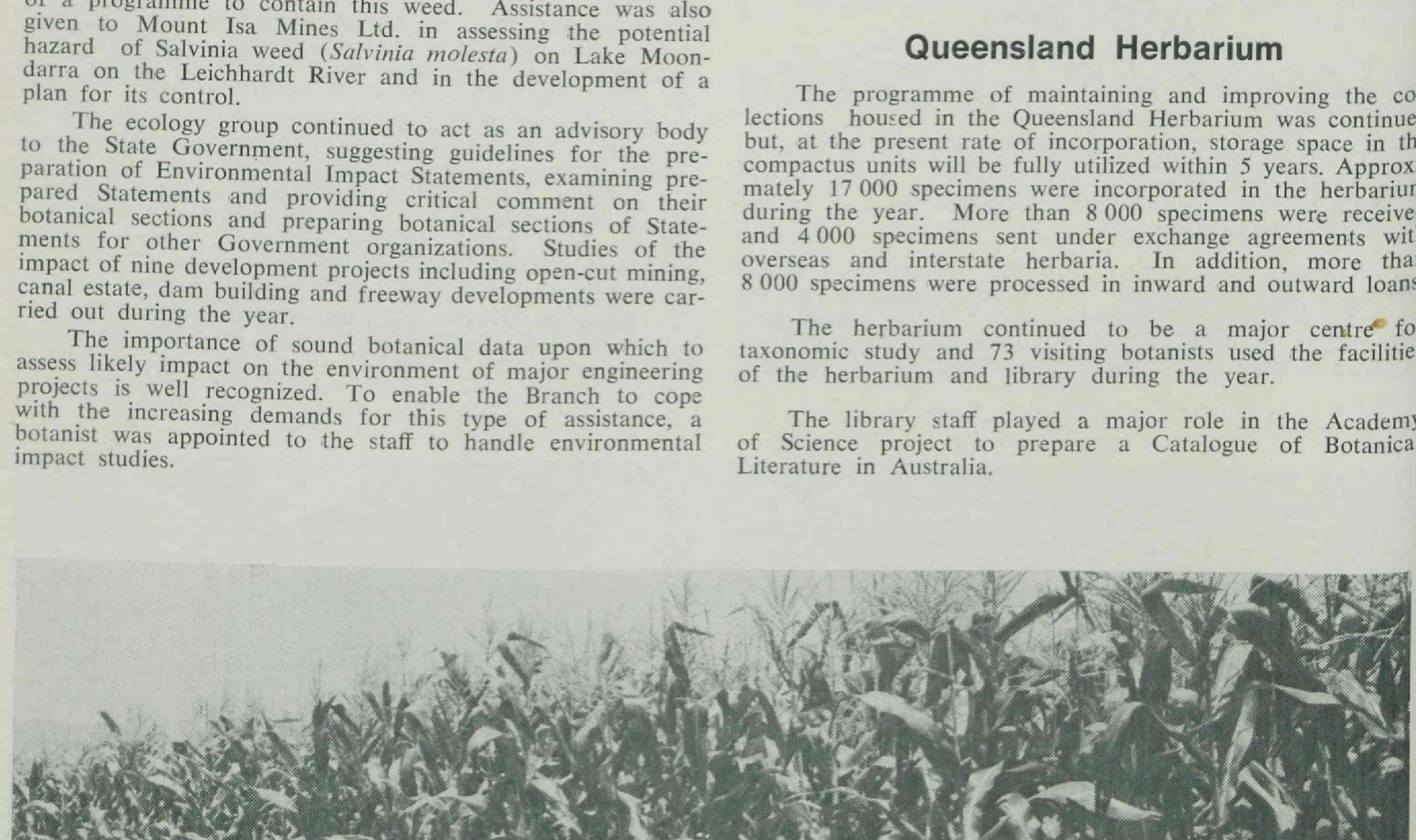
Two officers of the Branch attended a Chenopod Shrubland Symposium which aimed at providing a better understanding of the management of this important arid zone ecosystem. They contributed papers on the use of ERTS imagery and on the collection and processing of survey data. Another officer participated in a Coastal Management Workshop. This workshop was useful in that it exposed the participants to the wide range of disciplines involved in coastal management and thus promoted a greater understanding of the problems in what is obviously a most important sector of the Australian landscape.

Queensland Herbarium

The programme of maintaining and improving the collections housed in the Queensland Herbarium was continued but, at the present rate of incorporation, storage space in the compactus units will be fully utilized within 5 years. Approximately 17 000 specimens were incorporated in the herbarium during the year. More than 8 000 specimens were received and 4 000 specimens sent under exchange agreements with overseas and interstate herbaria. In addition, more than 8 000 specimens were processed in inward and outward loans.

The herbarium continued to be a major centre for taxonomic study and 73 visiting botanists used the facilities of the herbarium and library during the year.

The library staff played a major role in the Academy of Science project to prepare a Catalogue of Botanical Literature in Australia.



Production of maize on the Atherton Tableland is now the highest for about 30 years. Much of the credit for this goes to the hybrid varieties produced at the Kairi Research Station.

Division of Dairying

THE Division of Dairying has been involved in a series of modifications to its traditional role in servicing the dairying industry. With the decline in dairy farmer numbers, there has been a marked reduction in the number of farmers in certain regions necessitating adjustments in staffing both in numbers and disposition.

This reduction in the size of the industry has also resulted in the need for greater emphasis being placed on the market milk sector.

As part of a joint programme with the Commonwealth Department of Primary Industry, all the dairy factories in Queensland have been inspected to determine their level of conformity with the Australian Code of Practice for Dairy Factories.

Priorities for improvements are being discussed with factory management with emphasis being given to achieving the required standards in the pasteurization and market milk phases of their operations.

The Division co-operates with the Department of Lands in the State Government's Dairy Adjustment Programme. Besides providing financial assistance of more than $4 million to dairy farmers to install bulk milk vats and develop their farm and premises, a substantial amount of assistance from both Commonwealth and State funds totalling $1·5 million has been made available to dairy factories to modernize their milk receival facilities to cope with the increased supply of bulk milk. This has helped factories improve the milk sections of their premises, and so has facilitated the implementation of the requirements of the Code of Practice.

Another important step in the continued improvement of milk quality for the consumer is the introduction of the Total Bacterial Count for all milk supplied to dairy factories. This count is the most accurate test for milk keeping quality and age, and replaces the more indirect methods of determining bacteriological quality of milk used to date.

Another link in the chain of improvement of milk quality for the consumer has been the upgrading of milk vending vehicles by insulation of the milk compartment. Despite some initial difficulties, there is now fairly general acceptance by milk vendors of the need to leave milk for the consumer in as good a condition as possible.

Pasture production and use

A project using pangola grass at the Ayr Research Station compared milk production and composition of Friesian and Jersey cows grazing irrigated pangola grass fertilized with 670 kg nitrogen per hectare annually. Two stocking rates for each breed were used with Friesians being stocked at six and eight cows per hectare and Jerseys at eight cows and 10 cows per hectare. Half the cattle were fed a molasses supplement containing 2% urea and 1% mono-ammonium phosphate.

The Friesian cows fed the supplement at the high rate of stocking produced almost 26 000 kg of milk and 860 kg of butterfat per hectare while the Jerseys, also supplemented, produced more than 21 000 kg of milk and 950 kg of butterfat per hectare.

These are particularly high levels of production and are superior to those achieved with most temperate pasture species and demonstrate that high stocking rates can be used to achieve efficient use of tropical pastures while maintaining production per cow at a commercially acceptable level.

The Friesians produced 3 500 kg of milk at the eight cows per hectare stocking rate and the Jerseys 2 200 kg of milk at the 10 cows per hectare rate.

As a result of these trials, intensive development and use of pastures has been carried out as a pilot exercise on two dairy farms in south-east Queensland with similar results.

Sahiwal x Friesian crossbreeding

The programme to introduce tick resistance into highly productive dairy cows continues to produce promising results. In the season just completed, selected Australian Friesian Sahiwal (A.F.S.) cattle were compared with selected Friesian cattle at the Kairi Research Station, both groups being fed on pasture with a grain supplement.

The Friesian cows produced 4 600 kg of milk and 153 kg of butterfat in a 300-day lactation while the A.F.S. produced more than 4 100 kg of milk and 157 kg of butterfat over the 300 days. The A.F.S. produced 90% of the milk produced and 103% of the butterfat produced by the Friesians.

When similar groups have been fed only grass, the A.F.S. produced 65% of the milk and 80% of the butterfat produced by the Friesians. This would suggest that the A.F.S. responded proportionally more than the Friesians to a grain supplement to pasture.

These results are promising and the indications are that the A.F.S. breed should not differ markedly from the Friesian in productive capacity while including the desired additional trait of tick resistance.

Training artificial inseminators

Interest in artificial insemination by dairy farmers has increased, with the result that there has been a demand for 'herdsman' or 'do-it-yourself' artificial insemination courses. Because it has been difficult for farmers to leave their farms for the courses offered at Wacol, the courses have been modified so that they can be carried out using the farmers' own livestock. To date, 106 people have been trained, most reaching an acceptable standard of competence.

In addition to these field courses, more than 60 people have been trained in the regular courses offered at the Wacol A.I. Centre.

Butter quality

To meet local consumption requirements, it was necessary to supplement Queensland production with 9 060 tonnes of butter from interstate factories during 1975–76. During 1974–75, Queensland production was 10 338 tonnes and imports were 8 995 tonnes, so that 46% of the butter consumed in Queensland was imported.

During the year, 19 762 analyses were made on 4 511 butter samples drawn from pat and bulk butters produced in Queensland and bulk interstate imports. While most butters complied with Departmental standards, exceptions occurred with imported butters where moisture content frequently exceeded the regulatory limit of 16%.

Sampling methods for dairy products

Most dairy products sold within Australia and overseas are subjected to rigid specifications. Analysis of the end-product after manufacture can be done only on a sampling basis.

Programmes have been designed, involving the selection of appropriate sampling sites and frequencies, to yield results permitting assessment of compliance at minimal cost to manufacturers. The products which have been or are being covered are market milk, butter, cheddar cheese, fancy cheese and milk powders.

Accelerated cheese ripening

Maturing of cheddar cheese is a costly process so any reduction of the time required is a distinct advantage. Research at the Dairy Research Laboratory at Hamilton has demonstrated that the addition of cheddar cheese slurries to freshly salted milled curd before hooping gave 6 weeks' advancement of maturity over control cheese after 6 months' maturing.

When these procedures have been developed so that they can be consistently applied on a commercial basis, they should result in substantial savings to cheese manufacturers.

Training dairy factory operatives

A series of four successful staff training programmes was completed during the financial year with the active co-operation of the Queensland Branch of the Australian Institute of Dairy Factory Managers and Secretaries.

The schools covered the areas of liquid milk processing with 22 attending; milk and cream testing with 12 attending; milk and cream grading with 12 attending; and total count testing of milk with 19 attending.

These courses have been a great assistance to factories in meeting changing needs and in increasing the nucleus of trained staff to service the industry. It is expected that this will be a continuing and increasing function of the Field Services Branch. The courses have been possible only with the ready support of the staff of the Queensland Agricultural College.

Mastitis cell count programme

The mastitis cell count programme, which began in 1972, continued in 30 centres during the year. A full programme of milk sampling and analysis, computation and reporting of results, followed by field advisory meetings and farm visits was undertaken. Wisconsin Mastitis Tests conducted on bulk farm milks indicate a slight improvement in the W.M.T. score of milks from 1974–75 to 1975–76.

Unfortunately, while all areas reported an increase in the adoption of teat dipping and dry cow therapy practices, the adverse market for beef resulted in an almost complete cessation of culling of animals for sub-clinical mastitis, allowing the major source of re-infection to be retained in dairy herds. The programme will be modified in the ensuing year.

There will be a gradual phasing out of the Wisconsin Mastitis Test and its replacement by a direct cell counting technique using either a Coulter Counter or a newly acquired Fossomatic automatic cell counting unit.

New dairy foods like the blue vein flavoured quarg spread (top) are assessed for market potential in consumer acceptance trials (lower).

Dairy Field Services Branch

THE number and types of supply of registered dairies supervised by officers are detailed in the following table. Details for 1974-75 are included for comparison.

Type of Supply	1974–75	1975–76
Cream	1 568	1 185
Market milk	33	37
Manufacture milk	349	489
Market + manufacture milk	2 642	2 603
Milk – cheese	165	122
Cream + market milk	53	74
Cream + manufacture milk	0	0
Cream + market M + manufacture M	237	138
Milk – raw	35	24
TOTAL	5 082	4 672

This represents a decrease of 8·1% which compares with a 7% reduction in the previous year. The largest decline occurred within the cream supply group and it is expected the major change will continue in this section.

In contrast to the decrease in the number of suppliers, there have been variable patterns in levels of production of dairy products. Total butter production increased by 5·71% from 10 338 tonnes to 10 964 tonnes, and cheese production increased from 9 865 tonnes to 12 519 tonnes which represents a major increase of 21·2%. Total market milk sales increased from 229·7 million litres to 233·6 million litres which indicates a stable per capita consumption. Combined milk powder production rose from 16 111 tonnes to 17 299 tonnes and casein output changed from 1 146 tonnes to 1 527 tonnes as a consequence of diversion to cheese and powder production.

A total of 9 060 tonnes of Victorian butter was imported to supplement local supplies for internal consumption following the pattern of previous years.

Dairy cattle nutrition

Emphasis has been given to dairy cattle nutrition through the 11 'whole farm development' demonstrations being conducted throughout the State. The feed year plans on these properties have provided excellent commercial examples for advisory programmes.

In the West Moreton, Wide Bay, East Moreton and north Queensland regions, attention was directed to increasing winter feed supplies by using strategic fertilizer application accompanied by irrigation. Several successful field walks were conducted on properties which adopted this system.

A detailed annual costing analysis began in the West Moreton region to identify the major elements of feed costs. The results from industry meetings to date indicate keen producer interest in this data and its value in feed year planning.

Planning and preparation of a discussion guide for producer reviews of pasture feed supplies in dairy cattle rations began during the year. The material has been prepared by a joint interbranch group and will prove a valuable co-ordination in the establishment, maintenance and utilization of pastures in the several dairying regions of the state.

Mastitis

The mastitis cell count programme which began in 1972 continued in 30 centres during the year. The full programme of milk sampling and analysis, computation and return of results, and field advisory meetings and farm visits was implemented.

A slow reduction in cell content of milks is being effected. While all areas reported an increase in the adoption of teat dipping and dry cow therapy practices, the poor market for beef resulted in an almost complete cessation of culling of animals for sub clinical mastitis. This last action worked against removal of important foci of re-infection in herd animals.

Mastitis investigations

TEAT DIP AND DRY COW THERAPY TREATMENTS. A series of 16 commercial herds is associated with a variety of combinations of treatments to compare the efficiency of recommended procedures. Variable responses to treatment have been obtained.

TECHNIQUE FOR USE OF COULTER COUNTER. In association with other laboratories, several minor improvements in procedure were introduced in Coulter Counter operation. Interchange of milk samples for standardization of technique was undertaken with the New South Wales Departmental Laboratory.

Herd improvement

In the area of artificial breeding, a special programme of self-training for producers was developed with the conduct of herdsman courses. In all, 11 courses were completed with district staff supporting the training team from the Dairy Cattle Husbandry Branch. It is considered that this has minimized the declining usage of artificial breeding which has occurred because of the present economic difficulties suffered by the industry.

Two semen depots were opened in Mackay and Rockhampton to improve distribution.

A series of show exhibits was also presented to maintain sales of semen.

Calf rearing

To complement the programmes in herd improvement, special attention was given to young stock management. A special discussion guide on calf rearing, project CR, was prepared and used successfully in several districts. Twelve demonstrations on once-a-day feeding and early weaning were serviced. These provided valuable teaching sites for local producers and stimulated considerable interest. Several officers will continue the demonstrations to the stage of early mating and heifer management.

Dairy adjustment programme

In association with the Department of Lands, officers in many centres were involved in farm development and bulk milk conversion programmes.

From December 1974 to June 1976, 440 farm properties have been assisted by $4·3 million from Commonwealth funds and 170 properties received $1·4 million from State funds. This financial aid of both grant and low-interest funds has assisted materially in rationalization of the producing sector.

Dairy pasture subsidy scheme

The Dairy Pasture Subsidy Scheme has been operating for 10 years. While there has been a reduction in the work load, 1 110 applications and 1 084 claims were serviced throughout the State. An estimated sum of $190 000 will be provided from State funds to support the scheme during the year.

Industry liaison committees

Following a pattern developed over several years, officers continued to liaise directly with local producers on seven Dairy Extension Advisory Committees, and with industry representatives on 10 Milk Vending Advisory Committees. This association is regarded as extremely important in forming programmes and the subsequent adoption of recommended procedures.

In addition, officers have been closely associated with eight active district Discussion Groups and several Q.D.O. branches in their extension advisory work.

Australian Development Assistance Agency

In association with the Australian Development Assistance Agency, Branch staff were responsible for servicing an International Training Course in Animal Breeding in 1975 for 15 overseas officers. This required detailed organization for a 3-month period with course curriculum, published material and practical field attachments.

Two further courses in dairy husbandry and dairy technology are at present being prepared for presentation in late 1976 and mid 1977 respectively. Participation in these courses serves as a valuable in-service training function for nominated staff.

Newsletters

As a phase of the extension programmes in all regions, officers of the Dairy Field Services Branch have contributed materially to regional information news sheets. A total of 300 articles were prepared for publication.

Staff participate in publications in north Queensland, Wide Bay, East Moreton, West Moreton, Darling Downs, Mackay, Bundaberg and the South Burnett. These publications form an important avenue of communication with producers.

Dairy product processing

There are 51 dairy product processing centres operating in the State. Several of these are functioning as multi-product plants and the following process categories are provided: butter 20, cheese (cheddar) 10, cheese (other than cheddar) 13, pasteurized milk 22, powders 14, casein 4, ice-cream 7, yoghurt 6, other dairy 3.

Officers have serviced this section of the industry with routine visits to review quality control programmes and special surveys to identify causes of problem conditions. This service co-ordinates with the official gradings undertaken on manufactured products and the bacteriological and chemical analytical programmes undertaken by the Dairy Research Branch.

Code of practice inspections

The joint Commonwealth-State review programme continued during the year. A total of 32 inspections was completed and reports issued to factory management. Very few factories comply completely with the many requirements, but there has been a wider acceptance of the value and need for these inspections and standardization to satisfy market specifications.

Examination of building plans and specifications, together with associated consultation, is becoming an increasing responsibility of section staff.

New dairy foods

Unfortunately, during the period there was a declining industry interest in the manufacture of new forms of dairy products. In view of the export market difficulties for surplus domestic production, there is an urgent need to continue these development programmes.

Two products, a blue vein quarg and a diet yoghurt, were manufactured and offered, but no commercial manufacture was initiated. There will be continued efforts to promote these products in the coming year.

Factory operatives training

In association with the Australian Institute of Dairy Factory Managers and Secretaries, a series of four successful staff training programmes in liquid milk processing, milk and cream testing, milk and cream grading and total count testing of milk was completed.

This training is an important phase of industry development and will continue to be a service function of the Branch. The co-operation of the staff and facilities of the Queensland Agricultural College is acknowledged.

Dairy Products Bulletin

The successful publication, 'Dairy Products Bulletin', was again provided to the manfacturing segment of the industry and continues to provide an important means of disseminating information on industry practice and new technology. Contributors were drawn from a wide field of industry experts. A special issue was devoted to Total Count Testing of Raw Milk in preparation of the full introduction of this test procedure in 1977.

Investigational programmes

DIESSEL MILK METER. A comprehensive testing programme was undertaken on a Diessel milk meter fitted to a bulk tanker of the Downs Co-operative Dairy Association. In the initial stages, design faults were found and eliminated by various modifications. An error of ± 5 litres is generally accepted as being within tolerance when dipsticks are used for measurement. The accuracy of the meter of ± 1·1 litre established in this trial is well inside this range. An industry decision on adoption of this system of measurement, however, will await the outcome of investigations into turbine and inferential meters presently being completed in overseas countries.

'RENNILASE' MICROBIAL RENNET. Small-scale commercial trials along similar lines to those used for the evaluation of 'Fromase' and 'Marzyme' were completed. 'Rennilase' is produced by the pure culture fermentation of Mucor Meihei.

While gradings are still progressing, it is evident that this coagulant will produce cheese of equal grade quality to the other two rennets. There is, however, an evident reluctance by commercial processors to use these rennets as substitutes for traditional calf rennets.

PESTICIDE RESIDUES IN DAIRY PRODUCTS. The programme of monitoring levels of pesticide residues in dairy products continued during the year.

It is considered that, in general, there is not a serious problem with pesticide residues, although there is a need to investigate those isolated instances where results are in excess of tolerance levels. A total of 414 individual farm supplies of milk and cream was analysed with excess levels being found in 52 of these samples. Farm investigations were undertaken on 39 properties and special monitoring for dieldrin contamination is continuing on a small number of properties in Bundaberg, Southbrook and Southport.

DAIRY PRODUCE GRADING. Two officers perform full-time grading duties and several regional officers undertake grading as a phase of their programmes in product improvement.

A total of 51·81% of the State's butter production was examined. The general grade quality of this produce was—

—	Quantity (boxes)	%
Choice	127 498	56·10
First	81 081	35·68
Second	10 937	4·81
Below second	7 754	3·41

Main defects in below choice grade were of a storage origin caused by poor or lengthy storage of milk and cream on farms and in factories. In addition, the full consignments of 9 060 tonnes of interstate butters were also examined. Most of this butter was submitted as choice grade and the results expressed as per cent of quantity examined were—

Choice	First			Second				Below Second Grade
93	92	91	90	89	88	87	86	
77·9	9·7	6·6	2·9	0·9	0·9	0·6	0·3	0·2

The deterioration from the initial grade of choice is not unexpected as a consequence of the stored nature of the produce when utilized.

A total of 39·42% of cheese was also officially graded. The overall grade quality of this produce was—

—	Quantity (kg)	%
Choice	1 359 201	27·54
First	3 305 212	66·98
Second	244 925	4·96
Below second	25 216	0·52

This pattern is an improvement on that of the previous year and is considered to result from increased awareness of the importance of initial raw milk quality. Two large producing factories ensured that milk consignments were collected at intervals no longer than 48 hours between pick-ups.

On a trial basis, graders undertook regular field visits to Kenilworth and Woodford to make regional gradings at the point of manufacture. This proved successful and will be continued.

RAW MILK QUALITY TESTING. As a consequence of the amendments to the milk quality testing regulations, a comprehensive programme relating to Total Count Testing for raw milk was initiated. Consultation with factory management was undertaken in those centres where the test was not performed. To date nine factories pay on this test and 15 others are performing the test. During the remainder of 1976, attention will be given to standardizing factory laboratory operations to ensure the industry is fully equipped to adopt this procedure in 1977.

RESIDUE CONTAMINATION OF MILK. A particular problem occurred during the year with residual iodine contamination arising from sterilization procedures during milk production and milk processing. Field officers are investigating problem locations and undertaking advisory programmes to factory management and producers. It is expected that this will be a major activity in the coming year.

MILK LICENSING. There has been a consolidation of all legislation relating to orderly licensing and distribution of milk to consumers in the State. This has required considerable activity by field officers in the major cities outside of the capital. Fully insulated milk vending vehicles are now required for distribution and by March 1976, 300 vehicles representing 50% of all vehicles were constructed in this style. It is expected that all vehicles will comply during 1977. In addition, officers were responsible for the co-ordination of licensing of 3 043 milk shops throughout the state.

Dairy Cattle Husbandry Branch

RESPONSIBILITIES of Dairy Cattle Husbandry Branch lie in two major areas: dairy husbandry research and herd improvement services.

Herd improvement services

The specific aims of research programmes in dairy husbandry and herd improvement are developed from analyses of the problems and needs of Queensland dairy farmers and from potential improvements developed under other conditions and regions.

The production recording service provides information on individual animal milk production and composition to guide herd breeding and culling decisions. It is being modified to include reproduction and herd breeding records to provide a more complete service for farmers to use in their herd management. Research is performed into more efficient and economical recording procedures.

The artificial breeding service involves operation of two semen production centres, progeny testing-breeding programmes in three dairy breeds, training of inseminators, and technical support of artificial breeding operations in the field. Research is also conducted into cattle artificial breeding and artificial breeding of horses and swine.

Besides performing research and providing farmer support services, the branch co-operates with extension staff in having relevant new technology adopted and herd improvement services effectively used by farmers.

Dairy husbandry research

Grazing dairy herd production systems

The objective of the grazing dairy herd production systems programme is to develop feeding and herd management systems which can be employed by farmers in the various dairy farming situations that occur in Queensland. The main emphasis is on growing and using pastures and forage crops and the use of supplements during periods of seasonal forage deficiency to improve performance.

Within this programme, particular projects are grouped into areas. However, experiments in this field commonly provide valuable information in relation to several of the major parameters, for example, investigations concerned particularly with pasture production and use also employ supplementary feeding treatments.

PASTURE PRODUCTION AND USE. *Irrigated, nitrogen fertilized grass pastures.* A project using pangola grass at the Ayr Research Station, which has now been terminated after the completion of three full lactations, compared milk production and composition of Friesian and Jersey cows grazing irrigated pangola grass fertilized with 672 kg N per ha per annum. Friesians were stocked at 5·9 and 7·9 cows per ha and Jerseys at 7·9 and 9·9 cows per ha. A supplement of 3·6 kg a head a day of molasses-urea-M.A.P. (97:2:1) was also evaluated.

High levels of production per unit area were achieved. Supplemented Friesians at the high stocking rate produced 25 626 kg of milk and 863 kg of fat per ha. Corresponding values for the comparable Jersey group were 21 348 kg of milk and 950 kg of fat per ha.

These levels of production are among the highest recorded anywhere in the world. Friesians produced approximately 20% more milk per unit area than Jerseys at comparable stocking rates. However, Jerseys were slightly superior to Friesians in the output of milk constituents per unit area indicating that Jerseys may well compete favourably with Friesians if returns are based on production of milk solids, rather than on volume.

The stocking rate at which production per ha was greatest was 7·9 cows per ha for Friesians and 9·9 cows per ha for Jerseys. Average per cow production at these stocking rates was 3 500 kg for Friesians and 2 200 kg for Jerseys. Thus the trial showed that high stocking rates can be used to achieve efficient use of tropical pasture dry matter while maintaining production per cow at a commercially acceptable level.

The project has demonstrated that dairying can be successfully undertaken using tropical pastures under very intensive grazing conditions.

In south-east Queensland, farmer co-operators have provided facilities for trials to demonstrate high milk production from irrigated nitrogen fertilized kikuyu and pangola grass pastures.

At Toogoolawah, a 4·05 ha paddock of pangola grass was established and carried 47 milking cows and growing heifers from mid October to May. The remainder of the property of 21 ha of improved land consisted of varying areas of summer and winter crops, lucerne and pasture mixtures. It provided feed for 50 cows in milk only, all dry stock being removed to another property nearby.

Twenty milking animals grazed pangola grass during the day and were fed a meal supplement amounting to a token amount during the spring-summer period increasing to 1·5 to 2·5 kg per cow during the autumn. At night, the trial cows grazed with the rest of the farmer's herd on the unimproved part of the property.

Total production from the trial cows on the pangola grass was 49 296 kg of milk, 1 854 kg of fat and acceptable liveweight gains from 40 heifers. This represents 16·4% of the total dairy production from the farm as well as liveweight gains from heifers and milking cows.

At Ma Ma Creek, Grantham, 4·8 ha of Whittet kikuyu, irrigated and nitrogen fertilized, were grazed continuously by 20 cows throughout the year without any supplements.

The remainder of the property, 85 ha, consists of 40 ha of improved flats and slopes, including 12·5 ha of kikuyu and 6·5 ha of lucerne, and 45 ha of semi-improved or native grass-herbage pastures. Some 84 milking cows grazed this area of the property.

Milk production from the Whittet kikuyu pastures (5% of the farm) was 50 789 kg of milk and 2 363 kg of fat which represents 26% of the total farm production.

This project has been a stimulus to pasture feeding of the dairy herd for most of the year without costly supplements. A large proportion of Queensland dairy farms have sufficient irrigable land to use this system of heavy stocking of improved, fertilized pasture.

Rain-grown improved pastures. Twelve co-operators in three areas of the State assisted in a comparison of the productivity of kikuyu pastures at various stocking rates measured by the growth of dairy heifers.

The growth rate of a dairy heifer after weaning has a large influence on subsequent time of mating and age at first calving. Recommendations to farmers have stressed the advantages of mating heifers at 15 months and generous feeding during the first pregnancy. However, there is very little factual information to support these recommendations under Australian conditions.

Heifers in all treatments grew well during spring, summer and early autumn with liveweight gains above 0·6 kg per day. However, rate of gain was low over the winter, often being close to zero. Annual growth rates fell below the desired level of 0·57 kg per head per day. Energy supplementation during the period of slow growth (winter) may produce a higher mean annual growth rate.

The small effect of stocking rate in relation to the effect of seasonal conditions indicates that well-fertilized kikuyu pastures are capable of carrying at least 4·2 heifers per ha, which is higher than has been previously used by Queensland farmers. The limitation to carrying capacity is the availability of a supplement to the rain-grown pasture during the winter.

This project is being continued to measure milk production from these heifers on the same pastures.

SUPPLEMENTARY FEEDING OF GRAZING ANIMALS. Maize and molasses are being compared at the Kairi Research Station for their effect on milk production when fed at various levels, at different times of the year and over a range of stocking rates. Friesian cows graze green panic-glycine pastures and cows are individually fed their supplements.

Increasing stocking rate increased the milk yield response to both grain and molasses. When stocking rate increased from two to four cows per ha, milk response increased from 0·5 to 1·0 kg of milk per kg of maize.

Increasing the level of supplementary feeding did not reduce the efficiency of the milk-production response. A farmer could feed 1 or 6 kg maize per cow per day and obtain the same degree of response in kg milk for each kg maize. The supplement was therefore more likely to be used efficiently through feeding at the correct time of year or stage of lactation.

Feeding maize or molasses reduced the pasture intake of cows and so had the effect of reducing grazing pressure. Pasture yields were the same when 1 ha was grazed by four unfed cows or by five cows each fed 4 kg of maize per cow per day.

Fat content of the milk was reduced by 0·1% for each kg maize fed per cow per day. Solids-not-fat was increased by feeding 2 kg of maize per cow per day, but not further increased by feeding higher levels.

These results have led to recommendations for Atherton Tableland farmers including—

Molasses is a cheaper source of energy for cows than grain.

Energy supplements are best fed to cows during winter and spring when pasture yields are low.

The level of feeding will not affect the efficiency of milk production from supplement.

Pasture will be wasted if supplement is fed and stocking rates are not concurrently raised.

Rearing herd replacements

The objective of the programme on rearing herd replacements is to develop least-cost methods for rearing heifers on dairy farms to first calving. Research has amply demonstrated the importance of having heifers grow so that they can be mated to calve in good body condition at 2 years. However, there is no information on how this can be achieved under grazing conditions in Queensland.

Allied with these dairy heifer growth studies is the rearing of these types of animals for beef production. This aspect has been considered in the planning of experiments. It is likely that the beef market situation will change so that calves from dairy herds will again become a significant source of beef and consequently of income to dairy farmers.

Calf-rearing studies have shown that once-a-day feeding and early weaning will give dairy farmers sound calves at 8 to 10 weeks.

A programme at the Biloela Research Station, begun in 1972, is examining methods of calf rearing by multiple suckling. Recent work has examined the effect of commercial levels of nutrition on calf growth and cow reproductive performance.

The trial compares a machine milking treatment with multi-suckle rearing 10 calves per lactation, both under continuous paddock access to the cow and restricted access to the cow on a twice-a-day suckling system.

The main difficulty in the intensive heifer replacement rearing by multi-suckling is the occurrence of anoestrus in the cows. There is a sensitive balance between the expression of oestrus, suckling pressure in terms of numbers of calves per cow, and the level of nutrition of the cow. Continuous paddock access suckling is unlikely to be a stable, viable system compared with restricted access at commercial levels of nutrition. The use of a vasectomized teaser bull has also been shown to overcome the apparent anoestrus problem to a reasonable extent at high levels of nutrition.

All of the restricted-access cows showed oestrus this season within 130 days of calving, but only 66% of the free-access cows did so, in spite of the stimulus from the presence of teaser bulls.

Calf growth rates to a weaning age of 80 days averaged 0·77 kg per day for A.I.S. calves which is well in excess of the minimum rate required to attain mating weights if maintained to 12 to 15 months.

A.F.S. programme

The Australian Friesian Sahiwal (A.F.S.) crossbreeding programme has progressed satisfactorily at the Ayr and Kairi Research Stations with tick resistance evaluations being carried out at Kairi Research Station and production evaluation at Ayr on all heifers born in the programme.

Heifers were ranked on mean tick counts performed over approximately 12 consecutive months. A skewed distribution of counts was observed, most heifers having few engorged ticks. Fourteen out of 71 heifers (20%) had counts greater than six times the mean, while 24 had lower counts but were considered to be only moderately resistant. A total of 33 heifers had tick counts less than the mean and were given a **highly resistant** ranking.

Twenty-one A.F.S. bulls were evaluated for resistance to cattle tick. Of these nine were F_1 and only one-quarter Sahiwal. They carried four times the tick burden that was evident on the F_2 and F_3 bulls (22 against 100 ticks per side). The remaining 12 bulls will be selected for growth rate, suitable size for use in the A.I. Centre in early 1977, production of dam and temperament for use in an A.F.S. bull proving scheme.

Tested A.F.S. cows have been placed with co-operating dairy farmers with at least six prepared to take stock when available. These farmers are on the Atherton and Eungella Tablelands and at Sarina.

The following production figures have been recorded from a group of A.F.S. and Friesians being fed a comparable grain supplemented ration.

—	No. of Cows	Days	Milk kg	BF kg	SNF	BF%	SNF%
A.F.S. ..	13	300	4 159	157	332	4·09	8·70
Friesians ..	13	300	4 631	153	379	3·42	8·56

The A.F.S. produced 90% of the milk produced and 103% of the fat produced by the Friesians.

When similar groups have been fed only grass, production of 65% of the milk and 80% of the fat produced by the Friesians has been obtained from the A.F.S.

Herd improvement services

Dairy herd production recording

Since August 1975, centralized butterfat testing of milk samples has completely replaced testing milk for butterfat on farms. All milk samples are now tested at a laboratory at Wacol where four Mark III Milko-Testers are installed. A total of 385 584 milk samples were analysed for the year. The highest number tested in any month was 42 215 in October 1975.

Milk sample collection by contractors (replacing herd recorders) was introduced to reduce costs and is now firmly established. It is now possible to provide a regular service for most farmers who are isolated from main dairying areas and also the overall monthly service to farmers has improved. Few members now miss even one monthly service a year because of herd recorders taking leave.

Development of a new data processing system is continuing; the computer programmes are almost completed and field testing about to begin. The new programmes will provide members with more adequate information in a more usable form.

MILK PRODUCTION RECORDS. The number of herds recorded is slightly less than last year. The total number of cows tested fell from 44 420 to 43 928 a drop of 492 cows (1·1%). Approximately 18% of dairymen record the milk production of their herds.

Artificial breeding

Within Australia, dairy semen distribution increased to 70 393 doses distributed compared to 47 748 doses the previous year. This was mainly accounted for by the increasing sales of Friesian and A.I.S. semen from bulls owned by the Department. Beef semen distribution declined to 21 350 doses compared with 28 586 the previous year. Total distribution within Australia amounted to 91 743 doses.

Export of semen, mainly to the U.S.A., amounted to 19 180 doses from 10 breeds of cattle. A.I.S. semen accounted for 60% of exports while Sahiwal and Brahman each made up 10%.

The Department operates a storage service for unlicensed semen, use of which is restricted to owners' herds. Thirty-four consignments totalling 4 077 doses were distributed to owners during the year. Forty-nine bulls were represented.

A significant development was the decline in the number of full-scale co-operative and commercial insemination services and a marked increase in the number of individual operators providing limited services or inseminating only their own animals. This trend is likely to continue and promotional and technical support programmes have been designed to meet this development.

Semen depots were established at the Department's offices at Rockhampton and Mackay, and a consignment arrangement with the Atherton Tablelands A.B. Co-operative came into effect. These arrangements allow clients to obtain supplies of semen without added freight costs.

Eleven privately-owned bulls passed through the licensed semen production unit with six still located at Wacol on 31 May 1976. At the end of the year, the Centre held 108 bulls of which 89 are dairy sires and 19 are beef sires.

INSEMINATOR TRAINING. *Country.* 'On farm' herdsman training courses generated a great deal of interest and support from the dairy and beef industries. One hundred and six people were trained and most of these reached a satisfactory standard of competency.

Wacol. Twenty-nine people completed the 'Herdsman' course and 33 participated at the 'Commercial' level of instruction. Included in the programme was a course conducted in conjunction with an International Training Course in Artificial Breeding.

Thirty-five inseminators' certificates were issued and two applicants failed the examination for issue of a certificate. There was a marked decline in the number of certificates issued compared to 1974-75, when 72 were issued.

Two certificates were endorsed to permit the holders to offer a goat insemination service. Enquiries were received about the legal requirements for inseminating mares.

GENERAL TRAINING AND PROMOTIONAL ACTIVITY. The following courses and seminars were conducted during the year—

A.B. technicians' refresher school at Wacol (attendance 100).
A.B. technicians' refresher school at Rockhampton (attendance 31).
A.B. technicians' refresher school at Malanda (attendance 50).
Bull proving seminar for Dairying Division extension officers.
Management course for directors and managers of insemination services (jointly with Marketing Services Branch).

Support and assistance with display preparation was provided for eight shows. The emphasis on displays at country shows was reduced and a similar level of selectivity is intended next year.

Eight inseminator training courses were provided with extension support and promotional material. Arrangement of these courses and subsequent follow up are an important part of Centre's promotional activity.

Visits by Wacol staff with a substantial promotional content were made to New South Wales, Victoria, South Australia, New Zealand and Malaysia. These visits were beneficial to Centre promotional development through exposure to new ideas and methods of presentation.

Research in animal breeding

ARTIFICIAL BREEDING. *Swine.* Studies on the preservation of boar semen continued but more recently emphasis has been placed on the processing and use of liquid semen.

Attempts to freeze semen were discontinued after 53 collections had been processed. Recovery rates after freezing were extremely variable. Up to 40 to 50% motile sperm were recovered in the more successful trials but repeatability was unsatisfactory.

Early results from insemination trials were disappointing. More recently, a 70% conception rate with an average of 9·3 embryos present at slaughter was obtained with liquid semen.

Horse. The stallion at the Centre was worked regularly to provide semen for assessing the diluent which was developed in 1974. Collections from several privately-owned stallions were also studied.

Two normal foals were born in October and November 1975, both sired artificially with frozen semen. A third foal died at birth.

Goat. Several collections were made from a buck using a modified bull artificial vagina. The semen was frozen successfully and proved fertile on insemination. Satisfactory techniques are now available for the collection and frozen storage of semen and for inseminating goats.

CHROMOSOME STUDIES. The aim of this programme is to determine whether chromosome markers can be used to identify congenital diseases.

This procedure is well established in identifying defects in babies. Work with animals has been relatively limited, but correlations with specific chromosomal abnormalities and impaired reproductive performance in cattle have been reported.

Studies have been carried out with cattle using the bulls at the A.I. Centre and in conjunction with C.S.I.R.O. at Belmont.

Chromosomes of pigs have been studied with support from funds from the Australian Pig Industry Research Committee. The chromosome patterns will be related to the performance data of the pigs studied and of their progeny.

Dairy sire studies

The dairy sire progeny testing and breeding programme involves the progeny testing for milk production of groups of A.I.S., Friesian and Jersey sires each year. The top ranking (proven) sire from each test group is then mated to the highest-producing, production-recorded pure-bred cows of his breed to obtain the next generation of sires for testing.

To encourage participation by stud breeders and commercial dairymen, a sire nominated by the breed society is included in each test group. For the same purpose and also to check on the standards of genetic material in the local active breeding population, proven sires from other States or overseas, or their sons, have also been included in progeny test groups in recent years.

A typical test group, accordingly, contains four sons of a Queensland-proven sire, an imported proven sire and a sire nominated by the breed society.

With increasing costs, operators of artificial breeding services expressed concern that co-operating in bull proving was causing them to lose mark-ups on commercial semen and thus reducing the profitability of their operations. In an effort to keep technicians interested in bull proving, a system of issuing bonus semen to technicians or their employers was introduced this season. The bonus is based on the supply of one dose of semen for every four doses of semen from proving bulls used in co-operating farmers' herds. The bonus semen can be selected from a panel of Wacol bulls.

The increase in the number of farmers inseminating their own herds has assisted with the number of dairymen nominating cows for bull proving. Many farmers, who previously did not have an A.I. service available to them or who found the cost of an A.I. service too expensive except for special cows, have been trained to inseminate their own cows. A proportion of these dairymen who are production-recording their cows are co-operating in bull proving.

Dairymen are raising only the minimum number of heifers required for herd replacements. They are milking more cows than normal, not selling their older cows, and therefore not rearing the usual number of heifers.

Increasing insemination service fees are also causing some dairymen to reduce greatly the number of inseminations they are having performed, both for normal breeding and for bull proving.

It appears that, with the expansion of the Friesian breed in Queensland, there will be sufficient cows nominated to continue progeny testing without difficulty.

The A.I.S. breed is not expanding and the reduction in the number of farmers who are milking this breed must cause doubt about its long-term future in this State. Jersey cows are also declining rapidly in number in Queensland herds. Many dairymen, particularly those in milk supply areas who previously milked Jerseys, are changing to Friesians because of the greater quantity of milk produced. It is becoming increasingly difficult to obtain nominations of Jersey cows from dairymen who use both artificial breeding and herd recording.

During the year, the possibility of reducing the scale of the Jersey programme was closely studied. It was found that a feasible reduction would not give any appreciable saving. The alternatives are accordingly limited to the present programme or termination. It is therefore proposed to maintain the A.I.S. and Jersey programmes as at present, while continuing to monitor cow numbers and semen usage in these breeds.

Dairy Research Branch

DAIRY Research Branch maintains bacteriological, chemical and technological laboratories and a pilot plant capable of manufacturing a wide range of dairy products at the Otto Madsen complex, Hamilton.

This is supported by bacteriological and chemical laboratories in the Butter Marketing Board, Hamilton, as well as regional laboratories at Malanda, Murgon and Toowoomba.

A combination of increasing population and decreasing local dairy production has resulted in considerably increased volume and diversity of dairy produce from interstate and overseas. Regular analyses of these imports amply justify this service; thus the Branch has assumed an increasing protection role which has offset the reduced volume of analyses resulting from the decline in local production.

Quality advisory services

Quality advisory service results are used by Departmental extension and regulatory officers, and officers of the Brisbane Milk Board and the Queensland Butter Marketing Board in their surveillance of the quality of milk and milk products. These results are also reported direct to the producers or manufacturers for their quality maintenance and improvement.

To provide analytical data for quality assessment during 1975-76, 109 435 bacteriological analyses were made on 46 958 samples, and a further 74 029 chemical analyses covered 26 798 samples.

The range of products analysed is comprehensive: the various raw and pasteurized milks and creams (bulk and in bottles, cartons or sachets), as well as manufactured products such as the various butters, 'Junex', 'Melatone', cheeses (cheddar and fancy), powders, casein, yoghurts and other fermented products.

Those raw or manufactured products readily accessible to Dairy Research Branch regional laboratories are analysed in these laboratories. Those products in other areas of the State are serviced (by air or rail) from the Brisbane laboratories. This provides State-wide coverage, even for remote consumers like Mt. Isa.

Product quality usually complied with Departmental advisory and regulatory requirements. In those instances where defective quality was detected, the steps taken with the support of field officers stimulated quality improvement.

Technical advisory services

Technical assistance has been given in co-operation with other branches in officer training schools and factory operative training schools.

Detailed discussions have taken place with factory laboratory personnel to unify factory and Departmental laboratory techniques and the interpretation of results.

Radio broadcasts and technical-advisory articles have been prepared to provide dairying and fishing industry personnel with technical information.

Quality control services

The analytical results obtained in this section are used to indicate the degree of compliance of milk and milk products with State advisory and legal standards, export standards, or buyer specifications.

Where required National Association of Testing Authorities' certificates were issued as evidence of product composition (bacteriological and chemical). In addition to their direct consumer protection value, these results are used by manufacturers and producers as an external check on their quality, and their internal quality assurance programmes.

Raw milk

In general, raw milk quality has remained satisfactory during the year (as indicated by methylene blue reduction times, thermoduric colony counts, and percentage fat contents). Some seasonal variations continue to occur in solids-not-fat. There has been a decrease in the incidence of subnormal freezing point results.

As iodophors are widely used farm and factory sterilants, testing for iodine residues began during the year. Several of the 536 samples analysed gave readings greater than 300 μg per litre of milk. In co-operation with Dairy Field Services Branch, investigations have begun to determine residue levels attainable under 'acceptable conditions'. Acceptable conditions are also being defined.

Pasteurized milks and creams

This section covers a wide range of products such as creamline or homogenized bulk milk in cans or 'bags'; creamline bottled milk; homogenized milk in bottles, cartons or sachets; skim and lowered fat milks; a range of flavoured milks; flavoured, fortified products; coffee, whipping and thickened creams; imported creams (natural, thickened and synthetic); goats' milk; empty milk and cream containers. Some samples are taken direct from the processing line, others are obtained from shops. Consumer complaints are also serviced.

Of the 2 583 samples analysed, 99.8% were phosphatase negative, that is, they had been adequately heat treated. However, some of these samples contained coliform organisms. As these organisms do not survive pasteurization, their presence in phosphatase negative milk or cream indicates the occurrence of contamination after pasteurization. The incidence of coliform contamination varies widely between factories and occasionally between products within a factory. Efforts are being made to reduce this incidence.

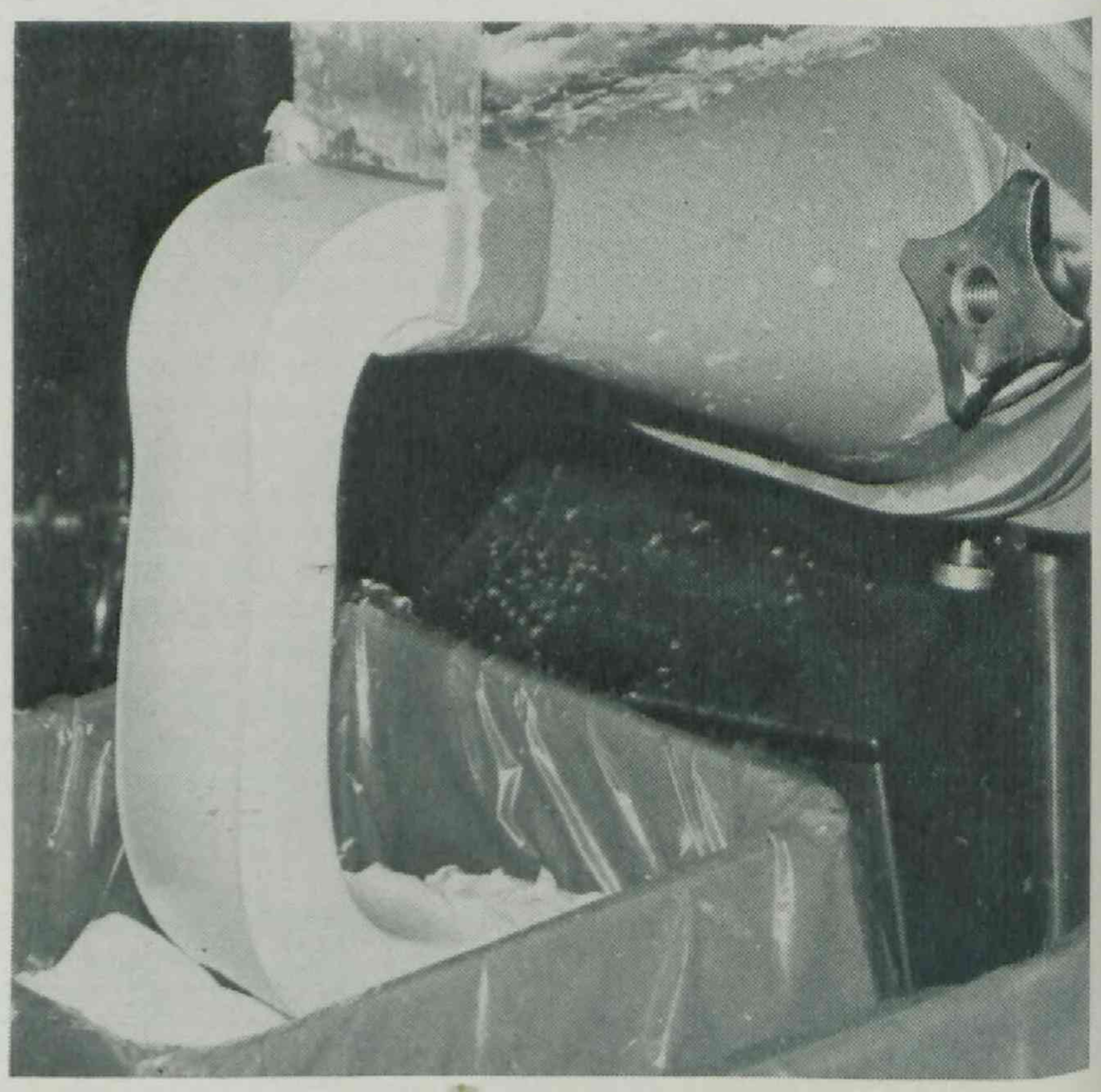
In general, the total counts of the products in this group comply with an advisory standard of 50 000 colonies per ml. Notable exceptions in two country areas are being stimulated to improve their degree of compliance.

The fat content of creams and the fat and solids-not-fat contents of milks generally comply with the regulatory standards. Although there are some seasonal variations in milk composition, it has been possible to ensure compliance at the consumer level.

During the year, there has been a decline in the percentage of milks with subnormal freezing points (10.7% for 1975-76 compared with 14.1% for 1974-75). Indications of levels in excess of 1% extraneous water fell from 5.6% to 5.1% during the same period.

Butter

To meet local consumption requirements, it has been necessary to supplement Queensland production with 9 060 tonnes of butter from interstate factories during 1975-76. For 1974-75, Queensland production was 10 338 tonnes and imports were 8 995 tonnes, so that 46% of the butter consumed in Queensland was imported.



Experimental butter being extruded from the continuous buttermaker in the pilot plant at the Otto Madsen Dairy Research Laboratory.

During the year, 19 762 analyses were made on 4 511 butter samples drawn from pat and bulk butters produced in Queensland and bulk interstate imports. These butters complied with most Departmental advisory standards and buyers' requirements.

The only exception occurred with imported butters where moisture contents frequently exceeded the regulatory limit of 16%. The interstate factories concerned have been stimulated to refrain from forwarding over-moisture butters to Queensland and the position is improving. However, constant vigilance is necessary.

Cheese

During the year, 339 National Association of Testing Authorities certificates were issued verifying the chemical and bacteriological composition of cheddar cheese submitted for export. Of these export cheeses, 10% of the samples submitted to Malanda laboratory and 14% of the samples submitted to the Otto Madsen Dairy Research Laboratory failed to meet buyers' requirements.

A further 367 samples of cheddar cheese, 61 samples of blue vein cheese, 13 samples of pizza cheese, 16 samples of processed cheese and six samples of other 'fancy' cheese were analysed to monitor the quality of cheese offered for sale in Queensland.

In addition, 271 samples of various cheeses manufactured in the pilot plant were analysed.

Powdered milk

During the year, 97% of the 272 National Association of Testing Authorities' certificates issued for spray-dried powders complied with export standards. By contrast, the majority of an additional 21 samples of roller-dried powders showed excessive scorched particles and sediment, as well as lowered solubility. These powders were suitable for non-human consumption, for example, animal feeding.

An additional three buttermilk powders and 11 skim-milk powders were analysed for the pilot plant.

Pesticide residues

The monitoring programme of the Commonwealth Department of Primary Industry continued during the year. Where results exceeded National Health and Medical Research Council acceptability levels, follow-up samples were taken for analysis at Hamilton to localize further the sources of contamination. Samples of milk, cream or butter were also taken to cover those areas of the State not covered by the Commonwealth monitor.

Margarine

During the year, fatty acid analyses of 64 margarines manufactured in Queensland and five manufactured in New South Wales showed 'cooking' margarines to range from 3% to 20% polyunsaturated (average 12%), whereas 'table' margarines ranged from 18% to 39% polyunsaturated (average 29%). On the other hand, 'polyunsaturated' margarines ranged from 46% to 52% polyunsaturated (average 47%). Only one sample of margarine contained more than the acceptable limit for cholesterol (5 μg per 100 g).

In general, the bacteriological and chemical composition was satisfactory for the 85 locally-manufactured and 10 New South Wales-manufactured margarines. Occasionally a sample had an extremely high total bacterial count.

Research

The research facilities of Dairy Research Branch comprises a pilot plant capable of manufacturing a wide range of dairy products on a semi-commercial scale, and laboratories for bacteriological or chemical investigations. Research is undertaken to provide information for solving industrially-important problems when such information is not already available. Frequently, this research covers more than one discipline and involves group discussion and participation.

Raw milk storage trials

Samples of farm milks were aseptically collected at production and sub-samples stored in the laboratory at 1 and 4°C. Daily determination of total counts for 3 days showed—

Increases in total count were much greater at 4°C than at 1°C.

Where initial counts were low only slight increases occurred during 3 days at 1°C.

Where initial counts were substantial the subsequent increases at 1°C were quite substantial in some samples.

Examination of changes in total count when the milk was stored on the farm indicated that, where initial total counts were low (<20 000 per ml), they remained fewer than 50 000 colonies per ml until the milk was collected shortly after the completion of the fourth milking (that is, every other day pickup). However, where initial counts were high (>100 000), considerable increases occurred during storage. Farm storage temperatures (minimum) varied from 1°C to 4°C.

Cold ripening

Cold ripening of raw milk for cheese manufacture was also studied. Psychrotrophic bacteria growth in milk during cold storage produces changes which ultimately spoil the flavour of milk and milk products. It has been shown that some lactic acid starter cultures inhibit the growth of psychrotrophs.

The manufacture of 20 paired experimental vats of cheddar cheese shows that cold ripening (the addition of 1% of selected starter culture to raw milk plus storage at 4°C for 20 hours) gave reduced renneting times and accelerated ripening.

Milk fat globular membrane

The protective effect of the protein-lipid complex 'membrane' surrounding fat globules in milk is extremely important in several milk processing operations. Characterization of sucrose density gradient centrifugation fractions of this membrane by enzyme, protein and lipid composition now permits study of the effects of disease, milk treatment, storage and processing on the structure of this 'membrane' and its relationship to fat stability over a wide range of products and processing conditions.

This information is required for industrially-important problem solving. It is not available in the undenatured form given by the above procedure.

The high melting point glyceride fraction of the milk fat globular membrane is being studied in relation to milk processing.

Lipolysis activation in milk

Studies have shown that, during agitation of milk at lowered temperatures (5 to 15°C), considerable amounts of milk lipase transfer from the aqueous phase to the milk fat globules. When such milk is separated, the resultant cream experiences high lipase activity.

It has also been demonstrated that ageing milk for 2 to 3 days before activation enhances the degree of transfer of lipase activity. On the basis of these studies, cream pasteurization immediately after separation is desirable to restrict lipolysis due to milk lipase.

Many microbial lipases are much more heat resistant than is milk lipase, and are not destroyed during normal pasteurization. Therefore, to avoid post-manufacture deterioration through microbial lipase, it is necessary to restrict the activity of lipolytic bacteria by reducing the time interval between removal of milk from the cow and pasteurization (which destroys the bacteria but not all of their enzymes) and by reducing microbial contamination to a minimum by efficient production methods (including sterilization of the milking equipment).

Whipped cream

Based on previous research into the whipping characteristics of recombined and natural creams, a device has been developed, in co-operation with Commonwealth Industrial Gases Ltd. in response to enquiries from a large restaurateur, for rapid whipping and multiple point dispensing of natural cream.

This device has been so well received that it is being demonstrated (at industry request) at the International Catering Trade Fair and Seminar in Sydney from 5 to 8 July 1976.

Spreadable butters

The addition to cream for buttermaking of lower melting point anhydrous milk-fat fractions obtained by low cost fractionation methods previously developed in the pilot plant of Dairy Research Branch has improved both the spreadability and flavour of resultant butters. These butters were more spreadable than those from 'Alnarp' treated creams or 'natural' butters, but less spreadable than polyunsaturated table margarines.

Flavour defects

Butyric flavour defects in butter have been prevalent in certain imported butters and have been associated with serious degrading for flavour shortly after arrival in Queensland. In many cases, the changes are progressive and deterioration is rapid. Pilot plant buttermaking trials with a continuous buttermaker (Contimab II) have investigated the effects of pre-pasteurization cream lipolysis and post manufacture lipolysis during storage.

Acid degree values of the resultant butters did not always provide a reliable indication of the degree of off-flavour development in the resultant butters as it did not measure the shorter-chain fatty acids; these strongly contribute to the off-flavour. Flavoursome fatty acids produced during cream lipolysis are largely lost during pasteurization, churning and washing.

Butyric defects in butter are most likely to be caused by post-manufacture lipolysis by enzymes of microbial origin. This work is proceeding. One of the aims is the development of a new diagnostic test.

Accelerated cheese ripening

Maturing of cheddar cheese is a costly process, so reduction of the time required is a distinct advantage. It has been demonstrated that the addition of cheddar cheese slurries to freshly salted, milled curd before hooping gave 6 weeks advancement of maturity over their controls after 6 months maturing. Other methods of accelerating cheese ripening are also being investigated.

Manufacture of non-cheddar cheese

The progression of dairying in Queensland towards a market milk economy provides a milk supply of the quality essential for fancy cheese.

The relatively small size of Queensland factories and the seasonal nature of probable future milk supplies, the relatively shorter maturing times, shorter manufacturing time and higher consumer prices of fancy cheese, all render these cheeses more attractive under Queensland conditions compared with cheddar cheese.

The aim of this work is not to copy overseas fancy cheese making but to develop modern production methods suitable to the Queensland conditions outlined above. The cheese produced will be similar to fancy cheese at present imported from overseas.

'Cheddamano', a hard, grating cheese similar to Romano, and an unnamed variety similar to Jarlsberg, have given promising results. Other non-cheddar types made are Feta, Pizza, Edam and Gouda. These are already in commercial production. Havarti is under consideration.

Fishing industry research

Fish spoilage

Computer analyses of the characteristics of Pseudomonads isolated from spoiled fish sorted the results into two main groups. Group I (dominantly *Pseudomonas putrefaciens*) contained all those bacteria producing sulphydryl-type odour. Group II (the remainder) contained those bacteria either not producing odour defects or producing 'fruity' aromas.

On the basis of these results, a method was developed for selective enumeration of fish spoilage bacteria. This method depends on the ability of spoilage organisms to colorimetrically change a reagent sensitive to sulphydryl compounds.

The presence of phosphorus-containing volatiles in the headspace of spoiling fish (unreported in literature) is at present being investigated as an alternative method for detection of incipient spoilage in fish.

Bacteriology of prawns

Preliminary investigations implicate *Arthobacter* spp. in the spoilage of cooked prawns. Current work indicates that the concentration of sulphur dioxide has little effect on the bacteriology of prawns. Familiarization studies have begun for determination of hypoxanthine, total volatile nitrogen, ammonium nitrogen and ammonia in prawns.

These techniques will be used during future storage trials to provide results for comparison with organoleptic grading, leading to identification of the principal prawn spoilage bacteria and the development of a simple test for their detection as an assessment of prawn quality.

Mastitis diagnosis

A new diagnostic test for mastitis detection has been devised from a study of the enzymes in bovine milk secreted from normal and diseased udders. As this test measures the level of N-acetyl-B-D-glucosaminidase enzyme in the secretion, it is referred to as 'NAG-ase test'. The main advantages of the test are—

RELIABILITY. There is a high correlation between NAG-ase results and somatic cell counts (excluding very early and very late lactation milks). The results are extremely reproducible. Samples preserved with formalin can be stored for extended periods without affecting NAG-ase results.

A selection of experimented cheeses manufactured at the Otto Madsen Dairy Research Laboratory. The Yarlsberg (with holes), Feta, Edam, Gouda and Cheddar varieties are represented.

SIMPLICITY. Little training or experience is required by NAG-ase testers. It can be used as a field test.

RAPIDITY. Without automation, 80 analyses per hour are practicable.

INEXPENSIVE. Equipment and reagents are inexpensive. Running costs are low (1 000 tests for $20). NAG-ase testing is superior to the currently-used mastitis-detection methods.

A simple, rapid conductivity meter has been developed. When its accuracy and reliability have been established, it will also be used as a mastitis diagnosis tool in parallel with NAG-ase testing, Coulter counter (cell counts) and W.M.T. testing.

Keeping quality

Another investigation was into the keeping quality of packaged pasteurized milks and creams.

Defects developing during low temperature storage of pasteurized milks, creams and fermented products are frequently quite objectionable and seriously contribute to consumer buyer resistance.

Current investigations indicate that many of these defects are associated with microbial enzyme activity. These enzymes may have survived pasteurization or they may be linked with the growth of post-pasteurization contaminant micro-organisms. On some occasions the micro-organisms survive pasteurization as spores, which subsequently germinate and produce defect-producing enzymes.

Isolation, identification and characterization of these micro-organisms has begun to provide data for assistance in the design of experiments leading to the development of a Keeping Quality Test more appropriate than the existing Keeping Quality Test, because of vast improvements in quality since the original K.Q. test was developed. This information will also be available for the re-design of production, processing and distribution methods to avoid defects developing during storage.

Queensland's cheese production in 1975-76 was 12 519 tonnes, an increase of 21·2% on the previous year's output. Manufacture of non-cheddar type cheese is increasing.

Division of Marketing

THE major function of the Division of Marketing is to assist the primary producer in maximizing returns on his units of production, over time.

This role of upgrading the producers' marketing expertise is achieved through the integrated operations of the Division's three branches, Marketing Services, Economic Services, and Agricultural Standards, and through consultation and liaison with other Departmental branches, other organizations and agencies.

The Division's function involves the basic activities of extension, research and regulation of specific activities. The Division provides also assistance to the Department in matters relating to Acts administered by the Department and in general policy matters.

The Department zealously guards the quality of bean seed produced in Queensland. Laboratory tests on seed are carried out by Standards Branch. In the test illustrated, the process involves germinating seed in soil boxes.

From an industry viewpoint, the major Divisional commitment was directed towards the beef, dairy, poultry and tobacco industries. All other industries received attention as required.

Advice and general extension support was provided to all of the State's statutory marketing boards and related organizations and to any co-operative association requesting assistance.

The training of Departmental staff, producers and their wives and persons providing professional support to producers, such as solicitors, bankers and accountants, proceeded strongly during the year.

Farm Management training courses and workshops and farm office management schools continued to be conducted. Since these courses and schools commenced, some 3 000 people have participated.

In conjunction with other agencies, the Division was involved in the evaluation of the economic feasibility of a number of projects including the Condamine River Flood Evaluation Survey, the proposed development of the Burdekin Basin and the development of the Right Bank of the Emerald Irrigation Area.

As Queensland is a major exporter of rural products, the reputation of the standard of such exports at time of shipment is of immense importance to our marketing strategy. In this, the Division provides an essential service in inspecting grains and fruit exported through Queensland ports.

During 1975-76, some 1·3 million tonnes of grain were exported. This involved 97 ships while 36 ships were involved in fruit exports.

Other regulatory roles of the Division continue as matters of considerable importance. The outstanding features of the service are to ensure that agricultural requisites sold to Queensland producers are safe and are correctly and honestly described on the product's label. Protection is provided also to landholders against drift of agricultural chemicals. The work of the Division's seed testing laboratories is world recognized and plays a major part in improving the economic performance of the State's agricultural industries.

At the end of 1975-76, 193 staff were employed in the Division of Marketing. Research and extension and regulatory duties each accounted for approximately 40% of the Division's activities.

Worry over beef

The beef industry has been in a very depressed state over the past 2 years occasioned partly by a marked reduction in demand in traditional overseas markets and partly by a substantial increase in the size of the Australian beef herd during recent years.

This has contributed to a large surplus of slaughter cattle, a curtailment of normal property management practices and severe financial liquidity problems for many producers. Production costs have risen at an alarming rate.

Although export market prospects improved slightly and are expected to continue to improve over the next 3 or 4 years, the rate of improvement is expected to be affected by the presence of surplus slaughter cattle.

A Government Beef Industry Inquiry Committee, under the Chairmanship of the Honourable the Minister, has attacked the problem from short-term and long-range benefit points of view.

Officers of the Marketing Services Branch have contributed a good deal of effort to the deliberations of the Committee and there is hope that a satisfactory stabilization scheme will be developed.

Marketing Services Branch officers have also been involved with the dairy industry which is faced with reduced overseas markets and a large surplus production particularly of skim-milk powder. Submissions were prepared on stabilization schemes for consideration by the Australian Agricultural Council and by the Industries Assistance Commission.

After a number of discussions with representatives of the processors and growers of chicken meat interests, the Chicken Meat Act was developed and passed through the Parliament.

Primarily this provides for the establishment of the Chicken Meat Industry Committee, representing processors and growers whose function is to arbitrate in disputes on prices between those parties.

A new minimum price for tobacco leaf for 1976 was negotiated and Marketing Services and Economic Services Branch officers contributed a good deal of material for this purpose.

The Tobacco Quota Committee and the Tobacco Quota Appeals Committee continue to function very effectively and have a major role in the stabilization of that industry.

The attendance of Branch officers at meetings of the 14 marketing boards constituted under the Primary Producers' Organisation and Marketing Act, the advice given at such meetings and in correspondence with boards and with other statutory and non-statutory bodies involved in various facets of primary production has provided a good liaison between the Department and industry leaders.

Co-operative associations, in particular dairy co-operatives, have availed themselves to an increasing extent of a financial management consultancy service initiated by the Branch a little more than a year ago.

An expansion has occurred in recent years of the crop forecasting service which gives producers and interests related to primary industries, such as banks, transport, fertilizer and fuel interests, vital information on crop prospects.

The Branch continues to play an important extension role in the Brisbane Market through which most of the fresh fruit and vegetables are sold. Excluding potatoes, but including fruit and vegetables grown for processing, this industry has a gross value of about $80 to $90 million. Approximately $50 million of this passes through the Brisbane Market at Rocklea. Daily Reports and a Weekly Review are issued on Brisbane Market sales through radio (A.B.C. and commercial) and newspapers. A report is issued twice a week from Townsville and Rockhampton.

Farm management training

Inservice training in farm management for Departmental extension officers was continued during the year. This brought to approximately 600 the number of officers who have undergone this basic training in farm management and budgeting techniques since these schools began in 1963. This training has had a significant effect in introducing a whole-farm orientation into the general extension programme.

During the year, follow-up training was provided at the regional level on the Darling Downs, the Central Highlands and at Gympie. At these regional workshops, the local agricultural economist is able to deal extensively with relevant district problems.

The farm office management schools are still very popular with the rural community. The schools are of a 2-day duration and provide a balanced mixture of basic principles and such topics as estate planning, taxation and insurance. The attendance and number of schools conducted since 1974 have been—Day 1, 1 200 total attendance at 40 centres; day 2, 900 total attendance at 20 centres.

The schools are conducted in association with local organizations, mainly the Queensland Country Women's Association. At the more recent schools, an increasing number of men are attending both first and second days. Excellent support continues to be received from local solicitors, bankers and accountants who actively participate in the lecturing programme.

The second edition of *Accounting and Planning for Farm Management* was reprinted during the year. The book is still widely used by educational institutions throughout Australia.

The fourth edition of the *Farm Management Handbook* published last year is almost sold out. A reprint is being prepared.

The Farm Management Supplement to the *Queensland Country Life* was again produced in April 1976. A monthly series of articles dealing with investment on the farm was also initiated in this newspaper.

The assessment of the economic feasibility of proposed irrigation developments continues to be a major exercise. A start has been made on the Condamine River Flood Evaluation Survey for the purpose of the likely flood prevention benefits from the construction by the Irrigation and Water Supply Commission of a dam on the Upper Condamine River.

The Branch is also committed to further work on the evaluation of the proposed development of the Burdekin Basin. A detailed study of the costs and returns of rice growing in the Burdekin has been virtually completed.

An economic evaluation was carried out of the various alternatives for development on the right bank of the Emerald Irrigation Area for consideration by the Development Planning Standing Committee meeting held at Emerald in November 1975. None of the various alternatives considered was an attractive proposition when judged purely on the basis of economic criteria.

With officers of the Division of Land Utilisation, an economic evaluation of pasture as an alternative to cropping on Zone 3 and 4 land is being carried out. This investigation was designed to assess the likely costs to Government of alternative soil conservation practices.

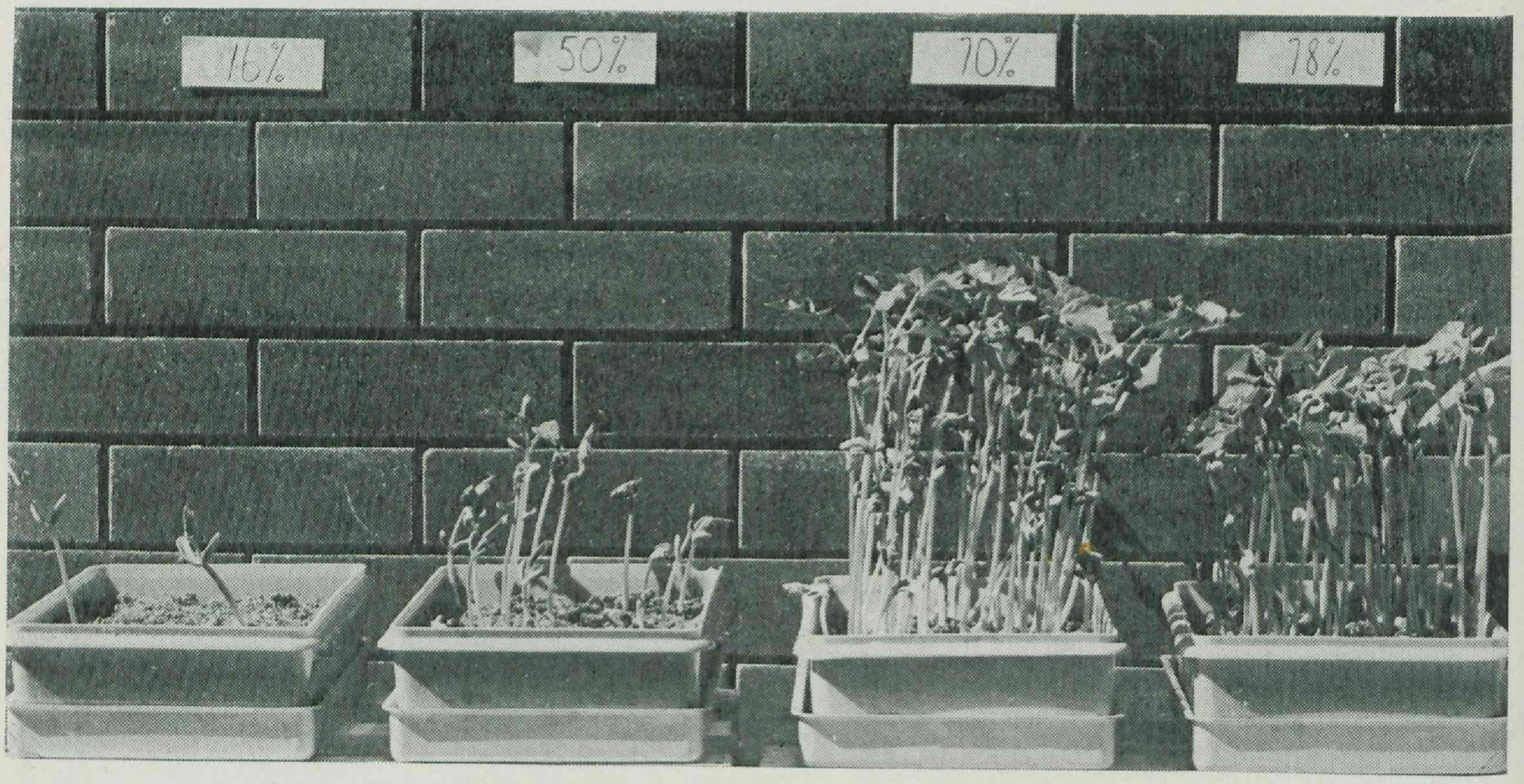
A supplementary survey to an earlier survey of the Australian Tobacco Industry was completed for the Australian Tobacco Board. The survey related to cost changes due to the introduction of specific practices of harvesting, sorting and selling of tobacco in Queensland, New South Wales and Victoria.

In co-operation with the North Queensland Tobacco Growers' Co-operative and the Southedge Tobacco Research Station, an economic assessment is being made of a fully mechanical tobacco harvester. A preliminary report was completed and the results showed that mechanical harvesting of tobacco is quite feasible. During the past year the work was repeated on a large scale and 45 ha were harvested mechanically. A final report is in preparation.

The final report on the Pig Industry Survey financed by the Australian Pig Research Committee is expected to be published in August 1976. Results indicate that there are no significant economies of size operating over the range of piggeries studied from 70 to 260 sows.

The Simulation Study of Decision Making in the Pastoral Zone of Queensland has begun to take shape. The study is intended to provide a greater understanding of the factors governing the viability of sheep properties. The project is financed by the Australian Wool Board.

The Farm Management Accounting Service has continued to operate satisfactorily although numbers have declined slightly. About 123 annual summaries for 1974-75 were prepared and some 112 members are currently recording in the Service.



Raising seed quality is another important activity of the Department. Laboratory vigour tests are used to identify differences in seed quality.

Record grain shipments

Among major activities of the Standards Branch were inspections of grain and fruit exported from Queensland, and further progress with a fruit and vegetable marketing extension service.

The quantity of export grain shipped exceeded 1 million tonnes for the second year in succession. The total grain export in 1975-76 stands at 1 270 000 tonnes carried in 97 ships, compared with 1 060 000 tonnes in 87 ships in 1974-75.

Export fruit shipments also increased, due chiefly to large movements of citrus in containers, mainly for European Common Market countries. In 1975-76, there were 36 container ships carrying 319 containers loaded with 224 000 cartons and cases. The main variety was Ellendale mandarins, with lesser quantities of oranges, lemons and grapefruit. These figures are markedly in excess of 15 ships carrying 150 000 packages during 1974-75.

The Fruit and Vegetable Marketing Extension Service operating within the Field Services Section of the Branch is worth special mention. This is an interdivisional project initiated by the Department of Primary Industries on the request of the fruit and vegetable industry. Its objective is to improve the quality of fresh produce available to the consumer and hence the demand for these commodities.

This service is now well established in the Brisbane Market giving a daily feedback to growers on the quality of produce on the fresh market. Consideration is being given to expanding this service to include all Queensland country markets as well as interstate markets. A complete coverage of all aspects in the marketing of Queensland fruit and vegetables will then be possible.

An advisory service providing technical information on handling and storing fresh produce has been introduced for Brisbane Metropolitan retailers. The activities of Standards Branch Inspectors responsible for the inspection of fruit and vegetables in retail stores have been revised with greater emphasis on extension to provide this service.

An aim of the Agricultural Standards Act through the Agricultural Requirements Board is to give buyers an assurance that agricultural chemicals will, when used as directed, be effective for the purposes for which they are sold. Work of this Board involved the consideration of 1 537 applications for registration or re-registration. Two of those applications were refused.

The Board continued with its review of the uses for organochlorine insecticides. Primary dealers of DDT preparations were informed of the uses for which DDT is now acceptable so that appropriate label changes could be made. DDT is now acceptable for only those uses for which no effective, less persistent replacement is known.

The Fruit and Vegetable Marketing Extension Service aims at giving housewives even better produce than they have been getting. In this picture, a market salesman and a D.P.I. inspector join in assessing the quality of Delicious apples.

The main objective of the Agricultural Chemicals Distribution Control Act is to offer some protection to landowners from drift of agricultural chemicals distributed by commercial users. Thirty-one notifications of complaint on damage were received during the year. These related to bees, calves and a variety of crops.

For the fourth year in succession, notifications of complaint on damage to cotton plants were received from growers in the Cecil Plains area. The Board has stressed the need for better co-operation between cotton growers, agricultural pilots, weed control operators and other users of weedkillers.

An increasing awareness of the value of seed testing by farmers and seed merchants was reflected in a marked increase in the volume of work in the seed testing laboratory in Toowoomba where the number of tests exceeded those for the previous year by 20%. On the other hand, the continued depression in the beef cattle industry caused a decrease of some 20% in the number of tests at the Indooroopilly seed testing laboratory where the bulk of pasture seed testing is conducted.

Maintainance of a good export market for pasture grass seed to South America was assisted by the extensive use of the tetrazolium test. This test has enabled lines of high quality but dormant seed (mainly of *Brachiaria decumbens*) to be selected and exported. This has meant much to the economy of the pasture seed industry in an otherwise difficult period.

A massive increase in the volume of canary seed exported to the continent of Europe (8 185 tonnes) occurred in 1975-76 compared with the previous year (561 tonnes). Inspectorial and seed testing work was increased to cope with this situation and all of the associated seed testing was transferred to Toowoomba to enable export certification to be handled more efficiently.

Seed testing authorities in all Australian States are at present considering introducing the concept of 'truth-in-labelling' in the marketing of seed for sowing. This concept has been approved in principle by Standing Committee on Agriculture. The proposed deadline for Australian-wide implementation is 1980.

'Truth-in-labelling' involves the mandatory labelling by vendors of all packages of seed offered for sale with adequate information on seed quality as revealed by analysis of samples. This information on the label will be subject to official checking.

Complaints of poor quality in Queensland-produced French bean seed were followed up by the planning of research programmes to locate the major source of trouble. Research work has been directed towards the measurement of seed vigour. Plans have been prepared for the subject to be examined at a national seed testing workshop. The building of a plant growth room suitable for special tests of bean seed was commenced at Indooroopilly.

Co-operative research between Standards and Botany Branches and the Lands Department was carried out on *Parthenium hysterophorus*. Germination studies disclosed that this species exhibits very little seed dormancy and therefore it is not likely to be a serious weed pest of cultivated areas.

The hybrid maize seed certification scheme continued to be of major importance in north Queensland and also remained significant in south-east Queensland. Total hybrid maize seed certified increased to 261 220 kg.

The quarantine area in the Burdekin Valley enabled certified disease-free bean seed to continue as the basis for the production of disease-free approved French bean seed. French bean seed certified at Bowen and on the Burdekin was 65 089 kg. In addition, 5 727 kg of navy bean seed were provisionally certified.

Standards Branch accepted a major commitment in assisting the Australian Development Assistance Agency with an intensive training programme in seed improvement and certification in Queensland over 4 weeks in September-October 1975. Fourteen students, mostly graduates, attended from Bhutan, Ghana, India, Lesotho, Malaysia, Philippines, Sri Lanka, Thailand and Uganda.

In September 1975, the amount of cover that licensed farm produce agents were required to have was considered insufficient. Some of the larger agents now carry security of $40 000 compared with a maximum of $12 000 before the amendment.

Marketing Services Branch

THE overall function of Marketing Services Branch is to improve the marketing expertise of the primary producer so that he can make the correct decisions and thereby maximize returns from his efforts.

The Branch aims at achieving this objective in an extension capacity by providing market advice and intelligence, and conveying the results of market research to producers and their organizations.

Market research activities include applied research as well as basic research which could be expected to have direct practical application. In 1975-76, a large part of the Branch research resources was applied to the animal industries area, particularly the problems confronting the beef, dairy and poultry industries.

Marketing extension activities represented the major Branch effort, accounting for 49% of staff involvement during the year. Research accounted for 32%, while administrative and clerical duties accounted for the remainder.

Beef industry

During the last 2 years, the beef industry has suffered the worst depression in its long history.

Although general industry conditions were a little more encouraging in 1975-76, the major problem continues to be the weakness in overseas demand for beef. The lack of export markets has been especially damaging in Queensland where, traditionally, some 70 to 80% of production is exported.

The export depression has resulted in other problems such as a large surplus of slaughter cattle, a curtailment of normal property management practices and severe financial liquidity problems for many producers.

The solution to the problems of the beef industry lies in the return of export markets to realistic levels. There were indications at the end of 1975-76 that export markets are gradually improving and should return to fairly healthy levels during 1977 and through towards the end of the 1970s.

Unfortunately, it is probable that the pressure of surplus cattle supplies will continue to have a depressing impact on prices, at least in the short term.

As a result of these serious problems, initiatives have been introduced at Commonwealth and State levels to reduce the severity of both short and long-term problems.

In June 1975, the Queensland Government appointed a top level Beef Industry Committee of Enquiry under the Chairmanship of the Honourable the Minister for Primary Industries. After perusal of more than 70 submissions, the Committee made a submission to the Queensland Cabinet recommending a number of short-term measures of assistance.

As a result of the submission and other representations to the Queensland Government, measures of short-term aid included assistance with payment of rates, road and rail freight concessions and subsidization of tickicides.

In May 1976, an expert Working Party was appointed from the Minister's Beef Committee to attempt to develop a workable stabilization scheme for the beef industry. The secretarial duties and research duties for the Working Party were provided by Marketing Services Branch. At the end of 1975-76, the Working Party was still undertaking its deliberations; there was, however, a degree of optimism that a workable scheme could be devised.

Dairy industry

The dairy industry, also, is confronted by serious international marketing problems arising, in the main, from a massive surplus of skim-milk powder in the European Economic Community and the collapse of the casein market.

Skim-milk powder prices slumped dramatically from their peak of $690 per tonne f.o.b. to the G.A.T.T. minimum export level of $278 per tonne. Average returns are expected to fall well below this level through the necessity of selling stocks as stockfeed.

The low returns on export markets for manufactured products have placed severe pressures on the present system of equalization. Returns to producers in all States have been reduced because of the equalizing effect of low export prices obtained from the disposal of substantial surpluses in Victoria and Tasmania.

The Queensland dairy industry is committed to the objective of maintaining supplies of liquid milk to the Queensland consumer. The industry in Queensland is of the opinion that adjustment has already occurred in Queensland to production levels more tailored to domestic needs. As such, it is most reluctant to be involved in any stabilization scheme which would involve levies on market milk which could be used to subsidize excess production in Victoria.

Proposals for achieving a national stabilization scheme were put forward by industry and Government bodies, but no agreement between the States was reached. The matter has been considered by the Australian Agricultural Council at several special meetings and it was agreed that the Industries Assistance Commission be asked to report. Officers of the Marketing Services Branch were involved in preparing a submission to the Commission.

Poultry industry

In spite of the supply-demand management scheme introduced into the egg industry in 1974-75, which involved the allocation of hen quotas to growers, egg production continued to increase. This resulted in a large surplus which had to be pulped and marketed overseas at a net loss to growers. Consequently, quotas had to be reduced in 1975-76.

Many egg producers were reluctant to accept the need for these reductions. However, a research project urgently undertaken in the Branch pointed out the eventual benefits growers could expect from these quota adjustments. Subsequently, these predictions have been confirmed and there has been a considerable improvement in growers' returns.

The chicken meat sector of the industry was also under stress in 1975-76. The main cause of the problem is that low retail prices for beef have caused a noticeable consumer demand shift from the now comparatively more expensive broiler to red meats, especially beef.

In an endeavour to provide a forum for broiler growers and processors to discuss their problems, legislation was enacted providing for the formation of the Chicken Meat Industry Committee. The Committee, representing both processors and growers, is charged with the responsibility of mediating in disputes between the parties, especially in relation to prices paid to growers.

Tobacco industry

In conjunction with Economic Services Branch, officers were involved in on-farm economic studies which played an important part in arriving at a negotiable tobacco price for 1976. This joint approach by the two Branches has become a key feature of the economic work of value to the tobacco industry and will continue with increased emphasis during 1976-77.

Branch extension

The extension role of the Branch continued to expand during the year. Since its inception as a separate Branch in 1966, and previously when it was embodied in the Division of Marketing, an important function has been representation on marketing boards, other statutory organizations, and on the directorates of primary producer co-operative associations. This is considered a very important extension activity as it brings marketing officers into close personal contact with industry leaders, and with individual farmers on the many occasions when officers attend grower meetings. The fact that there are 14 marketing boards constituted under the Primary Producers' Organisation and Marketing Act and other related statutory organizations on which Branch officers have involvement, ensures that marketing extension reaches a large section of primary producers in Queensland.

Close liaison is maintained also by Branch officers with other statutory organizations such as the Commercial Fishermens' Organisation, the Queensland Cane Growers' Council and The Egg Marketing Board Suppliers' Organisation. Close contact is kept with non-statutory organizations too, including the Queensland Grain Growers' Association and the Broiler Growers' Association, and with the many private firms and organizations servicing primary producers and those firms processing primary products.

In recent years, the Branch has widened its extension functions by providing a financial management consultancy service. This has been widely availed of by co-operative associations, in particular by the dairy co-operatives. Investigations have continued into amalgamation proposals involving three dairy associations. Particular attention was paid to the financial implications and share structure, and the rationalization of processing and distribution. Accounting advice was provided to three other associations on their internal costing and administration.

This service is also concerned, on behalf of Treasury, with the assessment of requests for Government guarantees of borrowings made by marketing boards and co-operative associations, and provides a continuing surveillance over the financial operations of these organizations.

The financial management service is available, on request, to all grower organizations throughout the State, and is designed to assist in the upgrading of the standard of financial management in the organized rural sector. Of particular interest during the year was the advice given to members of Queensland Artificial Breeding Co-operative Associations and other artificial breeding groups.

Since the early post-war years, marketing extension has included a crop forecasting service, and this has been greatly expanded in recent years. Six forecasts are now issued on summer and winter grains, three on peanuts, navy beans and oilseeds and three on potatoes and onions. In all, some 11 000 copies of these forecasts are issued annually.

The fruit and vegetable industry in Queensland has a gross value of about $80 to $90 million, excluding potatoes but including fruit and vegetables grown for processing. Most of the fresh fruit and vegetables are sold through the Brisbane Market at Rocklea, where the Branch plays an important extension role. A Daily Market Report is compiled on supplies and prices realized at the market, and this information is widely disseminated. Some 450 copies of the report are issued daily and there is also a Weekly Market Review with a circulation of more than 200.

The Daily Market Report in Brisbane also gives information on auction prices realized at the Metropolitan Fish Markets at Colmslie, while the Weekly Market Review gives information on retail prices of fruit and vegetables, and on selling prices of eggs, honey, wheat, flour, butter and cheese.

Branch research

Apart from submissions to the Industries Assistance Commission and other official bodies, seven research projects were published during 1975-76. Aspects covered included the navy bean industry, grower finance, egg production and quality, crop finance, fruit and vegetable marketing and north Queensland tobacco soils.

A further 12 projects, dealing with the broad range of rural marketing were at an advanced stage at the end of 1975-76.

Training

Under the aegis of the Commonwealth Department of Foreign Affairs, the Division of Marketing has arranged courses in the marketing of agricultural products for overseas students. Four such courses have been held in the past 5 years, and another course is scheduled to be held in March 1977. Lecturing staff have been drawn mainly from Marketing Services Branch. The courses are involved with both theoretical and practical aspects of marketing.

In-service staff training continued to be a feature of Branch activity during the year. A comprehensive training course dealing with the structure and functions of the Department was provided for new officiers early in the year.

The effective training of Branch officers requires that the officers be themselves experts in their own fields and that they keep up to date with modern techniques and developments in Australia and throughout the world. To this end, officers of the Branch attend industry and technical conferences whenever possible, and maintain close liaison with their counterparts in other areas.

During the year, various officers attended the National Agricultural Conference, the Annual Conference of Agricultural Economists, and the National Wheat Conference, took part in discussions with interstate officers on the dairying and meat industries, and gave evidence at hearings of the Industries Assistance Commission. Two officers attended courses on financial management.

At the end of the year, the Assistant Director of the Branch was in the United Kingdom and Europe investigating new developments in the marketing and processing of dairy products. Mr. W. Kidston acted as marketing consultant to the South Pacific Commission during April 1976 while Mr. G. S. Vinning is to undertake two-year post-graduate course in organised marketing in Canada, beginning in July 1976.

Economic Services Branch

THE main objectives of Economic Services Branch are to provide economic information and advice pertaining to the rural sector of Queensland, and to lead in farm management extension to the rural community.

To do this, the Branch has regional agricultural economists stationed at 17 country centres throughout Queensland and has a head office component of 12 economists whose main task is to back up the regional economists and to carry out research into specific problems.

Farm management extension

INSERVICE TRAINING FOR EXTENSION OFFICERS. Inservice training in farm management for Departmental extension officers was continued during the year. This brought to approximately 600 the number of officers who have undergone this basic training in farm management and budgeting techniques since these schools were commenced in 1963. This training has had a significant effect in introducing a whole-farm orientation into the general extension programme.

During the year, follow-up training was provided at the regional level on the Darling Downs, the Central Highlands and at Gympie. At these regional workshops, the local agricultural economist is able to deal extensively with relevant district problems.

SCHOOLS FOR PRIMARY PRODUCERS. The farm office management schools are still popular with the rural community. The schools are of a 2-day duration and provide a balanced mixture of basic principles and such topics as estate planning, taxation and insurance.

GENERAL EXTENSION ACTIVITIES. The activities of the regional economists stationed at the regional centres vary according to the background and experience of the officer and the needs of the districts and regions. In the districts where the number of departmental officers is relatively small, the economist tends to work directly with farmers and farmer organizations. In the large centres, the experienced economist's time is largely taken up attending meetings and in office discussions.

Regional economists are represented on all District Extension Committees and committees associated with the research stations administered by the Research Stations Board. The economists at Atherton and Rockhampton serve as deputy for the Director of Marketing on the local Maize, Sorghum and Egg Marketing Boards. In addition, economists are connected with several industry committees and advisory groups.

The 'average' economist makes about 27 farm visits a year, a quarter of which are connected with the Farm Management Accounting Service, while in one out of four visits he is accompanied by another departmental officer.

REFNOTE. The Branch is actively promoting the use of Refnote material in the Department. The system was introduced by the Economic Services Branch in an effort to keep officers up to date in their fields of interest. Four Refnotes were issued during 1976 dealing with Live Cattle Futures Markets, Depreciation and Investment Allowance, Flood Relief Concessions and Unemployment Benefits for Primary Producers.

Regional economists made significant contributions to departmental publications dealing with brigalow, dairy nutrition and poultry farm management.

Research

Irrigation projects

The assessment of the economic feasibility of proposed irrigation developments continues to be a major exercise. A start has been made on the Condamine River Flood Evaluation Survey for the purpose of the likely flood prevention benefits from the construction by the Irrigation and Water Supply Commission of a dam on the Upper Condamine River.

The Branch is also committed to further work on the evaluation of the proposed development of the Burdekin Basin. The agricultural economist at Townsville is completing a detailed study of the costs and returns of rice growing in the Burdekin. As well, the interdependency between agriculture and other sections of the economy in the Burdekin region is examined in detail in the Northern Region Input Output Study. This inter-industry model of the area is nearing completion and a draft report is expected by the end of 1976. Data for all 50 sectors have been collated.

The agricultural economist at Emerald carried out an economic evaluation of the various alternatives for development on the Right Bank of the Emerald Irrigation Area for consideration by the Development Planning Standing Committee meeting held at Emerald in November 1975. None of the various alternatives considered was an attractive proposition when judged purely on the basis of economic criteria.

Soil conservation

With officers of the Division of Land Utilisation, an economic evaluation of pasture as an alternative to cropping on Zone 3 and 4 land is being carried out. This investigation was designed to assess the likely costs to Government of alternative soil conservation practices.

Tobacco industry

A supplementary survey to an earlier survey of the Australian Tobacco Industry was completed for the Australian Tobacco Board. The survey related to cost changes due to the introduction of specific practices of harvesting, sorting and selling of tobacco in Queensland, New South Wales and Victoria.

Pig industry

The final report on the Pig Industry Survey, financed by the Australian Pig Research Committee, is expected to be published in August 1976. Results indicate that there are no significant economies of size operating over the range of piggeries studied from 70 to 260 sows.

Beef industry

Despite the depression in the beef industry, research is continuing into beef property management although, in most instances, the results will have practicable value only after the industry has returned to more profitable conditions.

With officers of the Beef Cattle Husbandry Branch, work is continuing in evaluating the value of feeding *ad lib.* high levels of meat meal with molasses as a finishing ration for beef cattle in winter.

A static model of a beef herd has been developed to generate data to investigate the profitability of various forms of pasture investment in the Central Burnett. This is a joint project with Agriculture Branch.

Work is also proceeding on examining the merits of spatial diversification as opposed to intensification of a western area beef property in the Monto Shire.

Sheep industry

The Simulation Study of Decision Making in the Pastoral Zone of Queensland has begun to take shape. The study is intended to provide a greater understanding of the factors governing the viability of sheep properties. The basic input data have been collected and the computer programme is completed.

Other industries

The regional economists at Atherton and Brisbane provided data on the potato industry for a submission to the Industries Assistance Commission.

Costs and returns in the ginger industry are under examination by the economists at Gympie.

The economics of leasing are being studied, and an article is being prepared on this contentious issue following an extensive review of the literature.

A draft report on the assessment of the potential agricultural development of Cape York Peninsula has been prepared. It is expected that the final report will be confined to an assessment of existing development in the area. Lack of suitable data has prevented a wider ranging assessment.

Farm Management Accounting Service

The Farm Management Accounting Service has continued to operate satisfactorily although numbers have declined slightly. About 123 annual summaries for 1974-75 were prepared and some 112 members are currently recording in the service.

Some testing of the Bureau of Sugar Experiment Stations (B.S.E.S.) system has been undertaken.

Support services

The Economic Services Branch continues to provide a valuable computer analysis service for Departmental surveys. Surveys of the spear grass area in Calliope Shire, of dystocia in beef cattle, of the beef industry and of departmental library services are in various stages of analysis. In addition, the data from the departmental survey of manpower and expenditure as related to various industries were specially collated for submissions to the Industries Assistance Commission and the Grants Commission.

Agricultural Standards Branch

BY enforcing official standards, Standards Branch exercises a quality control service over the sale of a number of commodities, chief of which are fresh fruit and vegetables, stock foods, seeds, fertilizers, pest destroyers and veterinary medicines, as well as other agricultural chemicals specified in legislation administered by the Branch.

Satisfaction to the consumer and legal protection to the buyer against an inferior product remain the main aims of this form of quality control. However, under conditions of rising production costs, considerable attention is now given by Standards Branch staff to encourage the producer and/or seller to market only products of the highest attainable quality.

One aspect of this widened scope of regulatory activity is the communication to industry of up-to-date technical information through liaison with other departmental branches, through co-operation with other Departments and by branch representation on authorized technical bodies within Queensland and interstate.

These activities are not necessarily related to a person to person sale of a commodity, but generally encompass broader issues that concern the rural community as a whole, such as restrictions or prohibitions on the sale of dangerous chemicals, the development of a fair system for the registration of agents selling farm produce on commission, or the introduction of improved marketing methods such as Government supervized truth-in-labelling of seed for sowing.

Another important part of regulatory activity is the responsibility delegated by the Commonwealth Government for the quality of grain, bird-seed, seeds for sowing, fresh fruit and vegetables, flour and peanuts exported overseas from Queensland, and also the acceptable levels of quality of pasture and forage seeds imported into the State. Standards Branch is entrusted with the administration of the provisions of Commonwealth legislation pertaining to the export and import of these commodities.

The Branch is organized according to areas of responsibility into a number of sections. These are Field Services, Chemical Services, Seed Services, and Administration. Country-based Standards Branch inspectors at Toowoomba, Rockhampton, Townsville and Cairns provide services in their respective districts similar to that of inspectors stationed at Standards Branch, Indooroopilly, the Brisbane Market, Rocklea and at the Quarantine and Export Centre, Hamilton.

Field Services Section

Field Services Section consists of inspectors stationed at Brisbane and country centres and includes graduate technologists who undertake investigations into sampling techniques and analytical procedures.

Major activities during the year were inspections of grain and fruit exported from Queensland, the development of an improved method of sampling and checking aqua-ammonia fertilizer, and further progress with a fruit and vegetable marketing extension service.

The quantity of export grain shipped exceeded 1 million tonnes for the second year in succession. The total grain export of 1975-76 stands at 1 270 000 tonnes carried in 97 ships, compared with 1 060 000 tonnes in 87 ships in 1974-75. Increases of approximately 30% occurred in shipments of wheat and barley to Russia, Japan and the Middle East.

Export fruit shipments also increased, due chiefly to large movements of citrus in containers, mainly for European Common Market countries. For 1975-76, there were 36 container ships carrying 319 containers loaded with 224 000 cartons and cases. The main variety was Ellendale mandarins, with lesser quantities of oranges, lemons and grapefruit. These figures are markedly in excess of 15 ships carrying 150 000 containers during 1974-75.

In fertilizer testing, a significant advance has been made in checking the strength of aqua-ammonia at points of distribution (for example, storage tanks) instead of relying on laboratory tests at the point of manufacture. A comparatively simple hydrometer test kit has been recently prepared for field use by inspectors, thus enabling rapid widespread checks to be made in the field at points of sale whenever required.

The Fruit and Vegetable Marketing Extension Service operating within the Field Services Section is worth special mention.

This is an interdivisional project initiated by the Department of Primary Industries on the request of the fruit and vegetable industry. The objective of the project is to improve the quality of fresh produce available to the consumer and hence the demand for these commodities.

A total of 694 Queensland fruit and vegetable growers was referred to field extension officers for assistance during the first 12 months' operation of the Fruit and Vegetable Marketing Extension Service.

Of the 658 growers referred to Horticulture Branch, tomatoes (147) and apples (75) received most attention while the Granite Belt (221), Lockyer (91), East Moreton South (87) and Near North Coast (74) were the major districts concerned.

This service is now well established in the Brisbane Market giving a daily feedback to growers on the quality of produce on the fresh market. Consideration is being given to expanding this service to include all Queensland country markets as well as interstate markets. A complete coverage of all aspects in marketing Queensland fruit and vegetables will then be possible.

If fresh fruit and vegetables are to withstand the increasing competition from processed and synthetic products, all groups involved in the production and distribution of fresh fruit and vegetables will have to take a greater responsibility for the quality of produce reaching the consumer.

The activities of the Marketing Extension Service are designed to emphasize a whole industry approach to quality, with maximum integration of activities at all levels. Six co-ordinated market extension projects have been initiated involving Marketing and Plant Industry staff as well as growers, market agents and retailers.

An advisory service providing technical information on handling and storing fresh produce has been introduced for Brisbane Metropolitan retailers. The activities of Standards Branch inspectors responsible for the inspection of fruit and vegetables in retail stores have been revised with greater emphasis on extension to provide this service.

The retail advisory service began operation in March 1976 and is backed by technical staff in the Divisions of Plant Industry and Marketing. This service will also be introduced in all major centres throughout Queensland. Training programmes for officers in these centres are envisaged.

'Seen in the Market', based on observations on produce quality at the wholesale and retail levels, has been established as a regular feature in the fortnightly publication *Fruit and Vegetable News*. It is designed to encourage growers to take a greater interest in market quality and market requirements, and has been highly successful in introducing the Fruit and Vegetable Marketing Extension Service.

Chemical Services Section

The Chemical Services Section provides the secretariat and ancillary services for the Agricultural Requirements Board and the Agricultural Chemicals Distribution Control Board.

An aim of the Agricultural Standards Act through the Agricultural Requirements Board is to provide buyers with an assurance that agricultural chemicals will, when used as directed, be effective for the purposes for which they are sold. Work of this Board involved the consideration of 1 537 applications for registration or re-registration. Two of these applications were refused.

The Board continued with its review of the uses of organochlorine insecticides. Primary dealers of DDT preparations were informed of the uses for which DDT is now acceptable so that appropriate label changes could be made. DDT is now acceptable for only those uses for which no known effective, less persistent replacement is known.

Information on insecticides and fungicides needed by extension officers and advisers was extracted during the year from the bank of data held. This information is to be presented in the form of data sheets for each chemical. These are to be distributed throughout the Department.

A pre-requisite to registration of many agricultural chemicals is clearance from the Technical Committee on Agricultural Chemicals or the Technical Committee on Veterinary Drugs. Both committees receive information on the experiences with agricultural chemicals in this State through their Queensland members. Committee members transmit information from consultants in various Branches of the Department to the Committee's Secretariat in Canberra. Clearance documents for 86 chemicals were received during the year.

The main objective of the Agricultural Chemicals Distribution Control Act is to offer some protection to landowners from drift of agricultural chemicals distributed by commercial users.

Licensing under the Act ensures that agricultural pilots and commercial weed control operators have a knowledge of the chemicals they use and of the hazards involved. Sixty-one agricultural pilots and 1 266 weed control operators were licensed during the year.

Thirty-one notifications of complaint on damage were received during the year. These related to bees, calves and a variety of crops.

The second set of amendments to the Commercial Operator's Manual was published and distributed during the year. The replacement pages incorporated changes due to metrication of directions for use. New pages were data sheets for weedkillers which have been registered for sale in Queensland since the publication of the Manual and the first set of amendments. In this way, commercial users

Efforts are being made to remove all risk of crop damage through aerial spraying. An aerial spraying demonstration was part of the curriculum at the Herbicide Training School last November.

of weedkillers are kept informed of new preparations and of changes to old preparations.

Officers involved in the operation of the Agricultural Chemicals Distribution Control Act attended a Herbicide Training School at the Redlands Horticultural Research Station in November 1975. The school was conducted by Horticulture Branch and numerous crops wre deliberately sprayed with different herbicides to produce visual symptoms of abnormal growth. These specimens of damage were the subject of a great deal of study and discussion. The flying skill needed by agricultural pilots and the precision of the equipment designed for the spraying of agricultural chemicals from aircraft were demonstrated in a half-day session at Archerfield.

Seed Services Section

The Seed Services Section is responsible for three distinct but related areas of activity—

The operation of seed testing laboratories at Indooroopilly and Toowoomba to provide reports and certificates of seed analysis to farmers, members of the seed industry and Departmental officers

Seed research, particularly into quality characteristics and field establishment value of tropical and sub-tropical seeds

The supervision and development of official seed certification schemes within Queensland including the storage of seed produced for certification purposes.

Seed testing activities

An increasing awareness of the value of seed testing by farmers and seed merchants was reflected in a marked increase in the volume of work in the seed testing laboratory in Toowoomba where the number of tests exceeded those for the previous year by 20%. On the other hand, the continued depression in the beef cattle industry caused a decrease of some 20% in the number of tests at the Indooroopilly seed testing laboratory where the bulk of pasture seed testing is conducted.

Extensive changes were introduced to the in-service seed testing training programme by the formulation of an intensive formal lectures and practical training period of 6 weeks for new appointees to the seed testing laboratory. This programme was introduced and supervised by graduate officers of the research section and is intended to enable recruits to attain reliable levels of proficiency in a relatively short time.

Seed testing authorities in all Australian States are at present considering introducing the concept of 'truth-in-labelling' in the marketing of seed for sowing. This concept has been approved in principle by Standing Committee on Agriculture. The proposed deadline for Australia-wide implementation is 1980.

'Truth-in-labelling' involves the mandatory labelling by vendors of all packages of seed offered for sale with adequate information on seed quality. This information on the label will be subject to official checking. The purchaser will be able to decide from the label whether the quality indicated on the label is acceptable for his requirements. Less importance need be placed on minimum numerical standards below which seed at present cannot be legally offered for sale.

Seed research

Problems of the seed industry involving seed testing were given close consideration in 1975–76.

Complaints of poor quality in Queensland-produced French bean seed were followed up by the planning of research programmes to locate the major source of trouble. Research work has been directed to the measurement of seed vigour. Plans have been prepared for a national seed testing workshop. The building of a plant growth room suitable for special tests of bean seed was begun at Indooroopilly.

A considerable amount of research was carried out on quality problems in soybean seed. Emphasis was placed on the measurement of harvest, cleaning and storage effects on seed viability. Poor emergence in soybean is a common problem and causes substantial losses of production. In addition to research in the area, steps were also taken to raise seed quality by increasing the minimum legal germination standard from 60% to 80%. Agreement was obtained with the other States for this new standard.

Continuing programmes of research into dormancy and longevity aspects of tropical grass seed continued in co-operation with Agriculture Branch. The work is confirming the harmful effects of rapid drying techniques which have been growing in popularity with seed producers in recent years. Suitable modifications were made to Departmental recommendations on harvest procedures following these results. The use of accelerated ageing techniques in the laboratory has disclosed that the longevity of grass seed can be predicted before seed is placed in storage.

Seed certification

The hybrid maize seed certification scheme continued to be of major importance in north Queensland and also remained significant in south-east Queensland. Total hybrid maize seed certified increased to 261 220 kg.

The quarantine area in the Burdekin Valley enabled certified disease-free bean seed to continue as the basis for the production of disease-free approved French bean seed. French bean seed certified at Bowen and on the Burdekin was 65 089 kg. In addition, 5 727 kg of navy bean seed were provisionally certified.

Certification schemes for pasture seeds and tomato seed were also kept active.

International training course

Standards Branch made a significant contribution to the international training course in seed improvement and certification in Queensland late in 1975. Thirty-one lectures or demonstrations were given by Standards Branch officers; 24 by specialists from other Branches of Department of Primary Industries; 13 by people from C.S.I.R.O., University, other State Departments of Agriculture and five by persons from industry.

For a further period of 4 weeks selected students were attached to Standards Branch field officers to obtain practical field experience.

Officers of Agricultural Standards Branch provide an advisory service to retailers on technical aspects in handling fresh produce.

Division of Land Utilisation

DURING the year special emphasis has been placed on the following activities mostly with satisfactory results—

Statutory soil conservation programmes and the establishment of autonomous local organizations to guide them.

Resources assessments in the western arid zone, the Burdekin catchment and the coastal lowlands.

Special problems of the beef industry.

Mitigation of the effects of natural disasters such as droughts and floods.

Organisation Development.

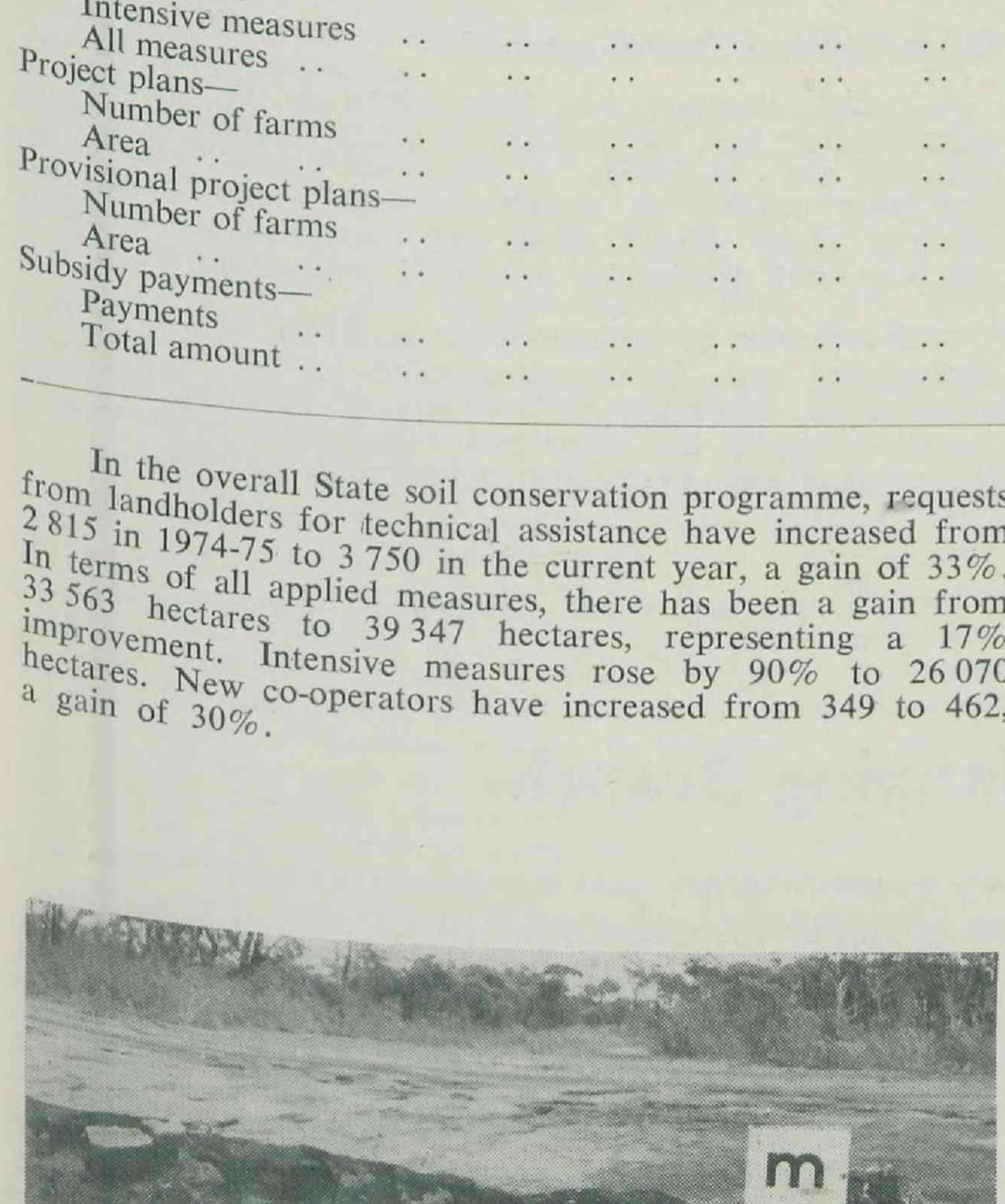
Progress in soil conservation

As shown below the Darling Downs statutory soil conservation programmes are now gaining momentum as farmers and staff become more accustomed to the special requirements.

DARLING DOWNS STATUTORY SOIL CONSERVATION PROGRAMME

	Units	1974–75	1975–76	% Improvement
Requests from farmers	Number ..	742	1 327	79
New co-operators	Number ..	64	106	66
Implementation—				
Intensive measures	Hectares ..	4 495	8 197	82
All measures	Hectares ..	7 052	10 704	52
Project plans—				
Number of farms	Number ..	138	217	58
Area	Hectares ..	13 950	31 836	128
Provisional project plans—				
Number of farms	Number ..	111	254	129
Area	Hectares ..	20 000	46 996	135
Subsidy payments—				
Payments	Number ..	132	275	108
Total amount	$	67 942	82 934	22

In the overall State soil conservation programme, requests from landholders for technical assistance have increased from 2 815 in 1974-75 to 3 750 in the current year, a gain of 33%. In terms of all applied measures, there has been a gain from 33 563 hectares to 39 347 hectares, representing a 17% improvement. Intensive measures rose by 90% to 26 070 hectares. New co-operators have increased from 349 to 462, a gain of 30%.



Silt 1 m deep, washed from adjacent cultivation, blocked the Abor Creek crossing on a road in the Capella area.

In general, the Queensland soil conservation programme shows distinct signs of improvement after a progressive decline which has been noted in almost all regions since 1969-70. If the current growth rate can be sustained over the next 5 years and implementation then maintained at the higher level, there are reasonable prospects of achieving control of the erosion problem on the State's agricultural lands by the turn of the century.

However, future soil conservation programming in Queensland received a setback towards the end of the year as a result of the termination of the Commonwealth Soil Conservation Grant. The provision of a $700 000 grant by the Commonwealth in 1975-76 to establish a basis for a long-term soil conservation programme seemed to provide an opportunity for an on-going joint Commonwealth-State approach to this problem of national importance. The future course of action is uncertain and no doubt will be influenced by the release, during 1976-77, of the report on a study of soil conservation needs, conducted jointly by the Commonwealth and States.

Major land resource studies

Divisional staff have devoted major effort during the year to expediting resource mapping in the western arid zone, the Burdekin catchment and the coastal lowlands. These projects require inter-disciplinary activities and involve participation by other branches of the Department as well as inter-departmental, and in one project Commonwealth-State interaction.

The Western Arid Land Use Study is a long-term project spanning a decade to 1980 and is divided into five parts aggregating 60 million hectares. Investigations have been completed in Part I (15 million hectares in the south-west) and in Part II (10 million hectares in the central sector). Part II was completed in the current year.

Field investigations were also completed in Part IV (about 3·5 million hectares) and preparations were made for the commencement of field investigations in Part III (5 million hectares) and Part V (26 million hectares).

Following the publication of the report on Part I, other agencies are finding that the classification system employed is providing a systematic basis suitable for their use.

The Commonwealth-State Burdekin Study is nearing completion and the report by the Burdekin Project Committee is being prepared for publication and release during 1976-77.

Under the auspices of a Steering Committee, the Department of Primary Industries accepted responsibility for identifying the characteristics of the Burdekin flood plains and catchment area, assessing their potential for commercial irrigated cropping and grazing as well as the potential for improved dryland agricultural practices. An evaluation of erosion incidence in the catchment was also undertaken.

The coastal lowlands lying between Maryborough and the Elliott River have been the object of study by an inter-departmental group from the Departments of Lands, Forestry and Primary Industries. The Study Area is some 202 000 hectares in area including 76 100 hectares of vacant Crown land.

The results of land classification study to determine suitability for various uses is set out in the table below.

LAND SUITABILITY CLASSIFICATION

Usage	Area (ha)	Percentage
Agriculture	11 200	15
Softwood forests	58 000	76
Recreation	18 300	24
Unique ecosystems	26 700	35
Urban and infrastructure	3 800	5

Special problems of the beef industry

Development Planning Branch senior staff, as well as those of other agencies, have been involved during the year in the documentation of various approaches to the resolution of beef industry problems.

Overall, these problems remain acute despite some temporary increases in cattle prices at some periods during the year. Cattle numbers have continued to rise in Queensland but have more or less stabilized over the remainder of Australia.

The Beef Industry Committee established last year by Cabinet has held several meetings and considered some 73 submissions. The Committee recommended 11 specific measures for short-term relief.

A stabilization scheme has been explored at interstate and Federal levels and a working group currently has responsibility for attempting to devise a marketing scheme which will provide for stability in the domestic market.

Natural disasters

The Drought Secretariat which is staffed by Development Planning Branch officers has been given a co-ordinating role in relation to natural disasters affecting primary production.

Though no widespread drought occurred during the year, staff were involved in the preparation of material and in convening a working party on 'land use and land management, with particular reference to the arid zones' and submitting a draft report to the initiating body, the Commonwealth and States Committee on Natural Disasters (which includes drought).

Floods and cyclones were experienced over the summer months. Major flooding occurred in the Condamine River system, the Border Rivers and the Warrego and Paroo in the south-west. At the farm level, estimates of primary losses due to abnormal flooding amounted to $8.4 million, comprising livestock $1.6 million; crops $3.3 million; structures, plant, stored fodder and grains and soil erosion $3.5 million.

Staff have been involved in the co-ordination of data for the development of a simulation model related to the use of arid lands for grazing with the accompanying risks of deterioration, erosion and loss of productivity. The wide-ranging model has been developed from sub-models consisting of climate, paddock, property (both biological and financial) saleyard, labour, transport, education, health, shire services, general business, tourist, population and social.

Organization Development

Special attention has been given to the training of approximately half the staff in improved methods of problem definition and resolution. A substantial amount of time has also been devoted to consultative approaches which have involved group identification and resolution of procedural and structural deficiencies in critical programme areas.

The results of both of these activities have been most encouraging and, in the measurable sectors of Divisional achievement, increased performance of 50% to 80% was recorded despite the substantial initial time involvement in the personal and organization development activities.

Development Planning Branch

THE principal responsibility of Development Planning Branch when set up some 14 years ago was to identify opportunities for institutionally-sponsored projects for development of rural industries.

It also collates technical and economic information contributed by other Branches and presents this as a cohesive Departmental Report on the agricultural, pastoral and economic prospects of the proposed development.

Development investigations and studies

Set out below are current projects being undertaken. The Burdekin Basin Investigations are funded jointly by the Commonwealth and the State, but all others are funded from Consolidated Revenue.

Burdekin Basin investigations

The Federal Government in April 1973 agreed to the request of the Queensland Government to establish a joint Federal-State Burdekin Project Committee to—

Examine the overall potential for land, water and mineral resource development in the Burdekin River Basin with particular reference to water availability and possible future needs or uses for urban, irrigation, power generation, industry (including minerals) and flood mitigation requirements.

Examine the interdependence of the resources of the Burdekin River Basin and the requirements of Townsville and other neighbouring areas of economic significance in plans for resource development and regional growth.

Against the background of the foregoing, to formulate proposals for the future development of the region.

Under the auspices of a Steering Committee, the Department of Primary Industries accepted responsibility for identifying the characteristics of the soils of the Burdekin flood plains and catchment area, assessing their potential for commercial irrigated cropping and grazing, as well as the potential for improved dryland agricultural practices. An evaluation of soil erosion problems was also required.

The report by the Burdekin Project Committee is being prepared for publication and release through both the Commonwealth and State Governments during 1976-77.

The Departmental studies involved are summarized below.

BURDEKIN BASIN LAND CAPABILITY STUDY. An agricultural land capability and productivity assessment for the Upper Burdekin Basin was completed this year by branch officers and involved the collection of land resource data for the 5.7 million hectares of land in the Upper Burdekin Basin.

The processing of objectively recorded land resource data such as soil, geology, topography and vegetation information was translated into land capability information by the use of automated selection routines. Two land uses—broad-acre cropping and pastoral use—were adopted and collated with other earlier Burdekin studies.

In terms of agricultural capability for the whole catchment, 6 508 square kilometres had a No. 1 Capability Rating; 16 433 square kilometres were in Rating 2; 45 320 square kilometres were in Rating 3; 42 534 square kilometres in Rating 4; and 27 841 square kilometres were in Rating 5. Only Ratings 1 and 2 are suitable for cash cropping on a regular basis with occasional cropping on Rating 3 lands.

Pastoral capability ratings ranged from 8 607 square kilometres in Rating 1; 23 964 square kilometres in Rating 2; 57 452 square kilometres in Rating 3; 31 805 square kilometres in Rating 4; and 16 808 square kilometres in Rating 5.

The study revealed the small proportion of land which is available for agricultural development using the technology and range of crop types that are available at present. Only some 6% of the Basin has good agricultural land, and three-quarters of this is found in the Belyando-Suttor region, mainly in the vicinity of Clermont.

BURDEKIN BASIN SOIL EROSION STUDIES. Though these studies have been undertaken by Soil Conservation Branch officers they are briefly reported here for continuity.

Though less than 0·5% of the Upper Burdekin Basin has been completely cleared of timber and insignificant areas are cultivated, approximately 12·5% of the area is subject to some form of water erosion.

Significant areas of severe erosion occur around the junction of the Burdekin River and Camel Creek and around Charters Towers. Advanced erosion is evident in the Camel Creek, Douglas Creek, Clarke River and Boughton River catchments.

The most eroded areas are generally texture contrast soils with neutral or alkaline subsoils or shallow loams and sands.

Yields of sediment from the North Burdekin catchment are likely to range from 4·2 to 8·6 million tonnes per annum.

Burning of pastures results in severe soil losses in the catchment.

STUDIES BY OTHER BRANCHES OF THE DEPARTMENT. In this category are soil surveys and edaphic studies conducted by Agricultural Chemistry Branch and commerical trials of various crops and pastures under irrigation on various soil types conducted by Agriculture, and Beef Cattle and Dairy Husbandry Branches.

Though reported in detail elsewhere some of the more important conclusions emerging from these studies are—

Agricultural Chemistry Branch completed a semi-detailed reconnaissance survey of 81 000 ha of commandable land between Home Hill and the Elliott River at a scale of 1:100 000, with supplementary field and laboratory studies to assess the suitability of soils for irrigation.

As far south as Molongle Creek there are appreciable areas of cracking clay soils (Koberinga, Barratta-Barrunga Series) suitable for a range of irrigated crops. The complex distribution of soils between Molongle Creek and Elliott River introduces greater problems for irrigation development in that area.

The agronomic programme, located on the Oakey-Barratta flood plain soils at Millaroo, has centred on research and commercial feasibility studies relating to the production of rice, maize, soybeans, grain sorghum, safflower and kenaf. Feasibility studies, to determine the productivity of these crops on the Dalrymple and Koberinga soils at the Fort Site, Home Hill, began in late 1974. Results to date at both locations indicate the potential for rice, maize and soybean rotations on the flood plain soils, while maize is most promising on the Dalrymple soils.

Outstanding milk production of 27 166 kg per ha per lactation has been obtained from Friesian cows grazing fertilized irrigated pangola grass pastures at Ayr Field Station, plus a stock supplement of molasses, urea and mono-sodium phosphate at the rate of 3·6 kg per animal a day. Fertilizer was applied every 6 weeks—the total annual application amounting to 672 kg of nitrogen, 43 kg of phosphorus and 63 kg of potassium per hectare.

Liveweight gain of beef animals grazing fertilized irrigated pangola grass at Millaroo Research Station has averaged 485 kg per ha per annum, which is considerably below results obtained at Parada Field Station in Far North Queensland.

Coastal Lowlands land use study

The Coastal Lowlands Study Committee comprising officers from the Departments of Lands, Forestry and Primary Industries completed its study during the year and prepared a draft report which has been forwarded to the Chairman of the Land Administration Commission.

The Committee sought during its studies to determine and draw conclusions on the best use of the considerable area of vacant Crown lands which are situated between Maryborough and Bundaberg. The study area encompassed some 202 000 hectares of which 76 100 hectares were identified as vacant Crown land.

In arriving at its conclusions concerning desirable future uses, the Committee considered both the suitabilities and the needs of the various competing land uses.

Land suitable for agriculture with some limitations comprises 17 000 ha or 9% of the study area. Of this, only 11 200 ha are located on vacant Crown land and account for 16% of the vacant Crown land. The Committee identified 8 000 hectares or about 10% which desirably should be used for agriculture particularly for locally processed crops such as sugar-cane and cassava.

Forestry Site Indices for exotic pines were assessed for the vacant Crown land. Some 76% or 58 000 hectares of the vacant Crown land had Site Index values which make growing of exotic pines an acceptable proposition. The area of vacant Crown land with desirable future usage for forestry totalled about 38 000 hectares or about 49%.

Assessments of recreational suitability of the vacant Crown lands were based on the potential number of recreation activities which could be pursued. Some 18 300 ha or 24% of the area were adjudged to have a high recreation potential.

All lands within the study area were appraised for their value as unique ecosystems and the necessity and suitability for preservation as permanent natural areas. Some 40 500 hectares were identified as being suitable. Of this approximately 26 000 hectares are vacant Crown land. The areas of desirable nature conservation use occur on 26 700 hectares or 35% of the vacant Crown land.

It was concluded that the most desirable future use for 5% of the vacant Crown land or 3 800 hectares was for urban and other infrastructure purposes. These areas were located mainly near Maryborough and Woodgate.

Mary River-Tinana Creek land use study

Following a preliminary investigation in 1972 and 1973, a joint feasibility study of the Mary River-Tinana Creek lands was undertaken by the Irrigation and Water Supply Commission, Bureau of Sugar Experiment Stations and Department of Primary Industries.

Sugar-cane planted in rows on the contour as part of a soil conservation plan for the farm.

As part of this task, Branch officers have been undertaking detailed assessments of existing potentially suitable sugar-cane land for the proposed irrigation scheme. Some 10 000 hectares of land adjacent to the Mary River and Tinana Creek have been surveyed and mapped. Within the completed area, there are 4 800 hectares of existing cane assignment. There is an additional gross area of about 4 000 hectares of land (some in small parcels) which is suitable for growing sugar-cane under irrigation.

Stage II Leslie Dam and Condamine River flooding

The major flooding of the Condamine River with consequent damage to farm lands, crops and structures raised the question of how effective a modification of Leslie Dam could be in flood mitigation. A raising of the level of the existing

Leslie Dam (described as Stage II Leslie Dam) is one of several possible alternative means of providing additional water for crop irrigation purposes along the Condamine to Cecil Plains, and in the Brookstead area where underground supplies are being depleted.

Local advisory officers, Irrigation and Water Supply Commission staff and Economic Services Branch officers are collaborating in a study designed to define the relationship between flood height, flood type and extent of damage.

Resource investigations and studies

During the last 7 years or so, land and associated resources data have come to be recognized as mandatory requirements for the effective planning of land use at both farm, region and State levels.

Because of special expertise in this field, Development Planning Branch officers have become increasingly involved in these types of projects.

Set out below are current projects being undertaken and all except the Boyne Valley study are wholly funded from Consolidated Revenue.

Western Arid land use study

The Western Arid land use is a long-term project spanning approximately a decade to 1980 and is divided into five parts aggregating approximately 60 million hectares. It embraces the pastoral areas lying generally west of the 400 mm isohyet.

The study is being conducted to provide an inventory and interpretation of resources as a basis for decisions by Government and industry on the principles of management, social organization and institutional structure required to maintain the desirable economic balance consistent with the conservation of the resources and the preservation of the long-term productivity of the area.

Investigations have been completed in Part I (about 15 million hectares) in the south-west sector, and Part II (about 10 million hectares) in the central sector extending westerly from Blackall-Adavale to Windorah. Maps and most of the sectional material for Part II were completed during the year under review.

Field investigations were completed in Part IV (about 3·5 million hectares) which lies to the east and north of Part II, and the compilation of maps and reports is proceeding. Preparations were made for the commencement of field investigations in Part III (about 5 million hectares) and Part V (about 26 million hectares).

Northern sheep area study

Preparation of the final report was continued. The study is based on a systems approach using a simulation model of a typical Mitchell grass downs sheep property and has the broad objective of defining the problems of management in an environment of climatic, and hence productive uncertainty.

Granite-traprock area

The report on the study of the granite-traprock area in south Queensland reached the printing stage and will be published in two volumes. Part I comprises a comprehensive inventory of the land resources of the region and Part II describes and discusses land use.

The study area includes Stanthorpe, extends along the State border with New South Wales westwards towards Inglewood and northwards to a point west of Warwick. A large number of Departmental and other officers has been involved in different aspects of the study, but the information is collated and presented in report form by an officer of Development Planning Branch.

The area is the most important pome and stone fruit producing area in the State while grape and vegetable production are also of significance. Pastoral lands have been made more productive by treatment of native timber and the introduction of sown pasture species. Substantial quantities of honey are produced. State forests provide timber and it is expected that the area will find an increasing role for tourism and recreation purposes. Girraween National Park is being used to capacity by visitors.

Boyne Valley study

A draft copy of the Boyne Valley Preliminary Land Use Assessment was completed and a limited edition report of 40 copies was published and forwarded to the Gladstone Area Water Board.

Following examination of the Preliminary Land Use Study, the board decided to commission a private consultant to undertake an in-depth study of the areas close to the proposed water storage and then draw up a catchment control plan including a set of maximum land use intensity guidelines.

The proposed land use controls would be enforceable under the board's power to control land use. Branch staff have been in liaison with the consultant and have made all working material and draft maps available for his use. They are also continuing with land resource assessments in the upper catchment.

Walloon soil studies—Glengallan Shire

Within the Glengallan Shire, there are approximately 25 000 hectares of land on which the soils are derived from Walloon sediments parent material. The soils are predominantly of the deep heavy clay type, are of suitable fertility and are extensively used for agricultural cropping. Due to the slopes on this strongly undulating land, serious soil erosion occurs.

A geomorphological survey of the Walloon sediments in Glengallan Shire was undertaken as a precurser to the detailed soils investigations. A map titled 'Warwick-Killarney Area, Geological Plan' at a scale of 1:100 000 has been prepared for publication.

Detailed soil and land studies in conjunction with land management, crop performance and productivity surveys have been carried out in typical areas of the forest Walloons. Initial work was concentrated in the Junabee area involving detailed mapping of some 5 000 hectares.

As a result of joint consultative work with Soil Conservation Branch staff in the area, minimum contour bank specifications were developed for the Walloon soils. Requirements are for banks with a broad base on the top side on all Walloon soils except the Toolburra types where narrow-based banks are adequate.

Eastern Downs soil conservation study

Officers of the Development Planning and Economic Services Branches are engaged in a study on the eastern Darling Downs to determine the feasibility of using pastures as a specified form of land use on the currently cultivated steeper zone 3 and 4a lands.

The study has used Project Plans to determine the distribution of zones for samples of farms on the uplands and is considering both the technical and economic feasibility of a change in land use from cultivation to pasture. A preliminary report on the study was completed towards the close of the year.

Special activities

In addition to the activities already outlined, some Branch officers have undertaken special duties in collaboration with other agencies in fields related to the effects of natural disasters (droughts and floods) and the resolution of problems of the beef industry.

The projects are outlined below and are funded from Consolidated Revenue.

Natural disasters

The Drought Secretariat which is staffed by Branch officers has assumed a co-ordinating role in relation to natural disasters affecting primary production. Though no widespread drought occurred during the year staff were involved in the preparation of material and in convening a working party on 'land use and land management, with particular reference to the arid zones' and submitting a draft report to the initiating body, the Commonwealth and States Committee on Natural Disasters (which includes drought).

Floods and cyclones were experienced over the summer months. Major flooding occurred in the Condamine River system, the Border Rivers and the Warrego and Paroo in the south-west. At the farm level, estimates of primary losses due to abnormal flooding amounted to $8·4 million, comprising livestock $1·6 million; crops $3·3 million; structures, plant, stored fodder and grains and soil erosion $3·5 million.

Concessions on the cost of freight on livestock and fodder were introduced by Government to aid producers in addition to loans for 'carry-on' purposes and restocking in necessitous cases.

Staff have been involved in the co-ordination of data for the development of a simulation model related to the use of arid lands for grazing with the accompanying risks of deterioration, erosion and loss of productivity. The project is under the auspices of the Australian National Committee for SCOPE (Standing Committee on Problems of the Environment) which is a Committee of the International Council of Scientific Unions.

Beef industry problems

The beef industry's problems have not been resolved, despite some temporary increases in cattle prices at some periods during the year. Cattle numbers have continued to rise in Queensland but have more or less stabilized over the remainder of Australia.

The Beef Industry Committee established last year by Cabinet has held several meetings and considered some 73 submissions in addition to suggestions in correspondence. The Committee recommended 11 specific measures for short-term relief. On marketing, a restructuring of the Australian Meat Board has been proposed. A stabilization scheme has been explored at interstate and Federal level and a working group currently has responsibility for attempting to devise a marketing scheme which will provide for stability in the domestic market.

Publications, reports and papers

An important objective of the Branch is to make known as widely and as soon as possible the results of its investigations. Because much of the data is original, is depicted in map form and is of value to a wide spectrum of users, publication is the simplest method of providing access to the data. Officers have contributed to 11 publications, reports and technical papers during the year.

Soil Conservation Branch

IT is a duty of the Branch under the provisions of *"The Soil Conservation Act of* 1965" to carry out investigations to ascertain the nature and extent of soil erosion throughout the State.

Set out below are investigations undertaken or observations made during the period under review.

Nature and extent of soil erosion

Soil conservation study

The Queensland section of collaborative Commonwealth-State soil conservation study investigations were undertaken wholly by Branch staff in accordance with the format determined by the Study Director. The assessments were made for non-arid and arid lands of the State.

The investigations reveal that over 200 000 square kilometres or about 25% of Queensland's non-arid areas required corrective treatment as at June 1975 while more than 400 000 square kilometres, or about 50% of the arid areas require treatment.

The non-arid areas which have received partial or full treatment in Queensland represent about 6% of the above total including about 30% of those extensively cropped lands which require treatment. The arid areas have received little attention.

Erosion and land degradation investigations

During the year, several programmes were established which will lead to the measurement of soil erosion in the field.

The results of soil erosion studies overseas have been reviewed resulting in the development of means for measuring sheet and gully erosion in the field. Flumes to measure run-off and sedimentation were designed and are under construction.

Investigations have been established in the Upper Nogoa catchment to measure gully head advancement while water samples from a selected tributary are being monitored for sediment content.

A review of the wind erosion situation was undertaken and there are indications that some 15% of the non-cultivated parts of the State are affected while a further 15% would be susceptible if protective vegetation cover were removed.

An investigation has begun on 377 000 hectares of the Bremer-Lockyer catchments to quantify the amount and distribution of various types of erosion and soil salinity, to determine the nature of the process and the factors responsible and to devise corrective management techniques and necessary land use controls.

A project was also commenced in the Mackay District cane lands to develop and test rapid methods of measuring erosion, to use these to demonstrate the existence of erosion and of the effectiveness of present erosion control methods, and to develop criteria for the determination of land suitable for sugar production.

The Burdekin Basin erosion study has been completed and the broad conclusions are that the area is almost wholly used for grazing, less than 0·5% of the region has been completely cleared of timber and about 12·5% of the area is subject to some form of water erosion. Significant areas of severe erosion occur around the junction of the Burdekin River and Camel Creek and around Charters Towers while advanced erosion is evident in the Camel Creek, Douglas Creek, Clarke River and Boughton River catchments. Yields of sediment from the North Burdekin are estimated to range from 4·6 to 8·6 million tonnes per annum.

Field observations

The abnormally high summer rainfall resulted in serious erosion in a number of parts of the State. In the Central Highlands, serious erosion occurred for the third successive summer, and severe erosion also occurred on cane lands of the Lower Burnett and on pineapple lands in the Maroochy area.

On the Darling Downs, severe erosion occurred in waterways and watercourses but vegetative cover on cultivated lands lessened the losses on farms.

Because of the persistent saturation of steeply sloping lands in the coastal belt of the State, many areas of the Maleny Plateau, Buderim Mountain, Gympie, parts of the Moreton Region and Darling Downs have experienced landslips.

Deep gullies developed on duplex soil in a grazing area in the West Moreton Region.

Land use and conservation practices

The maintenance of soil cover and the application of conservation practices for the mitigation of erosion is now universally accepted and it is a principal objective of the Branch to encourage the adoption of these practices by farmers.

In the year under review, the progress made is less than is desired though the protection afforded by weed and crop cover on the southern Darling Downs during the abnormally heavy summer rains emphasized the value of such protection.

On the other hand, increasing areas of the South Burnett are being changed from a protective pasture land use to row cropping with increase in the erosion hazard without the offset of structural works. Gains in stubble mulching are offset by increased use of rotary hoes.

The increase in Queensland sugar-cane assignments has led to cultivation of some unsuitable land including the ploughing of drainage lines and the use of lands steeper than can be effectively protected. On the other hand, an identifiable but slight increase in interest in the harvest of green cane provides an offset.

On the Atherton Tableland, the area under maize has increased at the expense of permanent pasture without a corresponding increase in protective measures.

Increased use of stubble mulching is reported from several regions and the acceptance of trash farming by some innovating Central Highlands farmers is a significant forward step.

Investigations have been undertaken into farming systems and special use of vegetation for protective purposes, including—

Cropping potential studies on the Darling Downs have continued and the WBAL3 programme has been used to simulate cropping frequency, crop yields and run-off for the different soils in the 'Key Area' studies. Of the three cropping systems simulated (continuous wheat, continuous sorghum and opportunity cropping) the opportunity cropping system seemed most suitable as it increased the cropping frequency and annual yield and decreased run-off.

Conservation land management studies were commenced on the Darling Downs basaltic uplands to collect data and demonstrate opportunity cropping and stubble mulching management systems. Run-off recording apparatus is being installed.

The Torsdale land system reclamation project has resulted in re-vegetation of the depositional areas and those with horizons intact. Pioneer species (annuals) are the major component and only Rhodes and creeping blue grasses have shown any promise among the introduced species.

Investigation is being made of the possibility of using hydro-mulching equipment for establishing vegetative cover in waterways on highly erodible texture contrast soils of the coastal lowlands near Bundaberg.

Continued success is reported with the establishment of *Bothriochloa insculpta* as a waterway stabilizer particularly on the brigalow soils at Millmerran.

Work programmes

The work programme is the most important activity of the Branch since it results in positive steps by landholders to prevent or mitigate soil erosion. It is a major duty under *"The Soil Conservation Act of* 1965".

The effective end-point in work programmes is the implementation of necessary land use, land management and structural measures by landholders and this depends on the adequate development of the following components:—

Landholders' interest and financial capability.

Assessment of land resources and delineation of the limitations to use in terms of soil erosion hazard.

Planning land use, land management and earthworks for control of run-off.

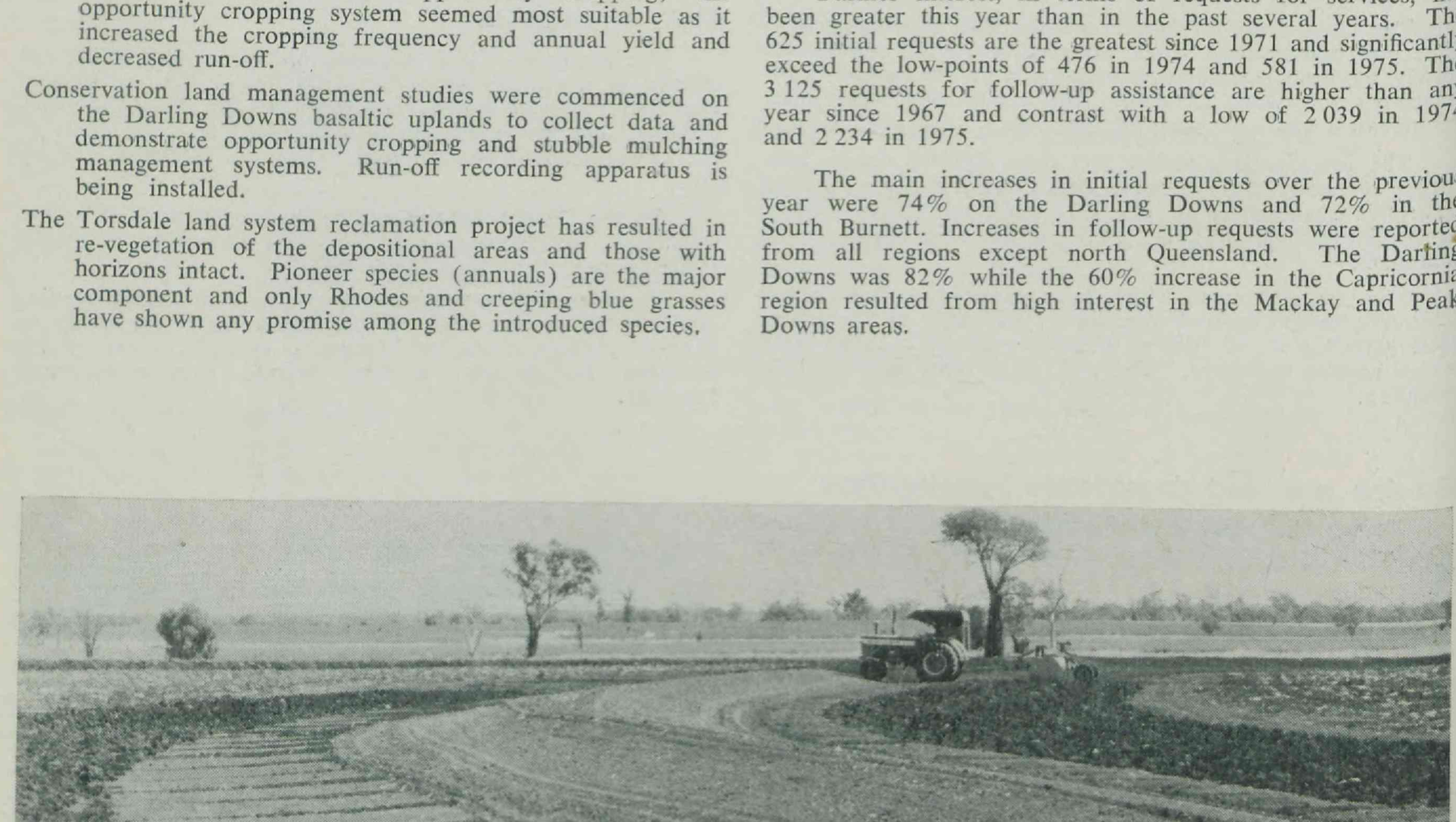
Implementation of planned measures.

Interest and activities under these headings are set out below and are funded principally from Consolidated Revenue but with some assistance from Commonwealth Extension Services Grant and Soil Conservation Grant funds.

Landholders' interest and financial capability

Farmer interest, in terms of requests for services, has been greater this year than in the past several years. The 625 initial requests are the greatest since 1971 and significantly exceed the low-points of 476 in 1974 and 581 in 1975. The 3 125 requests for follow-up assistance are higher than any year since 1967 and contrast with a low of 2 039 in 1974 and 2 234 in 1975.

The main increases in initial requests over the previous year were 74% on the Darling Downs and 72% in the South Burnett. Increases in follow-up requests were reported from all regions except north Queensland. The Darling Downs was 82% while the 60% increase in the Capricornia region resulted from high interest in the Mackay and Peak Downs areas.



A farmer using a special tractor-drawn implement to build his own broad-based contour banks.

Departmental activity was closely related to this upsurge and the 6 635 farm visits made by officers in the current year are double those for 1974 and an increase of 37% above 1975.

The 462 new co-operators for the current year are about equal to the previous comparable figure in 1971 and are substantially greater than the 263 in 1974 and the 349 for 1975.

Every effort has been made to stimulate the interest of landholders by numerous personal discussions on farms and by use of mass media, 32 field days and farm tours, 63 meetings, nine show displays, 122 press articles, 19 radio talks and five television appearances.

Landholders' interest is usually translated into action only if they have the financial capability to apply the required measures. Since soil conservation tends to reduce rather than increase income in the short-term, this activity is given lower priority for investment by farmers at financially critical times. The year under review is no exception, but there has been an increased investment in soil conservation measures.

The dollar-for-dollar subsidy scheme with maximum of $1 000 per farm, which is operative on the Darling Downs, has undoubtedly helped to bridge the financial gap and has no doubt helped in the remarkable increase in applied intensive measures. An amount of $82 934 in subsidies has been paid during the year.

On the other hand, the special soil conservation loans through the Agricultural Bank have been poorly patronized and only one application was made during 1975–76.

Land resources assessments

Though plans are in hand for the extension of land resources assessment work to other parts of the State, the principal activity in this field during 1975–76 was in relation to the Darling Downs statutory programmes.

The published 'Eastern Downs Technical Guide' emphasizes that much of the region is being used beyond its capability but because the report is broad-scale it lacks much of the detail required for farm planning.

During the year, special emphasis was placed on 'key area studies' which establish more detailed guidelines concerning the region's land resources. The relevant projects are—

WALLOON COAL MEASURES AND MARBURG SANDSTONES. Detailed reports covering these two resource areas have been completed. The information in this report has been made available to the field services staff.

Details on erodibility, soil moisture characteristics, salinity, fertility and other important land use factors are given in these reports together with soil conservation management recommendations.

BASALTIC UPLANDS (SCRUB). This programme started in early 1975 to characterize the agriculturally significant soils of this area; determine significant differences between the scrub and forest basalt soils; select easily recognizable features of the soils to develop zoning criteria; and determine physical and chemical properties, land use limitations and consequently management recommendations for each of the agriculturally significant soils.

Land slope is an important limitation in the use of land and to define this parameter topographic survey work was undertaken during 1975–76 on 19 277 hectares of land on the Darling Downs.

Planning

Planning activities are an essential process in integrating a landholder's interests and management aims with the technical requirements which the natural limitations impose on the use of land resources for permanent production. The end result is a land use and soil conservation plan for the property which also considers the integrated needs of all farms and public utilities in a common drainage area.

Special emphasis has been placed on planning activities during the year particularly in the statutory programmes where Project Plans or Provisional Project Plans form the basis for the implementation programme and payment of subsidy.

On the Darling Downs, 24 Project Plans were prepared and advertised. These plans covered 31 836 hectares in 11 subcatchments and include 217 farms. Other plans are in course of preparation. In addition, Provisional Project Plans were completed on 254 properties with an area of 46 996 hectares. Thus, in total, plans covering almost 80 000 hectares have been prepared on the Darling Downs and include 471 farms or about 8% of all Darling Downs farms likely to require control plans.

The Drafting Officers have been heavily involved in the presentation of plans acceptable for statutory programmes.

Elsewhere in the State, planning continued at a lower tempo but in the Burnett Region provisional project planning is nearing completion for 10 of the 32 catchments in the coastal lowlands land system. In the South Burnett, planning is almost complete for the Upper Yarraman planning area, while 39 property plans have been prepared.

Implementation

The year has been highly significant in the implementation of measures because on a State basis it has confirmed the reversal over the last 2 years of a downward trend which has been evident since the late 1960s.

A total of 39 347 hectares of land has been treated with a range of measures in 1975-76, a 17% increase over 1974-75 and 52% over 1973-74. However, the 1975-76 total is about equal to the achievement for 1972-73 and substantially less than the 59 696 hectares treated in 1969-70.

The Queensland total of 26 070 hectares of contour banks represents an 87% increase over the previous year and is the highest since 1970. The most notable increase occurred on the Darling Downs (85% increase), Capricornia (230% increase) and the Upper Burnett (230% increase). The implementation of 8 559 hectares of contour banks in the Capricornia Region is a remarkable effort having regard to relatively small staff numbers in the region and Emerald in particular.

The decline in the implementation of measures other than contour banks is due in part to a realization in some areas that simple measures do not adequately control erosion when high intensity rains occur. There has been a one-third reduction in such measures applied since the previous year but this loss is more than offset by gains in intensive measures on areas with higher erosion hazards.

Research

Research is a special duty under *"The Soil Conservation Act of* 1965" but has not been adequately catered for in the past. In the earlier years, the emphasis of the research programme has been placed on gaining information on the soil and land resources to develop guidelines for field programmes. While this is still continuing, more emphasis is being placed on the collection of basic data on soil erodibility, soil loss and erosion control measures.

To meet these needs, the research staff of the Branch was increased from 14 officers to 25 officers during the year, thus establishing an on-going basis for development of a constructive research effort.

Specific research activities have been described as part of broad Branch activities outlined earlier because the purpose of research is seen to be the provision of technical bases for work programmes and for the development of effective land use and land management criteria.

Special research activities are set out below and these, together with the other field research programmes, were funded from Consolidated Revenue, Commonwealth Extension Services Grants and the Soil Conservation Grant.

Indooroopilly Laboratory

Numerous field tests were conducted at this laboratory to assist in field activities and were related to problems with soil crusting, soil moisture and farm dam failures.

The rainfall simulator was placed in full working order during the year and a number of simulated runs were completed on soil from the Brigalow Research Station. Results from both the rainfall simulator and organic carbon analysis indicated considerable soil deterioration under the cropping treatment.

Toowoomba Laboratory

Aproximately 100 linear shrinkage tests have been conducted on soils from the 'Key Area' studies. Laboratory results have been related to field observations in contour banks. It appears that 16% linear shrinkage is a critical value for broad and narrow-based contour bank construction.

More than 570 soil moisture measurements at 15 bar have been completed for the Walloon Key Area survey.

Data collection, processing and analysis

The Research Section computing group act in both research and service roles. As a service, they are involved in the storage, retrieval and manipulation of survey data and the analysis of meteorological data. In their research role, they are concerned with the development and investigation of computer techniques for soil conservation purposes.

As a result of their investigation of the grid cell approach developed for use in Queensland, other organizations, including the New South Wales Soil Conservation Service, are using the technique.

Remote sensing

It is apparent that, as more and more work is done using imagery from the Landsat satellites, it will prove to have direct application in land degredation and land resource studies. Computer tapes covering images of the Darling Downs have been bought and investigations into their processing and use have commenced.

Special activities

Commonwealth-States study

A collaborate Commonwealth-States joint Soil Conservation Study was undertaken for the purpose of providing information on which long-term assistance by the Commonwealth to the States for Soil Conservation could be based. Queensland agreed to second to Canberra, for 12 months to 31 March 1976, its Director of Soil Conservation Branch to lead the collaborative study team, and the Acting Branch Director has served as State Liaison Officer.

A substantial number of Branch officers participated in various aspects of the Queensland part of the study. The Study Report is expected to be completed early in 1976-77.

Soil conservation conference

The theme of the Australian Soil Conservation Conference 1975 was 'the Role of Land Resource Evaluation in Soil Conservation' and proved to be particularly relevant to certain aspects of the current soil conservation study.

The conference highlighted the changing emphasis in soil conservation activity throughout Australia, particularly in the increasing involvement in rural and urban subdivision planning. However, desirable though the emphasis on land resource assessment and soil conservation in urban development may be, the soil conservation organization in Queensland can ill-afford, at present at least, the time and staff commitment necessary to cope with the detailed resource assessment and planning work.

It is necessary, however, to review the role of the Branch and other organizations, particularly in the rural subdivision areas, to determine the extent to which the Branch should be involved.

Branch reorganization

A combination of Organization Development (O.D.)—a participatory exercise in management—and Kepner Tregoe (K.T.)—a course involving training in techniques of problem solving and decision making—has resulted in an informal reorganization of administrative structure and procedures in the Darling Downs region.

The major changes include—

The setting-up of a Darling Downs Regional Management Group comprising the Officer-in-Charge, the Southern Area Leader, the Northern Area Leader, the Regional Research Supervisor and the General Activities Leader.

The regionalization of research, with the research staff responsible administratively and for regional programmes to the Officer-in-Charge of the Region, but technically to the Supervising Soil Conservationist (Research).

The communication link from the Region to Head Office is from the Officer-in-Charge to the Assistant Director who becomes the co-ordinator of Branch activities at Head Office.

The Head Office Branch Management Group comprises the Director, Assistant Director and the Supervising Soil Conservationists of the Research and Field Services Sections. Some changes in the functions of the members of this group have been made on a trial basis to complement those made in the Darling Downs Region. If they continue to be successful, it is envisaged that the changes will be adopted for other regions during 1976-77.

The regionalization of research throughout the Branch is a matter to be resolved as there are research staff in the Moreton, Darling Downs, South Burnett and Capricornia Regions.

Publications

Prompt publication of information resulting from investigations ensures that the data can be rapidly utilized in field programmes. In addition, the process is a vital requirement for communication of information to landholders and the general public.

Officers of the branch contributed to 11 technical publications during the year and additionally contributed 11 papers to the Australian Soil Conservation Conference.

Engineering Services Section

THIS report covers the first full year's activities of the recently-formed Engineering Services Section functioning as an integral part of the Division of Land Utilisation.

It is the principal responsibility of this section to provide engineering technical services to any unit of the Department requiring these services either directly in relation to Departmental institutions or indirectly on account of primary producers requiring such assistance.

As there are no engineers north of Toowoomba, the geographical range of assistance during the year has been somewhat restricted.

The programme of the section falls into various categories set out below and although salary and operating costs are funded principally from Consolidated Revenue very substantial assistance in equipping the Toowoomba Workshop has been provided from the Commonwealth Extension Services Grant.

Extension activities

Technical communication with Departmental officers and farmers is an important section objective but this extension work remains a very time-consuming activity. In an endeavour to maximize coverage, some of the section's engineers have made themselves available during evenings to address farmer groups and a library of reference drawings as well as technical bulletins are being produced for the use of both farmers and extension staff.

Workshop activities

One of the highlights of the year was the acceptance of a tender for the construction of the new workshop complex at Toowoomba. When completed, the new workshop will provide the properly set out machine and fabrication shops needed for the modification and fabrication of new designs for farm machinery.

Branches served

Soil Conservation Branch

Soil Conservation Branch is served by two engineers full-time and one engineer part-time.

These officers were engaged in work on the following projects—Civil engineering services related to interaction of soil conservation works with those of statutory authorities and to potential water storage and usage aimed at control of erosion. Design and construction of special machinery required for soil conservation purposes. Design of a modified rainfall simulator to simulate different energy levels of rainfall intensities. Undertaking topographic surveys. An area of 19 277 hectares was surveyed in 1975–76.

Agriculture Branch

Agriculture Branch is served by two engineers full-time and one engineer part-time. They were engaged in work on the following projects—

PRESS WHEEL PLANTING TECHNIQUE PROJECT. Efforts during the year were concentrated on the purchase of the necessary instruments, the development of techniques for attaining the measurements required and the re-definition and notification of objectives so that data collection and collation can proceed.

GRAIN DRYING. The preparation of a Divisional bulletin on grain dryers has begun.

NAVY BEAN CUTTER. A front-mounted, eight-row navy bean cutter was designed. The major feature of this machine is the vee belt drive interconnection between each bank of discs, which eliminated any tendency to counter rotate (a problem in uneven and stony ground) and thereby threaten bean damage and loss.

EXPERIMENTAL EQUIPMENT REGISTER. This register has now reached the printing stage. It may prove to be the forerunner of an eventual Autralian Register.

OTHER EQUIPMENT. The following items were either designed and fabricated, or were modified, in the workshop to meet some additional requirement: maize plot harvester, field drying oven, horticulture fertilizer applicator, tobacco fertilizer applicator, market for potato planter, mechanized soil sampler.

Pig and Poultry Branch

Pig and Poultry Branch is served by one engineer full-time who is engaged in work on the following projects—

FERTILIZER VALUE AND POLLUTING POTENTIAL OF PIGGERY EFFLUENT. Because of the narrowing gap caused by the continuing expansion of cities and towns as they push closer to the farmer, this project had a high priority.

CATALYTIC BROODERS IN TENTS. Investigations were carried out into the performance of a new type brooder and showed that tent management, positioning of temperature controller senser, and placing of brooders within the tent, were more important factors influencing brooding than the heating capacity of the brooders themselves.

Advisory service

MACHINERY AND IMPLEMENT ADVISORY SERVICE. The development of a machinery selection and advisory service to farmers is an essential Departmental service and is one in which the section should become more involved. Staffing difficulties prevented this being undertaken during the year but, with a field services engineer soon to be appointed for Redlands Horticultural Research Station, the gathering of background data and information from that area could enable a limited start during 1976–77.

Drafting Section

THE Drafting Section performs a most important service function in the Division because it visually depicts in map form the large volumes of technical data emerging from the many land resource investigations of the Division and, to a lesser extent, other Divisions of the Department.

Other Divisions are serviced to the extent of about 10% of total drafting time.

The section also translates into map form the measures specified for erosion mitigation and defines their areal location.

Set out below are specific work areas most of which are funded from Consolidated Revenue.

(1) *Resources Survey Maps*

These activities accounted for 61% of the total drafting time and included the mapping requirements for the following Divisional Projects:—

Moreton Region Non-Urban Land Suitability Study
Elphinstone—Talgai Soils
Bremer—Lockyer Study
Nambour Study Area
Burdekin Basin Study
Granite-Traprock Study
Western Arid Study
Coastal Lowlands Land Use Study
Northern Sheep Industry Study
Boyne River Catchment Study
Atlas of Queensland Resources
Mary River-Tinana Creek Land Use Study
Geological Report Maps
Burdekin-Elliott River Soils Maps.

(2) *Soil Conservation Guides and Maps*

These activities accounted for 9% of the total drafting time and supplemented the activities of regional mapping units. Work for the year included:—

Rosalie Shire Area of Erosion Hazard
Wooroolin Swamp Catchment Plan
Property Plans
Data Preparation Forms
Miles Technical Guide.

(3) *Miscellaneous Drafting*

These activities accounted for 20% of the total drafting time.

An example of the sound soil conservation measures recommended by the Department of Primary Industries. This is an aerial view of strip cropping and contour ploughing on the Darling Downs.

By Authority: S. R. HAMPSON, Acting Government Printer, Brisbane