QUEENSLAND

Annual Report

of the

DEPARTMENT of AGRICULTURE and STOCK

1960-61

PRESENTED TO PARLIAMENT BY COMMAND

A. 20—1961

ORGANISATION OF THE DEPARTMENT AS AT 30th JUNE, 1961

MINISTER FOR AGRICULTURE AND FORESTRY .. Hon. O. O. Madsen, M.L.A.

CENTRAL ADMINISTRATION AND CLERICAL AND GENERAL DIVISION—

Director-General and Under Secretary .. .. W. A. T. Summerville, D.Sc.
Deputy Director-General .. .. W. Webster, B.V.Sc.
Assistant Under Secretary .. .. H. Barnes.
Special Administration Officer .. .. C. L. Harris, A.A.S.A.
Officer in Charge, Information Services .. .. C. W. Winders, B.Sc.Agr.
Accountant .. .. E. C. R. Sadler, A.A.U.Q.

DIVISION OF PLANT INDUSTRY—

Director of the Division .. .. W. J. S. Sloan, M.Sc.Agr.

Agriculture Branch—

Director of Agriculture .. .. L. G. Miles, B.Sc.Agr., Ph.D.

Horticulture Branch—

Director of Horticulture .. .. J. H. Smith, N.D.A., M.Sc.

Regional Experiment Stations Branch—

Director of Regional Experiment Stations .. .. W. J. Cartmill, M.Sc., A.R.A.C.I.

Science Branch—

Sections of Botany (S. L. Everist, B.Sc., Government Botanist); Entomology (W. A. McDougall, D.Sc., Government Entomologist); and Plant Pathology (J. H. Simmonds, M.B.E., M.Sc., Government Plant Pathologist).

Chemical Laboratory—

Agricultural Chemist .. .. C. R. von Stieglitz, F.R.A.C.I.

Food Preservation Research Branch—

Director, Food Preservation Research Branch .. S. A. Trout, M.Sc., Ph.D., F.R.A.C.I

DIVISION OF ANIMAL INDUSTRY—

Director of the Division .. .. A. L. Clay, B.V.Sc.
Assistant Director .. .. C. R. Mulhearn, B.V.Sc.

Veterinary Services Branch—

Director of Veterinary Services .. .. .. C. R. Mulhearn, B.V.Sc.

Pathology Branch—

Director .. .. L. G. Newton, B.V.Sc.

Biochemical Branch—

Biochemist .. .. J. M. Harvey, D.Sc., A.R.A.C.I.

Husbandry Research Branch—

Director of Husbandry Research .. .. .. J. W. Ryley, B.V.Sc.

Sheep and Wool Branch—

Director of Sheep Husbandry .. .. A. T. Bell, B.V.Sc.

Cattle Husbandry Branch—

Director of Cattle Husbandry .. .. .. D. N. Sutherland, B.V.Sc.

Pig and Poultry Branch—

Sections of Pig Husbandry (F. Bostock, Senior Pig Husbandry Officer); and Poultry Husbandry (F. N. J. Milne B.Sc., Senior Poultry Husbandry Officer).

DIVISION OF DAIRYING—

Director of Dairying .. .. E. B. Rice, Dip.Ind.Chem., M.Inst.Biol.

Research Branch—

Director of Research .. .. L. E. Nichols, B.Sc.Agr., A.R.A.C.I.

Field Services Branch—

Director of Field Services .. .. F. C. Coleman, Q.D.D.

DIVISION OF MARKETING—

Director of Marketing .. .. H. S. Hunter.

Marketing Branch—

Director of Marketing .. .. H. S. Hunter.
Assistant Director of Marketing .. .. .. A. A. Ross, M.Agr.Sc.

Economics Research Branch—

Director of Economic Services .. .. C. H. P. Defries, H.D.A., B.Com., A.F.I.A.

Standards Branch—

Standards Officer .. .. A. C. Peel, Dip.Ind.Chem., A.R.A.C.I.

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REPORT OF THE DEPARTMENT OF AGRICULTURE AND STOCK FOR THE YEAR 1960-61

To the Honourable the Minister for Agriculture and Forestry

Dear Sir,

I have the honour to submit herewith the Annual Report of the Department of Agriculture and Stock for the year ended June 30, 1961. It takes the form of an overall review of the various primary industries and the major activities of the Department, followed by a summary of the operations of the various Branches of the Department.

Yours faithfully,

W. A. T. SUMMERVILLE,
Director-General of Agriculture and Stock.

GENERAL REVIEW

Seasonal conditions were somewhat irregular throughout the State and on the whole the year was not a favourable one for the primary industries.

July 1960 rainfall was below normal in most areas and widespread heavy frosts dried out pastures. By the end of September, drought conditions prevailed over a vast area of the State and led in early October to the cutting and baling of large areas of winter cereal crops to provide emergency fodder. Rain towards the end of October improved conditions in agricultural and contiguous districts in the south-east, but cattle and sheep areas remained dry, with water supplies and pasture poor.

Temporary relief came to many dry pastoral areas late in November, but the extreme west remained drought-stricken until late in December, when good rains were received in the north-west and central-west. These were followed by good rains in January, which extended into the Channel Country.

Above-average rains in February ended a dry period in the central and southern districts, but conditions deteriorated with the failure of monsoon rains in March and the season continued dry for the remainder of the period.

TRADE CONDITIONS

Australia's rural industries in 1960-61 showed a volume increase estimated at 6 per cent. over the previous year and the volume was the highest ever recorded. Reduction in output and price of wool and reductions in slaughterings of beef cattle and production of dairy products contributed, however, to the increase in the gross value of rural production being less than 2 per cent. (estimated).

The value of rural exports is estimated at £700m., this being £29m. lower than the previous year's aggregate. Wheat export value was up by £46m., barley by £4m., and sugar by £8m., but wool fell by £54m., meats by £16m., and dairy products by £10m.

THE SHEEP INDUSTRY

A large increase in slaughterings of mutton sheep at abattoirs reflected the dry conditions that prevailed over most of the sheep area during the year. Graziers disposed of older sheep that would have been fed on grain had wool values been higher. The demand for mutton in lieu of beef as a base meat for smallgoods increased greatly because of the cheapness of mutton.

In the 1960-61 series of wool sales, offerings were 776,503 bales, which realised almost £54m. for an average price of 53.42d. per lb. compared with 57.22d. in 1959-60. The volume marketed was 2.15 per cent. lower than in the previous year and realisations were 9.3 per cent. down. The first sale of the series realised an average of 49.57d. per lb. and the next three sales were around this low value. A slight recovery came in November, but this was followed by considerable drops at the next two sales. The highest average reached was 60.07d. and the decline from this for the last two sales was due to some extent to a percentage of offerings of lower standard. Japanese buyers were most prominent throughout the selling season, with United Kingdom and Continental buyers giving good support.

Reaction to general industry anxiety concerning low wool values and the increasing competition from synthetics was reflected in moves to improve the position at a national level. The Commonwealth Government set up a Wool Marketing Committee to investigate wool promotion and the advisability or otherwise of a floor price at auction sales of Australian wool. A referendum was organised by the Australian Wool Bureau on the question of increased payments by wool producers for wool promotion.

The steady upward trend in fat lamb production continued, slaughterings of 313,744 at Queensland meatworks in 1960 being 31.4 per cent. higher than the 1959 figures.

BEEF

The year was a difficult one for the meat industry generally and for the beef industry in particular. Dry conditions over most of the State resulted in fewer good quality cattle for the local trade. The highest prices ever recorded at the Brisbane Abattoir saleyards were obtained for prime cattle when the shortage was most acute. It was not until prices fell in April that operators could trade profitably on the export market, and this resulted in a month's delay in opening of export works. The export boner trade afforded a useful outlet for the poorer type of cattle.

Beef cattle were in fair condition in July 1960 and no losses were reported up to the end of September, though slaughterings were well down. Subsequent losses up to the December rains were lighter than in previous droughts of equal severity due to better watering facilities and lower stocking rates attributable to heavy slaughterings in the previous year. Road transports permitted movements to agistment over stock routes which would otherwise have been impassable.

Considerable interest was shown during the year in the potentialities for increased turn-off of beef cattle in Queensland. One result of this was an offer by the Commonwealth Government to assist financially towards the construction of outlet roads from some of the more remote breeding and fattening areas, in particular, the Gulf country and the Channel country. The State Government acted quickly and a contract for construction of a road to link Normanton with Julia Creek on the Great Northern Railway was let during the year.

The possibility of releasing a substantial area of Crown land on the wet tropical coast for development of tropical pastures for cattle fattening was further examined, and a special Land Classification Committee, which includes a representative of this Department, was set up to advise on the matter.

Delays in deciding ways and means of collecting a levy for beef cattle research at a national level hindered the development of research plans.

The national campaign for the eradication of contagious pleuropneumonia of cattle got under way during the year. The Department set up a special team of stock officers to conduct the season's operations.

CROPS

Australia had a record wheat harvest in 1960-61 estimated at 271 million bus., valued at £193m. The average price was slightly higher than for the previous crop. Exports of Australian wheat were more than 50 per cent. higher at 180 million bus., higher sales to China and Italy contributing to the boost. The national barley harvest of 67 million bus. was also a record, but export and domestic prices were lower than in the previous year.

Plate 1.—Aerial photograph showing how the usual mosaic of squares and rectangles on sloping farmlands is being changed to an integrated pattern of contours in order to control soil erosion. This is portion of some 50,000 acres of maize and peanut land in the Kingaroy district that is now being contour farmed. A similar area is being farmed this way on the Darling Downs.

Plate 2.—Seed of hybrid grain sorghum Texas 610 being grown under Departmental supervision on the Darling Downs.

Because of dry conditions at planting time, wheat sowings in Queensland were restricted to 850,000 acres and prolonged dry weather resulted in a yield of only about 10 million bushels from 650,000 acres retained for grain. The average yield was thus less than 16 bus. per ac., compared with 19.8 for the previous season. For the 1961 planting an estimated 850,000 acres was prepared.

Approximately half the 1960 crop was handled in bulk and new storages being built by the State Wheat Board will increase the bulk handling capacity by about 1 million bushels.

Though rust infestation was light because of the dry weather between early August and late October, rust was observed on a number of hitherto resistant varieties and undoubtedly a new race of rust has made its appearance. This is causing much concern, as there are now very few strains of wheat available with completely satisfactory resistance.

In anticipation of the opening of the Wheat Research Institute at Toowoomba in 1962, a Senior Plant Pathologist was sent overseas to examine investigational work akin to that which is proposed for the new Institute.

The State's barley crop of about 3½ million bushels from an estimated 220,000 acres reserved for grain was the smallest crop since the 1957 harvest. So far, growers have concentrated on malting barleys, but as barley continues to demonstrate its yield advantages over wheat on older and less fertile land, it is possible that wheat will give way to some extent to plantings of 6-row barley for feed grain.

Grain sorghum yielded an estimated 5,800,000 bushels from 200,000 acres reserved for grain at the 1960 harvest. It is possible that the advent of hybrid varieties will lead to an increase in the acreage under grain sorghum within the next two or three seasons. Despite the dry season, hybrids in many cases gave twice the yield of the standard varieties. Satisfactory progress has been made with arrangements for seed increase of hybrid varieties, 11 apprentice growers completing their apprenticeship for a production of 3,400 bus. of seed.

With a more general acceptance of hybrid maize and a wider ownership of all-crop grain harvesters, there has been a movement of maize back into traditional maize-growing areas that had surrendered ground to grain sorghum. Total production for the 1960 season is estimated at 3½ million bushels from 130,000 acres harvested. The North Queensland crop was the best since 1952-53, but the Darling Downs crop was a poor one. The 1961 harvest is estimated as 3½ million bushels from 140,000 acres. About two-thirds of the total acreage is now planted to hybrid varieties. A noteworthy development is the expansion of the acreage of hybrids on the Atherton Tableland from 2 per cent. to nearly 50 per cent. within the past five years.

Linseed yield was low in 1960 because of dry conditions and only 400,000 bushels was obtained from a planting of 62,000 acres. Prospects for the 1961 harvest are poor because of bad planting conditions. The popularity of the crop is declining because of a nutritional disorder and the need to apply insecticides for pest control.

The 1960 sugar crop experienced very favourable weather conditions in all districts and quality of cane reached a record level, the commercial cane sugar averaging 15.2 per cent. and one ton of sugar being made from only 6.58 tons of cane. The total crushing of 8,686,369 tons of cane yielded 1,319,944 tons of raw sugar, valued at £64,500,000. About 2.7 per cent. of the cane was mechanically harvested and 47.8 per cent. was mechanically loaded.

The Sugar Board acquired 8½ per cent. in excess of the 1960 mill peaks to fill orders, but substantial quantities of cane remained unharvested because of restricted market outlets.

Adverse seasonal conditions caused many crops to be backward for the 1961 harvest, but the official estimate is that the crop available for harvesting is 8,975,000 tons, with an anticipated yield of 1,270,880 tons. The United States Government announced in June that it would purchase 80,357 tons of Australian raw sugar as part replacement of supplies previously received from Cuba. This will enable most surplus sugar stocks on hand to be cleared.

The 1960 harvest of peanuts yielded 40,355,133 lb. from 41,547 acres planted. Both acreage and yield were considerably depressed by dry weather in the South Burnett. The 1961 crop is expected to be at least 47 million lb. from an effective area of about 46,000 acres. The urgent need for peanut hay for stock fodder in 1961 resulted in a trend away from fully mechanised harvesting and back towards stooking. However, the development and production of locally made pick-up threshers continues in the Kingaroy district.

The 1960 cotton harvest yielded 11,770 bales of raw cotton from about 42,000 acres picked. Variable planting rains for the 1961 crop caused sowings to be spread from October to early January. Inadequate rainfall in February and succeeding months caused crop losses in the southern and Central Burnett districts and the total crop is estimated at about 7,000 bales from 20,000-25,000 acres harvested. The production is not unsatisfactory considering that the southern crops were almost a total failure. New ginning and cleaning processes at both the Glenmore and the Whinstanes ginneries will improve the quality of lint produced.

Remarkable expansion of tobacco acreages in all recognised growing areas occurred during the year. The 1959-60 crop occupied about 10,000 acres and 9,750,000 lb. of leaf was produced. The 1960-61 crop area rose to 15,500 acres and the yield is estimated at over 15 million lb. A similar rate of expansion has occurred also in Victoria, and New South Wales acreages have increased, too, with the result that fears are held for the stability of the industry should the trend continue.

In recent years, high monetary returns per acre because of high yields, almost total clearances of leaf and average prices generally in excess of 12s. per lb. gave the industry a tremendous boost. New farms were opened up in Mareeba, Ingham, Bundaberg and lower North Coast districts, and areas were increased on existing farms in the lower Burdekin and southern border districts. The position has now been reached at which a substantial proportion of the leaf offered for sale is attracting low bids or no bids at all from buyers because of unacceptable quality.

Manufacturers cannot be expected to spoil their blends by using inferior leaf, and it is obvious that quality must be the keynote of future production.

Research and extension activities proceeded in both northern and southern producing areas.

Production of apples again exceeded 1,000,000 bushels, and about 120,000 bushels were exported, including some in experimental 25 bus. bulk bins. Cold stores were severely taxed to handle the crop and the erection of units additional to the present capacity of 390,000 cases in the Granite Belt is under consideration. An interesting recent development is the provision of irrigation facilities for about 150 acres of apples. There is a growing interest in pear production and this can be expected to continue if there is an appreciable demand from canners for Queensland-grown fruit. The season was a reasonably good one for stone fruits, and grape growers had an excellent year.

The pineapple industry is emerging from the doldrums of the past three years but a number of small producers have left the industry. The 1960-61 summer crop was a poor one owing to small fruit size. Production was estimated at 1¼ million 1½ bus. cases from about 12,000 acres under crop. Plantings in 1961 were very heavy and production may shortly cause concern to the industry if markets cannot be expanded. The recession in the industry had some good effect, inasmuch as the need to reduce production costs led to the adoption of improved management practices in many plantations. Contouring is widely practised on hilly country, new fertilizer schedules have been adopted, there has been a trend towards close planting in the row, and weed control and harvesting operations are becoming mechanised.

Papaw production was down slightly on the previous year due to dry conditions and dieback. About 40 per cent. of the crop of 240,000 bus. went to canneries. On present prospects, only limited quantities of fruit will be available to canneries from the current crop.

Banana production for the year was high at an estimated 510,000 bus. from 6,250 acres under crop. Weather conditions over the past few years have upset the normal cropping habit in many plantations. The normal glut of fruit in the summer did not occur in 1960-61 and returns were high; on the other hand, there promises to be a very heavy cut in winter and spring. There has been some interest in dam construction to provide irrigation facilities for bananas.

The 1960 citrus crop was below average at about 650,000 bus. from 5,700 acres, and the 1961 crop was also light. Meyer lemon plantings of a few years ago are now bearing and the fruit appears on the Brisbane and Sydney markets in the summer months. The grapefruit market has improved in the last four years and there is a demand for budwood under the Citrus Budwood Distribution Scheme.

Production of avocadoes is static at about 2,700 bus., but the supply position should improve as young trees come into bearing. The market demand for the fruit remains limited.

Strawberry production in 1960 was relatively light, the estimate being 950,000 lb., with a factory intake of 460 tons being well below requirements. Crop prospects for 1961 are good. Consignments being sent by air to potential markets in the tropics might open up new outlets for the crop.

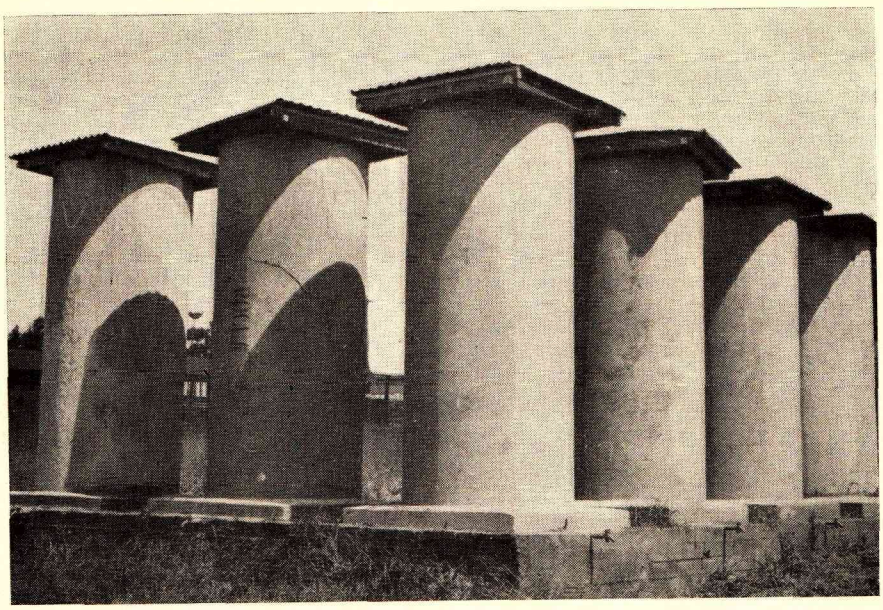

Plate 3.—Experimental silos used for pasture silage experiments at Kairi Regional Experiment Station on the Atherton Tableland.

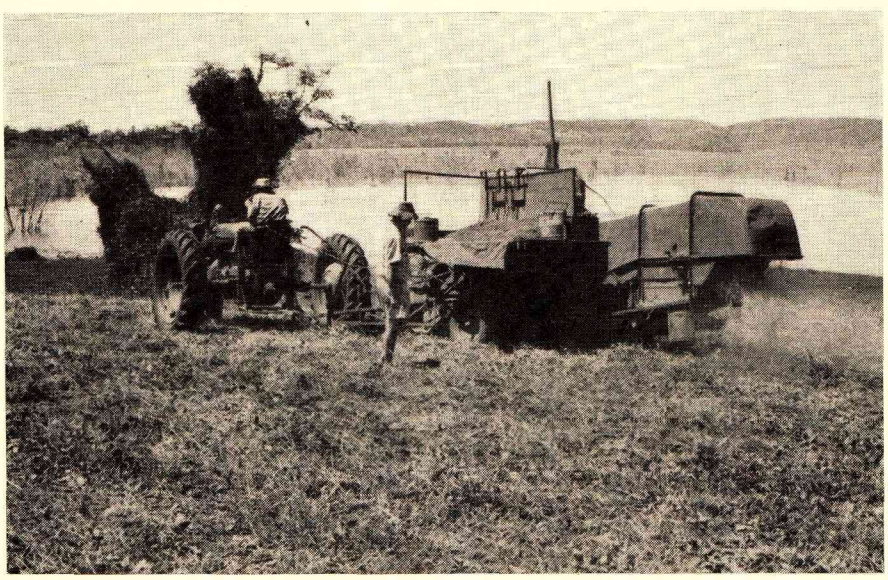

Plate 4.—Harvesting seed of the pasture legume glycine at Kairi Regional Experiment Station. This legume has assisted in converting blady grass and other weed-infested country on the Atherton Tableland to productive pasture.

Plate 5.—Numerous crops and pastures are being tested under irrigation at Millaroo Regional Experiment Station on the Burdekin. The crop shown is cotton being grown for pure seed purposes.

Plate 6.—North Coast country typical of that on which molasses grass and centro are now being successfully established.

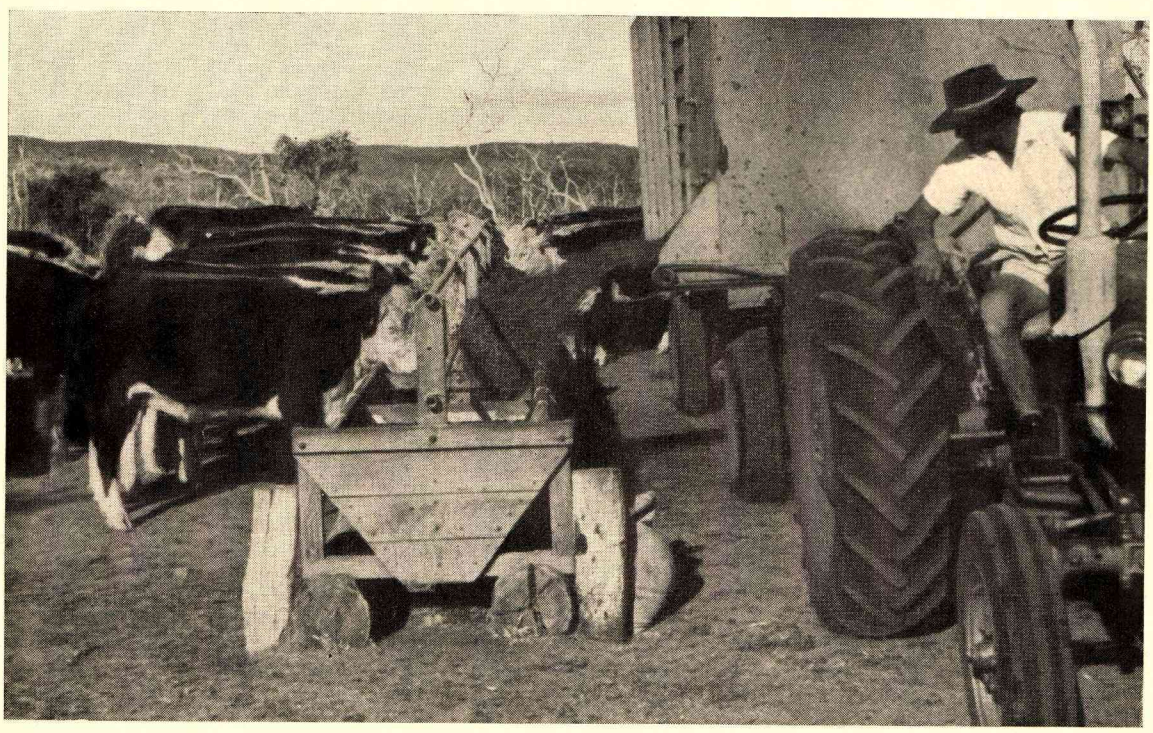

Plate 7.—Supplementary feeding of beef cattle in the paddock on a Central Queensland property. A self-emptying trailer is filling the trough with chopped green lucerne.

Tomato production was high, the crop estimate being 1,800,000 half-bushel cases from 5,800 acres under crop. The high production of beans, 900,000 bus., resulted in generally low returns to growers. Processors placed contracts for 150 acres of stringless green beans with growers at Bundaberg and the beans were carried by road to New South Wales for treatment.

Ginger growers had a reasonably good year, production being about 290 tons from 50 acres under crop. Practically the whole of the output is used for the manufacture of ginger in syrup. Interest is being taken in mechanisation of field operations, which could lead to the exploitation of the Australian market for dried ginger.

Planning for the new fruit and vegetable market at Rocklea was forwarded during the year. The Brisbane Market Trust, with the assistance of an engineer of the Department of the Co-ordinator-General of Public Works, gave much attention to planning and design of the site and the projected buildings. Work proceeded on the realignment of access roads and the diversion of water mains.

DAIRYING

Adverse seasonal conditions were reflected in a sharp drop in dairy production during the winter and spring, with only partial relief in October and November. The effect of seasonal conditions on butter and cheese production is shown by the following figures:—

QUEENSLAND

Butter Production

	Lb. 1959–60	Lb. 1960–61 (Est.)
July–September	14,949,880	10,908,096
Octoner–December	29,314,946	19,633,027
January–March	30,515,049	25,565,738
April–June	12,429,506	13,513,000
Total	87,209,399	69,619,861

Cheese Production

	Lb. 1959–60	Lb. 1960–61 (Est.)
July–September	4,100,841	3,229,288
October–December	6,861,914	5,118,431
January–March	5,741,064	5,278,801
April–June	2,319,218	2,550,000
Total	19,023,037	16,176,520

There was keen competition among butter and cheese exporting countries on the United Kingdom market and average prices for Australian supplies were appreciably lower than in the previous year.

The report of the Dairy Industry Committee of Enquiry appointed by the Commonwealth Government in 1959 was released in November 1960. The report contains many observations by the Committee, the views of industry organisations and others and the Committee's recommendations. Some of the recommendations are quite contentious, and action on the report has been deferred by the Commonwealth Government pending its consideration by interested parties.

The two proposals which would most affect the industry are (1) that the Commonwealth Government subsidy of £13,500,000 should be gradually reduced over a period of 10 years with partial replacement by financial assistance for research and advisory services, and (2) that long-term low-interest loans be granted to enable a group within the industry to be brought up to a production level which the Committee regards as being desirable for dairy-farming under Australian conditions.

The Committee has defined an economic dairy farm as one on which the yearly production is equivalent to 8,000 lb. butterfat. It estimates that there are 9,000 farms in Queensland which are, or are capable of, producing at this level, 1,000 farms which have not the potential, 5,300 mixed farms on which dairying provides more than one-third of the income derived from all enterprises, and 1,400 farms that produce relatively unimportant quantities of dairy produce.

The quantity of milk used in Queensland during the year for purposes other than butter and cheese is estimated at 55 m. gallons. The pasteurised and non-pasteurised milk trade now represents about 21 per cent. of total milk production.

STAFF AND FACILITIES

The number of scientific and technical staff showed a net gain of 30 permanent officers and 31 temporary officers. Resignations of experienced staff were fairly high, and there were 13 University graduates among the 56 resignations of scientific and technical officers. The year's intake included 16 scholarship holders who had completed their University courses, 8 in Agricultural Science, 5 in Pure Science and 3 in Veterinary Science.

University scholarships awarded during the year totalled 27, comprising 12 in Agricultural Science, 8 in Veterinary Science, 4 in Pure Science, 2 in Science/Veterinary Science and 1 in Commerce. Four scholarships were awarded to final-year Queensland Diploma of Agriculture students who have been recruited for tobacco extension work.

Doctorates in Philosophy were gained by Messrs. R. W. Downes (Division of Plant Industry) and J. G. Morris (Division of Animal Industry). Miss A. Gillies (Division of Dairying) obtained an M.Sc.App.Med. and Mr. K. Scott (Division of Dairying) secured an Honours degree in Pure Science.

Among officers who retired during the year were several with long service in the Department. They included Messrs. F. C. Coleman (Director of Field Services, Division of Dairying), C. R. von Stieglitz (Agricultural Chemist), A. Nagle (Irrigationist) and R. A. Tarrant (Senior Adviser in Agriculture) and R. J. Holdsworth (Seeds Analyst). The deaths of two serving officers—Messrs. E. Taylor (Senior Adviser, Poultry) and F. Meijer (Experimentalist) are recorded with regret.

A number of officers were overseas on various assignments during the year. Messrs. S. Marriott (Assistant Director of Agriculture) and L. R. Humphreys (Chief Agrostologist) returned in 1960 from study tours undertaken after attending the 8th International Grasslands Congress. Mr. T. J. Beckmann (Senior Chemist) resumed duty after several months in France on a French Government technical co-operation scholarship. Two officers—Dr. R. W. Downes (Plant Breeder) and Dr. J. G. Morris (Animal Husbandry Officer)—returned after long study periods at American Universities. Mr. J. G. Young (Senior Cattle Husbandry Officer) spent several weeks in New Zealand studying dairy husbandry practices, and Mr. F. N. J. Milne (Senior Poultry Husbandry Officer) also visited New Zealand, where he investigated the marketing of poultry products after completing an assignment for the New Zealand Poultry Board. Mr. T. McKnight (Senior Plant Pathologist) left in March 1961 on study visits to North America and Europe in connection with wheat problems. Special leave was granted to Mr. D. I. Sillar (Agrostologist) for a private study tour overseas.

Adjustments in the organisation of the Department to take effect on the filling of vacancies created were announced in June. The major alteration was in relation to the administration of Regional Experiment Stations. Because of the increasing importance of animal husbandry and dairying projects, the Stations will in future be administered by an Experiment Stations Board, comprising the Directors of the Divisions of Animal Industry, Dairying and Plant Industry under the chairmanship of the Deputy Director-General. Previously the stations had been attached to the Division of Plant Industry because of the emphasis on crop research.

The ambit of the work of the Agricultural Chemical Laboratory is to be expanded, with greater emphasis being placed on work in chemical laboratories outside Brisbane and close co-ordination between chemists and field workers in crop and animal husbandry.

Another important change is in soil conservation services, which will be provided by a separate Branch instead of by a section of Agriculture Branch, as previously.

Because of the great increase in work in connection with abattoirs throughout Queensland, a Slaughtering Section will be set up within the Veterinary Services Branch in charge of a Chief Inspector of Slaughterhouses.

Early in the year under review, a Food Preservation Research Branch was established, with Dr. S. A. Trout as Director, with headquarters at the Food Preservation Research Laboratory at Hamilton.

Construction of the first units of a new entomological laboratory and glasshouse at Indooroopilly was commenced, and plans were prepared for the construction of a laboratory and glasshouse at Maroochy Experiment Station for Horticulture Branch. An extension to the laboratory at Redlands Experiment Station was built.

The establishment of a new Artificial Insemination Centre at Wacol is in progress, while at the Animal Husbandry Farm at Rocklea construction of a feed and hay shed and an intensive laying shed with automatic feeding is under way. New dairy buildings are being built at Ayr Cattle Field Station.

Tenders have been called for the construction of offices and a chemical laboratory at Mareeba. Plans are also being prepared for a laboratory and seed-handling building at Hermitage Regional Experiment Station.

These new facilities are easing a position that has been unsatisfactory for some time, but the expanding activities and responsibilities of the Department will necessitate a continuing increase in both office space and research facilities.

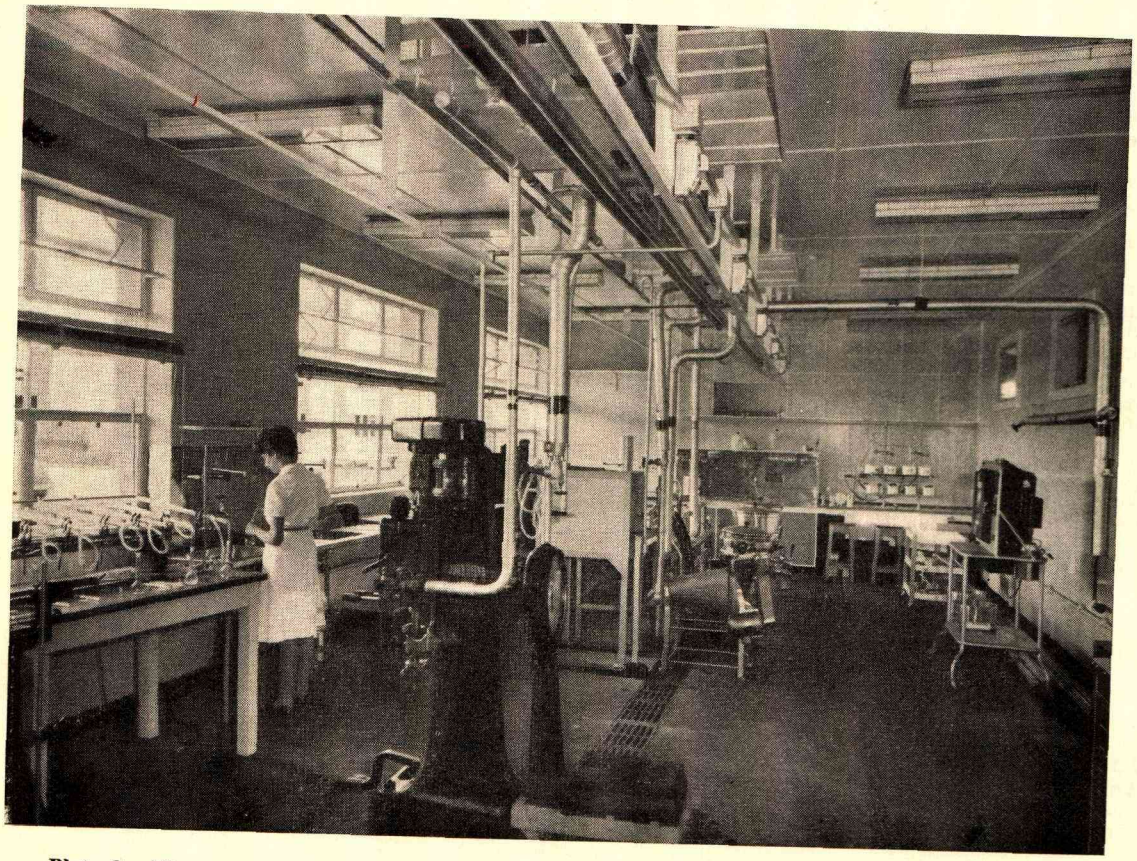

Plate 8.—The processing section of the Department's Food Preservation Research Laboratory at Hamilton.

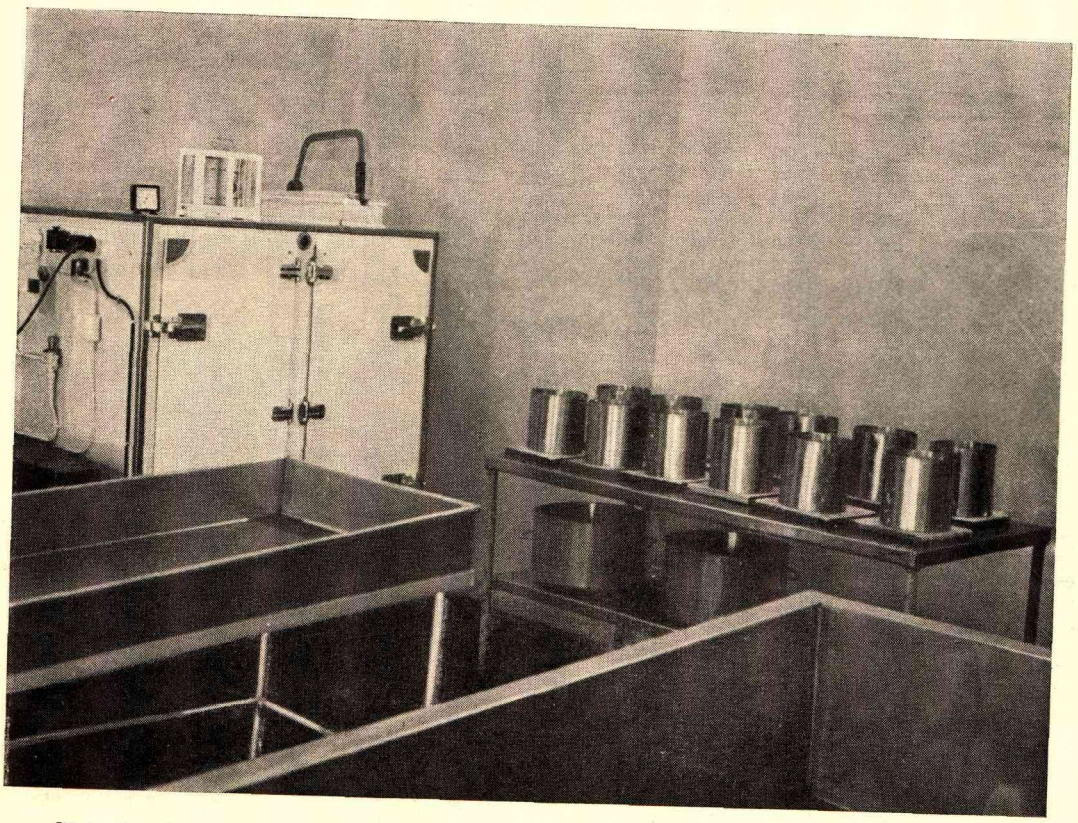

Plate 9.—A corner of the experimental cheesemaking room in which the manufacture of blue vein cheese is being developed.

DIVISION OF PLANT INDUSTRY

The absence of widespread soaking rains in 1960-61 following the failure of a general wet season in 1959-60 again emphasised the necessity for managing land to make the most effective use of rainfall.

Conserving surplus growth of crops and pastures for feeding to stock when pasture growth is poor and of low quality, the sowing of crops on land in which subsoil moisture reserves have been built up by fallowing, the use of water for irrigation from streams, underground sources and farm storages constructed to hold water which would otherwise run off properties, and the planting of the best available strains of crops and pasture species to suit our climatic hazards are all avenues which can be exploited much further in strengthening the resistance of our primary industries against the irregular and erratic distribution of the rainfall.

Queensland's need for more drought-resistant strains of crops and pastures is a ceaseless challenge to agricultural scientists. It has been said that bad times have a scientific value. These are occasions a good learner would not miss. The weather pattern in 1960 and 1961 has provided ample opportunity for lessons to be learnt by farmers, graziers and scientists.

The latest data compiled by the Bureau of Census and Statistics show that the area under crops in Queensland in 1959-60 was 2,921,401 acres. Allowing for areas on which two or more crops were grown during the year the actual area used for crops was 2,861,767 acres, while 439,314 acres lay fallow, making a total area of 3,301,081 acres of cultivated land. The area cultivated for sugar cane was 461,885 acres. Although the sugar cane area declined by 24,916 acres the total area of crops grown during 1959-60 was the highest ever recorded, exceeding the previous year's record by 113,034 acres.

This continuing expansion in cultivated acreage and the wide interest in pasture improvement impose an ever-increasing strain on research and extension services. By depleting staff in near-coastal centres it was possible to improve the extension services in pastoral areas by appointing Advisers in Agriculture at Roma and Blackall. Further appointments of specialist pasture officers in western areas are planned for 1961-62.

RESEARCH FACILITIES

The installation and testing of equipment at the Food Preservation Research Laboratory at Hamilton made excellent progress and the stage is now set for a vigorous programme of research into the transport, storage and preservation problems concerned with Queensland-grown fruits and vegetables.

Construction of the laboratory and glasshouse for the Pineapple Plant Physiological Unit at the Maroochy Experiment Station was delayed but a suitable tender has now been accepted and the buildings should be completed by the end of 1961.

A useful extension to provide additional office and laboratory space was completed at Redlands Horticultural Station. The Chief Horticulturist (Vegetable Crops) will now have his permanent headquarters at this centre.

Plans were completed for the Wheat Research Institute at Toowoomba and the successful tenderer has commenced operations on the first stage of the building, which is expected to be available by June, 1962.

Work commenced on the new laboratory and glasshouse at Indooroopilly for entomological research and the facility will be ready for occupation before the end of 1961.

Unfortunately, little progress was made with the seed store at Rocklea or the seed store at Hermitage Regional Experiment Station, two units which are urgently needed. Plant breeders' seed is the result of several years' work and it is most important to ensure that such valuable material is well protected from the ravages of vermin. Construction of both projects is scheduled to commence in 1961-62.

No progress was made in the erection of a laboratory unit for the Agricultural Chemical Laboratory Branch at Mareeba, but a start may be made in 1961-62.

There is a real need for adequate combined office and laboratory buildings at all Experiment Stations. The position is satisfactory on the Stations at Parada, Inglewood and Millaroo but there are severe deficiencies at Kairi, Kamerunga, Biloela, Maroochy, Redlands, Gatton and Hermitage. Plans for the building to be erected at Biloela have reached an advanced stage and construction is expected to commence in 1962.

Following the decision to inaugurate a hybrid maize plant breeding programme at the Kairi Experiment Station in collaboration with the plant breeding section of the Queensland Agricultural High School and College, arrangements were made for the construction of a suitable building in 1961-62 at Kairi. The programme is aimed at developing hybrid maize varieties adaptable to the difficult conditions of the Atherton Tableland.

As a result of the co-operative programme agreed upon between this Department and the University of Queensland, scheduled to commence in 1963, and to provide special training in tropical agriculture for selected Agricultural Science undergraduates, it is proposed to give consideration to certain building improvements on the Bureau of Tropical Agriculture at South Johnstone in 1962.

EXTENSION

Further groups of officers were given training at extension schools during the year. The extension school system has been in operation long enough to evaluate the results achieved. It is clear that the training has been very beneficial, as evidenced by the increased activities displayed by officers in publicising useful research results and the interest shown by farmers and graziers in applying those results in practice. Field days, schools for primary producers, radio broadcasts and articles in newspapers and journals are extension methods now much more commonly used than five years ago.

Contacts and co-operation between Departmental officers and primary producer organisations have increased greatly, particularly through industry committees on which both organisations have representatives. The following committees of this type operated actively during the year:—Queensland Wheat Industry Research Committee, "Brian Pastures" Pasture Technical Committee, and advisory committees for Dairy Pasture Improvement, Tobacco, Vegetables, Pineapples, Citrus and the Granite Belt. A further advisory committee for the banana industry is also being considered.

Divisional officers also continued to participate in the several Dairy Extension Advisory Committees which operate in dairying zones.

STAFF

A total of 24 technical officers was lost during the year for various reasons. Recruitment of new staff showed much improvement and included 25 graduates, 15 diplomate grades, 11 cadets, most of whom are studying for Science Degrees on a part-time basis, and five laboratory assistants. Of the graduates, 14 were products of the Department's scholarship and cadetship schemes, including the first two graduates from scholarships sponsored by the Queensland Dairymen's Organisation and two whose scholarships were paid for from funds made available by the tobacco industry. The scholarship and cadetship schemes are expected to produce at the conclusion of the 1961 academic year eight graduates in Agricultural Science and 16 graduates in Pure Science.

Without question the policy of assisting suitable candidates to obtain University degrees for the purpose of filling staff deficiencies in the Division has been an unqualified success.

Unfortunately, recruitment of officers with diplomas from recognised Australian Agricultural Colleges has been far from satisfactory. Recognising the seriousness of the position and the need to increase tobacco extension services, funds provided from the Tobacco Industry Trust Account were used to award four scholarships to students completing the diploma course at the Queensland Agricultural High School and College in 1961.

AGRICULTURE BRANCH

SOME HIGHLIGHTS

One of the most significant features of the year 1960-61 was the demand for increased agricultural advisory services in western areas. In response to such demands, Agricultural Advisers were stationed at Roma and Blackall, and an Agrostologist was appointed to the latter centre. In addition, part-time advisory services in pasture establishment and soil conservation were supplied from Toowoomba to centres as far west as Charleville and Quilpie.

Another prominent aspect of the Branch's extension services is the participation required in connection with the Pasture and Water Harvesting Competitions conducted by the Royal National Association, Brisbane, and the Wheat Crop Competition conducted by the Royal Agricultural Society, Toowoomba. Branch officers are heavily involved in the judging of these State-wide competitions and in the field days held on properties as a result of these competitions.

The most widely attended field day held during the year was that conducted in conjunction with Cattle Husbandry Branch at the "Brian Pastures" Pasture Research Station in April. This most successful day was attended by leaders of the beef cattle industry and by more than 600 farmers and graziers from a very considerable area of Queensland.

One of the outstanding advances in the agronomic field was the progress made in the production and testing of hybrid grain sorghums for Queensland. In spite of a very dry season, some commercial production of hybrid seed on large areas was achieved, and the stage is now set for the commencement of certified hybrid seed production. A number of hybrids continued to show important yield increases over standard varieties and three of the best have now been recommended for certification.

AGRONOMY

Wheat.—The main features of the year's activities were the generally unfavourable dry and frosty season, the satisfactory completion of the 3rd year of an 8-year-cycle rotation trial comparing continuous wheat and pasture on the open plains soils of the Darling Downs, the naming and release of the Queensland-bred variety Gala, the release and seed increase in Queensland of two wheat varieties (Mengavi and Gamenya) bred by Sydney University, and the appearance of a new strain of rust capable of attacking most of the popular wheat varieties grown in this State.

The plant breeding programme has been maintained at Hermitage Regional Experiment Station, with special emphasis on frost and rust resistance, and also yield and flour quality. Particular attention has also been given to providing a rust-resistant substitute for Gabo, and this has resulted in the naming and release of the Lawrence x Gabo cross, Gala. The annual strain trial was conducted to compare new hybrids with standard varieties; in the absence of rust no new strains outyielded the commercial varieties Spica and Gabo. The seed purification scheme to provide true-to-type seed stocks for commercial plantings was continued, the varieties concerned being Spica, Gala and Lawrence.

The usual trials comparing new varieties and new crosses with standard commercial varieties were conducted at Hermitage Regional Experiment Station, on the open plains soils of the Darling Downs and in the Wandoan district. While the season generally was dry and cold, only the late-planted trials were seriously affected by lack of soil moisture. At Hermitage good yields were recorded in the slow-maturing trial, with the winter wheat Windibri (with a grain yield of 57.3 bus./ac. after two grazings) outyielding the standard slow-maturing variety Lawrence (49.5 bus.). On account of the cold dry season, rust was not a problem. Yields were also high in the mid-season trial, with the new Sydney University bred varieties Gamenya (61.6 bus.) and Mengavi (60.3 bus.) outyielding Gala (57.4 bus.). Spica (24.6 bus.) and Kenora (22.7 bus.) gave the highest yields in the quick-maturing trial, which was most affected by dry weather and by weed competition following October rains.

In the main wheat-growing areas Gala and Mengavi appear to be comparable in performance, with Mengavi in its first season of testing showing a slight yield advantage in western districts. Kenora again performed successfully but showed a decided preference for good growing conditions. Of current varieties it seems most sensitive to frost damage. Hopps again gave a satisfactory though somewhat irregular performance.

The appearance of a new race of rust capable of attacking Kenora, Festival, and related varieties is of great significance and has attracted much publicity to the varieties Mengavi and Gamenya. Mengavi is resistant to this new rust race but Gamenya is susceptible. Although Mengavi has been tested experimentally for only one year, it has given a satisfactory performance and is being keenly sought for commercial plantings.

The third season of the pasture-wheat rotation trial on the open plains soils of the Darling Downs was completed successfully. This trial is designed to compare over an 8-year cycle the effect on wheat yield and quality of a grass-lucerne pasture of one, two, three and four years' duration. The wheat variety Spica is being used. The grass component in the pasture decreased and the grazing figure (2.5 sheep per acre) was lower than in the previous season. Although there was no significant change in total nitrogen content of the soil, the content of available nitrogen was considerably higher following two years of pasture (35.1 p.p.m. as against 13.1 p.p.m. nitrate nitrogen in the top 24 in. of soil). Similarly, the 2-year pasture phase resulted in a significant increase in wheat yield (24.6 bus./ac. as against 20.5 bus.), an increase in grain protein (15.2 per cent. as against 13.6 per cent.) and an improvement in baking quality.

Maize.—Seed of the following hybrids was produced during the year under the Department's seed certification scheme: Q23, Q440, Q462, Q526, Q692, Q716, Q724, Q739 and Q790. Queensland-bred hybrid maize varieties have proved satisfactory in all but two maize-growing areas in Queensland, viz. the south-eastern Darling Downs and the Atherton Tableland. Even in these areas Q hybrids outyield open-pollinated varieties but they have certain disadvantages. In the south-eastern Downs, present hybrids are not popular because of their mid-season to late maturity and because certain DS hybrids bred in New South Wales can outyield them. On the Atherton Tableland most hybrids are susceptible to cob rots and stalk rots and best results to date have been obtained from certain Grafton hybrids bred in New South Wales.

In a recent variety trial on the south-eastern Downs, top yield (67.9 bus./ac.) was provided by DS456W (a white-seeded variety), followed by DS65A (67.5 bus.), Q790 (66.2 bus.) and Q692 (65.0 bus.). DS65A, the highest yielding yellow hybrid, was the latest to mature. Mice damage was serious in this trial, the hybrids with poor husk cover being worst affected. Q hybrids generally have better husk cover than DS hybrids. Because of likely hot dry conditions in October-November, a late November-December planting is preferred in this area and thus quick-maturing varieties are sought. No further testing in this area is proposed until new quick-maturing hybrids are available.

In the search for a more satisfactory hybrid for the Atherton Tableland a co-operative testing programme was carried out comparing inbreds, single crosses and hybrids bred at Grafton Experiment Farm, New South Wales, and at Queensland Agricultural College, Lawes. On the Atherton Tableland maize is frequently subjected to prolonged wet periods, not only during early growth, but also towards maturity. The latter condition is very favourable to the development of stalk and cob rots, and also tropical rust, which has appeared in the last two seasons. In the 1959-60 season nine Grafton hybrids outyielded the local Dent strain (34.1 bus./ac.). The top hybrids, GH211 (45.9 bus.), GH202 (43.6 bus.), GH321 (42.9 bus.) and GH261 (42.5 bus.), have a desirable low cob setting but their poor husk cover increases weevil attack and cob rot incidence. GH128 (41.7 bus.) has performed successfully for five years and accounted for about half the district planting. Q23 (33.7 bus.) was outyielded by the local Dent strain. GH170, which showed promise in the previous season yielded well on this occasion (41.3 bus.) without being spectacular.

Sorghum.—The success of the hybrid grain sorghum breeding programme is possibly the highlight of Departmental plant breeding activities for the year. The results forecast in last year's report were confirmed when details of all 1959-60 trials were examined. Seven trials were carried out in the Darling Downs and South Burnett. Mean yields over this series were as follow: Texas 610, 75.9 bus./ac., Texas 630, 73.3 bus., Texas 660, 72.9 bus., Texas 620, 70.3 bus. and Alpha, the present popular commercial variety, 53.8 bus. These yields represent substantial increases over the standard variety, up to 40 per cent. in the case of Texas 610. Details of all the current season's trials are not yet available but results to hand are similar to those reported above.

After the encouraging results of the previous season the number of "apprentice" crossing plots was increased and commercial crossing plots were planted by those producers who had successfully completed their apprenticeship in 1959-60. Appreciable quantities of hybrid seed will therefore be on sale for 1961-62 plantings. The same season should also see the first production of certified seed of selected hybrids.

There still remains a heavy demand for seed of standard grain sorghum varieties, and during the year certified seed of the following was produced:—Alpha, Wheatland, Early Kalo, Martin and Caprock.

Cotton.—The main experimental activity was aimed at sorting out the varietal position and introducing and increasing seed of new varieties. A pure seed scheme to maintain varietal uniformity is in operation, and while this is demanding of advisory officers' time, it is considered necessary and worthwhile. Some 17 varietal trials were laid down in the main cotton districts, comprising the western Downs, Lockyer Valley, Central Burnett, Bundaberg, Callide and Dawson Valleys and North Queensland. Seed-increase plots of seven newly introduced varieties were also established. While drought conditions affected some of these trials, information should be obtained on plant behaviour and lint properties of about 15 varieties under different climatic conditions. Newer varieties showing promise are Dixie King, Paymaster, D. & P.L. Smoothleaf, and, under irrigation, Acala 1517 BR.

Fertilizer trials were established in the Central District, on the western Downs, and at Bundaberg, in association with the variety trials.

A number of farms in all cotton districts have been selected to assess the effect of various cultural methods and climatic conditions on lint characters. The cotton from these properties is being suitably labelled and its identity kept through the various treating and ginning operations at Whinstanes and Glenmore ginneries. The effect of these ginning processes on lint characters is also being checked. As excessive moisture in machine-harvested cotton can result in down-grading, a drive was initiated to advise growers and machine operators on the correct moisture content for machine picking.

Tobacco.—Rejection of substantial quantities of leaf at recent sales indicates an urgent need for detailed checks by extension officers of the soils, water, and management techniques of many farmers, and for more knowledge of the influence of irrigation, fertilizer and other cultural practices on the type and quality of leaf produced.

Variety trials were continued to test promising mould-resistant lines against commercially available varieties. The

Virginia Gold types (Virginia 21, V.G. 2, Special Virginia) continued to outyield all others, but unless variety demand changes drastically may never become as popular as Hicks. A number of agronomically sound, highly mould-resistant lines are now being tested, but their leaf quality appears to be slightly inferior to that of Hicks. Field testing of the A1 and A2 mould-resistant crossbreds was extended to commercial farms in all major areas, but policy on unrestricted release will depend on consultation with other States.

Plant spacing trials indicated that wider plant spacings (24 in.) improved body and quality of the leaf although heavier yields were obtained with 15 in. plant spacings. Fertilizer trials at both Parada and Inglewood gave heavy responses to phosphate in particular and suggested that fertilizer rates could generally be increased with advantages in both yield and quality. A rotation trial at the Inglewood Experiment Station was designed to demonstrate the inferiority of yield and quality when tobacco is grown continuously on the same land.

Weed Control.—The onion weedicide trial was again conducted at Gatton Regional Experiment Station and a heavy infestation of barnyard millet (*Echinochloa crus-galli*) was encountered. CIPC (6-24 lb./ac.) controlled this species best, but did not have much effect on broadleaved weeds. Simazine (½-2 lb./ac.), "Ureabor" (6-18 lb./ac.) and 2,4-DB (1½ pt.-4½ pt./ac.) were unsatisfactory. Because of the heavy infestation of barnyard millet no yields were recorded.

During the year the susceptibility of weed-free maize to "broadcast" and "directed" spray applications of 2,4-D at two rates (¾ lb. and 1½ lb. acid equivalent/ac.) and at four stages of growth (6 in., 12 in., 24 in. and 48 in. high) was examined. Because of plant height, "directed" sprays were made at only two growth stages—24 in. and 48 in. high. There were no significant differences in yield in this trial. In the previous season, however, a broadcast spraying of 1 lb. a.e./ac. of 2,4-D caused severe injury and reduced yield in maize 12 in. high at the time of spraying. This rate of 2,4-D must therefore be regarded as dangerous. Half this rate of application of 2,4-D is adequate to control seedling weeds in maize and it should seldom be necessary to use the higher concentration.

The use of chemical weedicides in peanuts was further examined and two trials were carried out. Treatments were applied to Virginia Bunch peanuts at three growth stages—1 week, 6 weeks and 12 weeks after emergence. Treatment with 2,4-D at 8 oz. a.e./ac. reduced yields severely at all stages (control, 1,770 lb./ac.; 2,4-D, 1,561 lb.). The 2,4-DB plots gave a mean yield (1,736 lb.) significantly greater than 2,4-D plots (1,561 lb.) but not significantly less than control (1,770 lb.). In the second series of trials, both Virginia Bunch and Red Spanish peanuts were used with 2,4-D, 2,4-DB and MCPB at rates of 4 oz.a.e./ac. to 16 oz.a.e./ac. The Red Spanish variety showed no visible differences between treatments, and it would appear that 2,4-D at 8 oz.a.e./ac. can be safely used as a post-emergence spray on this variety. The Virginia Bunch variety, however, showed significant yield reductions from 4 oz. and 8 oz.a.e./ac. of 2,4-D and also from the higher rates of 2,4-DB and MCPB (8 oz. and 16 oz.a.e./ac.). These trials indicated that Virginia Bunch is considerably more susceptible to hormone weedicides than Red Spanish, and that only the phenoxybutyric compounds at rates not exceeding 4 oz.a.e./ac. can be used as post-emergence sprays on Virginia Bunch.

Two chemicals with trade names "Avadex" and "Carbyne," with overseas claims of wild oat control in winter cereals, were tested on the Darling Downs. "Avadex" is a pre-emergent weedicide and "Carbyne" a post-emergent. Both of these gave promise, with some qualifications, of effective control of wild oats in the main winter cereals—wheat, barley and linseed. "Avadex" at rates of 1½-2½ lb./ac. gave virtually complete control of wild oats (85% *Avena ludoviciana,* 15% *Avena fatua*) in linseed, wheat and barley, but reduced plant stands, particularly in the case of wheat and barley. Unfavourable climatic conditions interfered with the post-emergence application of "Carbyne" and results were rather less spectacular than with "Avadex." "Carbyne" is effective in controlling wild oats between the 1 and 2½ leaf stages only and precise application is therefore required. Rates of 2-8 oz. per acre were used; the higher rates affected plant growth, especially of linseed.

Irrigation Studies.—Irrigation studies relating to techniques, amounts and frequencies of water application were continued.

In the Mareeba-Dimbulah Irrigation Area a study of five soil types gave basic information regarding field capacity, wilting point, bulk density, available soil moisture and some infiltration characteristics. This information is useful in determining the irrigation techniques to be used on a particular soil type.

Frequency of irrigation for a tobacco crop on two of these soil types (Walsh sandy clay loam and Algoma loamy sand) was investigated. It has become a fairly common practice in North Queensland to withhold irrigation for varying periods in the early stages of growth of the tobacco, some of the reasons given being to restrict blue mould development, to hold a portion of the crop back due to limited curing facilities, and to conserve a limited water supply. Results on Walsh sandy clay loam indicated that, provided adequate irrigations are given at planting, irrigation water can be withheld for periods in excess of six weeks without restricting growth, yield or quality. This soil has a fairly high available soil moisture level. A similar trial on Algoma loamy sand, which has a fairly low available soil moisture level, showed that withholding irrigation for four weeks restricted growth but that this restriction did not affect final yield and quality in comparison with treatments in which irrigation was not withheld.

Investigation of the effects of amount and frequency of irrigation on the yield and specific gravity of Sebago potato tubers was continued. The 1960 spring trial was again spoiled by heavy rainfall during the period when treatments were still being applied, while final details of the 1961 autumn crop are not yet available. Results of the 1960 autumn trial showed that total amount of irrigation applied (or average applied per week) appeared to be the important factor for yield rather than amount per irrigation or frequency of application. Increases in yield occurred with increasing quantity of water applied up to a maximum yield at 2 in. applied per week (7.01 tons/ac.), with a probable optimum irrigation level of 1 in. per week (6.4 tons). However, specific gravity of the tubers decreased with increasing quantity of water applied. In addition, frequency was important from the viewpoint of quality in that 1 in. applied weekly gave a lower specific gravity (1.067) than 2 in. applied every 14 days or 3 in. applied every 21 days (1.073). Trials along these lines are continuing.

AGROSTOLOGY

A total of 395 pasture investigations and demonstrations of varying size and complexity was undertaken by Branch officers during the year. A number of these trials (283) were financed by funds from the Australian Dairy Produce Board, the Australian Meat Board, the Wool Research Trust Fund and Shell Chemical (Australia) Pty. Ltd.

Pasture Species.—Species and strains of grasses and legumes numbering 86 were received for testing during the year. The legumes centro, stylo, Townsville lucerne, *Glycine javanica, Desmodium uncinatum,* siratro, phasey bean and lucerne continued to show promise over a wide range of soil conditions. Regional testing of *Leucaena glauca* continued along the eastern seaboard and at "Brian Pastures" Research Station, Gayndah.

A demand for tropical legume seed has been met to some extent by the importation of 40 tons of centro seed during the last 18 months. Considerable effort is being expended on attempts to encourage production of several types of tropical pasture seed, including the legumes centro, stylo and *Glycine javanica.*

Widespread interest in the establishment of *Panicum coloratum* on the heavy soil types continued on the Darling Downs and in the Burnett and Mary Valleys. In particular, certain "Makarikari" types and a "Bambatsi" type impressed with their winter greenness, productivity and palatability. Studies on morphological type, frost-tolerance and seed-setting are in progress, while seed increases of Makarikari SCS-383 and Rhodesian "Bambatsi" will enable commercial areas of these admirable strains to be developed.

Pangola grass (*Digitaria decumbens*) in combination with either centro or stylo has shown a capacity to compete with weeds and make vigorous growth on well-drained soils on the wet tropical coast. Pangola pastures produced 550 lb. liveweight gain per acre during the past season.

Lucerne is the most important perennial legume for the heavy soils on the Darling Downs and in the Maranoa. This legume continued to be a satisfactory pasture component when established on fertile soils in the 25-35 in. rainfall zone.

Pasture Seed Production.—The lack of adequate seed supplies is limiting the wide-scale use of certain proven pasture species but the position is improving. At Moolboolaman and Wallaville, near Bundaberg, 1,000 lb. scrobic seed was harvested mechanically. Mechanical harvesting of siratro and phasey bean is also being attempted at Bundaberg, while *Glycine javanica* will be harvested at Imbil, in the Mary Valley.

Determined efforts to produce commercial quantities of various tropical legume seeds on the Atherton Tableland and in the Burdekin largely failed due to dry seasonal conditions. Similarly, poor seasonal conditions in all growing districts prevented the harvesting of worthwhile quantities of Townsville lucerne seed. Adequate stocks of paspalum, Rhodes grass, green panic, molasses grass and most strains of buffel grass are expected to be available for the coming season. In the Taroom Shire 2½ tons of buffel grass seed, including 1,000 lb. of Molopo buffel, are now available for pasture establishment in the brigalow country. Advantage has been taken of the excellent seed crops of buffel grass in the Blackall district. Following deferment of grazing, the area to be harvested (either by hand or by machine) could well be 5,000 acres. Biloela, Gayndah, American and Western Australian varieties will be represented in the district harvest.

Pasture Yield and Fertilizer Trials.—Pasture trials have given useful data on yield and protein level.

Irrigated pastures established at Emu Vale near Warwick in 1954 were systematically sampled for yield. A pasture comprising white clover, *Phalaris tuberosa* and cocksfoot showed the following yields and protein levels:—

Growth Period	Green Matter (tons/ac.)	Dry Matter (tons/ac.)	Protein (dry-matter basis) %
1–10–60—3–11–60 ..	7·14	1·09	26·0
3–11–60—20–12–60 ..	6·03	0·93	26·0
20–12–60—6–2–61 ..	3·40	0·50	28·5
6–2–61—24–3–61 ..	6·60	0·99	26·1

A trial planting of three tropical legumes in a sandy levee soil of the Nogoa River at Emerald has shown *Glycine javanica* to be promising. The development of early-maturing strains which could seed in this environment would be a welcome achievement. Hunter River lucerne established at "Abingdon Downs," via Georgetown, grew vigorously. Inoculated lucerne produced 1.1 tons of hay per acre 10 weeks after planting, while non-inoculated lucerne produced 0.5 ton.

Superphosphate and molybdenum, when applied in combination, show promise for promoting the growth of white and red clover on irrigated forest soils in the Nambour district. The results of a trial in this area are as follows:—

Treatment	*Yield lb./ac. (green-matter basis)*
Control	435
2 cwt. superphosphate	726
4 cwt. superphosphate	3,557
4 oz. ammonium molybdate ..	580
2 cwt. superphosphate + 4 oz. ammonium molybdate ..	7,986
4 cwt. superphosphate + 4 oz. ammonium molybdate ..	12,487

Pasture Grazing Trials.—A 4-year-old green panic, phasey bean and centro pasture established on heavy black soil at "Belbroughton" near Rockhampton was stocked at the rate of 1 beast per acre for a grazing period of 3 months. Stock made 1½ lb. liveweight gain per head daily, while cattle grazing on adjacent native pastures lost weight at the rate of 1 lb. daily.

At "Culcraigie" near Eidsvold the "unit development" programme produced satisfactory results. This plan envisages the development of land for pasture sowing by pre-cropping to cowpeas and/or oats, with fertilizer where required. It was shown in an experiment on this property that weaners with access to oats gained 0.9 lb. daily during the period 31st May, 1960, to 12th July, 1960, while calves remaining on their mothers lost 0.24 lb. daily. The practice of autumn or early weaning with supplementary feed has been shown to be profitable at "Culcraigie."

Lucerne is still forming the basis of most pastures established on traprock country in the Warwick district. A study of stocking figures for a stand of grazing lucerne showed that over a period of 12 months the stand had been grazed at the rate of 3 sheep per acre. This paddock was grazed for periods of from 10 to 40 days at the rate of 7 sheep/acre.

A molasses grass/centro pasture established in 1957 at Ridgewood, near Cooroy, on a brown shaly forest soil continued to provide excellent grazing. With careful grazing management and regular annual applications of nitrogen-phosphate fertilizer at 160 lb. per ac., a highly productive pasture has been maintained. Grazing data recorded from 30th July, 1960 to 12th December, 1960 show the capabilities of this pasture for frost-free hillsides:—

——	Total Grazing (hours)	Cow Grazing (hours/ac.)
Check area (forest pasture)	1,050	210
Molasses grass + centro	2,310	462

Pasture Establishment.—Detailed investigations on pasture germination and establishment continued on the black earths of the Darling Downs. A fortnightly planting experiment to determine the basic causes of establishment difficulties on the black earths commenced in September, 1960. Both green panic and Rhodes grass were sown in the field at half-inch depth on 17 occasions, and germinations and emergences recorded after falls of rain. This trial is being repeated for a further season.

"Brian Pastures" Pasture Research Station.—Pasture investigations continued on pasture species assessment, management, establishment, and the physiology of pasture growth.

Two new species sward trials were sown in February, 1960. In the 1960 growing season the Nunbank and Crooble varieties of Columbus grass (*Sorghum almum*) produced almost as well as Sweet Sudan grass, and outyielded green panic and elephant grass. In the 1961 season, Columbus grass suffered acute nitrogen deficiency and severe leaf streak, and grew less than green panic or elephant grass. In a second trial, Makarikari grass outyielded green panic, the average presentation yields being 3,040 and 2,030 lb. dry matter/ac. respectively. Makarikari grass showed poorer seedling vigour and legumes established better with it than with green panic. Lucerne outyielded various strains of *Glycine javanica* in this first year.

Seed production in Makarikari grass was increased by growing the plants in rows 8 ft. apart and by adding nitrogen, as shown in the following table (yield in lb./ac.):—

——	No Added Nitrogen	75 lb. N/ac.	150 lb. N/ac.	Mean
8 ft. rows	188	158	241	196
Swards	142	180	177	166
Mean	165	169	209	..

There were three main waves of seed production from the beginning of January to the beginning of April, and the response to nitrogen only occurred from March onwards. Row culture and applied nitrogen increased both the number of heads bearing seed and the amount of seed per head.

A native pasture management trial continued to show sharply contrasting animal productivity. The trial area is stocked at a beast to six acres, and the group of animals weighed 659 lb. (average) on 20th November, 1959. In this unfavourable season the liveweight changes until September 23, 1960, were:—

Continuous grazing (control)	+54 lb./head
Rotational grazing	−37 lb./head
Slashing + Deferred grazing	−32 lb./head
Chisel renovation	+88 lb./head
Supplementary winter lucerne	+301 lb./head

Lucerne was successfully established in native pasture in each of the three years 1958, 1959, and 1960. Sowings at 1 lb./ac. made in May 1960 on falls of 1.11 in. produced 20 plants/sq. yd., despite the fact that only 1.71 in. were recorded in the subsequent five months. As a result of a series of experiments, the following conditions have been found to be desirable:—

(*a*) Removal of native pasture top growth, preferably by burning, immediately before sowing.
(*b*) At least one chisel ploughing.
(*c*) Autumn sowing.
(*d*) Inoculation of lucerne seed.
(*e*) Seed coverage.

Two experiments studying management effects on the growth, nitrogen uptake and nodule development of legumes were completed in conjunction with the Chemical Laboratory Branch. Plants were grown in a nitrogen-deficient soil in large boxes, and supplied with adequate water and non-nitrogenous fertilizer. In the first experiment, the control was undefoliated, and light and heavy defoliation treatments were imposed by removing 20 per cent. or 60 per cent. respectively of the leaves each fortnight. In the second experiment an additional series was undefoliated but shaded to 0.67 daylight. Results were as follows:—

NITROGEN UPTAKE (SHOOTS, ROOTS AND NODULES) AS LB./AC.

Species	Control	Light Defoliation	Heavy Defoliation	Shade	Mean
Atro	58	71	63	..	64
Centro	65	74	46	..	61
Glycine	86	100	56	..	81
Lucerne	438	463	400	392	423

NITROGEN IN ROOTS AND NODULES AS PERCENTAGE OF WHOLE PLANT NITROGEN

Species	Control	Light Defoliation	Heavy Defoliation	Shade	Mean
Atro	54	42	37	..	44
Centro	54	33	20	..	36
Glycine	29	31	22	..	27
Lucerne	56	54	25	56	48

The high nitrogen production of lucerne and its resistance to heavy defoliation were noteworthy. The structural carbohydrate stored was much higher than in the tropical legumes. Of the latter, the early flowering atro was least affected by heavy defoliation and yielded more non-structural carbohydrate in its roots, but glycine produced most shoot dry matter and shoot nitrogen.

Evapotranspiration from a green panic sward for the period April-December, 1960, was inversely related to the severity of defoliation. However, the differences in moisture use over the summer growing season were not consistently related to defoliation intensity.

SOIL CONSERVATION

Soil conservation activity expanded and protective earthworks were installed on 22 per cent. more cultivated land than the previous year's record total.

During the year 1,580 landholders requested technical assistance and of these 468 were farmers making their first

systematic attempt to apply soil conservation measures. In order to meet these requests, 19 soil conservation extension officers travelled 90,000 miles in making 3,663 visits to farms for the purpose of evaluating problems, making topographic maps, preparing farm soil conservation plans, surveying sites for earthworks and advising on improved land utilisation.

Because soil conservation measures usually require a major change in farm management, there is no substitute for the farm visit in implementing this work. However, mass media were also widely used to create interest and draw attention to new methods or existent needs. Fourteen field days, schools or inspection tours were conducted, 48 lectures were delivered and 52 press articles released. Twenty-six radio talks were given and 3 show displays prepared.

Run-off and Erosion Control Works.—Departmental officers planned and supervised the installation of 84,000 chains of protective earthworks on 22,648 acres of eroded cultivated land during the year. The greater part (90 per cent.) of this work was executed in the Darling Downs and Burnett zones. The Burnett area reached the record total of 10,660 acres protected; the Darling Downs with a total of 8,969 acres showed an increase of 35 per cent. over the previous year. In the Maranoa, Central Highlands and Wandoan areas, where the adoption of contour cultivation and strip cropping are the first steps in erosion mitigation on new cultivation lands, very satisfactory progress was made. Soil conservation officers surveyed contour guide lines aggregating 6,474 chains in length on 4,492 acres of cultivated land, making a total of 8,477 acres now treated in this way.

Good progress was made in the installation of artificial waterways and over 6,900 chains of these works were constructed during the year. Unfavourable weather conditions retarded the establishment of protective vegetation in many of these and they cannot be used for water disposal before the next wet season.

Planning.—The improvement in planning procedures continued during the year. The further development of episcopic projection methods and the utilisation of photogrammetry for the plotting of topographic information facilitated plan preparation. Base plans were prepared for a further 1,300,000 acres, making a total of three million acres now covered by these preliminary plans. Complete soil conservation plans were prepared for 130,000 acres, making a total of 500,000 acres of land now planned in some detail. Individual farm plans issued totalled 325.

Investigations.—Trials were conducted in the South Burnett to determine the relative suitability of various strains of African star grass and of kikuyu grass and green couch grass for the colonisation of waterways. Considerable variability was noted in the behaviour of the various strains of African star grass and the Dalby strain proved superior in colonising ability. Though more susceptible to frost damage than kikuyu or green couch grasses, it spread more rapidly and provided a channel lining with the desired low water retardance factor.

On the Darling Downs studies were initiated to determine the infiltration pattern for the main soil types in that area. The initial work was carried out on black earths and although not finalised, a tentative assessment of infiltration rates for these soils can now be made. On the cultivated soils the most rapid intake occurs during the initial period of mass infiltration. The rate ranges from 2 to 4 in. for the first hour and is governed mainly by the physical condition of the soil at the time and the soil moisture content of the 0-12 in. layer. After the mass infiltration requirements are satisfied there is a rapid decline in the infiltration rate. In a soil at or near field capacity, the rate falls to two points or less per hour within 3-5 hours, and the base infiltration rate is then established at between zero and two points per hour. Where the soil moisture has been depleted by a preceding crop and not replenished, the decline from the high mass infiltration rate is not as rapid as with the moist soil. Here the mass rate progressively declines over a period of 12-16 hours until a "temporary base rate" of between 5 and 15 points per hour is reached. The duration of the temporary base rate is determined by the time required to reach field capacity in the profile and may extend for a further 12 hours or more. Thereafter the base rate is established at between zero and two points per hour.

During the year an attempt was made to determine the effect of previous inundation on the subsequent yield of wheat crops on the plains areas of the Darling Downs. Yield results were obtained from sample areas on 18 farms where a valid comparison could be made between flooded and non-flooded country. An average increase in yield of 3.65 bus./ac. (significant at the 5 per cent. level) was recorded on areas which had been inundated in the previous 12 months. The control areas were comparable in other respects but had not been subject to flooding. Rainfall was below average during the growing season of the crop and it is probable that the beneficial effects recorded are approaching the maximum. In a growing season of above-average rainfall, prior inundation could possibly have a detrimental effect.

Investigations relating to the maintenance of kikuyu grass cover on Darling Downs waterways showed that the availability of moisture is the main factor limiting growth. The deep clay soils are capable of storing ample moisture in the root zone of the grass. In these cases, although the grass cover could be improved by high rates of application of nitrogen (4 cwt. sulphate of ammonia per acre), the minor improvement did not justify the fertilizer investment. In trials on lighter soils there were good responses to nitrogen application but only under conditions of abundant moisture. In African star grass waterways on the Darling Downs, there was an immediate and marked response in colour and cover to an autumn application of urea. The ammonium sulphate treatments showed little obvious response but, as with the urea treatments, it was noted that the grass survived better during winter and an improved cover resulted during the following spring.

Demonstrations.—A number of Local Authorities and Government Departments responsible for public utilities showed a keen interest in the results of the investigations, reported last year, relating to the use of kikuyu grass and asphalt emulsion for stabilisation of water disposal sites. The method was demonstrated in field practice on a number of sites during the year and treated areas withstood flow velocities of up to 10 ft./sec. without damage.

SOUTH JOHNSTONE EXPERIMENT STATION

The year's rainfall here was just under 82 in., 40 in. less than the average. Generally, there was ample moisture for pasture growth except during the dry spring, when less than 1½ in. fell in three months. The drought effects were widespread on crops and pastures at this time, but later pastures were more productive than in normal years.

Tropical Pastures.—The most significant development was the experimental evidence that tropical pastures can withstand heavier grazing rates than was previously believed possible. The 20 ac. grazing management trial was discontinued because a pure enough pasture of guinea and para grasses with centro could not be established. However, just before abandonment, the pastures as established produced at the rate of 730 lb. liveweight gain per acre per year. *Brachiaria decumbens* without legumes produced 500 lb. liveweight gain per acre for the year. Centro is now planted into this pasture. Pangola grass (*Digitaria decumbens*) with a liveweight gain of 550 lb. per acre per year outyielded para grass and puero by almost 10 per cent. Several tropical legumes have now been planted with pangola grass. During 1960-61, under continuous grazing at Utchee Creek, guinea grass and centro produced 750 lb. liveweight per acre per year compared with 453 lb. from guinea grass and puero, 442 lb. from green panic and *Glycine javanica,* and only 252 lb. from para grass and puero. Rotational grazing is being compared with continuous grazing on a guinea grass/centro pasture in another trial.

Tea.—The effects of the long spring drought were severe and spray irrigation was applied in September 1960 to maintain the plantings. Production was depressed, but the annual yield from the hedges was at the rate of 2,000 lb. manufactured tea per acre. Tea seed gardens were maintained, although the dry weather caused some plants to die. In the fertilizer trial neither phosphate at 24 lb. P_2O_5, nor potash at 54 lb. K_2O per acre, superimposed on a basic application of 42 lb. nitrogen, 18 lb. phosphate and 25 lb. potash per acre, had any significant effect on production.

Miscellaneous.—Weed control trials showed that various forms of 2,4-D in distillate only partly killed lantana tops and did not suppress regrowth. The use of fire and guinea grass combined exerted some suppressive effects on guavas. Coarse guinea grass, a vigorous strain of *Panicum maximum,* is a serious weed firmly established in road reserves and such places. It is coarse, unpalatable and free seeding, is avoided by grazing animals and is quite difficult to control in pasture.

AGRICULTURAL ENGINEERING

The advisory service in agricultural engineering was maintained throughout the year and close liaison with machinery manufacturers and distributors continued.

The development of special equipment for soil conservation research enabled the Department to obtain valuable data on infiltration, run-off and soil loss. In order to assist farmers anxious to safeguard their soil conservation waterways, a turf-cutting machine was developed to facilitate the collection of planting material from kikuyu nursery areas which it is intended to establish on Council or Crown reserves.

With the financial assistance of the Commonwealth Department of Primary Industry, the urgent need of an autoheader for the harvesting of experimental plots was met by the development of a machine by a Kingaroy manufacturer. This machine has already undergone successful preliminary trials in the harvesting of soybeans. Further trials are contemplated, as the autoheader was designed for the harvesting of a wide range of crops, including cereals.

HORTICULTURE BRANCH

SOME HIGHLIGHTS

Following earlier investigations, fertilizer recommendations for the pineapple crop were modified in 1960 to provide for the application of a pre-planting basal dressing containing the whole phosphorus and potassium requirements of the crop during the growing period. Nitrogen is supplied in the form of urea sprays at intervals of 6 weeks. Results in commercial practice have been very satisfactory and the fertilizer bill to the grower reduced substantially.

Salt damage to citrus at Gayndah and some other irrigated citrus districts during the past few years has been eased considerably by varying methods of water application. Close checks are now maintained on the salt content of the water used for irrigation. If water quality becomes marginal, orchards are irrigated at night when evaporation from the surface of the leaves is negligible. In addition, rates of application are increased.

A new bean variety—*Redlands Greenleaf*—released for commercial production in 1961 has field resistance to both rust and angular leaf spot. Its performance in trials to date has been outstanding and better than that of *Redlands Belle* and *Redlands Beauty*. The new variety may find a permanent niche in the green bean industry.

DECIDUOUS FRUITS

Apple trees in a soil management trial showed a marked growth response to straw mulch. However, trees under clean cultivation made better progress than in the first year. Treatment responses may be correlated with soil moisture availability in the various plots.

Fertilizer trials in apples in various parts of the district have shown no significant differences in yield for the several treatments. In the Jonathan trial, a positive correlation was established between growth and yield. These and previous trials have provided little information on which to base fertilizer recommendations. This may be due to variability in the soils of the Granite Belt, particularly in their physical characteristics.

Chemical thinners were again studied in plums, the material of particular interest being DNOC (dinitroorthocresol) applied at petal fall at a concentration of 0.6 per cent. No benefit was derived from increasing the concentration beyond this level. Treatment effects varied considerably with the age of the tree; commercial thinning was obtained in young vigorous trees but in old trees over-thinning sometimes occurred. Selective treatment for individual trees or blocks of trees seems necessary. DNBP (dinitrobutylphenol), a new chemical thinner under test, gave results comparable with those from DNOC. The value of NAA (naphthalene acetic acid) and other materials as chemical thinners for the apple variety Delicious is also being investigated.

Data on plant patent practice in overseas countries which might be relevant to the enactment of similar legislation in Australia was collated. Without questioning the right of private plant breeders to an adequate reward for any worthwhile varieties they may produce, administrative difficulties in plant patent legislation appear to outweigh any benefits likely to accrue to the pome fruit and stone fruit industries in Australia.

Although the grape phylloxera-resistant stocks differ in both vigour and growth habit, no firm recommendation for the use of particular stocks with the three commercial varieties Muscatel, Waltham Cross and Purple Hamburg seems likely to emerge from Stanthorpe trials. However, resistant stocks in the experimental vineyard provide a useful source of cuttings for growers of Waltham Cross and Purple Cornichon, the two varieties which do not thrive on their own roots. The demand is primarily for Rupestris du Lot and 3309. In a comparable trial at the Redlands Experiment Station, experimental trends are more clear-cut. Rupestris du Lot is the outstanding stock for the varieties grown commercially in southern coastal Queensland.

PLANTATION FRUITS

The research programme in pineapples, bananas and papaws proceeded according to plan and considerable progress was made in solving production problems.

Pineapples.—Fertilizer schedules based on the application of phosphorus and potassium in the basal dressing are now in common use. Sufficient of both elements is applied to meet plant requirements during the whole crop cycle and nitrogen is applied in the form of urea through foliage sprays at intervals of 6 weeks. Experimental results indicate that yields are at least as good and frequently better than in the treatment schedules formerly used commercially. The amount of potassium specified in current recommendations may require modification in the light of later work. It is quite clear the potassium is used much more efficiently by pineapples when applied in the form of a basal dressing than when applied as a side-dressing.

Time of planting is critical for tops planted in autumn. If they are planted after the end of March, the young plants frequently make little growth before the onset of winter and the plantation does not mature a summer plant crop. Exploratory investigations on root initiation in nutrient solutions indicate that this problem may be overcome in part at least by special nutritional treatments at planting designed to stimulate both root initiation and root elongation. Nitrogen, magnesium and possibly boron availability may be involved.

The plant crop from the first field trial with clonal selections made in 1956 has been completed. Differences in both yield and fruit quality between clones were recorded but these are not necessarily correlated with each other. A number of better clones will be propagated for commercial use and should prove much superior to even the best of mass-selected planting material.

Variability in the results obtained with ANA as a flower-inducing agent in pineapples prompted a re-examination of the associated problems. Failure to induce flowering is common with treatments in February, and, in Central and North Queensland, at other periods of the year. Work at Rockhampton indicated that while ANA and acetylene are about equally effective in promoting flower formation, actual flowering is delayed by ANA and optimum results are obtained from a mixture of the two materials. Exploratory work suggested that BOH (betahydroxyethylhydrazine) may be of value for this special problem.

A series of weedicide trials leave little doubt that monuron and diuron are better pre-emergence weedicides for pineapple plantations than PCP, the material now used commercially. The higher cost of materials is more than compensated for by the extended period of control. Minor complaints of injury following treatment are apparently due to weedicide intake through exposed roots at the time of treatment.

A long-range project at Ayr designed to determine the practicability of producing the plant and ratoon crops of fruit during the winter and spring months is now in its second cycle. So far cropping has followed the anticipated pattern. Success is contingent on precise times of planting and precise times of flower induction both of which are critical for this cropping programme.

Bananas.—Each of the principal banana varieties—Cavendish, Mons Mari and Lady Finger—includes a number of selected strains. Cavendish clonal material from several strains was studied in the field. Records to date indicate that some important differences in plant type are inherent and not due to environmental factors. One of the strains is distinctly cold-tolerant and could be useful when the Cavendish variety is grown under marginal climatic conditions.

A major physiological disorder known as yellow leaf in North Queensland is apparently due to a temporary shortage of available potassium during the February-April period after the monsoonal rains. Responses were obtained in the soils concerned from fertilizers with large amounts of potassium, such as 5:8:22. Nevertheless, there may be a second factor involved in the disorder.

Spacing trials at the Maroochy Experiment Station suggested that the optimum distance between plants in non-irrigated plantations is approximately 9 ft. x 6 ft. At closer spacings, control of cropping with the object of harvesting the bulk of the crop during winter and spring becomes increasingly difficult. This secondary effect of excessively close spacing is due to reduced sucker production and the prolonged period from sucker emergence to bunch development. Slightly closer spacing may be permissible in irrigated plantations, where soil moisture is less likely to be a limiting factor to plant growth.

Papaws.—In southern Queensland it is usual to plant papaw seed in November-December and transplant the seedlings to their permanent positions in the field during February-March. With this programme, the plants are approximately 18 in. high at the onset of winter. Shortening back of the seedlings and partial defoliation may be practised before transplanting. Even so, losses in the field are frequently high. Several methods of propagation are, therefore, now under investigation at the Maroochy Experiment Station.

At the Redlands Experiment Station, a spacing trial in irrigated papaws was completed. The results suggest that a spacing of 8 ft. x 5 ft. is associated with high yields per acre. Effective control of spacing in commercial practice is, however, not easy; the surplus plants necessarily held in the field until the sexes can be separated at flowering introduce a competitive factor which can appreciably affect tree development.

A local Sunnybank selection now in its fourth generation at the Redlands Experiment Station seems well adapted to this and adjacent districts. Fruit quality and fruit size are up to market requirements and yields are substantially above average. Seed from the better selections has been supplied to commercial growers during the past few years and the over-all effect may have contributed to the recent improvement in commercial fruit consigned to market.

Attempts to stimulate early flowering in papaws in order to exploit the payable market for April-May fruit have so far met with little success. The materials used, ANA and acetylene, had only a negligible effect in trials at the Maroochy Experiment Station. The position may, however, be complicated by the stress conditions encountered in spring when treatments are applied to induce early flowering and fruit setting.

SUBTROPICAL TREE FRUITS

Citrus.—Stock-scion trials were established in all the more important citrus growing districts during the year. The trees were produced on Departmental nurseries and were of a particularly high standard. However, losses were rather high in trees from Redlands Experiment Station, where the soil type is a clay loam; root damage at transplanting is almost inevitable in this type of soil. Losses at transplanting reached a maximum in trees on Cleopatra and Trifoliata stocks. In all, 14 trials have been established, but a further series is projected with supplementary stocks which recently became available. In an earlier stock-scion trial at the Maroochy Experiment Station, significant effects of the stock on the scion performance are now apparent. Current data indicate that in coastal areas at least the preferred stocks for oranges should be: for Washington Navel, citronelle; for Joppa and Valencia Late, sweet orange.

Salting problems in citrus orchards at Gayndah have been investigated during the past four years. Chlorine determinations in orange, lemon and mandarin varieties under three different systems of irrigation indicate that significant amounts of chlorides may be absorbed through the leaves from irrigation water. They also indicate that the practice of irrigating at night is effective in reducing this intake of chlorides. Root absorption was also involved in some cases but this may be reduced by leaching the chlorides from the soil with heavy applications of water. However, more data are required on frequencies and times of irrigation as well as the susceptibility of rootstock and scion varieties to waters with a high chlorine content.

Avocado.—The avocado stock-scion trial at the Redlands Experiment Station continued to provide useful information on varietal performance and to serve as a valuable source of scion material for commercial nurseries. To date, the outstanding tree types are Fuerte and Hass. The latter could play an increasingly important part in the industry; it crops over a long period and is available when the market is normally under-supplied with fruit.

Even though avocado production in Queensland is limited, returns to the grower are sometimes low. In part, this is due to consumer aversion to poor quality seedling avocadoes of little or no commercial value and partly to the better varieties being harvested before they are fully mature. Accurate criteria of maturity are therefore important. Chemical standards based on oil content have a limited value and a joint study with the Food Preservation Research Branch is concerned with growth measurements of the fruit as a possible field index of maturity.

Propagation of young trees under glasshouse conditions in containers is now recognized commercial practice following trials at the Redlands Experiment Station. With this system, young trees are available for planting in the field in less than 12 months from sowing the seed and losses at transplanting are negligible.

Macadamia Nut.—Trees in the stock-scion trial at the Maroochy Experiment Station continued to make good progress and commenced to bear. Growth characteristics of the several scion selections vary a great deal and some of the more erect types may not be suitable for commercial orchards, particularly in areas where sprays are needed to control the major pests. Limited amounts of scionwood were supplied to nurserymen who propagate the nut.

So far no progress can be reported in studies on propagation techniques. A number of nurseries are co-operating with Departmental officers in these investigations and it is hoped that a break-through will be achieved in the near future. It may, however, be necessary to propagate the nut in glasshouses, where temperature and humidity can be controlled within reasonable limits.

Some Queensland selections are now being propagated overseas, notably in California. The best of the available types have, therefore, been named and described in the *Queensland Agricultural Journal.* The series includes both thin-shelled nuts suitable for table purposes in the shell and thick-shelled nuts suitable for processing.

OTHER CROPS

Strawberries.—Nutritional investigations carried out during the year at the Redlands Experiment Station indicated that current fertilizer schedules in the strawberry crop might be improved by increasing the amounts of phosphorus and potassium in the basal dressing and reducing the amounts applied in side-dressings. They also established the value of nitrogenous side-dressings.

Although the new variety Majestic proved disappointing in 1959 trials at the Redlands Experiment Station, a number of growers, particularly on the North Coast, are planting extensively. They are clearly impressed by the inherent vigour of the plant on the sandy loams characteristic of that district. The Redlands trial was therefore duplicated at Palmwoods to provide a statistical appraisal of its performance in the area.

Existing strawberry varieties are not well suited for canning purposes, and as the market for the canned fruit is expanding, a breeding programme has been initiated with the primary aim of developing varieties more suitable for factory purposes than Phenomenal. Parental material comes from both local and overseas sources. About 4,000 seedling progenies from crosses made in 1960 were planted at the Redlands Experiment Station for observation.

Tanbark, the traditional mulching material for strawberries in Queensland, is rapidly losing favour following experimental work which has demonstrated that the mulch markedly depresses yields as compared with those from plants grown under plastic mulch or under clean cultivation. Yields from strawberries under plastic mulch in the most recent trial were satisfactory and furnished no evidence to suggest that the ground cover in any way interferes with the penetration of irrigation water or the movement of side-dressing fertilizers into the root zone of the plants.

Passionfruit.—Progeny selections from crosses between *Passiflora edulis* and *P. edulis* forma *flavicarpa* are now in the third generation. Some of them show considerable promise but further purification will certainly be necessary to ensure uniformity in type in plants propagated from seed. In the best of these selections, yields are high, bearing is consistent and pulp quality satisfactory, while resistance to Fusarium wilt is adequate for commercial purposes. The selections show some diversity in flowering habits. Some types normally bear the bulk of the crop in summer; others bear the main crop in winter; while the third series are intermediate in cropping habits. Some selections have the ability to mature sound fruit even when the vines show acute symptoms of the virus disease known as woodiness. In this respect, they differ from the commercial *P. edulis* vine, which seldom matures much marketable fruit on vines showing comparable symptoms.

Practically all commercial plantings of passionfruit now comprise grafted vines with an *edulis* scion on an *edulis* forma *flavicarpa* stock. This constitutes a revolution in the industry and has resulted from investigations by Horticulture and Plant Pathology Branches. Most commercial growers are now skilled in propagation techniques.

Watermelon.—Few of the recognized watermelon varieties are well suited to Queensland requirements, and some locally propagated strains selected for their yield, vigour and fruit quality are grown commercially. Recent trials at the Redlands Experiment Station indicated that some of these are superior to their commercial equivalents such as Candy Red.

Ginger.—In fertilizer trials in the ginger crop, the most serviceable schedule was a basal pre-planting dressing of a 2:16:6 mixture at 9 cwt. per acre and side-dressings of sulphate of ammonia at 1 cwt. per acre in December and in January.

Spacing practices on commercial farms show considerable variation and proponents of close spacing claim high yields and less damage from sunburn. This has been partly confirmed by trials at the Maroochy Experiment Station, where increased yields were recorded by reducing plant spacing from 12 in. to 9 in. in the rows, which are normally 2 ft. apart. Sunburn can still be a major problem at the 9 in. spacing unless the crop is lightly irrigated daily during hot weather; sunburn rarely occurs if the soil is moist when atmospheric temperatures rise to danger levels.

Mulching trials leave no doubt that, provided the rhizomes are harvested at the same physiological age, yields under mulch are considerably greater than under clean cultivation. The response to sawdust mulch was better than that from plastic sheeting placed on the bed at planting and removed at the commencement of sprouting, even though sprouting under plastic mulch was earlier and more even than in any other treatment. Early flowering was a charactertistic of sawdust-mulched ginger and this may reflect the even soil temperature maintained during the growing period.

Cocoa.—Climatic conditions in the coastal Wet Tropics are suitable for the cocoa plant. In order to study the performance of this crop in Queensland, seed of the Amelonado variety was introduced from North Borneo and established at the Kamerunga Experiment Station, near Cairns. Germination was satisfactory and the seedlings were transplanted to three quarantine areas in North Queensland. These plantings should provide adequate seed in two or three years' time to meet commercial requirements should prospects for the crop continue to be favourable.

VEGETABLES

Soil Management.—A long-term soil management trial designed to determine the effect of organic matter on the availability of applied superphosphate is still in progress. Vegetable crops grown in rotation indicate a significant

response to applied superphosphate in the red brown clay loams of Redlands. There was also a response to organic matter applied as green manure. How far this latter response to organic matter is due to its effect on phosphorus uptake and/or some other nutrients has yet to be determined.

Marked responses to cultural treatments are being obtained on an infertile grey sandy loam which formerly would have been classed as unsuitable for horticultural purposes. In this type of soil, normal crops cannot be grown until the extreme deficiency of phosphate has been corrected. Even then, steps must be taken to incorporate bulky organic matter into the soil before adequate responses are obtained to the fertilizer schedules recommended for specific crops. Nevertheless, the trial demonstrated very effectively that, given appropriate treatments, even the most unpromising of soils can be brought into commercial production under irrigation.

Tomato.—The value of the F1 hybrid tomato derived from Q2 and Salads Special was confirmed in the winter tomato crop in the Redlands district. Its ability to set in relatively cold weather, its vigour and its consequent tolerance of leaf shrivelling virus suggest that the variety may stabilise winter tomato production in the district.

Significant responses were obtained in fertilizer placement trials in tomato seedbeds on the red-brown clay loams of Redlands. Superphosphate banded 1 in. below the seed promoted early and rapid growth after germination and the effect persisted when the seedlings were transplanted to the field. It would appear that tomato seedlings have a high phosphate requirement which is not adequately met by normal fertilizer practice in the seedbeds.

The most promising tomato selections obtained at Bundaberg from breeding and selection work in that area are derived from Urbana x Acc progenies. They have considerable resistance to Fusarium wilt and set fruit reasonably well in cold weather. The appearance and internal quality of the fruit are up to acceptable market standards. Commercial interest in the type is, at present, restricted to the Bundaberg district.

Pith rot and blossom end rot are both common disorders in tomatoes at certain periods of the year. They are normally associated with faulty calcium nutrition. In pot culture studies, the ammonium ion concentration of the nutrient solution had an influence on the incidence of both disorders; a high concentration in the solution was linked with low calcium content of the plant tissues. The implications of this work are now being investigated in the field. If a correlation is established between results from pot culture trials and the field work, there will probably be a case for replacing sulphate of ammonia in the fertilizer schedule by other forms of nitrogen.

Q2, a certified tomato variety widely grown in southern and central Queensland, recently came under criticism for its allegedly high incidence of catface, a blemish which is very pronounced in large fruit. At Stanthorpe, plants grown from seed stocks varying in age from 1 to 8 years showed no differences in plant type or susceptibility to catface. It would appear, however, that fruit from the lower hands of Q2 is rather large for current market requirements, at least when grown in fertile soils under irrigation.

Pulse Crops.—A breeding programme designed to produce rust-resistant varieties of French bean led to the interim release of Redlands Belle and Redlands Beauty in 1958. Both have been in strong demand in areas where the disease is troublesome. A further release named Redlands Greenleaf is resistant not only to rust but also to angular leaf spot. Commercial production of the seed is now in progress. The ultimate place of these three varieties in the green bean industry will necessarily depend on grower appraisal over a period of years.

The stringless bean project seems likely to continue for a few years yet. The best of the available lines produce pods as attractive as those of Brown Beauty, the commercial string variety, when the crop is grown under reasonably good conditions. However, should stringless selections encounter difficult weather during the growing period, the proportion of curled and misshapen pods is excessive. This would be of no importance were the crop grown only at certain specified periods of the year. However, it could be a complication when, as at present, beans are grown for the fresh vegetable market in successional plantings over a long period.

Nucleus stocks of culinary dry bean varieties were built up in 1958-59 and subsequently placed in pilot trials on grower properties in the Burdekin Delta. Those which performed satisfactorily were Saluggia, Borlotti, Cannellini, Mandaloni and Black Eye. Rossini yielded only a light crop and is not rated highly by consumers. Yields were generally up to expectation and costs of production should be competitive with those elsewhere in the Commonwealth. However, further development in the industry is contingent on a market demand for Australian seed as against seed of the same varieties imported from overseas. Technical interest in the crop is now restricted to the purification of the varieties to reduce the incidence of off-type seed colour.

The desirable erect bush habit and superior seed quality of Sanelac navy bean have been combined with the rust resistance of California Small White in a cross which has yielded 200 productive bush progenies. These will be screened for rust resistance in the coming spring, when about 50 rust-resistant progenies should be recovered. After this screening the project will pass to the plant breeder in Kingaroy who will select for agronomic type and seed quality in the area where the crop is produced commercially.

Pea selections derived from progenies of Massey x Canner, Greenfeast x Meteor, and Massey x Meteor may replace both Massey and Greenfeast on the fresh vegetable market in Queensland. The seed of the best of these is being bulked at the Redlands Experiment Station and will be available for semi-commercial plantings in April 1962. The most outstanding type is B27 derived from Greenfeast x Meteor. Curiously enough, these selections have a high laboratory rating from the Food Preservation Research Laboratory for processing in terms of pea quality in the deep-frozen and canned product. They can therefore be considered as potential dual-purpose varieties.

Cucurbits.—Methods of promoting earliness of maturity in spring-planted rockmelons were investigated at the Redlands Experiment Station. Contrary to overseas experience, the use of mulches did not advance the cropping period. However, yields from polythene-mulched rockmelons were almost 100 per cent. greater than in unmulched plots owing to the reduced incidence of mildews and the consequent longer cropping life of the vines. Similarly, "Windolite" covers proved disappointing. Germination under these covers was rapid and seedling growth surprisingly fast. However, in spite of reasonable care in hardening-off before the covers were finally removed, cold winds gave the young plants a severe setback.

Root Crops.—Some years ago, varietal trials at Stanthorpe established the suitability of the Osborne Park carrot for the district. A further trial was carried out partly to re-appraise varieties and partly to evaluate some new varieties on the market. The results demonstrated the superiority of Topweight. The relatively poor performance of Osborne Park was primarily due to its high susceptibility to rots. However, it is quite clear that the Topweight now available is a much better carrot than its commercial counterpart of 10 years ago. Experimental data from both Redlands and Stanthorpe confirm the suitability of this variety for all vegetable-growing districts in southern Queensland.

Crucifers.—For many years past, the Stanthorpe district has shown a strong preference for drum-head varieties of cabbage such as Succession mainly because of their ability to mature satisfactory heads under stress conditions. With the gradual extension of irrigation facilities in the district, greater interest is being displayed in Enkhuizen Glory and other ball-headed types which have performed well in Departmental trials. Variety and nutritional trials were therefore investigated. The experimental data indicated that Enkhuizen Glory is the best of the ball-head types when planted 2½ ft. apart in 3 ft. rows. At this spacing, head size falls within the 5 lb. limit for which the market pays a premium.

Satisfactory crops of cabbage can be produced at Stanthorpe with lower applications of fertilizer than in coastal areas. Maximum yields were obtained from a basal dressing of 5:13:5 at 6 cwt. per acre and a single side-dressing of sulphate of ammonia at 2 cwt. per acre. No benefit was derived from a second side-dressing.

Salad Crops.—Strain trials at Stanthorpe with local selections of South Australian White celery showed wide differences in both yield and plant type. The best selections proved superior to commercial seed and this suggests some adaptability to climatic conditions in the Granite Belt. The selections probably possess some heat tolerance, but for some times of planting cold tolerance might also be valuable.

SERVICE PROJECTS

The Banana Industry Protection Board has had an uneventful year. Bunchy top remained more or less quiescent in southern Queensland where the disease is established, except for two areas. On one property at Wamuran, the disease appeared in rather a severe form but was brought under control as soon as plantation management was tightened up and regular patrols were instituted. The second outbreak, at Guanaba on the South Coast, involved one of the largest plantations in Queensland. It was near the end of its commercial life and total eradication was effected immediately. Patrols in the Metropolitan district disclosed no sign of bunchy top in residential areas.

Inspectional services to bean seed growers under contract to commercial seed firms is a major commitment in the Burdekin Delta and elsewhere. Collaboration between the Department and the firms concerned in programme planning presumes that trade practices conform with technical requirements for trueness to plant type and freedom from disease. Participating firms now contribute to a standing fund which meets some of the expense incurred by the inspectional services. Production of seed under certification rules for

mother seed purposes in 1960 amounted to 437 bus. Approved seed grown for sale to the green bean industry was 3,031 bus.

Citrus budwood and seed distribution operations place a heavy strain on the staff in the Burnett district, mainly because of the increasing orders placed for autumn delivery of budwood, the shortage of good quality Valencia Late budwood, and difficulties in obtaining adequate supplies of citronelle seed. However, all orders were ultimately met. The quality of the budwood was good except for some lines of Emperor mandarin from the Rockhampton district. Supplies of virus-free budwood are more freely available than hitherto and in strong demand. This is due not only to their accredited freedom from disease but also, in the case of Valencia Late oranges, to the high quality of the Newton strain introduced some years ago from Victoria. Distribution of budwood (A grade varieties) for the year amounted to: oranges, 77,430; mandarins, 32,350; lemons, 17,675. Seed distribution comprised citronelle, 106 lb.; sweet orange, 100 lb.; Emperor, 27 lb.

The Approved Strawberry Runner Scheme is still in abeyance but will probably be resumed in 1963. When it was temporarily suspended in 1958 following a serious shortage of disease-free planting material, steps were immediately taken to select healthy plants at the Redlands Experiment Station. These have now been bulked up in isolation for two years, and by the end of 1961 sufficient runners should be on hand to re-inaugurate the scheme. In this event, approved runners should be on the market prior to the 1963 season.

EXTENSION

Extension work in the Horticulture Branch followed the usual pattern, with regular contributions to the *Queensland Agricultural Journal, Fruit and Vegetable News* and the Press as the most appropriate mass media.

Farm visits again occupied much of the time of the extension staff. Featured themes in extension programmes were: autumn planting of pineapple slips; hybrid tomato seed for the Redlands district; high potassium fertilizers for banana plantations in North Queensland; propagation of avocadoes in containers; high working of citrus trees; control of salt damage in irrigated citrus; and fertilizer usage in the strawberry crop.

School packing class instruction practice has been reviewed. District officers are now being groomed to handle classes in their districts as well as packing enquiries from growers. This decentralisation should maintain and possibly increase the interest of field staffs in the need for better presentation of fruits and vegetables on markets.

EXPERIMENT STATIONS

The three horticultural experiment stations remained focal points for research and extension work during the past year. Visits by individual growers were numerous, but perhaps more important were the annual visits by groups of growers from fruit and vegetable grower organisations in various districts. These visits tend to foster close links between the Departmental staffs and the horticultural industries which they serve.

At the Maroochy Experiment Station an access road was made leading to the site of the proposed pineapple research unit, construction of which should commence in spring. The new manager's residence is occupied and the last of the old buildings acquired with the property were removed.

At the Redlands Experiment Station, an extension to the headhouse section of the glasshouse now under construction will improve accommodation for the plant physiology staff and lead to greater efficiency. A building to house other technical staff and administrative, extension and ancillary personnel is urgently needed. The existing water supply for irrigation is now quite inadequate and steps have been taken to find a means of substantially improving the position.

The Kamerunga Experiment Station still awaits development, the two main requirements being an adequate water supply for irrigation and suitable buildings for laboratory work. The need for both has been accentuated by research commitments accepted on behalf of the tobacco industry.

LEGISLATION

Only minor amendments were made to the *Diseases in Plants Acts* during the year. Regulations 12 and 13, dealing with grade standards for fruits and vegetables, and Regulation 36, dealing with inspectional fees, were rescinded; all are superseded by provisions in the *Fruit and Vegetables Act*. Regulation 40 was altered to provide for the declaration of both stock and scion varieties on labels attached to consignments of fruit trees offered for sale.

QUARANTINE

Quarantine services on behalf of the Commonwealth Department of Health were fully taxed during the year, as the traffic in quarantinable goods is increasing with improved transport facilities from oversea countries. Each improvement is accompanied by shorter stops at terminal points. Quarantine services must, therefore, be geared to rigid time schedules.

The traffic in plants and planting materials, in spite of severe restrictions, continued to pose problems. Queensland is the focal point of entry for tropical and subtropical plants of actual or potential importance to an expanding floricultural industry. Some species of interest come from countries where disease hazards can only be roughly assessed, and strict post-entry quarantine is therefore inevitable, with all irritations and delays involved. However, most of the associated procedures have now been standardised and importers are familiar with requirements.

Quarantine traffic for the year may be summarised as follows:—Orchids, 10,545 orchids and 115 flasks with seedling orchids; miscellaneous plants, 5,482; logs, 21,188 containing 14,572,500 super feet; sawn timber, 281,501 bundles containing 12,286,000 super feet; veneers and plywood, 1,670 bundles; onions (ex New Zealand), 24,480 bags; household effects, 17,174 cases.

REGIONAL EXPERIMENT STATIONS

The function of the Regional Experiment Stations is to investigate production problems of the various primary industries of the districts that they serve. Originally most of the activities of the Branch were concerned with investigations related specifically to crop production, but with increasing emphasis on balanced farming, the scope of the work on the Stations has greatly expanded to cover problems of both plant and animal industries. Much of the investigational work is carried out and reported upon by other Branches and Sections.

Rainfall data for all Stations are shown in Table 1.

TABLE 1

REGIONAL EXPERIMENT STATIONS—RAINFALL, *1960–61* (INCHES)

	Biloela		Gatton		Hermitage		Kairi		Millaroo		Theodore	Walkamin
	1960–61	Mean (38 years)	1960–61	Mean (College 62 years)	1960–61	Mean (15 years)	1960–61	Mean (9 years)	1960–61	Mean (4 years)	1960–61	1960–61
July	0·86	1·29	1·17	1·43	1·20	1·14	1·57	0·86	0·00	0·53	1·23	0·55
August	0·51	0·69	0·56	1·03	1·32	0·97	0·25	1·02	0·14	0·22	0·54	0·03
September	0·23	0·82	0·15	1·49	0·42	1·55	0·20	0·77	0·17	0·11	0·33	0·40
October	2·20	2·09	2·81	2·48	4·01	3·70	1·92	1·20	0·09	0·23	1·07	0·14
November	4·14	2·86	4·07	2·79	2·38	2·63	1·29	2·13	3·10	2·08	3·19	4·26
December	1·86	3·64	2·73	3·88	3·89	3·70	8·28	4·90	2·57	4·11	1·80	1·38
January	2·65	4·12	3·95	4·35	1·66	3·89	5·06	11·29	4·16	5·13	2·24	5·46
February	7·22	4·98	5·19	4·06	5·39	3·31	1·58	10·59	5·74	9·07	7·34	1·08
March	0·87	2·66	0·69	3·07	2·12	2·49	8·20	10·77	1·75	4·05	2·16	7·35
April	0·77	1·65	1·19	1·89	0·18	1·26	2·06	3·43	0·54	3·68	1·95	1·18
May	0·92	1·59	0·78	1·50	0·70	1·38	2·11	2·00	0·63	1·25	0·61	0·93
June	0·48	1·67	1·08	1·78	0·84	2·15	0·56	1·73	0·07	0·62	0·33	0·04
Annual Rainfall ..	22·71	28·06	24·37	29·75	24·11	28·17	33·08	50·69	18·96	31·08	22·79	22·80

HERMITAGE

Weather.—Dry spells were a feature of the season. Winter cereals were affected in August and September while summer crops of maize, sorghum and sunflowers were adversely affected by drought conditions in January. Both cotton and soybean crops benefited from the February rains and made satisfactory yields despite the hard conditions experienced in mid-season. Low winter temperatures had severe effects on crop growth. A total of 53 frosts was recorded during the July-December period. A temperature of 14.9 deg. Fahrenheit on the grass was registered in July, and young linseed and susceptible wheat varieties were damaged. Relatively low temperatures in early summer slowed down the growth of cotton. Temperatures were high during the remainder of the summer and good growth was made generally. No frosts were experienced in 1961 until early May.

Wheat.—Despite the dry weather satisfactory yields were obtained. The two standard variety trials provided information additional to that obtained from the three variety and strain trials planted at monthly intervals. A difference of only 12 days in rate of maturity separated the earliest and latest varieties grown and the average yield from the earlier varieties (34.4 bus./ac.) was only 4 bus. better than that of the late-maturing types (30.3 bus.). Wheat grown on land which followed 4 years of pasture became stunted and yielded only 24.7 bus./ac., while an attractive crop, yielding 32.7 bus., developed on land which followed summer and winter cropping but allowed for a fallow to replenish the moisture supplies. Two grazings, yielding 3.86 tons/ac., were obtained from the trial of slow-maturing varieties, while a grain yield of 48.9 bus. per ac. was subsequently obtained.

Oats.—The oats grazing trial provided four grazings altogether, with a mean weight of 6.7 tons of oven-dried hay per acre. The later varieties, Algerian and Trispernia, produced a greater tonnage of feed.

Sorghum.—The hybrid grain sorghum breeding work was continued at this Station, and in addition two large trials to compare the 23 more important hybrids with the standard varieties were conducted. The leading strains, Texas 610 (103 bus.) and Texas 630 (94 bus.) outyielded the open-pollinated varieties, Early Kalo (74 bus.) and Alpha (52 bus.). In rotation areas sorghum growth was restricted by moisture stress in borders immediately following 4 years of lucerne, mean yields following lucerne being 30.0 bus., as against 55.7 bus. elsewhere.

Cotton.—Because the cotton season at Hermitage is so short, a quick-germinating, early-maturing type is needed. The emphasis has therefore been on variety testing. Material for the investigation of the fibre quality of each of 24 varieties was harvested, and leading strains yielded over 1,400 lb. seed cotton per acre. Yields of over 3,000 lb./ac. were obtained from small areas planted in October with the aid of supplementary irrigation.

Soybeans.—The varieties DEH12423, Nanda, ECG973 and two MBH strains gave better yields (over 1,000 lb./ac.) than those maturing more slowly. This crop held on well during January but benefited considerably from the February rains.

Other Crops.—An area of Pole Star sunflowers grew well, producing 25 bus. of seed per acre. Seed from two bulk selections, based on plant height and earliness, was obtained for further work. Although quite a good setting of seed had taken place in an increase crop of French beans, halo blight appeared, making the crop unsuitable for certification purposes. Small trials of linseed, guar bean and Russian comfrey were grown and will be continued next season.

Pastures.—All pastures were affected by the generally dry season. Oats could not be planted on time and only poor growth of both native and improved pasture has taken place.

Livestock.—Sow performance and progeny trials were continued. Growth rate was satisfactory and work to improve carcase quality is in progress. Other trials showed that the hybrid grain sorghum Texas 630 (a white-seeded strain) is more palatable to pigs than Early Kalo, which in its turn is more readily taken than either Alpha or Martin. The inclusion in the ration of soybean meal as a substitute for skim-milk did not significantly affect the growth rate of young pigs.

GATTON

Investigations at this Lockyer Valley Station are directed primarily to irrigated crops and pastures. Research studies were conducted with potatoes, onions, maize, soybeans, cotton, rockmelons, cucumbers, peas and irrigated grasses and clovers. The citrus budwood orchard was extended, and nut-grass control trials were commenced. Some 450 lb. of tobacco seed was grown. In a year of low rainfall, water supplies for irrigation were frequently restricted. There was a marked drop in the water level in wells and storages and the creek was almost exhausted on several occasions.

Irrigated Pastures.—A range of irrigated pasture mixtures established in 1956 is maintained and grazed by dairy cows or sheep and fat lambs. These areas serve as a demonstration for visiting farmers. In an adjacent land utilisation project it is being shown that maize can be grown in summer, and sub-clover for grazing in winter and spring, on the same land.

Permanent irrigated pastures produced record yields in the year, all producing over 50 tons of green material per acre. Mixtures of H1 ryegrass and white clover were outstanding in a year free of heat-wave conditions or long wet periods. In a dry year with rainfall of 25 in., approximately 44 in. of irrigation water was applied to highly productive pastures.

Pasture mixtures which incorporate new species of potential value were sown in June 1960 and were ready for grazing in September. Weekly growth averaged 1.26 tons of green material per acre. New plantings of summer and winter grasses were made in April 1961 in combination with Louisiana and Ladino white clover, to study methods of establishment and management.

Elephant grass strains and para grass have been found important for summer production in wet areas, and preliminary trials indicate that the perennial Ronpha grass is capable of very high winter production. The legume glycine is being utilised in some pastures as an alternative to clovers. A pasture of paspalum and white clover in its thirteenth year was sod-seeded to oats for winter grazing.

Potatoes.—Outstanding features during the year were: (1) the high incidence of purple top or autumn wilt in both spring and autumn crops; (2) the ineffectiveness of DDT in giving adequate local control of potato tuber moth; (3) indications that the use of cut seed potatoes of single eye type has certain economic advantages in the Lockyer Valley; and (4) confirmation that the origin of seed potatoes is of great importance.

Severe losses occurred in the autumn and spring 1960 crops due to wilt. The disease appears to be caused by the aster yellows virus, which affects many other crop plants and which was suspected of causing serious damage to Lockyer Valley potatoes in 1947 to 1949. The source of infection seems to be local from a wide range of host plants, and primary infection causes severe yield losses due to early collapse of the plants, or the plants produce smaller or fewer tubers. Tubers held as seed for the autumn crops, if infected, fail to sprout or produce normally. Studies directed to preventive and direct control are in progress. The apparent resistance of tuber moth to DDT is also being investigated.

In a spring-planted trial of varieties, Kennebec (7.1 tons/ac. 1st grade) was outstanding. This variety, and also Sebago and Sequoia, gave total yields of over 9 tons/ac. In autumn, six varieties were tested for yield, and their suitability for processing and dehydration will be determined. Pontiac produced 10.8 tons/ac. and Kennebec 10.1 tons with emergence of 93 and 88 per cent. respectively. The yield of Sequoia (4.8 tons) was favourable from an emergence of only 58 per cent. of planted sets. No significant differences were obtained from plantings of three set sizes at three spacings in the autumn crop, but the level of fertility may have been inadequate for the higher populations. The percentage of 1st grade potatoes was low, especially in close spacings (55 per cent.), but total yields in the trial ranged from 4 to 7 tons/ac. In the spring crop six set sizes and five spacings were examined. Use of 2½-3½ oz. sets at 12 in. spacing gave the highest yield (12.8 tons). Spacings did not affect yield of 1st grade potatoes but close spacings gave higher total yields. Spacing also had an effect on the number of tubers set.

Further trials showed that plantings of whole large sets gave increased vigour and early growth but yield increases were not economic. Yields from plantings of the apical half of cut tubers gave threefold increases over plantings of basal halves, but poor emergence resulted in lower yields than those obtained from whole seed. However, whole seed gave a lower percentage of 1st grade tubers than did cut sets.

The production of potatoes and another crop annually for three years followed by three years lucerne is being studied in a long-term rotation.

Lucerne.—Nutrition studies have shown that applications of magnesium sulphate to lucerne watered from underground sources corrects the suspected sulphur deficiency. The effect of fertilizer treatments involving different sources of sulphur is being studied.

Maize.—Trials were conducted under rain-grown conditions and with supplementary irrigation and fertilizer to determine the optimum and most economic yields of maize grown in varying plant populations and spacings. The 1959-60 trial showed significant yield increases due to irrigation (71.0 bus. irrigated, 48.4 bus. rain-grown), but effects of plant spacings and nitrogenous fertilizer were masked by severe lodging and hail damage during heavy storms. The rotation areas were also affected but average yields were 92.1, 85.2 and 78.6 bus. from areas one, two and three years out of pasture respectively.

Cotton.—A new variety for machine harvesting, Deltapine Smooth Leaf, was studied in a seed increase area. Under dry conditions but with supplementary irrigation and spraying for insect control very promising results were obtained. The area of 0.8 ac. yielded at a rate of 3,100 lb. of seed cotton per acre. Fibre studies are in progress to determine suitability of this variety for the Australian trade. Another promising variety, Acala 1517 B.R., was increased and progenies of this blight-resistant cotton are being raised from selections having full staple length and strong fibre.

Miscellaneous Crops.—Cowpeas were grown with irrigation to provide conditions favourable for disease development with a view to studying varietal resistance to disease. Stem rot was apparent in Reeves and Black varieties. The most productive varieties for green manuring were Malabar (15.8 tons), Havana (14.7), Santiago (13.8), and Cristaudo (12.5). Eight varieties of soybeans gave favourable growth, green foliage weights being over 10 tons/ac. for Avoyelles and Congo. Flowering was prolific, and although root rots diagnosed as *Fusarium* spp. and *Macrophomia phaseoli* affected all varieties, some satisfactory grain yields should be obtained. Preliminary trials were conducted with guar bean, and seed of several oat varieties and French beans was increased. Wheat varieties were grown for rust studies but under the dry conditions yields did not exceed 36.5 bus. (from Kenora), and there was no stem rust.

Sheep.—Fat lamb production on irrigated pastures continued. The lambing percentage (lambs slaughtered to ewes mated) was 125 following a 7-weeks' mating from March. The lambs had an average cold dressed weight of 32 lb. and averaged 82 days old at slaughter.

BILOELA

Rainfall for the year was only 22 in., compared with a 37-year mean of 28.06 in. Winter and autumn months were drier than normal, as were also December and January. The winter of 1960 was colder than usual, a total of 29 frosts being recorded during July and August.

Cotton.—In spite of the dry conditions experienced in early summer and autumn, rain-grown cotton produced well and an overall yield of 800 lb. of seed cotton per acre is expected. Bobshaw (944 lb. s.c./ac.) outyielded other varieties in the rain-grown variety trial, which averaged 774 lb. at the first pick. Other rain-grown trials included a pest control trial in which spray treatments did not appear to outyield unsprayed treatment; and a fertilizer trial in which for the third year in succession there was no yield response to nitrogenous fertilizer.

Cotton in irrigated trials was not affected by the dry conditions in late summer and autumn and final yields in excess of 2,200 lb. of seed cotton per acre were obtained in some trials where nitrogenous fertilizer had been applied. Although much has still to be learnt about agronomic aspects of nitrogenous fertilizer use in irrigated cotton, the need for it on the Station's soils under most circumstances has become an established fact. Spectacular yield increases due to fertilizer have now been obtained in three of five seasons since detailed trial work began. In two trials completed in the past season, fertilized treatments of 4 cwt. sulphate of ammonia per acre yielded 2,248 and 2,215 lb. of seed cotton per acre, while the respective unfertilized treatments yielded 1,181 and 1,386 lb. Time of application of the fertilizer does not appear to be critical.

There was only a slight recurrence of an unidentified boll malady which caused serious reduction in yields in the previous two seasons. As a result, the current Abnormal Boll Trial designed to test whether insects were the primary cause of the malady may not produce effective results.

Considerable emphasis was placed on defoliation experiments in irrigated cotton. In a defoliant time-of-application trial yields appear to have been decreased by defoliation prior to mid-March in fertilized and unfertilized cotton. "Folex" and monosodium cyanamide performed very well in a defoliant screening trial.

Investigations into the effect of pre-emergence weedicides, spraying with plant hormones to reduce boll shedding, and skip row planting, were continued.

As a counter to bacterial blight disease, seed increases were made of resistant American varieties, Acala 1517 B.R. and Austin. In addition, some resistant strains from Uganda were growing in observation plots.

Sorghum.—Yields from the rain-grown variety trial showed an obvious superiority of Texas 610 hybrid, which yielded 49.9 bus./ac. Other yields were Martin x Alpha 35.8, Martin 35, Early Kalo 31.6, Alpha 30.8, B.C. 7-10-1-3 30.1, and Wheatland 27.1.

Leguminous Seed Crops.—A soybean variety trial suffered from moisture stress and only averaged 5 bus./ac. Guar bean grown for the second season performed extremely well and showed good drought resistance. A reasonable yield should result when beans are harvested.

Silage and Hay.—Approximately 200 tons of Sugardrip sweet sorghum and velvet bean mixture was ensiled to ensure an adequate supply for dairy stock. Excellent hay was produced from irrigated lucerne throughout the year.

Wheat.—Good storage of soil moisture to a depth of 60 in. at planting time was sufficient to produce an average yield of 34.9 bus./ac. in the rain-grown variety trial. Little useful rain was received during the growing season. Gabo and Saga (each 39.5 bus.) topped the trial because of low rust incidence. Mengavi (33.3), Festival (32.0) and Spica (29.4) were disappointing.

Safflower.—Good subsoil moisture at planting enabled reasonably good yields to be realized in the variety trial. Gila produced 1,462 lb., Horowitz 1,212 lb., and a Horowitz selection 1,110 lb./ac. Gila, apart from having a high grain yield, also had a very high oil content. In this trial Gila yielded 50 per cent. more oil per acre than Horowitz. Similar results to those of the previous season were obtained in the safflower versus oats grazing trial, safflower (1.3 tons dry weight per acre) withstanding the drought conditions better than oats (0.9 tons).

Rotation Experiment.—An important innovation was the setting up of a new Cash Crop Rotation which is designed to test the merits of different methods of fallowing for cotton, sorghum and wheat. Criteria to be applied will be mainly changes in physical properties of the soil, including depth of stored moisture at planting. It is hoped that by sound farming it will be possible to extend well beyond the four years at present recommended for a cropping phase before returning to pasture.

Rain-grown Pasture.—In two different trials where Biloela buffel grass or green panic was grown alone or in association with lucerne or glycine, a heavy stand of lucerne contributed up to 50 per cent. of available forage. The glycine stand was sparse and early growth was slow.

In an extension of the nitrogenous fertilizer programme to rain-grown pastures a spectacular response was obtained in a 6-year-old Biloela buffel grass stand when nitrogenous fertilizer was added and discing carried out in spring and rain followed. A February application which was followed by dry weather resulted in no increase over untreated plots. Yield data are tabulated below:

Treatment	October Application (Dry-matter yield, lb./ac.)	February Application (Dry-matter yield, lb./ac.)
Discing + N (1 cwt. urea/ac.) ..	2,606	753
N	1,461	829
Discing	705	378
Discing + oversowing with glycine	619	476
Control (untreated)	548	742

A second experiment using rain-grown elephant grass failed to give a yield response due to nitrogenous fertilizer on land that had previously been long-fallowed following a cow-pea crop.

During the second year following establishment of a *Sorghum almum* versus annual sorghum and elephant grass yield trial, all four species showed good spring recovery. At the time of sampling in January both *Sorghum almum* strains were rank and stemmy, while Sugardrip sweet sorghum and elephant grass were at an attractive leafy stage, as is indicated by dry-matter content:

Species	Mean Yield (tons/ac.)		Dry-matter (%)
	Green	Dry-matter	
Sorghum almum, Nunbank	2·43	0·98	40·4
Sorghum almum, Crooble	2·96	1·21	40·7
Sugardrip sweet sorghum	2·36	0·63	26·4
Elephant grass	3·82	0·85	22·3

Irrigated Pasture.—Large yield responses to nitrogenous fertilizer occurred during the summer months in irrigated elephant grass. Amounts of up to 200 lb. N/ac. were applied following each grazing. Spring applications were not as effective. Data are tabulated below:

Application Date	Sept. 5		Nov. 3		Dec. 22	
Sampling Date	Oct. 10		Dec. 15		March 2	
Treatment	Yield (tons/ac.)	Protein (lb./ac.)	Yield (tons/ac.)	Protein (lb./ac.)	Yield (tons/ac.)	Protein (lb./ac.)
Control	0·21	10	3·74	65	4·2	107
50 lb. N/ac. ..	0·44	20	12·42	237	10·5	191
100 lb. N/ac. ..	0·61	30	19·67	350	13·2	257
200 lb. N/ac. ..	0·96	43	20·88	513	21·3	483

Spelling from grazing in spring and autumn allowed Pricbe prairie grass to seed more freely and thus maintain a better grass-to-legume balance, especially when grazing interval was kept at six weeks instead of four. Investigations showed that application of nitrogenous fertilizer to two irrigated pasture mixtures had little effect on dry-matter production or pasture composition.

Work on selection and propagation of new strains was encouraging. A small seed-increase of two desirable H1 ryegrass strains was possible, and a broad-leafed medium-tall elephant grass strain (9-0-1) showed promise in irrigated and rain-grown trials. Promising progenies of Ronpha grass, a Phalaris hybrid, are being increased.

Livestock.—The dairy herd on irrigated pasture reached a satisfactory level of production, groups giving up to 283 lb. butterfat per cow. Pig feeding and sow performance trials are reported by the Pig Section.

THEODORE

Weather conditions at the Irrigation Research Station were similar to those at Biloela Regional Experiment Station, from which this sub-station operates as a subsidiary.

The main theme was the evaluation of pasture species and mixtures in terms of carrying capacity of breeding ewes and fat lambs. Three major pasture mixtures contributed to give steady production throughout the year. These were (1) Ladino clover and Priebe prairie grass (for winter, spring and summer); (2) Ladino clover and *Phalaris arundinacea* (for spring and summer); (3) *Paspalum dilatatum* and Irrigation white clover (for spring, summer and early autumn).

Crossbred ewes (Border Leicester x Merino) and Merino ewes were both mated with Dorset Horn rams. A satisfactory growth rate of ½ lb. liveweight gain per day was averaged by lambs from crossbred mothers over a period of 20 weeks. Fully established pastures carried 10 ewes plus lambs per acre. Due to an anomaly in current market prices, wool from crossbred ewes was of higher value than that from Merino ewes. However, fleece weight of Merino ewes was greater. Crossbred ewes produced 17 per cent. more lambs and their lambs matured earlier than those from Merino ewes.

MILLAROO

This Station is adjacent to the Burdekin River some 40 miles upstream from Ayr. Investigations include study of crops such as tobacco, maize, beans, cotton, citrus and pineapples, all of which have commercial significance on the free-working levee bank soils of the irrigation settlement. As any future development of a major irrigation programme would have to include utilisation of the heavy flood plain soils, projects are being conducted to determine the most suitable crops, grasses or legumes for development of these areas. The season was characterised by low winter temperatures in 1960, when 13 frosts were recorded, and by below-average wet-season rains in 1961.

Tobacco.—In the seven trials high yields were obtained but leaf quality was variable. Blue mould was of some consequence but other pests and diseases were adequately controlled.

In studying for the third season the use of methyl bromide fumigation and heat sterilization on seedbed treatments and their effect on plant growth, no apparent yield or quality differences due to these treatments were obtained in graded leaf. Any lack of vigour in seedlings in methyl bromide treated beds can be overcome by the addition of extra nitrogenous fertilizer to the seedbeds.

A comprehensive fertilizer trial with major elements supported earlier findings that responses are not obtained from applications of phosphate or potash. Applications of nitrogen gave variable responses. In 1958 nitrogen had no effect; in 1959 it suppressed yield and value; and in the 1960 crop increases of 170 lb. of leaf per acre followed the application of 20 lb. N/ac. Nitrogen as urea produced significantly less flat leaf than did treatments with no nitrogen or with nitrogen as nitrate of soda. Yields ranged from 1,307 lb. to 1,499 lb. of graded leaf per acre.

In a study of furrow and spray irrigation combined with watering programmes, spray irrigation gave larger and greener plants but lower quality leaf than tobacco receiving surface watering. Watering in alternate furrows has produced good yields of high quality over the last two seasons, and delaying of the first irrigation until seven weeks after planting has not reduced yields.

Leaf chlorine content is being examined. Yields from the trial were from 1,169 lb. in unirrigated areas to 1,490 lb. from plots receiving 10 in. of irrigation and extra nitrogenous fertilizer.

In a variety trial, four Virginia types yielded 2,200-2,407 lb. of saleable leaf per acre, while two mould-resistant hybrids also produced over 2,000 lb. Hicks and Hamilton varieties gave 1,556 and 1,666 lb. respectively.

The rotation trial was continued but yield difference was not significant following different cropping histories. However, leaf from areas which previously grew a legume-based pasture were large and dark-green and difficult to cure. Annual cropping to tobacco in the fourth year gave yields of 1,772 lb. of total leaf per acre.

Maize.—Production of maize on the levee bank soils now possesses few problems and regular yields of 100 bus./ac. can be obtained. Work has now been initiated on the flood plain soils of lower fertility to ascertain fertilizer requirements and to study methods of control of streak, a virus disease possibly carried by the aphid *Peregrinus maidis.*

Soybeans.—Earlier trials showed the importance of day length in growth and productivity of soybeans and November plantings appear most suitable. The most promising strain in a variety trial was C.P.I. 15944 (17.2 bus./ac.). This variety has desirable growth habit, and although it took 70 days to flower, harvesting was done in April.

Castor Beans.—Observations towards successful cultivation of castor beans continued. Plant spacing is important to control vegetative growth. A yield trial is in progress using five introduced varieties.

Guar.—This legume crop has potential value in industry and it may also prove suitable as a pioneer plant on new land. Some 15 strains are being studied and grown for seed increase.

Sorghum.—Seed increase of hybrid parent material continued to obtain an extra generation each year for use in the breeding programme conducted at Hermitage. Material planted in June was harvested in November and returned to Hermitage for use in the normal summer season.

Leucaena glauca.—Four varieties of this potential browse plant are being studied for yield and suitability for the region.

Rice.—Seed increase was arranged for 12 varieties to be used in future trial. A bulk area of Prelude, though badly lodged, produced 1¾ tons/ac.

French Beans.—Two acres of French beans grown for certified seed were utilised for a fertilizer trial. Yields of 23.7 bus./ac. were obtained with 48 lb. N/ac. and 20.7 bus. from 24 lb. of nitrogen. Results over recent years indicated that 60 lb. N/ac. may be the optimum amount for French beans and that neither phosphate nor potash have improved yields of seed.

Cotton.—Cotton trials were damaged by low winter temperatures but one March planting produced 820 lb. of seed cotton per acre in the spring.

Horticulture.—A section has been established on the Station and plantings include oranges, mandarins, pineapples and bananas. Variety and yield trials are in progress with tomatoes, culinary beans and peas.

Trials on the Flood Plain Soils.—These heavy soils present many problems due to soil characteristics which impede drainage and aeration in combination with an inadequate or unavailable supply of essential plant nutrients. The programme of study is centred on crop and fertilizer investigations, soil amelioration studies, pasture species trials with grazing, and pasture and crop rotations. It has been found that large responses can be obtained from initial applications of nitrogen and phosphate. Using oats as an indicator crop, complete fertilizer produced 3.4 tons air-dry weight per acre, whereas treatments lacking superphosphate gave 1.5 tons, those lacking only potash 2.7 tons and the unfertilized area 0.7 ton.

Soil amelioration trials including gypsum, dry and in solution, in conjunction with different depths of ploughing, resulted in higher yields of the indicator crop on areas deep ploughed or receiving 5-10 tons of gypsum per acre. In another trial, ploughing to 15 in. gave higher crop yields than 4 in. cultivation and similar increases were obtained by application of gypsum. Pasture trial areas have improved considerably with age and the legumes centro, glycine and self-regenerating phasey bean are superior. Twelve Hereford steers, run part-time on the para and centro pastures, made an average liveweight gain of 355 lb. in 228 days.

KAIRI

This Station is concerned with problems of the primary industries of the Atherton Tableland. The wide range of investigations conducted includes those related to land usage, cropping systems, crop and pasture production and associated soil studies, and various animal industry pursuits such as dairying, poultry, and pig-raising.

Maize.—Studies relating to maize have included the testing of a number of hybrid varieties for possible suitability for Tableland conditions, similar testing of certain inbred lines, and agronomic investigations of pasture-maize rotations, plant populations, and fertilizer applications.

The crop planted in December 1959 experienced favourable growing conditions. Good cob development occurred and the crop matured in fairly dry weather which favoured rapid drying-out of the grain, suppression of weed growth, and early harvesting. Cob diseases were less severe than usual. The average yield from all areas was 65.5 bus./ac.

In a trial to test yields of open-pollinated Tableland strains against two selected hybrids, good yields were obtained from all varieties. The hybrids Q23 and GH128 yielded 86 and 93 bus./ac. respectively, and were better than the open-pollinated strains, which ranged from 75 to 84 bus. The hybrid Q23, however, was considered to be unsuitable because of its poor husk cover and high disease incidence.

In another trial all of 10 hybrid strains tested yielded better than open-pollinated Dent variety, despite a high yield of 80 bus./ac. from the latter. The best hybrids were GH128 and GH170, with 104 bus., followed closely by GH134 with 103 bus. The other hybrids ranged from 88 to 98 bus. However, most of the hybrids tested would not be considered suitable for Tableland conditions because of poor husk cover or disease incidence. Although the latter feature did not seriously affect the yields of the more susceptible strains in this particular season, it might well do so in wetter seasons.

Two interesting trials were run to test responses to fertilizer on soils with different cropping histories. On one area that had been subject to rotational cropping for 10 years, which included a 4-year period under pasture ley, no response to fertilizer was obtained and all plots yielded well with an average of 98 bus./ac. On the other area where the soil had grown maize for 30-40 years and had suffered a fair amount of erosion, a marked response was obtained to nitrogen up to levels equivalent to approximately 4 cwt. of sulphate of ammonia per acre. At this rate of application yields were increased from 40 to 90 bus./ac., so the application was quite economic.

Pastures.—Despite a few storms in late October the dry spring weather continued into early summer and was not really broken until mid-December. Pasture growth was much reduced during this period and maize silage was used to supplement the feed supply of the dairy herds. Lush pasture growth followed the December rains and silage feeding was not then required for herd maintenance.

The recent replacement of lucerne by glycine as the legume component of pastures in the demonstration rotation trial improved the value of the pasture phase of the rotation in respect of both stock carrying capacities and the maintenance and improvement of soil productivity. Whereas pastures based on lucerne have a tendency to deteriorate over a period of 3-4 years, glycine pastures tend to improve steadily. It is probable that the consequent greater soil improvement will allow a longer period of cropping and, overall, give increased net returns.

Glycine has emerged as a legume with high potential for the improvement of Tableland pastures and considerable attention is being given to it on the Station with respect to problems associated with its ready establishment in different districts, and studies of its effects on associated grass species. Trials so far indicate that early summer plantings of glycine pastures will give quicker growth and earlier grazing than later plantings, and by giving a good early establishment of the legume, facilitate management of the pasture in subsequent summers when flush grass growth would otherwise upset the balance of the species.

It has been observed that it is more difficult to establish legumes on some areas of the southern part of the Tableland than is the case at Kairi. Investigations of this problem by Station staff have given strong indications that some plant food deficiencies exist in these areas that will require to be overcome by use of fertilizers before satisfactory establishment of legumes can be expected. Studies are being continued to determine the most economical and satisfactory way of doing this.

The popularity of glycine has extended beyond the Tableland and the requests for seed have been numerous. During the spring of 1960 about 2,500 lb. of seed was harvested on the Station and distributed to about 200 local farmers and to various organisations.

Studies of the potential for grazing purposes of other legumes were continued or extended; for example, with *Leucaena glauca,* a tall-growing shrubby legume that could be useful either grown alone or in association with tall-growing grass species such as elephant grass. Similarly, four African *Trifolium* species are being examined in a pasture association with kikuyu and *Paspalum plicatulum.* Studies of time-of-planting of lucerne so far indicate that May plantings give better stands than earlier plantings in February or April because of less weed competition in the late crop.

Legumes under test include a number of strains of *Glycine javanica, Phaseolus atropurpureus, Leucaena glauca, Dolichos lab-lab, Centrosema pubescens,* and *Desmodium* spp., as well as a variety of winter-growing species.

Silage Studies.—The large excess of high quality feed produced by legume-rich pastures during summer suggests that a suitable method of conservation might help to overcome the winter feed shortage to which the district is periodically subject. Good quality pasture silage would be of considerable value, and methods of making this are being investigated using two cutting techniques and ensiling the material with and without additives. Material ensiled in April will be opened for examination next spring.

Livestock.—Two dairy herds are maintained on the Station. The Jersey herd is restricted to the demonstration area where pastures and maize are grown on a rotational cropping pattern. The A.I.S. herd has access to a variety of pastures. Production of the Jersey herd amounted to 221 lb. of butterfat per cow in the last completed year. This was a decline from the 240 lb. recorded in the previous year due to the erratic weather pattern experienced which adversely affected the productivity of the pastures. The A.I.S. herd increased production from 148 lb. in the previous year to 154 lb. butterfat per cow. The increase was probably due to a larger area made available to the herd and the corresponding increase in available grazing.

Details of Division of Animal Industry projects with pigs and poultry are reported separately by the respective Branches.

WALKAMIN

This recently-established Experiment Station is located within the Mareeba-Dimbulah irrigation area, about 10 miles south of Mareeba. It is being developed to investigate the usage under irrigation of certain soil types that are considered to be unsuitable for tobacco production. At the present stage of development approximately 12 acres are laid out for border irrigation of pastures and 20 acres for crop production under irrigation.

Water for irrigation of the maize crop was not available in the 1959-60 season, so the crop was grown under rainfall. Fertilizers, especially nitrogenous fertilizers, greatly improved yields on both of the soil types used for cropping, the range extending from 25 bus./ac. for unfertilized areas to 84 bus. for fertilized plots.

Grown under irrigation, the peanut variety Red Spanish yielded 1,458 lb./ac. and Virginia Bunch 2,263 lb. Yields were not improved by applications of a mixed fertilizer at 2 cwt./ac.

Cotton grown without irrigation in the 1959-60 season (water was not then available) yielded up to 595 lb. of seed cotton per acre. With irrigation in the 1960-61 season, yields of 1,352 and 1,261 lb. were obtained from Acala 5675 and D & PL 14 respectively from crops planted in November.

Other crops under investigation include soybean, cowpea, French beans, and oats.

A series of temperate species of pastures were planted in April. Simple mixtures of one clover and one grass were sown, using Ladino, Louisiana, and Irrigation white clovers, and *Phalaris tuberosa, P. arundinacea,* Priebe perennial prairie, and H1 ryegrass. Although initial growth has been generally slow, a marked improvement was made where superphosphate was applied at 6 cwt./ac. Another series of tropical species was planted in February, again using simple mixtures of one legume and one grass species. The legumes comprise glycine, centro and stylo, and the grasses green panic, guinea, kikuyu and paspalum. Early growth has been satisfactory and has been promoted by an application of superphosphate at 2 cwt./ac. at planting.

BOTANY SECTION

Identification of specimens remained the principal function of the Section and about 7,500 were received from the general public and officers of State and Commonwealth Departments. About 120 samples of stomach contents were examined for the presence of poisonous plants. Work proceeded also in the fields of systematic botany, weed control and vegetation survey.

Systematic Botany

Taxonomic studies were continued in the genera *Acacia, Carpobrotus, Eremophila, Fimbristylis, Leptospermum, Melaleuca, Myoporum, Plectranthus, Sarcozona, Scirpus* and *Scleria.* New studies were made of species in the genera *Cordyline, Drosera* and *Drypetes.* The Australian species included in the tribes *Xanthoxyleae* and *Toddalieae* in the family *Rutaceae* were studied and keys prepared. Three new genera and several new species were recognized in this group. A collection of about 1,500 plant specimens was made in the Bloomfield River area south of Cooktown. Although these have not been examined critically, it is known that they include at least one new species.

Brigalow

Field work was completed on the survey of brigalow areas in Queensland. During the year the western limits were studied, chiefly in the Tambo, Springsure, Roma and Injune areas. Isolated trees were found as far west as the Grey Range near Quilpie. Detailed study is proceeding of the large mass of data and of more than 1,000 specimens of associated plants collected during the course of the survey. A report is being prepared which will discuss the methods now in use for controlling brigalow, with a critical appraisal of their usefulness and limitations in each district.

Assessment was made of the results of aerial spraying trials laid down in 1959 on brigalow about 8-12 ft. high Results were variable. Kills of top growth ranged from

0 to 95 per cent. but there was no consistent improvement with increase in rate of 2,4,5-T up to 2 lb. per acre or volume of distillate up to 8 gal. per acre. Although results were not consistent, they indicated that volumes of less than 2 gal. per acre are not desirable because of the possibility of irregular results due to uneven application. Earlier findings were confirmed that brigalow which is branched low is more difficult to kill than brigalow which is branched only near the top. Production of root suckers did not seem to be related directly to the top kill. Earlier experience was confirmed that brigalow sprayed during March produced fewer suckers than that sprayed during May and November and also that there is a great difference in suckering on different soils and in different districts. The trial indicates that, although under certain conditions 2,4,5-T can be useful as a first treatment of dense low-branched brigalow suckers, spraying alone will not bring them under control. The area will be kept under observation and retreated when necessary.

No final assessment is yet possible of the spraying trial laid down in March 1960 on very young suckers which came up after a burn. Top kills were excellent and very few new suckers have appeared on these treated areas, but seasonal conditions have been unfavourable and it is not yet possible to determine whether the treatment has given permanent control of these young suckers.

Two new trials were begun in December, using ground spraying equipment to treat brigalow suckers less than 4 ft. high. In one series a low-volume, knapsack power misting machine was used to apply a number of chemicals, including two formulations of 2,4,5-T, 2,4,5-TP, amitrol and monuron in various solvents and emulsions. In the other series suckers are being treated with 2,4,5-T at approximately monthly intervals, using both a low-volume misting machine and conventional high-volume equipment. No assessment of the results of these trials will be possible for at least another 12 months.

Gidyea

A brief preliminary examination was made of some of the problems associated with large-scale clearing of gidyea (*Acacia cambagei*) in the Blackall district. The principal problem is the increase in budda or bastard sandalwood (*Eremophila mitchellii*), which occurs as scattered individuals in the original scrubs but which on some properties has become very abundant after clearing. It was found that the problem is by no means new, although it is greater at present because of the large amounts of scrub which have been treated in recent years. Heavy regrowth of sandalwood was found in areas which were ringbarked with an axe more than 20 years ago as well as in scrubs pulled within the last six years. There was evidence to suggest that the present infestation may be a result of the series of abnormally wet years in the period between 1950 and 1956. The older infestations appeared to date from similar wet years in 1940 and 1941. There is also a possibility that heavy grazing may help to reduce the amount of sandalwood which persists in cleared scrub. Time and severity of burning also appeared to have some influence on the amount of sandalwood regrowth. The whole problem remains unsolved and it is proposed to detail an officer to make a field survey next year.

Another native shrub, *Cassia eremophila,* sometimes known as butter bush, has become a problem on some of the pulled and burnt gidyea scrubs in the Blackall district. This plant also occurs in the virgin scrubs but is usually inconspicuous. It is not eaten by stock. Examination of one such area showed that the dense growth of butter bush was in a paddock where a fierce fire followed the pulling. The fire apparently killed the top growth of the existing plants, stimulated the production of numerous suckers and also stimulated germination of seeds which were lying dormant in the soil. In an adjoining area where the fire burned quietly, little or no butter bush had survived and there were very few new seedling plants. Further reports have since been received of heavy infestations of this plant on other properties and this problem also will be given attention next year.

Feather-top Wire Grass

Feather-top wire grass (*Aristida latifolia*), another native species, has become a troublesome pest on many properties in central-western Queensland in the last 10 years. Observations in the Blackall district were consistent with earlier observations in the Wyandra and St. George districts. These indicated that the properties most seriously affected were those which had been lightly stocked for a long time. There appears also to be some correlation between increase in this plant and disturbance in the normal rainfall pattern. Examination of records from a few of the affected properties in the Blackall district showed abnormally high rains in October and/or April for several years in the last decade. This problem also will be studied in more detail next year.

Weeds

Wild Oats.—A considerable amount of work was done on the species of wild oats which are naturalized in Queensland. Surveys near Millmerran and Jondaryan and examination of seed cleanings from various districts showed that there are two species of wild oats common in southern Queensland and that the more prevalent species is *Avena ludoviciana* and not *A. fatua,* which is the common wild oat in other parts of Australia and in most other parts of the world. The former species constituted from 75 to 96 per cent. of the total wild oats populations in the areas studied. In each species three different hull colours could be distinguished and these appeared to breed true. It was found that hairiness or otherwise of plants could not be correlated with seed characters in either species and so far no character has been found which can be used to distinguish one species from the other in the seedling stage.

In co-operation with Standards Branch, tests were conducted on germination of the two species of wild oats. In one series of tests the germination capacity of wild oats seeds harvested by hand in November was tested at monthly intervals beginning in January. After the initial test some seeds were held in the laboratory and others were mixed with soil and exposed to the weather, samples being taken from each batch at monthly intervals and tested in the laboratory. Initial germination percentages ranged from 3 per cent. for grey-hulled *Avena ludoviciana* to 17 per cent. for brown-hulled *A. fatua.* Seeds held in the laboratory mostly showed a fairly steady increase in germination up to a maximum of 88 per cent. in May. Germination of seeds exposed in the soil remained very low until May, when there was a sudden increase, but in every case the maximum germination was considerably less than for seeds which had been held in the laboratory, the highest germination being 55 per cent. for grey-hulled *A. ludoviciana.* This indicates that exposure to weather apparently induces dormancy in a large percentage of the seeds produced by wild oats plants.

Comparison was also made of the germination capacity of wild oat seeds which had been taken from grain cleanings and those which had been harvested by hand from plants in the field. Both lots of wild oat seed were produced during the 1960 season. Results of these tests showed clearly that seeds whose hulls had been damaged by cleaning machinery had considerably higher germination rates than seeds with undamaged hulls taken directly from the plants. Germination rates in May ranged from 89 to 96 per cent. in seeds with damaged hulls and from 38 to 70 per cent. in undamaged seeds. These figures suggest that the use for experimental work of wild oats taken from seed cleanings may give results not strictly comparable with what could be expected with natural populations of wild oats whose seeds fall from the plants in the field and could therefore be expected to show a larger percentage of dormancy.

Pot trials with 2,3-dichloroallyldiisopropylthiolcarbamate ("Avadex") showed that this chemical can be absorbed into wild oats through the undamaged hull of the seed, through the young root and through the coleoptile. Irrespective of the site of absorption, the action on the plant appears to be the same, that is, to toughen the tip of the coleoptile to such an extent that emergence of the true leaves is impossible. Once the coleoptile reaches the splitting stage, this chemical appears to be ineffective. This would explain why "Avadex" is effective as a pre-emergence herbicide but not post-emergence.

Sampling of survivors in a wild oats control trial laid down by Agriculture Branch on the Darling Downs suggested that there may be differences in susceptibility between the different hull colours of *Avena ludoviciana.* This possibility is to be further explored in the field in 1961.

Johnson Grass.—A more extensive trial on the effect of amitrol and 2,2-dichloropropionic acid (dalapon) on Johnson grass was carried out between December and March. A final harvest of rhizomes from this experiment was made in June but results have not yet been assessed.

Milk-tainting Weeds.—A quantitative study of the populations of milk-tainting weeds in a cultivated area near Brisbane, begun in co-operation with the Division of Dairying, failed because of adverse seasonal conditions which prevented the appearance of the weeds in sufficient quantity to be significant. Valuable experience was obtained in sampling methods and the survey will be undertaken at a favourable season. A spraying trial in the Ipswich district indicated that 2,4-DB at 2 lb. per acre gave complete control of bitter cress or lesser swine cress (*Coronopus didymus*) and slender celery (*Apium leptophyllum*) and 50 per cent. control of stagger- weed (*Stachys arvensis*) and jo-jo weed (*Soliva sessilis*). There was no control of nut grass (*Cyperus rotundus*) or yellow wood-sorrel (*Oxalis corniculatus*). Lucerne was injured by the 2 lb. rate and yields (dry weight) from clipped quadrats seven weeks after spraying were 30 per cent. lower in treated areas than in the controls.

Noxious Weeds.—Two new infestations of skeleton weed (*Chondrilla juncea*) were reported during the year. Action was taken by the landholders concerned to destroy these patches. Some extension of range was recorded for the declared noxious weeds hoary cress (*Cardaria draba*), green cestrum (*Cestrum parqui*), hemlock (*Conium maculatum*), Crofton weed (*Eupatorium adenophorum*), Paterson's curse (*Echium plantagineum*), knobweed (*Hyptis capitata*), rope pear (*Opuntia imbricata*), mintweed (*Salvia reflexa*) and

Bathurst burr (*Xanthium spinosum*). All these were reported to the Co-ordinating Board of the Department of Public Lands.

Other Weeds.—In the Mackay district, *Themeda quadrivalvis,* a tall annual grass native to southern Asia, caused some concern as a potential weed. It has been naturalized in this area for about 25 years but in the last year increased considerably along roadsides and was reported to be spreading into some pastures. The position is being investigated in the field by the Department of Public Lands. *Eragrostis tenuifolia,* an African grass introduced about 30 years ago as a potential fodder, has now spread widely in coastal and sub-coastal areas as far north as Mareeba, chiefly as a weed of footpaths. It is known as elastic grass or lightning grass and was reported to be a serious weed of some pineapple plantations in the Beerwah area. *Sorghum almum* (Columbus grass), widely grown as a fodder crop, was reported to be growing as a weed in several areas, including one at South Johnstone adjacent to sugar growing areas. One report stated that attempts to eradicate the plant by cultivation had been unsuccessful.

Suspected Poisonous Plants

As usual in a dry season there was an increase in the number of suspected plant poisonings and the large number of stomach contents handled during the year reflects this. More than 45 records were added to the poisonous plants files. Amongst them were several cases of poisoning by *Gastrolobium grandiflorum* and *Macrozamia* spp. *Wedelia asperrima* (sunflower daisy or yellow daisy) was apparently responsible for the death of about 1,000 sheep in the Richmond district. Field investigation was made of mortalities in cattle in the Clermont district but it was not possible to decide with any certainty what plants were involved, if any.

Herbarium and Library

Two notable contributions to the herbarium were received during the year. One, a gift from Mr. J. H. Simmonds of the plants collected by his father early in this century, is a collection of considerable historic importance, comprising about 700 specimens. Another large gift was a complete set of the plants collected by Dr. R. F. Thorne, State University of Iowa, during the 18 months that he spent in Australia and New Caledonia in 1959 and 1960.

A total of 436 specimens was sent on loan to other herbaria in the United States, Europe, United Kingdom, Vietnam and Australia; 68 specimens were received on loan for specialist study. Exchanges sent to other institutions amounted to 1,060 specimens and 750 specimens were received.

Fifty-two volumes from the library of the late W. D. Francis were presented by Mrs. Francis, the gift including miscellaneous reprints and manuscripts of papers by Mr. Francis. A total of 50 new books, 402 parts of periodicals and 16 rare second-hand books were added to the library and approximately 300 reprints were received on exchange.

During the year 32 visiting botanists worked in the herbarium. These included visitors from Indonesia, Hong Kong, U.S.A., India, Malaya and New Zealand, as well as from a number of herbaria in other parts of Australia.

ENTOMOLOGY SECTION

Throughout the State generally pest infestations were not of serious concern. With the exception of the tuber moth or leaf miner (*Gnorimoschema operculella* (Zell.)), pest populations were seldom high enough to create any outstanding control difficulties. Although weather conditions and pest incidence limited opportunities for field work, a worthwhile programme of work, including the preparation of technical and extension articles, was accomplished.

At Long Pocket, Indooroopilly, progress was made with the building and equipping of a laboratory and glasshouse designed for nematode, insecticide and related studies. After completion of exploratory work centred on St. George, the entomologist was transferred to Hermitage Regional Experiment Station, where more permanent structures for fauna studies have been erected. Pens for use in wild duck investigations have been built at the Animal Health Station, Oonoonba.

The Department was responsible for the organisation of the Interstate Fauna Conference, held in Queensland for the first time, at Brisbane during September 12-15.

Deciduous Fruits

In the Stanthorpe district, mites, codling moth (*Cydia pomonella* (L.)), light-brown apple moth (*Austrotortrix postvittana* (Walk.)) and fruit fly (*Strumeta tryoni* (Frogg.)) were not very active, and generally were well controlled. The tendency towards change and variation in control programmes in this district has altered pest status, and there have been upsurges of pests such as aphids, including woolly aphid (*Eriosoma lanigerum* (Hausm.)) and scales which for many years were of negligible importance.

Investigational work included orchard control trials against all pests, and biological studies. Again in the past season pest populations were low in most trials. Surveys of deciduous fruit pests were extended to districts other than those usually associated with the commercial growing of these crops, and many new locality and species records were obtained.

Tropical Fruits

Benefits to be gained from careful attention to pest control are evident in some North Queensland banana plantations. The relevant extension article is now available. Detailed work with nematodes in South Queensland pineapple fields was continued, with emphasis on correlating pest populations with reduced yields, improving commercial fumigation, and testing resistant cover crops as a possible help in control.

Citrus

Wax scales (*Ceroplastes destructor* Newst. and *C. rubens* Mask.) are still prominent in southern districts. A survey of the citrus gall wasp (*Eurytoma fellis* Gir.) was made during spring. This pest, as trace infestations and with parasites, has extended north of Maryborough into Torbanlea and part of the Burrum citrus district. A citrus leaf roller, present as a limited infestation at Gayndah during February, was identified as *Psorosticha zizyphi* (Staint) (Oecophoridae), the first Queensland record of this South-East Asian pest. Attention is being given to mites in North Queensland orchards. Attacks by fruit-sucking moths (*Othreis* species) were rare, and the control of these pests, which in some seasons may be of serious concern to the individual orchardist, still remains one of the few pest problems in the State for which a reasonable solution has not been found.

Data from control trials over several years were prepared for publication and are being reviewed as a basis for the periodic check on Departmental recommendations which is planned for the coming season.

Fruit Flies

These pests were not commercially troublesome to any appreciable extent, and low populations also limited some phases of field investigations, particularly the screening of insecticides. Ecological studies were continued; the new male attractants are proving useful for research purposes.

Tobacco

In the far northern and Burdekin districts light to moderate pest infestations occurred. Budworm (*Heliothis* species) was present during October, the tobacco looper (*Plusia argentifera* Guen.) was more active than during the past few seasons, and leaf miner (*G. operculella*) although on the wane, caused some trouble late in the season. All were controlled reasonably well, and damage which did occur was often the result of preoccupation on the part of the grower with other farm operations, e.g. harvesting. Remedial control measures when properly applied brought quick and satisfactory results. Infestations of leaf-miner were the worst for some years in the Inglewood district: the position was aggravated by agronomic difficulties and inadequate spray coverage. There were no appreciable pest troubles in the seedbed and early field stages of winter crops in the Burdekin district.

Research projects were concerned with insecticide taints, nematocides, and the effects of nematocides on leaf quality. Available results have been submitted for publication. In demonstration trials at Parada and Millaroo respectively the yields (lb./ac.) of control treatments were 1,550 and 1,400, and of checks 1,000 and 600. Costing data from these trials when compared with those on farms should be interesting, as commercial control of tobacco pests in general appears wasteful and unnecessarily costly.

Forestry

Work at Imbil on the control of the cedar shoot borer (*Hypsipyla robusta* (Moore)) reached the stage at which power spraying has become necessary. Other State-wide investigations concerned mites, scale insects, mealy bugs, longicorns, the elephant beetle (*Dynastes gideon* var. *australicus* (Thom.)), bagworm (*Hyalarcta hubneri* (Westw.)), native rats and nursery pests. Routine identifications of insects associated with timber and enquiries on pest control continued at a high level. Post-fumigation checking of timber samples from imported houses infested by the European house borer (*Hylotrupes bajulus* L.) was undertaken as required. Work on forestry pests is increasing.

Nematodes

In addition to investigations mentioned elsewhere in this report, a survey of citrus nurseries in Queensland, testing of hot-water treatment of young trees before planting, trials in South Queensland banana plantations, and field trials which

demonstrated that yields of ginger grown in land infested by root-knot nematodes are increased by pre-plant fumigation were carried out.

Routine surveys and host recording yielded much new and interesting data. Systematics, as required for economic purposes, have been kept reasonably well advanced.

Pastures

As expected during an abnormally dry summer, white grubs, mostly *Lepidiota caudata* Blkb., caused severe damage on several properties on the Atherton Tableland with histories of overstocking. The species *Othnonius batesii* Olliff also fluctuates in importance with seasonal rainfall and pasture management. This year some damage occurred at Brigalow but there was good evidence that methods of successfully combating this pest were well understood locally. White grubs were also active on golf fairways, as well as in pastures, in some of the drier areas in South Queensland.

During December in North Queensland armyworms suddenly invaded coastal pastures. Damage was spectacular and many farmers were persuaded to use insecticides. This was unnecessary as most of the damage had been done before the larvae were observed. Fortunately, regrowth of these coastal pastures was rapid during summer.

Work, including biological studies, with funnel ants (*Aphaenogaster* species) is progressing satisfactorily. In field trials all treatments reduced ant activity and the swards are outstanding. These results clearly demonstrated a sound economic control of funnel ants in pastures, and the importance of pasture and farm management in counteracting the activities of these pests. Detailed biological studies of webworms (*Oncopera* species) were initiated, and satisfactory methods of screening insecticides against these pests have been established. This was necessary before progress in control trials, and ultimately economic control, could be worked out under local conditions.

Vegetables

Severe attacks by the leaf-miner (*G. operculella*) were experienced in tomatoes in coastal districts from Ayr to Brisbane, and lesser damage in eggfruit was reported. Regular and efficient use of sulphur was necessary to control the tomato mite (*Aculus lycopersici* (Massee)) in northern areas. Screening and levels trials against both these pests were carried through in the Rockhampton district, and more extensive efforts against tomato pests have been planned for the coming spring.

Large-scale phytotoxicity trials with a range of materials were undertaken in cucurbits at Lawes and Ormiston as a preliminary to further work on the control of pests in these crops.

Pest infestations in most vegetable crops other than tomatoes and beans were light. The cabbage moth (*Plutella maculipennis* (Curt.)), which is controlled by a number of insecticides, was the only pest present in appreciable numbers in cabbage pest control trials at Ormiston. The long-term studies of the bean fly (*Melanagromyza phaseoli* (Tryon)) in the Nambour district will terminate in the spring of 1961.

Cotton

On the Darling Downs numerous insect species were recorded on cotton, but rough bollworm (*Earias huegeli* Rog.) was again the chief concern, and insecticide applications were not a commercial success. Some spraying was carried out against *Heliothis* species, which generally were of little importance. Where DDT had been used regularly, red spider mites required additional attention. In southern coastal districts crops were subjected to prolonged attacks by rough bollworm and the yellow peach moth (*Dichocrocis punctiferalis* (Guen.)). Economic control was difficult.

Pest incidence in demonstration control trials in the central districts was not high. Harvesting of the irrigated trial at Kabra was completed. Mean yield was 1,950 lb./ac. with no apparent differences among treatments. Pink bollworm (*Pectinophora scutigera* (Hold.)) was active at the end of March in three trials in the Callide Valley, and although DDT was applied appreciable yield differences are not expected except in the late rain-grown trial.

Technical data on cotton pest control in districts other than Central Queensland are being prepared for publication.

Miscellaneous Field Crops

On the Central Highlands *Heliothis* species were active in linseed during July, some four weeks earlier than usual. Somewhat similarly on the Darling Downs crops were infested in early September and, as is usual during a dry spring, moth emergence was protracted. In widely separated localities many larval populations were exterminated by disease following showers of rain. Spraying with DDT was general.

Infestations of the jassid (*Austroasca alfalfae* (Evans)), the leaf roller (*Tortrix divulsana* (Walk.)) and the looper (*Zermizinga indocilisaria* Walk.) were recorded from lucerne, mostly in poorly grown crops. The mite *Petrobia latens* (Muller) was prevalent in several crops, including linseed, especially those suffering from stress. Localised infestations of armyworms (*Pseudaletia unipuncta* (Haw.)) and cutworms occurred in barley, grain sorghum and maize; these seldom warranted spraying. Sorghum midge (*Contarinia sorghicola* (Coq.)) was recorded at Georgetown. Throughout the State damage by this pest was light and confined to tiller heads. Potato tuber moth (*G. operculella*) was severe in the Lockyer Valley and Rockhampton district. Changes in agricultural practices over the past few years necessitate a review of pest control in potato crops. Field trials were established during autumn, and further work is planned for the coming spring.

Miscellaneous

Attention was given to pests of avocadoes, Queensland nut, native trees, ornamentals, stored grain and stored peanuts. The extensive Departmental reference collections of insects and nematodes were kept in good order. Detailed studies with the following groups are being continued—Acarina, Agromyzidae, Aphididae, Coccoidea, Dacinae and Thysanoptera.

Beekeeping

Poor conditions were experienced throughout the year, honey flows were not heavy, and colony survival was the principal aim of beekeeping husbandry. A thousand colonies died in the Maryborough district.

Extension work covered 2,775 colonies in 18 districts. In addition, publicity was given to better techniques by 5 talks and film evenings, 10 press and journal articles, 4 radio and television talks, 2 beekeeping schools, 3 Agricultural Show exhibits, and a field day.

Nosema disease (*Nosema apis* Zander) was recorded from apiaries at Rockhampton and Brisbane. A survey of mites was continued and *Acarapis woodi* (Rennie) was found externally on bees in districts from Warwick to Atherton: details have been published in two technical notes.

On March 31, 1961, 1,445 beekeepers were registered, compared with 1,430 for the previous year.

Flora and Fauna Conservation

By the end of the marsupial skin year (December 31) 1931 permits and licences were issued under *"The Fauna Conservation Act of* 1952." Shooting for skins tapered off in August with a fall in skin quality and prices. Shooting for carcasses eased in early September when accessible areas carrying large numbers of kangaroos were becoming scarce. A review of the kangaroo industry in Queensland over the past 40 years is at an advanced stage.

An open season for duck was declared for Central and North Queensland commencing July 2 and terminating September 25, and for Southern Queensland from June 4 to August 28. Takes were even smaller than last year. Both ducks and shooters congregated on drought refuges and management areas (Townsville district), where some good shooting was obtained.

Extension activities included 3 talks and slide evenings, 23 press items, 3 radio and television talks, 1 Agricultural Show exhibit and 5 journal articles. Nine prosecutions under *"The Fauna Conservation Act of* 1952" were conducted.

A wide range of duck and marsupial research projects, with emphasis on ecology, management areas and sanctuaries, is being implemented.

PLANT PATHOLOGY SECTION

A dry spring, a temperate summer and the absence of the normal wet season all had an influence on crop diseases.

Seasonal conditions were responsible for a low incidence of air-borne diseases except for the powdery mildews. In cereals, rust was virtually absent but *Erysiphe graminis* (powdery mildew) was widespread, causing conspicuous damage in barley crops. Leaf diseases of the banana and blue mould of tobacco were much less prevalent than usual and in the case of the latter the absence of disease seriously interfered with the experimental programme. In contrast to these fungous troubles the virus disease spotted wilt occurred in epidemic proportions in such widely separated areas as Stanthorpe, Toowoomba and Kingaroy and this may also bear some relation to the prevailing seasonal pattern.

A brief description of the experimental work carried out over the year follows.

Wheat

Further surveys on the incidence of crown rot (*Fusarium graminearum*) demonstrated the advantages to be derived from fallowing and growing one or two resistant crops before returning to wheat. An interesting observation now to be

examined further was that the introduction of grain sorghum into fallowed land resulted in a lower incidence of the disease than did continuous fallow.

Severe outbreaks of crown rot have been shown to be associated with seasons in which the rainfall for the two months following seeding was well below average. The affect of optimum and low soil moisture on the development of the fungus is now being examined in more detail in the glasshouse.

Maize

In North Queensland dry weather during the maize-growing season kept the incidence of tropical rust (*Puccinia polysora*) to a reasonably low level. Brown spot (*Physoderma maydis*) and a leaf spot due to *Diplodia macrospora* appeared to have caused more leaf loss than rust. Attempts to locate tropical rust in the more southern parts of the State have so far failed; the common rust there is *P. sorghi.*

In a small-scale experiment at the Kairi Regional Experiment Station the value of a zineb/nickel chloride tetrahydrate spray for the control of tropical maize rust was tested. The total leaf area affected by the rust was not altered by the treatment but there was some reduction in the spore-producing potential of the fungus. The economics of control by this method would seem to be doubtful.

The leaf hopper *Peregrinis maidis* has been used to transmit the virus disease maize stripe from infected material from southern Queensland and the Atherton Tableland. This virus produces chlorotic stripes on the leaves of infected plants and results in general stunting and malformation of tassel and cob. Sorghum and Sudan grass were also shown to be hosts of this virus.

Tobacco

A blue mould fungicide screening trial was completed early in September as a forerunner to the field spray experiments. Sixteen different treatments compared the efficiency of zineb and maneb alone and in combination with benzyl salicylate. Artificial inoculation with blue mould spores was employed to ensure satisfactory disease incidence. The outstanding feature of the trial was the superiority of the maneb formulation Dithane M22 both alone and in combination with benzyl salicylate. A zineb/zinc salicylate dust also performed well in this trial. Phytotoxicity of zineb and maneb when used alone was negligible but was present to varying degrees when benzyl salicylate was added. This was apparently a direct result of root damage to seedlings caused by spray run-off and no phytotoxic effects occurred when the same spray was used in the field.

A subsequent field trial to confirm these results was unfortunately inconclusive owing to the low incidence of blue mould in the experimental area. The same fate overcame a field misting trial in which water-based concentrates of zineb, maneb and benzyl salicylate combinations were applied by two different misting machines.

In a fourth experiment fumigation techniques were investigated using various frequencies of benzol application and 4.15 and 5.15 p.m. commencing times. A zineb/benzyl salicylate spray was also included. Subsequent development of blue mould in the field did not differ greatly with the different benzol treatments but was less where the spray had been used. This point needs further investigation.

Peanuts

Despite the dry weather experienced in the later life of the peanut crop, disease incidence was heavy. Two diseases have predominated—stem, peg and pod rot (*Sclerotium rolfsii*) and wilt (*Verticillium dahliae*). Both of these troubles have noticeably increased over the last few years, this increase coinciding with the more widespread use of mechanical harvesting equipment and chisel ploughs. This equipment widely scatters plant debris with its associated disease-producing organisms.

Wilt was formerly regarded as serious only on the sites where the stationary thrashing plant had operated but now occurs in up to 100 per cent. of plants in some fields. A marked decrease in yield and an uneven ripening of the crop were associated with this disease.

The prevalence of *Sclerotium rolfsii* is also increased by another common cultural practice, namely hilling or throwing dirt over the crown of the plants to control weeds. Fungicidal treatment of the soil as a substitute for non-hilling has not proved altogether satisfactory in field experiments up to date.

Cotton

Wilt (*Verticillium dahliae*) was recorded in isolated cotton crops. This disease was more prevalent on land which had grown cotton the previous year. Affected plants showed severe symptoms during dry weather but recovered well when soil moisture was high. Noogoora burr, a common weed in the area, was found to be carrying heavy infection of *V. dahliae* and is therefore an important alternative host for this disease as it is in the case of peanuts. Wilt has not proved as serious in the case of cotton as it has in peanuts.

Following reports of the frequent occurrence in the field of the boll malformation known as "parrot beaking" and uncertainty regarding its origin, a laboratory and glasshouse investigation of this trouble was undertaken. Parrot beaking occurred on untreated bolls in several cases. On cutting the boll open it was seen that the ovules in one or more locules had failed to develop but there was no internal rotting. Low temperatures in the glasshouse may have been responsible in this instance. Injecting the locule with sterile water or each of three different bacteria caused locule damage and boll shedding or malformation. Pronounced internal rotting occurred when the bacteria were injected, whereas sterile water caused ovule necrosis without rotting. Apparently any agency able to inhibit locule development in the early stage of boll formation could be responsible for parrot beak.

Cowpea

Hybrid cowpea material developed for resistance to stem rot (*Phytophthora vignae*) was planted out on infected soil at Kingaroy and the Darling Downs and further selections made. Much of the Poona backcross material now seems to be fixed for resistance to stem rot and to be very similar in agronomic features to the original Poona variety. This work has now proceeded to the point where seed increase of the most promising lines can be considered.

Citrus

The latest inoculations of the common causal agent of root and collar rot of citrus in Queensland (*Phytophthora parasitica*) into a number of different stocks held at Kamerunga showed that these could be grouped according to their reaction into the following categories:

(1) Resistant—Trifoliata, Morton citrange and Sour orange.
(2) Moderately resistant—Pummelo, Scarlet mandarin and Emperor mandarin.
(3) Moderately susceptible—Samson tangelo and Cleopatra mandarin.
(4) Susceptible—Rough lemon and Sweet orange.

These results insofar as Cleopatra mandarin is concerned were at variance with the generally accepted reaction, which is one of moderate resistance. Seed of a reputable rootstock strain of Cleopatra was therefore obtained from Florida and compared in a series of glasshouse tests with plants from the Australian source (Mildura). It is apparent from this work that the Florida strain is more resistant than the Mildura. Trees of the former line have now been planted out for seed production.

Strawberries

The Strawberry Approved Runner Scheme which had operated for several years was suspended in 1957 when it became apparent that a mottle virus was widespread in the approved stocks. A few virus-free plants were located in a Horticulture Branch collection of Phenomenal clones and were then multiplied and further indexed to *Fragaria vesca* virus indicators. This stock of plants has been multiplied in isolation and several thousand of the progeny were planted at the Redlands Experiment Station this season. It is anticipated that sufficient plants will be available next year to supply a small number of selected runner producers. Planting material will then be available for the industry in 1963. A mother stock of plants is kept for annual virus indexing and the healthy progeny of these tested plants will be fed into the multiplication scheme each year.

Vegetables

The tomato leaf mould resistance trial at Kamerunga was planted later in 1960, in August instead of June as previously. The crop was subjected to a succession of hot dry days and a considerable amount of cat-face and deformation of the blossom end appeared, especially in the Mason x Manalucie types. This defect had not been noticed in crops grown during the winter. In spite of this the best of the leaf mould resistant strains, namely, several Mason x Manalucie selections, far outyielded the standard variety Stokesdale.

The result of many attempts over the past five years to locate a variety of tomato resistant to leaf shrivel (potato virus Y) has been disappointing. A great deal of local and imported material has been subjected to glasshouse and field testing but so far none has exhibited a resistance greater than some of the more tolerant varieties at present in commercial use. A similar position exists in Florida, where the disease is now a major problem.

With a view to reducing transport losses in French beans when *Sclerotinia sclerotiorum* is prevalent, experiments were carried out with dipping prior to packing. "Griseofulvin" (1/2,000) and "Shirlan" (1 lb. in 60 gal.) reduced the number of infected beans after 12 days' storage by 30-40 per cent. However, it is doubtful whether this would be sufficient to justify the procedure on a commercial scale. Washing the beans prior to packing had no effect either way.

Powdery mildew of French beans was observed for the first time in Queensland during the winter of 1960. In two instances there was good evidence that the disease had passed from cucumbers to the beans. To check this, cucumbers and beans were inoculated simultaneously in an infection chamber with mildew from beans and both subsequently

developed the disease. This mildew is regarded by B. G. Clare to be the imperfect form of *Sphaerotheca fuliginea*.

Cabbage yellows caused by the fungus *Fusarium oxysporum* f. *conglutinans* has been recorded in Queensland for the first time. This disease is a serious threat to successful cabbage growing and the only satisfactory means of combating it is through the use of resistant varieties. In a glasshouse test of the amount of resistance borne by the varieties of cabbage in local use, only the variety All Seasons was completely resistant. Of the others, some exhibit partial resistance and may provide material for further selection. Other resistant types suited to local conditions are probably available overseas in countries where cabbage yellows has been long established.

Forestry

Several fungicidal soil drenches and a seed treatment were used in an attempt to control damping-off in slash pine seedlings at Beerwah Forest Nursery. *Rhizoctonia solani* and to a lesser extent *Pythium debaryanum* were the organisms responsible for the damping-off occurring. Captan, thiram and copper oxychloride drenches were equally effective in controlling damping-off. The addition of P.C.N.B. to captan did not improve the control obtained. Thiram seed treatment did not improve stand or effect any control of damping-off.

Microbiology

For over 25 years the Plant Pathology Section has prepared and distributed bacterial cultures for legume seed to Queensland farmers free of charge. This has no doubt helped in no small measure to popularise the use of legumes in this State. However, in recent years commercial inoculum has steadily improved in quality until now it can be recommended with confidence. Laboratory, glasshouse and field trials have confirmed the opinion that the commercial peat and freeze dried inoculum as now prepared is superior in some respects to the older agar type culture. It was accordingly decided to cease supplying culture for those legumes which are now adequately covered by commercial firms.

By arrangement with the University–Department of Agriculture Laboratory Service (UDALS), the New South Wales body controlling the standardisation of commercial inoculum in Australia, the Queensland Department will be responsible for selecting efficient Rhizobium strains for tropical legumes to serve as mother cultures for distribution to commercial manufacturers. In view of this, routine strain testing has been intensified over the last 12 months. Trials included cowpea, phasey bean, mung bean, guar, velvet bean, centro, puero and glycine.

More detailed strain selection is being carried out on legumes assuming importance in Queensland agriculture, such as *Glycine javanica*. Sixty-four isolates from nodules of this species collected from 10 different areas have been made and 46 of these tested in the glasshouse for effectiveness. A stock culture collection of Rhizobium strains is being maintained with particular emphasis given to the collection of effective strains for a wide variety of tropical and subtropical legumes.

To extend the work already carried out on the reaction of Rhizobium to temperature, a further selection of strains resistant to high temperatures and desiccation is being made. Some such strains for centro, about which a considerable amount of information is already available, are being used in the first instance.

A number of nodulation problems were investigated in the field. There was a response to superphosphate on Mt. Mee and Springbrook soils in a pot trial using centro, glycine and stylo which resulted in increased top growth and better nodulation. Failure of clover to nodulate at Coolum was attributed to a deficiency of potassium and phosphorus. Poor nodulation of centro at Peachester, Brookfield, Mt. Mee and Ormeau was attributed to the failure of the Rhizobium to survive round the seed. This could be an important problem in connection with legume establishment in Queensland and is being made the subject of further investigation.

CHEMICAL LABORATORY

All sections of the Chemical Laboratory were called upon to handle larger programmes as a result of the increasing need for chemical data in the investigations of the Division of Plant Industry.

The chief demands on the staff of the Plant Nutrition Section were in connection with soil surveys, tobacco quality and wallum country research; and on the General Analytical Section with investigations on the carbohydrate content of pastures and an expanding programme connected with the quality of products registered under the *Agricultural Standards Act*. An infra-red spectrophotometer which has recently been purchased will be an invaluable aid in the detection and identification of complex chemical compounds contained in pesticides and fungicides. The Cereal Section concentrated on the correlation of wheat quality with soil fertility and related this to the various wheat-growing districts. In addition, the decomposition of urea in low-nitrogen, high-phosphate soils was investigated. The main work of the sections is given under the respective headings.

GENERAL ANALYTICAL SECTION

The General Analytical Section completed the analysis of 1,986 samples during the year, composed as follows:—

Pastures	854
Pesticides, fungicides, and veterinary medicines	213
Stock foods	809
Fertilizers	73
Miscellaneous	37

Comments on stock foods and other products registered under the *Agricultural Standards Act* are given in the Standards Branch section of this report.

A big proportion of the pasture samples came from "Brian Pastures" Research Station, where co-operative work with agrostologists of Agriculture Branch is involved. Results are given in the report of the Agriculture Branch. Other pasture samples came from the Coolum Experiment Station.

CEREAL SECTION

Plant Breeding.—Co-operation with the Senior Plant Breeder of Agriculture Branch in his programme of producing new varieties is an important part of the work of the Cereal Section. Following harvest the wheats are examined in the laboratory for bushel weight and appearance, and given the various physical tests which determine the suitability of the flour for baking and in particular for machine baking. None of the varieties tested during the year showed outstanding qualities although some were worthy of further tests. Most samples showed lack of extensibility, which is essential for machine baking.

Variety Trials.—In the variety trials the best results came from Biloela Regional Experiment Station, where high protein values were obtained (16-18 per cent.).

Rotation Trials.—These gave interesting but conflicting results. For instance, a long fallow at Biloela Regional Experiment Station incorporating cowpeas for green manure and cowpeas for seed when followed by wheat resulted in high-protein grain of good quality. On the other hand, wheat following several years of white clover and grass at Gatton Regional Experiment Station produced poor quality grain. At Hermitage Regional Experiment Station, high-protein wheat (15 per cent.) was obtained following lucerne and Rhodes grass and this was superior to other rotations in the same trial which included lucerne and several other grasses, grazing oats and summer crops without lucerne; the lowest protein from this trial was from a crop of wheat following grazing oats (12.3 per cent.).

Urea.—Work on urea included observations of the residual effect of the applied nitrogen on wheat protein and a laboratory study to obtain data relating to urea decomposition in the soil. It was shown that urea applied to the soil surface in 1958 at planting time at 2 cwt./ac. had a marked effect on the protein of the 1960 wheat crop. The urea-treated plots produced wheat with 13.4 per cent. protein, as against 10.2 per cent. protein from the untreated plots. A laboratory study, although not yet complete, has shown that appreciable amounts of urea decompose and are lost to the atmosphere as ammonia when it is applied to the surface of moist soil but that when mixed with the soil at a depth of 3 in. very little loss occurs.

Wheat Quality Surveys.—Wheat quality surveys are now being recorded on a parish basis and by determining the nitrogen and phosphorus contents of wheat from the various parishes it is hoped to be able to get an assessment of the soil fertility of these areas. In the past season 237 samples were examined and were found to average 13.3 per cent. protein, the range being 8.7 to 19.5 per cent. The phosphoric acid content averaged 0.70 per cent., with a range of 0.41 to 1.11 per cent.

Wheat Competitions.—The annual Royal Agricultural Society's "Best Bushel of Wheat" competition at Toowoomba attracted 113 entries. These averaged 14.5 per cent. protein. The winning entry was a sample of Spica with a protein content of 16.8 per cent. A competition on similar lines was held at Wandoan. There were 18 entries, which averaged 16.6 per cent. protein. The winning wheat was Koda with 18.5 per cent. protein of good quality.

Barley.—Quality work on barley was carried out on samples submitted by the Barley Marketing Board from 48 depots and 179 growers for the 1959 season. Protein values varied from 7.7 to 14.7 per cent., with no marked differences between districts. Similar variations were evident for the predicted extract figures and bushel weights.

Moisture Meters.—Increasing interest was shown by growers and grain operators in the use of moisture meters for storage purposes. Meters are tested for accuracy by the Cereal Section free of charge.

PLANT NUTRITION SECTION

Soil Survey.—The demand for soil survey work during the year was greater than usual and in addition to the planned yearly schedule of detailed surveys in the Mareeba-Dimbulah district the soil technologists were called upon to do reconnaissance surveys of widely spaced areas with entirely different topographical features. Detailed work in the Mareeba-Dimbulah district included the Cattle Creek and Paddy's Green sections, a total area of over 15,000 acres.

The Paddy's Green section, of 6,346 acres, contains an appreciable area of rather attractive red soils derived from granite which are well suited to tobacco culture. There are 1,900 acres of first-class tobacco soil there and another 1,055 acres which could probably be used for tobacco but about which further cropping data have to be assembled before the soils can be placed with confidence into their land use groups. Unfortunately, a large portion (over 3,000 acres in extent) of Paddy's Green consists of badly structured and infertile soils (Arriga complex and associated soils) which will be difficult to work but which can be regarded as potential pasture land once suitable methods of handling them have been evolved.

The Cattle Creek section, an area of 9,000 acres, is much less attractive as a possible irrigation district than is Paddy's Green. Much of the land (some 3,000 acres) is quite unsuitable for irrigation, as it either contains rugged sections with rock outcrops or is traversed by numerous gullies. Many of the soils have bad internal drainage and are subject to waterlogging. Of the 9,000 acres which were surveyed, only 470 were considered to be suitable for tobacco, with another 1,200 acres as second-class tobacco land. Planned drainage would be necesary to enable much of the remaining country to be used for cropping or pastures.

In addition to the detailed surveys in the Mareeba-Dimbulah district, two reconnaissance surveys were made there. One was of the Clohesy River/Davies Creek section and the other of an area adjoining Cattle Creek. The results of the former survey were rather disappointing. Although some 1,500 acres have potential for tobacco and a few hundred acres for pastures, the topography of the country is such that most of the arable land occurs in pockets near the stream banks and so presents difficult problems associated with water reticulation and farm management.

It was hoped in the Cattle Creek survey to find land which could be used for sown pastures and approximately 2,500 acres were inspected. Most of the soils were found to be unsuitable for irrigated pastures but an area of approximately 200 acres suitable for pasture experiments was selected.

Two other small reconnaissance surveys, one near Warwick and one at St. George, were undertaken during the year. The former was to assess the possibilities for an extension of irrigation in the Warwick district and the other to investigate the problems associated with the failure of cotton on the demonstration farm at St. George. The Warwick inspection showed that water for irrigation would benefit the present established apricot orchards and would permit the use of appreciable areas of alluvial soils on river flats for irrigated pastures. The St. George problem appears to be one associated with the physical properties of the soils and samples are now being examined by the Soil Physicist.

Investigational Work.—Considerable laboratory and co-operative field work in connection with tobacco quality was carried out. The special problems associated with bad quality tobacco leaf, known as "flat leaf", were given particular attention and many leaf and soil analyses were carried out both at the Brisbane Laboratory and at the Tobacco Research Laboratory at Northgate. In addition, field trials to observe the effect of different fertilizer applications and different cultivation procedures on leaf quality were designed by the section and a number of visits to the Burdekin district were made by a soils technologist to observe soil conditions. Considerable field and laboratory data concerning the "flat leaf" problem were obtained and these suggest that the disorder is associated with a number of causes. The amounts of chlorides and nitrates which are absorbed by the plant are known to be of importance but are not the only factors to be considered. Soil type, land preparation and pre-planting cultivation procedures all have important bearings on leaf quality. Additional work on this problem at the Northgate laboratory was associated with the uptake of bromine by the plant following the use of ethylene dibromide as a fumigant for nematodes. It was found that appreciable amounts of bromine were absorbed by plants growing on fumigated soil. Investigations on this aspect of the problem are continuing.

Other investigations included nutritional work on tomatoes, zinc deficiency in linseed and soil salinity work.

General Analysis.—In all, 1,581 waters and 3,644 soil samples were analysed during this year. Of the soils, 606 were in connection with field trials, 714 for tobacco work, and the remainder for checks on the nutritional status of farmers' samples. The waters were sent in by graziers and farmers who required an assessment of the water quality for irrigation or stock.

Wallum Investigations, Coolum Experiment Station.—Two fertilizer field trials (3 x 3 x 3) in connection with the legumes centro and stylo were harvested during the year and good results obtained. The experiments were designed to compile further data on the amounts of dolomite, superphosphate and muriate of potash which are necessary for optimum growth. Dolomite treatments in both trials were at the rates of nil, 1 ton and 2 tons/ac. and superphosphate at rates of 3, 6 and 9 cwt./ac. Muriate of potash applications were ½, 1 and 2 cwt./ac. for stylo and 1, 2 and 4 cwt. for centro. In both trials highly significant increases were obtained with dolomite, but the yield from the 2 ton application was not significantly greater than that from the 1 ton. In the centro trial, the effect of dolomite at 2 tons/ac. was more marked at the highest phosphate level and there was a significant interaction between phosphorus and potassium. In the case of stylo, both the 1 and 2 cwt. applications of muriate of potash were highly significantly greater than the ½ cwt. application. These results mean that for the establishment of these summer legumes an application of 1 ton of dolomite per acre is necessary on these soils plus at least 3 cwt. of superphosphate and 1 cwt. of muriate of potash.

A somewhat similar trial with white clover also established the necessity for lime or dolomite applications of at least 1 ton/ac. and somewhat higher dressings of phosphorus and potassium than was the case with the summer legumes. On the harvested material from the centro plots, analyses were carried out by the General Analytical Section for protein, phosphorus, calcium, magnesium, potassium and sodium. The protein values on the dry material varied from 10.1 to 21.4 per cent., the lowest values being associated with the nil dolomite plots. Compared with figures from other countries, the values for calcium and potassium are low, but phosphorus levels are normal.

Summer pastures at Coolum in general did well, and of the newer ones, *Paspalum plicatulum* looks particularly attractive. Kikuyu grass, which normally does not do well on the heath soils, looks very promising in association with *Lotononis bainsii* on some moist areas of heath bordering the tea-tree soils.

Of the winter pastures, Ronpha grass grew particularly well, especially in association with *Lotononis bainsii.* Cocksfoot and Louisiana white clover as a winter mixture is also worthy of further trial.

During the dry year of 1960 it was possible to maintain one beast to approximately 2 acres in good condition on the Coolum pastures without supplementary feeding.

To study further the fertilizer requirements of summer legumes a large trial incorporating three treatments at three levels and three replications of each treatment, for six legumes, was established. The treatments were dolomite, phosphorus, and potassium and the legumes were centro, stylo, puero, *Desmodium uncinatum, Lotononis bainsii* and *Glycine javanica.* These will be harvested next summer. In addition to the legume trial, a trial to determine the nitrogen requirements of a number of summer grasses was laid down. These will all be sampled periodically during the summer and analysed for protein, calcium and phosphorus.

An additional five acres of pastures were planted last summer and should be ready for grazing experiments in the 1961-62 summer.

FOOD PRESERVATION RESEARCH BRANCH

Construction of the Food Preservation Research Laboratory at Hamilton was completed in May 1960 and a Food Preservation Research Branch was created on August 4, 1960, with headquarters at the Laboratory. During the initial stages, much time had to be spent in testing experimental storage rooms and various items of equipment. The surveys have shown that pulp temperatures of fruit are constant in the storage rooms to within ± 0.1°F. The Branch has been consolidated into an efficient working unit and an intensive programme of research is planned for the staff and facilities now available.

The Laboratory is divided into four main sections—Physiology, Food Technology, Microbiology, and Chemical.

The function of the Physiology Section is to develop improved methods of storing, transporting and handling fruits and vegetables grown in Queensland, in order to eliminate much of the wastage which takes place between production and consumption, and to determine whether it is possible to export to distant markets a greater range of Queensland-grown fruits and vegetables.

The Food Technology Section is concerned with improved methods of canning, freezing and dehydrating foods, and

developing a wider range of tropical fruit products and frozen juice concentrates.

The Microbiology Section is working on the identification and control of spoilage organisms in fresh and processed foods, and with developing methods for the utilisation of fruit residues.

The Chemical Section will be concerned with changes in stored and processed foods and in evaluating fruit quality by estimating the flavour constituents. Details of the research programme in the four Sections are as follows.

PHYSIOLOGY

Apples.—Methods of controlling superficial scald in apples by chemical sprays or dips have been under investigation for several seasons. The 12 chemicals which gave good control of scald for the 1959 crop were again effective in 1960 when the chemical dips were applied as soon as possible after the fruit was harvested. The most effective substances were diphenylamine and a proprietary compound "Santoquin." Post-harvest dips using ascorbic acid, gallic acid and tannic acid are also being investigated as scald inhibitors.

The use of mixtures containing less oxygen and more carbon dioxide than present in the normal atmosphere has considerably increased the storage life of Queensland Granny Smith apples provided the fruit is treated with a scald-inhibiting compound. As "Santoquin" is an approved scald inhibitor, an extensive series of experiments is now in progress to determine the optimum maturity at which the fruit should be picked for storage and the most satisfactory storage atmosphere and temperature. It is hoped that as a result of the controlled atmosphere storage investigations, which have extended over a period of eight years, it will be possible to make definite recommendations on the commercial application of this method.

There is a good market in the United Kingdom for Granny Smith apples shipped from Queensland in February, but early apples, particularly those from young trees, are very susceptible to bitter pit development. Investigations have therefore been carried out to determine the effect on bitter pit incidence of (1) picking maturity, (2) calcium sprays, and (3) a short period in refrigerated storage. Although calcium chloride was applied as five pre-harvest sprays, the effect on bitter bit incidence was not significant, possibly because of the high incidence of pit in the control fruit. Significant results have been obtained elsewhere in fruit with a low incidence of bitter pit. Fruit picked on February 6 had significantly less pit than that picked on February 17 and February 28. The various cold storage treatments did affect pit incidence considerably, but wide differences in fruit from various sources were encountered.

Pears.—It has been the practice for Brisbane canneries either to import WBC pears which have been in storage in the southern States, or to use cold-stored Stanthorpe pears for the manufacture of fruit salad, the production of which has to be delayed until pineapples are readily available. Results with the Stanthorpe pears have not compared favourably with those with southern fruit because of uneven ripening and breakdown. Experiments carried out with the 1961 crop showed that Stanthorpe pears can be canned satisfactorily if stored at a temperature of 30° F., when the storage life is about eight weeks, compared with about three weeks at 34°F. Uniform ripening with good quality was obtained by cooling the fruit to 30°F. as soon as possible after harvesting.

Grapes.—Investigations on grapes were concerned with the effect of rootstock on storage life, and the use of sulphur dioxide to control mould in storage. Results show no significant effect of rootstock on the storage life of Waltham Cross and Purple Cornichon varieties. Due to the dry conditions, mould wastage was negligible, and no differences were recorded between the control and treated fruit.

Oranges.—Experiments were carried out to determine the effect of wax emulsions on weight loss and mould wastage in oranges, using a number of proprietary compounds. Weight loss was reduced and the appearance of the fruit considerably improved by waxing treatments, but such treatments had no effect on mould wastage. Experiments are in progress to determine the optimum temperature and length of storage life of oranges and mandarins in order to obtain data on export potential.

Stone Fruit.—Plums and peaches are frequently stored in the Stanthorpe district with variable results. Results from experiments with Wilson plums and Elberta peaches showed that a fall in soluble pectin which occurred after 16 days at 30°F. in Wilson plums, and 14 days at 30°F. in Elberta peaches, was accompanied by a marked deterioration in ripening quality which terminated their storage life. Changes in soluble pectin are being further investigated.

Pineapples.—In conjunction with the C.S.I.R.O. Division of Plant Industry, measurements were made of the electrical conductivity of healthy and blackheart pineapples, using an AC conductivity bridge. Marked differences in readings were obtained between healthy and affected fruit. It is possible that storage potential can be measured in terms of electrical resistance, and this technique will be further studied with a number of other fruits. Work is also being conducted to determine the effect of picking maturity on the rate of respiration, with a view to using the respiratory index as a basis of maturity.

Papaws.—During the winter months papaws are coloured artificially by kerosene burners at a temperature of about 85°F. but it is not known whether the heat or the ethylene generated by the burner is the accelerating agent. Experiments are in progress to determine the effect of ethylene, temperature and humidity on ripening, using fruit picked over a range of maturities.

Bananas.—The use of wax emulsion dips for treating bananas on a commercial basis is continuing. While the industry is satisfied that emulsions improve the appearance and keeping quality of the fruit, little is known of the effect of these dips on the respiratory activity of the fruit. Investigations were commenced to measure the effects of a number of commercial preparations on banana respiration. Ripening experiments are also in progress in which the effect of ethylene and the rate of ventilation are being investigated. Bananas treated with a wax emulsion and packed in hands or clusters in fibreboard cartons gave very good results in commercial trials in Queensland, and the fruit commanded a premium over unwaxed singles packed in wooden boxes. In order to compare wooden cases with fibreboard containers as packages for bananas, large-scale tests were carried out in June, 1961, from Murwillumbah to Sydney by the Banana Growers' Federation of New South Wales, in conjunction with the C.O.D., Fibreboard Development Council, the Departments of Agriculture of Queensland and New South Wales, the N.S.W. Railways Department, and the C.S.I.R.O. Division of Food Preservation. Results are not yet available.

Tomatoes.—During the second half of 1960, investigations were conducted in Bowen to determine whether it was possible to ripen the Lady Cunningham variety artificially after packing and prior to transport. As this variety is subject to ring-cracking if bush-ripened, much of the fruit is picked immature and takes a considerable time to ripen on the Sydney market. Results indicated that colouring can be accelerated by gassing, but the longer the gassing time the more uniform is the colour. However, it was difficult to obtain uniform colour throughout the pack, and sorting for colour before packing is necessary in order to ensure a uniform coloured pack on arrival in Sydney.

FOOD TECHNOLOGY

Pineapples.—Although the concentration of sugar and acid in pineapples determines whether the fruit is sweet or sour to the taste, it is the esters which give the fruit its characteristic pineapple flavour. Changes in ester values in samples of pineapple juice drawn at regular intervals from the Northgate Cannery over a period of about 11 months were determined. The most significant feature of the results was the considerable variation in ester values, the range being from 20 to 500 p.p.m., with the summer crop having a value three times as great as the winter crop. Such variable results could be associated with climatic conditions or cultural practices.

It was also found that some of the flavouring constituents are lost during the processing of the juice, and this is being investigated.

The canning quality of fruit from selected clones grown at the Maroochy Experiment Station was evaluated on the basis of shape, size, translucency and colour. Evaluation of the clonal material on the basis of flavour is proceeding and ester values are being determined.

Juice Concentration.—The greater consumption of fruit juices *per capita* in the United States of America as compared with Australia is largely due to the sale of frozen concentrates there. A turbulent film evaporator with ester recovery equipment capable of converting 5 gal. of juice into 1 gal. of concentrate is being developed. The pilot plant will be used initially for the production of frozen pineapple concentrates, and later applied to other fruits. Preliminary work showed that most of the pineapple flavours can be removed and fractionated before passing through the main evaporator, thus avoiding flavour destruction.

Frozen Peas.—The pea varieties normally grown in southern States for processing developed excessive vine growth and poor pods under experimental conditions in Queensland. There was also a wide variation in pod maturity at the time of harvest. Massey and Hybrids B27 and A12 all grew satisfactorily and yields and pea quality were at least equal to those recorded for the commercial varieties grown in other States. It appears that the Optimum Maturometer Index which has been found satisfactory for peas grown in other States does not apply to varieties grown in Queensland, and a new Index will have to be determined.

Experiments are planned in conjunction with Horticulture Branch at the Redlands Experiment Station, and at

Lawes and Bundaberg. The installation of an experimental pea viner permitted larger plots to be planted and more accurate sampling to be carried out. An officer from the Branch gained valuable experience in experimental and commercial pea harvesting and processing by working with officers of the C.S.I.R.O. in Tasmania during the pea season in January, 1961.

Macadamia Nuts.—Most Macadamia nuts grown in Queensland are now being sold in a processed form, using a method involving dehydration and cooking in coconut oil. There are indications that cooking oils can cause rancidity. A rotary oven was constructed and experiments are now in progress on oven roasting. Commercial observations indicate that the intergrifolia variety has better storage qualities than the tetraphylla type.

Mangoes.—Stringless Kensington mangoes are being used commercially at Gladstone for the production of quick-frozen mango slices which are being exported to other States and the United States of America. A survey was made of other stringless types grown in Queensland to determine whether a firmer textured type with the attractive appearance of the Kensington is available. Over 30 selections were examined for processing characteristics, but only five were considered suitable for further investigation.

Ginger.—A varietal trial carried out in conjunction with Horticulture Branch indicated that Chinese ginger had a significantly higher yield of stringless rhizomes than local ginger, but yields per plot were correspondingly smaller. Departmental officers assisted the Buderim Ginger Growers' Co-operative Association in the production of dried, syruped, and crystallised ginger, and the quality of the ginger was vastly improved by picking the rhizomes at the correct stage of maturity and by improved processing methods. Examination of methods of storing raw ginger, using salt brines plus sulphur dioxide as a preservative, together with experiments on flavour improvement, are now in progress.

Papaws.—Papaws are normally canned at a near-mature stage when the fruit is susceptible to mould, and considerable wastage occurs in the initial preparation of the fruit for canning. At the request of the Other Fruits Sectional Group Committee of the C.O.D., experiments were carried out to determine whether fruit picked at a less advanced stage would make a satisfactory canned papaw or fruit salad pack with correspondingly less wastage. The most attractive pack was obtained by using a stage of maturity slightly less than that normally used by factories. It is possible that fruit could be forwarded to the factory in a less mature condition and ripened artificially, because artificially ripened fruit was firmer in texture and gave a higher recovery of flesh than tree-ripened fruit.

Mandarins.—As canned mandarins imported from Japan are popular in Queensland, investigations are being carried out, at the request of the Citrus Sectional Group Committee of the C.O.D., to determine the suitability of Queensland-grown mandarins for processing. The seedless types are preferred because of their ease of preparation and retention of texture. A number of varieties are being tested.

Frozen Foods.—A preliminary survey of frozen peas imported from other States, taken from wholesale and retail establishments, showed considerable variation in quality due to poor grading of the raw material and unsatisfactory retail storage, where the temperatures are far above that recommended. Steps are being taken by the Australian Food Technology Association, in conjunction with Departmental Officers, to institute an educational programme on frozen foods for the benefit of the processor and the distributor.

MICROBIOLOGY

Fruit Residues.—Juice is extracted from the first press of pineapple skins, cores and trimmings, and the residue disposed of as stock food. Work was begun on the production of vinegar and wine from these residues, using five different strains of yeast. Fermentation was carried out under conditions similar to those used for wine-making. The vinegar obtained had a pleasant flavour and an attractive colour, but the yield was comparatively small. Further experiments in fermentation showed that the utilisation of sugar and a high yield of alcohol could be obtained by aerating the juice inoculated with yeast for 10 hours to give a high yeast population, and then allowing the fermentation to proceed anaerobically for another 40 hours. Semi-commercial trials are now proceeding, using a special fermentation plant lent to the Department by the Medical School of the University of Queensland.

Wastage in Citrus Fruits.—Experiments are being carried out in conjunction with officers of the Pathology Section to determine how mould development occurs in oranges, and whether it can be controlled by better handling methods and the use of certain fungicides. The nature and extent of injuries which occur during and after harvesting are being examined by means of 235 triphenyl tetrazolium chloride, which gives a red stain at points of infection. In order to determine the efficiency of certain fungicides it is necessary to obtain a 100 per cent. infection in the control fruit, but the techniques of inoculation have so far proved unsatisfactory. Investigations on methods of inoculation are now in progress together with work on the control of mould development, using small concentrations of ammonia gas.

CHEMICAL

The identification and separation of flavour components of fruit by ordinary chemical methods has been difficult in the past because large quantities of flavouring substances were required, and isolation of the various flavours often resulted in changes in their composition. Flavour has hitherto been assessed by tasting tests. Chemical methods have now been simplified and expedited by the use of chromatography, and a Perkin-Elmer Vapour Fractometer now installed at the Laboratory will enable the volatile flavouring constituents to be separated and identified. The work will be conducted initially with pineapples in order to determine quality differences in respect of picking maturity, and to link up with the work on ester recovery in the production of frozen concentrates. Although it has been shown that ethyl acetate is the main flavouring compound in the pineapple, it is possible that one of the minor constituents may have a more pronounced effect on palatability. In conjunction with the Chemistry Department of the University of Queensland, pure samples of the various volatile components of pineapple flavour are being prepared in order to calibrate the instrument.

Other chemical work in progress is concerned with the chemical nature of scald in Granny Smith apples, particularly in relation to changes in beta carotene.

An electrical method for the determination of ascorbic acid in coloured solutions has been developed for work in connection with changes in the quality of frozen foods.

ADVISORY AND EXTENSION

A number of articles on the functions and scope of the Laboratory were published in Australian and overseas journals, while regular contributions were made to *Queensland Fruit and Vegetable News.* Over 600 visitors have already inspected the Laboratory, including the various Sectional Group Committees of the Committee of Direction of Fruit Marketing, Junior Farmers' Clubs, the Fibreboard Development Council, the Queensland Branch of the Australian Refrigeration Institute, the Australian Citrus Growers' Federation, Commonwealth Association of Food Technology, and people associated with various food and allied industries. Already there has been a heavy demand on the officers' services for advice on food preservation and transport problems.

DIVISION OF ANIMAL INDUSTRY

The impact of continuing dry conditions on the animal industries of the State is brought out quite plainly in the reports of the several Branches of this Division. Perhaps not so clear is the fact that a fair to bad situation would have been much worse were it not for the great amount of property improvement work carried out by so many in recent years. Subdivision of land and the providing of additional water facilities; scrub clearing and sowing of pastures; growing of crops and conservation of fodder: all are part of the story. Without them the absence of a general wet season as such in two successive years must surely have resulted in a very serious situation indeed.

Staff of the Cattle Husbandry and Sheep and Wool Branches have been most active in encouraging development along the lines indicated, though the Veterinary Services Branch, what with its more widespread coverage of the State, has had a part to play also. There need be no doubt that staff of these field Branches are alive to what is happening and the importance of doing all possible to assist producers with programmes for property improvement. In this they have powerful support and encouragement from the Husbandry Research and Biochemical Branches of the Division. Reference to the reports from these two Branches will show how work on subsistence feeding (the use of low quality roughages and/or grain for this purpose), grazing management techniques and silage making have continued as far as facilities permit.

The subsistence feeding studies were extended to embrace pregnant and lactating cows, these being the class of cattle most seriously affected by drought conditions. The feeding of early-weaned calves too was brought into the studies to explore its possibilities as a drought relief measure. Keeping cattle alive may well be described as the theme running through all this work.

A new angle on the use of urea in conjunction with poor quality grass hay (simulating standing mature native grasses) was explored during the year. Incorporated in a salt lick block and made available to cattle in yards, urea demonstrated its ability to increase consumption of hay and improve body-weight. In this experiment (progress results are given in the Husbandry Research Branch report), molasses on its own

once again failed to stimulate higher consumption of hay or increase body-weight. It would seem molasses has been somewhat over-rated as a cattle feed in the past.

LIVING WITH DRY CONDITIONS

Dry conditions have some saving graces. In the year under review cattle tick infestation was generally light, conditions were against the spread of the buffalo fly, pleuropneumonia of cattle was at low ebb, heavy infestations of sheep with internal parasites were uncommon, and the occurrence of leptospirosis of pigs and calves was below the levels of the last several years (see Veterinary Services Branch report). There were few if any large-scale waves of sheep blowfly strike. Raising livestock under near-drought conditions is not easy, but it has some compensations. In Queensland we have to learn to live with dry conditions in most parts of the State. It can be done and is being done comfortably enough by the more progressive spirits in the pastoral and dairying industries.

The class of livestock producer least well placed to cope with the vagaries of the season is the poultry farmer. If the season is such as to result in high prices for grain there is nothing much he can do about it. There are limits to the amount of grain he can store effectively at times when prices are "right". To an extent, the pig producer too is at the mercy of the grain market. Until the year just passed, grain sorghum was an attractive economic alternative to wheat and maize for the poultry farmer and pig producer, but of late the favourable price differential has largely disappeared. Extension directed at the use of sorghum as an alternative grain to other (previously) much more expensive grains has clearly been successful to the point where it comes close to defeating its own end. More recently white French millet has been revealed as a suitable substitute grain for poultry. Being cheaper and available earlier in the season than other grains, it offers a double advantage. More information on the matter is to be found in the report of the Poultry Section.

NEW CHAPTER WITH POISONOUS PLANTS

Over the years the Division, often in association with the Government Botanist's staff, has built up an impressive record of discovery in the poison plants field. The importance of poison plants in the livestock scheme of things can scarcely be over-emphasized in Queensland. A reliable estimate of the annual loss in the past due to poison plants would be very hard to come by, but it would certainly far outweigh losses due to most diseases considered individually.

The very large body of information now available about plants poisonous to livestock has, of course, had its effect but there is still another chapter to be written. This concerns the toxic principles in the plants concerned and antidotes to them. Complex chemical work using in some instances quite expensive and intricate equipment is called for. It is highly satisfactory, therefore, to be able to point to the reference in the report of the Biochemical Branch to the isolation and identification of the toxic principle in Georgina gidyea (*Acacia georginae*), the cause of Georgina River disease; also to the fact that work in a similar connection is in hand where heart-leaf poison bush (*Gastrolobium grandiflorum*) and cestrum (*Cestrum parqui*) are concerned. Both are renowned killers of livestock.

One can point also with much satisfaction to the work on selenium accumulator plants (set out also in the Biochemical Branch report.) This work has revealed the answer to what was for a time a seemingly insoluble disease problem of horses and sheep.

Noteworthy also during the year was the finding of considerable quantities of nitrates in certain plants and crops not previously recognised as dangerous in this regard. Details will be found in the Biochemical, Pathology and Veterinary Services Branch reports.

Increasingly the need for a close association between the services on offer by the modern biochemist and those engaged on research into animal diseases as well as animal production is seen.

PROGRESS WITH ARTIFICIAL INSEMINATION

Those in the dairying industry continued to evince great interest in the development of a large-scale insemination centre by the Department. This is no small undertaking, but some really worthwhile progress was made. At the year's end planning and survey work had been completed and construction was well and truly under way on the selected site at Wacol.

A number of co-operative or proprietary groups are now providing an artificial insemination service using deep-frozen semen obtained from Graham Park, Berry, N.S.W. There will thus be a "lead-in" and a hard core of experience available to other groups when the Department is in a position to supply semen from the Wacol centre.

It is becoming increasingly evident that although dairy farmers see in A.I. an opportunity to improve the quality of their herds, their main interest springs from the fact that A.I. allows controlled breeding and hence assists greatly in dealing with some of the more important infertility diseases.

Details relating to services provided by the Division in the field of A.I. will be found in the Cattle Husbandry, Sheep and Wool and Veterinary Services Branch reports.

ON THE DISEASE FRONT

Equine infectious anaemia (first reported in Australia from Queensland in 1958–59) was not reported during the year. This makes it a period of two years since a fresh occurrence of the disease has come under notice. As is mentioned in the Pathology Branch report, a satisfactory routine procedure for diagnosing this disease has been developed.

No further information is available at this stage in relation to the suspected presence of an influenza-like disease of horses in Queensland.

The presence in the State of inclusion body rhinitis of pigs was confirmed right at the year's end. Rhinitis of pigs had been under investigation on a number of properties in Queensland previously, but inclusion bodies were not detected in the material examined. Conclusive diagnosis of this disease is made difficult by the fact that the inclusion bodies on which diagnosis depends are rather transient. Thus another disease of pigs is added to the list of those occurring in Queensland. Fortunately, however, there is not now the same necessity to fear the consequences as appeared at the time of the original outbreak of the disease in South Australia in 1959–60. After its initial impact on a herd, which may in truth be quite serious, the disease is reported to assume a role of only minor importance.

Of special note was the commencement of operations in Queensland in terms of the National Plan for the Control and Eradication of Bovine Contagious Pleuropneumonia. The work has the financial support of New South Wales, Victoria, South Australia and Western Australia. An attack is being made on the disease on a wide front and with co-operation from those in the cattle industry is certain to make good headway. An outline of what is in hand will be found in the Veterinary Services Branch report.

An interesting side-light of the laboratory examination of cattle lungs in connection with the B.C.P.P. control plan is the new information on cattle pneumonias generally that is being obtained. A note on this aspect will be found in the Pathology Branch report.

The Protozoology Section at the Animal Research Institute, Yeerongpilly, achieved a considerable success on the score of contributing new information to knowledge of cattle tick fever. This is set out in some detail in the report of the Pathology Branch. The importance of this work lies in the fact that a complete answer to the tick fever problem is largely indispensable to a successful tick eradication programme. Experiments in hand or in prospect at the year's end are designed to explore factors influencing the "strength" (virulence) and "taking power" (infectivity) of tick fever blood vaccine. These experiments could lead to effectual standardisation of tick fever vaccine. This would be a big step forward.

SLAUGHTERING SECTION

A Slaughtering Section as such (within the Veterinary Services Branch) was formally recognised near the year's end by the creation of a Chief Inspector of Slaughterhouses position separate from that of Director of Veterinary Services. A little earlier on all regulatory work relating to the slaughter of poultry was transferred from the Poultry Section to the Veterinary Services Branch.

The new Slaughtering Section will almost certainly become a separate Branch in its own right at some future date. There are some problems, however, arising chiefly from the fact that in many centres Veterinary Services Branch staff carry out both stock and slaughtering duties.

Throughout the year the administrative demands made on the Division arising out of considerations related to the District Abattoir system in the State were very heavy indeed. It was fortunate that the Slaughtering Section was already virtually operative even though not officially constituted.

ADVISORY COMMITTEES

Advisory committees, on which graziers are represented, were set up to assist in the development and planning of work at the Toorak Sheep Field Station and Swan's Lagoon Cattle Field Station. This is regarded as a very satisfactory arrangement. For one thing, it is an acknowledgement by the graziers' associations of a degree of responsibility in these matters.

More important, however, is the assurance grazier representation brings that the pastoral industry will be kept fully informed on the work of these stations as well as having a voice in such work. This is entirely proper, not only by reason of the fact that the industry makes a direct contribution to the cost of the work, but also because past experience has shown that graziers can make a decidedly worthwhile contribution to the successful planning and conducting of field experimental work.

STAFF

The staff situation in the Division of Animal Industry, so far as actual numbers go, was again relatively stable and particularly in the research Branches. Indeed it can be said without fear of contradiction that at the Animal Research

Institute, Yeerongpilly, there is now a group of research workers (graduates and technicians) who have amply demonstrated their ability to cope successfully with manifold and difficult assignments. There is an eagerness to come to grips with problems that demand original and fundamental research and it is to be profoundly hoped the necessarily extensive facilities for this will be forthcoming. Certainly the Institute, because of its past record and present strength, must have a strong claim on the good offices of those charged with the distribution of funds for research.

It should be stated that in some Branches, notably Veterinary Services and Cattle Husbandry, the maintaining of staff numbers was effected by intake of inexperienced staff. This, of course, is a matter for deep disquiet. There is no room for complacency where the retaining of experienced officers services is concerned.

Field Branches still have a number of vacancies for graduates, and particularly veterinary graduates. The prospects of adding much to the veterinary staff in 1961-62 do not appear bright but in the following year the Government's scholarship scheme will start to make its presence felt in earnest.

There was a pleasing revival of interest in working with the Division on the part of agricultural diploma holders and it was possible to fill several positions from their ranks during the year.

The Poultry Section of the Division was actually the worst off proportionately for staff at the year's end, a combination of resignation, retirement and death of an officer during his service being responsible.

NEW LEGISLATION

An amendment to *The Stock Acts,* 1915 *to* 1959, was effected during the year. The amending Bill provided for increased maximum rates of assessment on livestock; for tighter control over waybills used in connection with the travelling and sale of livestock; for testing or treating livestock prior to introduction into Queensland; and for the taking of adequate counter measures in the event of illegal entries of stock. The 1960 Act is numbered 9 Elizabeth II. 42.

An Order in Council issued under the Stock Acts and dated 11th August, 1960, varied the restrictions on introduction of swine from other States and the Northern Territory. The effect of the variation is to allow pigs entry into Queensland from States in which infectious rhinitis occurs, provided the pigs themselves are free from the disease and have not been in contact with affected pigs.

As a result of outbreaks of swine fever in New South Wales, further restrictions were imposed on pigs from that State by Orders in Council dated 13th April, 1961, and 25th May, 1961. At the year's end New South Wales pigs were admissible only from the Northern Rivers area of the State.

VETERINARY SERVICES BRANCH

STAFF

Three Assistant Veterinary Officers were appointed during the year but three experienced professional officers were lost by resignation or transfer to other Branches. Additional temporary staff was employed to permit the release of experienced officers on B.C.P.P. work. The temporary loss of two District Inspectors and one Veterinary Officer in this regard has increased staffing problems. Two Inspectors of Stock resigned and two retired.

CATTLE DISEASES

Bovine Contagious Pleuropneumonia.—With the formation of the National Pleuropneumonia Fund by contributions from all mainland States, the previous drive against the disease was intensified. Whereas four specialist officers were employed in supervising inoculation of travelling cattle in the endemic area and advising pastoralists on property control through routine vaccination, 11 experienced officers, including a Veterinary Officer and two District Inspectors of Stock, were seconded to this work in April for the current cattle season after attending a training school in Brisbane.

In co-operation with the Commonwealth and State meat inspection services, returns are obtained of the incidence of lesions of pleuropneumonia on all cattle killed at principal meatworks. Specimens derived from meatworks are tested by cultural and serological methods, including the precipitin test.

To establish the incidence of the disease in the area between the Great Dividing Range and the Expedition Range in Central Queensland, as far as practicable all slaughter cattle from this area are being blood-sampled at killing works with a view ultimately to including this area in the B.C.P.P. protected area of south-east Queensland. Properties on which B.C.P.P. is detected are quarantined, clinical cases destroyed and the remainder vaccinated. Quarantine restrictions are not lifted for at least six months after the last known case.

In the Protected Area of the State it is proposed to blood-test prior to vaccination to remove carriers, vaccinate, and again blood-test some six months later immediately prior to removal of quarantine restrictions. Any reactors must go to slaughter before release of the property. As far as practicable a similar procedure will be followed outside the Protected Area where the method of management is such that close control can be maintained.

The eight properties that were under quarantine for B.C.P.P. at June 30, 1960, were all released during the year. Seven new properties were quarantined and three released. Of the four properties remaining under restriction at June 30, 1961, one in the endemic area of the south-west was quarantined because of a field outbreak, and one in the north-west because of the introduction of suspect cattle from an adjoining State. The remaining two properties are in the protected area. Infection on one property, which was detected by follow-up of an active case sent to a meatworks, is thought to have been introduced with store cattle from endemic areas. All cattle were bled to enable reactors to be removed. The other quarantine was of a precautionary nature following the illegal introduction of suspect cattle into the area. Serological and cultural work on meatworks cattle have demonstrated the presence of carriers in this mob.

Tuberculosis.—An Approved Veterinary Surgeon was obtained for the Mackay Zone and the Crow's Nest area was gazetted under the Compulsory Tuberculin Testing Scheme for dairy cattle, but resignations were received from Approved veterinarians at Wondai and Gatton. Assessments were cancelled in those areas where the testing service could no longer be supplied, but it is hoped to open up these areas again as suitable contractors become available; otherwise the considerable headway which has been made in the eradication of tuberculosis in these areas will be lost. The gazettal of Crow's Nest completed the coverage of the eastern Darling Downs. Some 12,000 head were involved and they were allocated to neighbouring Approved Veterinary Surgeons. Mackay was previously under test but was left vacant when the previous Approved Veterinary Surgeon left the State.

Details of testing under the Compulsory Scheme are set out in Table 1 and of herds tested by Government Veterinary Officers in Table 2.

TABLE 1

SUMMARY OF TUBERCULIN TESTING BY APPROVED VETERINARY SURGEONS, JULY 1, 1960-JUNE 30, 1961

Division	No. of Herds	No. of Tests	No. of Reactors	Percentage of Reactors
Brisbane	1,997	123,463	174	·14
Cairns	352	17,869	1	·006
Townsville	1	159	..	..
Rockhampton	412	34,035	..	..
Maryborough	1,622	97,104	45	·05
Toowoomba	1,490	83,414	22	·02
Total	5,874	356,044	242	·07

TABLE 2

SUMMARY OF TUBERCULIN TESTING BY GOVERNMENT VETERINARY OFFICERS, JULY 1, 1960-JUNE 30, 1961

Division	No. of Herds	No. of Tests	No. of Reactors	Percentage of Reactors
Rockhampton	12	1,939	4	·2
Roma	3	283	2	·7
Barcaldine	1	444	1	·23
Cairns	10	790	2	·25
Maryborough	38	4,327	15	·35
Toowoomba	25	1,848	48	2·59
Townsville	25	5,910	294	4·97
Totals	114	15,541	366	2·36

The majority of cattle tested in the Townsville Division were selected portions of beef breeding herds. These tests were undertaken because of suspected high incidence following condemnation of slaughter cattle. The positive reactors ranged as high as 22 per cent. in a group where 167 head were tested and in one group of 1,771 constituted 10 per cent.

Infertility.—The level of Strain 19 vaccination showed continued improvement and the total vaccinations for the year are estimated to exceed 60,000 head. However, the position cannot be regarded as satisfactory until all retained dairy heifers and beef heifers at risk have been protected against brucellosis. Proof of the continued importance of brucellosis as a disease of dairy cattle is shown by a series of 820 blood samples from the Burnett area, 147 being positive.

Death of two valuable bulls from acute orchitis probably due to *B. abortus* was reported. Vibriosis was again widespread in all dairying areas and was detected in individual

beef herds. The economics of vibriosis control in beef cattle is being tested on a property near Mundubbera. Three of the seven herds recorded in the last annual report as infected with trichomoniasis were released from quarantine. A further neighbouring property was found to be infected, so five herds remain under treatment.

Therapeutic treatment of a valuable bull infected with trichomoniasis was attempted at the University of Queensland, and in spite of great attention to detail, several attempts at treatment were unsuccessful. He was finally cured by local application of an imported specific. Mating trials on six virgin heifers three months after completion of treatment confirmed freedom from infection.

Two stock inspectors were trained in artificial insemination technique to maintain an A.I. service to quarantined herds, thus obviating the usual difficulties of bull control experienced in trichomonad eradication.

Leptospirosis.—Except perhaps in the Rockhampton district, where a number of beef cattle were shown to have blood titres, particularly to *L. pomona,* the incidence of leptospirosis, in regard to both calf losses and abortions in pigs and cows, was lower than normal. Dry conditions may have influenced the incidence of infection.

Mastitis.—Considerable concern is evinced by cheese manufacturers in regard to antibiotic residues in milk used too soon following therapeutic treatment for mastitis. Competition amongst drug manufacturers and the erratic results obtained against staphylococcic mastitis initiated a growing tendency to market ever-increasing concentrations of antibiotics for the treatment of mastitis. Trials are now in hand to check the excretion rates of various antibiotics in milk following normal therapeutic use. The value of dye indicators to the presence of excreted penicillin in milk is also being assessed.

Organisms incriminated in the causation of mastitis during the year included *Streptococcus agalactiae, S. uberis, S. dysgalactiae,* haemolytic and unclassified streptococci, *Staphylococcus aureus, Pasteurella* spp. *P. multocida, Klebsiella pneumoniae, Corynobacterium pyogenes, Nocardia* spp. and *Pseudomonas.* The Nocardia infection was restricted to one herd, some four animals being affected over a period. On another property, freshly calved cows developed an acute mastitis infection with severe systemic symptoms and deaths within three days. *P. multocida* was isolated from milk samples.

Tick Fever.—While tick fever in marginal areas was extremely light, a disturbing number of deaths occurred from babesiosis throughout the endemic tick area. Losses were particularly heavy in the Gympie and Brisbane areas. Continued low level of tick infestation throughout the winter and dry spring is regarded as the cause of loss of normal immunity. Heavy losses in weaners and introduced cattle occurred in the Rockhampton Division. Severe anaemia following the immunisation of introduced beef Shorthorns during a period of high tick infestation was noted near Brisbane. Repeated dipping and iron therapy were necessary. Anaplasmosis as an individual problem was noted in the Rockhampton Division.

Virus Diarrhoea.—No extensive outbreak of this disease was reported, although suspected cases were recorded in most Divisions. It was fairly severe on individual farms near Chinchilla and Toowoomba late in the winter of 1960 and isolated cases have been noted since.

Neonatal Mortalities.—In spite of conditions which were believed to favour the onset of this disease, no cases were reported from Kingaroy and only isolated ones from the Toowoomba district.

Encephalomyelitis.—A light incidence of non-purulent encephalomyelitis in calves was observed in the Oakey-Toowoomba area. Similar cases occurred at Nambour and in the Brisbane area but the incidence was much reduced. This disease was probably involved in the loss of 64 calves in the Burnett but management factors were also incriminated.

DISEASES OF SHEEP

Infertility.—Further evidence of the prevalence of ovine brucellosis in rams on the Darling Downs was obtained and a detailed survey of breeding flocks of British breeds is being made by serological and cultural methods. Infection is making serious headway in a Dorset Horn flock in the South Burnett. Continued blood-testing and culling have failed to eliminate infection from the ram flock and there is evidence that the ewes may be infected.

A condition closely resembling the infertility syndrome produced on subterranean clover pastures was noted near Texas. Infertility had been experienced in the previous season but was more pronounced in the spring of 1960. Affected ewes showed signs of false pregnancy, dystokia and vaginal prolapse. The pasture was predominantly burr medic (*Medicago denticulata*).

Muscular Dystrophy of Lambs.—In further investigations of this condition normal lambs showed no growth response to selenium. No cases of dystrophy occurred in lambs from 800 ewes dosed with 5 mg. of selenium orally four weeks before lambing. Three thousand control ewes produced approximately 2 per cent. affected lambs.

Humpy-back.—This disease was prevalent in the central-west, particularly in the Blackall area. *Solanum esuriale,* a suspected plant, was plentiful at the time but feeding trials, both on affected properties and at the laboratory, were negative. Attempts to simulate normal conditions under which the disease occurs were kept in mind in reference to both exercise and selection of animals but without results. It appears that the role of *S. esuriale* in causation of this syndrome should be reconsidered.

Miscellaneous.—Blackleg in sheep was reported near Millmerran. Limited cases of enterotoxaemia in sheep and goats were encountered, but the trouble is not economically important in Queensland. Sporadic outbreaks of tetanus were reported from most sheep-raising areas. Mycotic dermatitis was confirmed near Millmerran. Renal calculi, infectious labial dermatitis and salmonellosis were encountered.

DISEASES OF PIGS

Swine Fever.—Owing to the occurrence of swine fever in New South Wales, the introduction of pigs or pigmeats from any part of that State with the exception of the Northern Pastures Protection Board districts of Tenterfield, Casino, Tweed-Lismore and Grafton was prohibited. Piggeries to which New South Wales pigs had been recently introduced were placed under close surveillance. All swill-feeding establishments are being kept under surveillance and the requirements of the Stock Acts in regard to boiling of swill rigorously enforced. It was clear from the history of the New South Wales outbreaks that the typical explosive outbreaks of swine fever may not occur and that early knowledge of the entry of the disease might only be obtained by careful investigation of every suspicious sickness in pigs.

Oedema Disease.—Six outbreaks of oedema disease were confirmed in the Brisbane district, and four occurred in the Maryborough Division. Its presence is suspected near Toowoomba. Outbreaks have been confirmed by isolation of an haemolytic type of *Escherichia coli.* This disease has only rarely been reported from Queensland. Field treatment with nitrofurazone appears reasonably effective. On one property, the sty was spelled for nine weeks after the first outbreak but cases recurred within a week of restocking the sty.

Erysipelas.—Acute field outbreaks of erysipelas were less numerous than in previous years. Vaccination is being used to a certain extent but its use is as yet too restricted to have any great influence on the number of outbreaks. However, chronic erysipelas, as judged by the number of condemnations for arthritis, many of which are considered to be of erysipeloid origin, is increasing.

Brucellosis.—Extensive exposure to *Brucella suis* was demonstrated in two northern commercial piggeries and a serious breakdown occurred in a stud herd registered under the brucellosis testing scheme. Quarantine restrictions were imposed on the stud piggery and a satisfactory clean-up programme instituted.

Virus Pneumonia.—This Department is co-operating with the Virus Pneumonia Free Pig Society of Queensland by the examination at slaughter of a proportion of the litters owned by members.

Miscellaneous.—Necrotic enteritis, Glassers disease and salmonellosis were commonly encountered and caused serious economic losses. Paralysis of suckers associated with copper deficiency, and paraplegia of older pigs associated with vitamin A deficiency, were recorded. Piglet anaemia was recorded and treated by iron injections.

DISEASES OF POULTRY

Infectious Laryngotracheitis.—No vaccination breakdowns were reported and approximately 161,500 birds were inoculated. Of these, 128,000 were in the Cairns area, where several large broiler growers insist on this protection for their stock. All these properties had a previous history of infection, but no cases of I.L.T. were recorded in the area during the year.

Nephritis.—Nephritis has become more prevalent and is the main single cause of deaths in table chickens. A chronic form of unknown cause has been noted in laying hens.

Coccidiosis.—Following the extensive use of coccidiostatic drugs the most commonly observed forms are intestinal and duodenal coccidiosis in chickens over nine weeks. These forms appear after withdrawal of preventive medication, and are associated with the failure to develop immunity during continuous medication.

Streptococcal Septicaemia.—This disease caused a 55 per cent. death rate in laying fowls on a Brisbane property. It was shown to be due to *Streptococcus zooepidemicus,* which was transmissible to susceptible fowls. There are no previous records of this disease in Queensland.

Miscellaneous.—Septicaemic cholera appears to be becoming more common, six outbreaks being recorded in the Brisbane area in fowls. Two occurred in ducks, in one case 100 dying in three days. Penicillin caused abrupt termination of losses. Staphylococcosis was encountered in colony cage birds, apparently associated with lowered resistance and injuries by wire, birds, nails and day-old pox vaccination. Chronic respiratory disease proved troublesome on most table chicken broiler farms and often became complicated by secondary air sac infection.

DISEASES OF HORSES

In spite of continued examination no cases of equine infectious anaemia were detected this year. Following a period of observation after the wet season in which no cases were observed, all quarantine restrictions on horses in regard to this disease within the State were removed. An influenza-like disease of horses is prevalent in the Central districts. It appears to respond satisfactorily to oxytetracycline, particularly in the early stages. Strangles was not prevalent but sporadic cases of tetanus, ringworm and colic were reported. Ophthalmia was prevalent in the Longreach-Barcaldine area. An interesting observation was the prevalence of stake wounds of the coronet in areas of rolled gidyea scrub in the central-west.

POISONING

Arsenic was again very destructive, 11 positive cases occurring in the Burnett alone. Some cases were associated with potentially dangerous concentrations of arsenic on grass. Cattle and occasionally pigs are the main animals involved. Almost an entire herd of 45 cattle was lost following power spraying with arsenic in drizzling rain. Six died and 20 head were badly scalded at Townsville and 20 head were lost at Bowen from arsenical poisoning. Disposal of dip arsenic killed five fat bullocks at Yuleba. Lead poisoning caused sporadic losses, mainly in pigs and calves. Twenty sheep were poisoned by an old tin of phosphorus bait, and phosphorus rat baits caused heavy losses in pigs.

BHC and organic phosphates caused some losses, and pasture contamination by endrin sprays, particularly in tobacco areas, was fatal to stock. Some heavy losses of calves followed dipping in organic phosphates under heat-wave conditions in the Rockhampton area.

Owing to the drought conditions generally prevailing throughout the year, losses from poison plants were severe. Very heavy mortalities occurred in sheep after depasturing on *Wedelia asperrima* at Richmond and *Portulaca oleracea* at Cunnamulla. *Salvia reflexa* was blamed for the loss of 14 head on the Glenmorgan stock route and was also responsible for the loss of 60 sheep at Goondiwindi. A serious loss of sheep occurred on the eastern Darling Downs, where hungry sheep were turned onto oats containing 2·1 per cent. potassium nitrate on a dry-matter basis. Losses of 6-10 per cent. of travelling stock followed ingestion of wild tobacco (*Nicotiana* spp.) in several mobs in the vicinity of Augathella.

In addition to the poison plants normally causing troubles, losses were suspected to have followed ingestion of *Boletus* spp. by cattle, pepperina (*Schinus molle*) berries by fowls, and rough poppy (*Papaver hybridum*) by horses and cattle.

EXTERNAL PARASITES

Cattle Tick.—Due to the cold dry winter in 1960 and the dry conditions prevailing throughout the year, tick infestation was generally extremely light. However, there were extensions into clean country, usually involving only the finding of a few ticks. Most of these were in marginal areas. Ninety quarantines were in force at the beginning of the year, 43 were lifted and 34 new quarantines were imposed. Eighty-one quarantines were in force at the end of the year. Outlying outbreaks were reported from the Killarney, Toowoomba, Oakey and Dalby districts. All quarantines previously reported in the Crow's Nest, Oakey and Jandowae and Dalby districts were lifted, including the restrictions on Oakey, Quinalow and Jandowae saleyards. Cleansing operations in the Crow's Nest and Helidon districts are proceeding satisfactorily. Twenty fresh outbreaks were reported in the Kingaroy area.

Buffalo Fly.—Conditions were against the spread of buffalo fly. It did not reach Rosedale on the coast but the rail spray was maintained at that centre to deal with cattle travelling from the north by train.

Stickfast Flea.—This pest is now well established in some western areas, such as Barcaldine, Blackall and Goondiwindi, and in the Cairns area. Further localised outbreaks were reported from Rockhampton, Chinchilla, Brisbane and Toowoomba.

Itch Mite.—This parasite is endemic in parts of the Warwick district but is not a major problem. Satisfactory control is being maintained with arsenicals.

Scrub Tick.—Ixodes holocyclis, besides causing numerous deaths in dogs, was incriminated in extensive stock losses in the Toowoomba and Cairns divisions. Losses of calves and pigs were mainly encountered but in the Cairns area the deaths of 41 adult cattle and 10 mature horses were confirmed as due to scrub tick.

INTERNAL PARASITES

Again dry conditions militated against heavy infestations with internal parasites in western areas. Pathogenic burdens of *Haemonchus* and lungworms were commonly encountered in calves in the Brisbane area. Extreme losses included 50 calves from haemonchosis at Toogoolawah. Heavy losses in the Goondiwindi area in sheep infested with lungworm were ascribed mainly to nutritional stress from drought.

EXTENSION

Staff members assisted in organising and conducting schools for primary producers at Yeppoon and Gayndah. The usual extension activities, such as field days, newspaper articles and broadcasts, were well covered.

STOCK MOVEMENTS

Interstate stock movements are set out in Table 3.

TABLE 3

INTERSTATE MOVEMENTS OF STOCK, 1960-1961

—	Cattle	Sheep	Swine	Others
Entered from Northern Territory	74,133	..	..	..
*Entered from New South Wales	27,850	396,384	779	1,136
Removed to Northern Territory	2,296	..	..	326
*Removed to New South Wales	251,338	341,605	72,739	4,040

* Figures to March 31, 1961, only.

SLAUGHTERING SERVICES

The year was a busy one in regard to slaughtering activities generally and the advantages of a strengthened staff were fully appreciated. Full-time meat inspection was provided at centralised killing establishments and part-time services were available in country districts for slaughterhouse inspections. Slaughtering Inspectors were also concerned in obtaining data on disease conditions found at slaughter. This is of ever-increasing importance in relation to field disease control projects, particularly the campaign to eradicate contagious bovine pleuropneumonia. The co-operation of officers of the Commonwealth Department of Primary Industry at export meatworks, where this Department does not maintain staff, is acknowledged.

Retail premises continued to meet the changing trends and demands of the industry. New shops constructed have been of a very satisfactory standard, commensurate with the maximum degree of hygiene possible. The use of air conditioning as a means of ventilation of butcher shops is becoming more popular. A major step in improvement in handling of meat from the butcher to the consumer was made during the year in the City of Brisbane by the banning of the use and presence of newspaper in butcher shops for wrapping of meat.

Expansion and improvement to slaughtering and cold storage facilities in different parts of the State continues. The "on the chain" method of beef slaughtering introduced at a North Queensland abattoir the previous year has given satisfactory results. Developments in the use of more humane slaughtering methods can be anticipated in the near future.

Poultry slaughtering duties were transferred from the Poultry section to the Veterinary Services Branch during the year because of the more widespread distribution within the State of Slaughtering Inspectors, who are adequately trained in the procedures of meat inspection and slaughterhouse hygiene. This change should give greater control over illegal poultry slaughtering activities and a greater protection to licensed slaughteryard owners. Since licensing of poultry slaughterhouses commenced in March 1960, 136 licences have been issued, of which 134 are still operative. In addition, 13 premises are operating on provisional licences pending alterations or improvements. Details of poultry slaughterings appear in the report of the Poultry Section.

The voluntary system of prime marking and classification of meat operating at Cannon Hill and certain district abattoirs continued to meet the favour of the trade and consumers alike. Identification of quality meat by ribbon branding now includes prime beef, prime yearling, yearling, lamb and hogget. The increased requests for this service indicate that it is generally favoured by the trade. Thirty-two operators, including six large wholesalers, are now submitting carcass beef for prime branding. Apart from prime marking of beef, all lamb, hogget and yearling beef is marked accordingly.

The Branch continued its interest in District Abattoir activities. Senior Veterinary Officers of the Department are appointed to each Board and this has helped considerably to foster good relationship with the Boards concerned. As well, the Departmental officers are suitably placed to render technical advice on problems that may arise. The central

slaughtering staff is now also equipped to give specialised assistance on financial matters, abattoir construction and design, and management. This service has been welcomed by District Abattoir Boards.

An annual conference of all District Abattoir Boards has been established and the formation of a District Abattoirs Association with recognition under *The Abattoirs Acts,* 1930 *to* 1958 is under consideration. Such an association could help to consolidate the standing of District Abattoirs in the meat industry of the State generally.

District Abattoirs have been constructed and functioning for some years at Toowoomba, Townsville, Ipswich and Bundaberg. Boards at Mackay and Rockhampton are now considering the establishment of District Abattoirs and it is expected the forthcoming year will see the Mackay project well advanced.

The year was generally better than the previous one for District Abattoir finances, due mainly to an increase in the price of by-products and a greater throughput at some of the abattoirs. Increases in costs, including such items as basic wage rises, were absorbed from normal income in most cases but at one abattoir it was found necessary to increase slaughtering fees. Two of the District Abattoirs, after meeting local requirements, used excess capacity to kill for outside areas, with benefit to the finances of the Boards concerned.

TABLE 4

STOCK SLAUGHTERED FOR LOCAL CONSUMPTION, 1960-61

——	Bullocks	Cows	Calves	Sheep	Swine
Bacon Factories ..	18,993	37,805	43,976	103,129	314,523
City of Brisbane (Abattoir) ..	69,790	47,739	92,758	912,418	45,991
District Abattoirs (Bundaberg, Ipswich, Toowoomba, Townsville)	31,262	18,138	19,015	270,026	23,813
Other Centres ..	160,781	109,313	134,268	578,000	92,206
Total	280,826	212,995	290,017	1,863,573	476,533

The trade generally has co-operated with the inspectorial staff of the Department. Co-operation of this nature is appreciated and is reflected in the small number of prosecutions (12) undertaken during the year under the Slaughtering Acts.

Table 4 shows stock slaughtered for local consumption for the 12 months to June 30, 1961.

BRANDS

There was a slight decrease in the number of Registrations and Transfers of Horse and Cattle Brands and Earmarks as compared with the previous year. However, the number of registrations and transfers and the total fees received were above the average for the previous two years. The number of Registrations and Transfers of Sheep Brands and Earmarks decreased considerably and was well below the average of the last 10 years.

DETAILS OF REGISTRATION, TRANSFERS, ETC., 1960-61

Item	Number	No. since Inception of Legislation
Ordinary three-piece horse and cattle brands registered	..	92,242
Cancelled horse and cattle brands re-allotted ..	841	21,748
Horse and cattle symbol brands registered	166	3,844
Horse and cattle brands transferred	1,657	93,889
Cattle earmarks registered	682	40,914
Sheep brands and earmarks registered	132	16,247
Sheep brands and earmarks transferred	198	11,298
Distinctive brands registered	6	1,374
Alterations of address	256	..
Brands cancelled	29	..
Earmarks cancelled	158	..

Very few reports of irregular branding and earmarking were received and owners generally appear to be observing the requirements of the Acts. However, one owner was proceeded against successfully for failing to produce his branding irons for inspection when required to do so by an inspector.

PATHOLOGY BRANCH

Improved facilities and staffing enabled a better balance of work within the Branch and this year it was possible to turn attention to some new problems as well as continuing research on major diseases such as tick fever of cattle.

DIAGNOSTIC WORK

Again there was an increase in the number of specimens submitted for examination, a total of 5,983 being received, and a corresponding increase in the individual tests carried out by the specialist workers. For example, more than 50,000 tubes of media were used by the bacteriology section and nearly 10,000 blood examinations were made by the haematology section. Photography is recognized as a basic tool of science and several techniques have been developed by the histopathology section.

At Yeerongpilly 26,927 serological tests were carried out and 7,930 were done at Oonoonba. Table 1 shows the number of tests made in connection with the more important diseases.

Some of the more common and important conditions diagnosed during the year are set out below.

TABLE 1

SEROLOGICAL TESTS

——	Yeerongpilly	Oonoonba	Total
Brucellosis—cattle, pigs and sheep	8,555	1,471	10,026
Leptospirosis—cattle and pigs	6,956	1,616	8,572
Contagious pleuropneumonia	4,658	883	5,541
Actinobacillosis—sheep	3,852	..	3,852
Vibriosis—cattle	2,456	270	2,726

Cattle

Arthritis.—Two outbreaks on different properties due to *Mycoplasma* sp. occurred. In the first, three out of 29 calves were affected. On autopsy of one calf *Mycoplasma* sp. was isolated from all six joints which were cultured but not from the lungs, which showed purulent bronchopneumonia. The other two calves showed clinical evidence of pneumonia and *Mycoplasma* sp. was isolated from fluid aspirated from swollen joints. Both these calves survived after treatment with tetracycline. Intra-articular inoculation of a young calf with this *Mycoplasma* sp. resulted in death 17 days after inoculation. Pipettes of fluid from swollen joints of one calf on the second property yielded *Mycoplasma* sp. on culture. These organisms have been sent to C.S.I.R.O. for further investigation.

Nervous Disorders.—During the year 12 calves showing clinical signs of involvement of the nervous system were examined and cerebellar hypoplasia (1), hydrocephalus (1), cerebellar hypoplasia and hydrocephalus (1), abscess in the vertebral canal (1) and encephalomyelitis (8) were found. An outbreak of encephalomyelitis occurred on one property in which 30 of 120 calves died during a period of one month. This disease has been transmitted experimentally to calves. The pathology and absence of bacteria in the brains suggest that it is a viral infection.

Allergic Rhinitis.—Cattle with allergic rhinitis were examined from two properties. Twenty cows from the first property initially showed ocular and nasal discharge. The ocular discharge ceased after 10 days but the nasal discharge has continued in some cows for as long as two years. Examination of two slaughtered cows showed the presence of allergic rhinitis and sinusitis. A feed supplement is thought to be the cause of the allergy.

Trichomoniasis.—No further properties have been found infected since last year but examination of genitalia of slaughtered cows from one quarantined property showed that two cows had pyometron, from which *Trichomonas foetus* was isolated.

Salmonellosis.—*Salmonella* was isolated from specimens from 15 properties on which 41 animals were reported to have died and 27 were sick.

Pneumonias.—The intensified measures for control of bovine contagious pleuropneumonia (B.C.P.P.) resulted in an increase in the number of pneumonic lungs examined. In routine examination, the specimens are first examined by naked eye. When satisfactory specimens are submitted this examination nearly always serves to distinguish between B.C.P.P. and other diseases. Under field conditions therefore it should generally be possible to make a satisfactory diagnosis. If a complete range of specimens is submitted, bacteriological examination is done as well as precipitin and complement fixation tests. The precipitin test has not been used by our laboratories previously. It is proving a useful diagnostic test.

Seventy-eight lungs were submitted. In 26 of these, lesions were confirmed as B.C.P.P. and 47 were not B.C.P.P. The lungs in which B.C.P.P. was not confirmed showed several interesting conditions. *Streptomyces* sp. was isolated from two lung abscesses; two others had typical actinomycotic lesions on microscopic examination: *Actinobacillus lignieresi* was isolated from three cases; and *Pasteurella multocida* was isolated from seven lungs, the lesions in one of which closely resembled B.C.P.P. on microscopic examination.

Sheep

As judged by the number of specimens submitted, infectious diseases are either of no great importance in sheep or laboratory assistance in diagnosis is sought infrequently. Specimens received were principally associated with feed intake either as plant poisoning or as digestive upsets following hand feeding. Heavy mortalities have again occurred from plant poisoning. In a flock of 780 wethers at Cunnamulla 180 died after eating lush pigweed (*Portulaca oleracea*) which had a high nitrate content. A heavy mortality also occurred at Richmond in sheep which had access to yellow daisy (*Wedelia asperrima*). This plant had been shown to be toxic to sheep many years ago. In the recent mortality the Biochemical Branch found high levels of nitrate in the plant, indicating that it may be toxic by virtue of its nitrate content. A recent feeding test at Oonoonba, however, showed that the total nitrate in a lethal dose of the plant would not be sufficient to kill. The toxic effects of this plant are therefore due to a specific toxin other than nitrate. Phalaris staggers was diagnosed in sheep submitted from Kingston and Texas. The Texas outbreak affected about 4 per cent. of 1,200 sheep in September. The outbreak at Kingston occurred in November and nine sheep in a flock of 90 were affected. Microscopic lesions were demonstrated in the central nervous system of all sheep examined. *Asclepias curassavica* was incriminated as the cause of death of sheep at a South Coast slaughteryard.

At Nanango 15 sheep out of 180 died from phosphorus poisoning presumably due to eating from a tin of poison left in the paddock.

Acidosis was diagnosed from the examination of a ruminal sample submitted from Emerald. This sample appeared sour and had a pH of 4·85. In this outbreak 150 lambs died in a flock of 450 lambs being fed silage *ad lib.*, grain sorghum and meatmeal.

At Dalby a flock of 200 2-tooth and weaner sheep were being fed in yards. They received 3 lb. sorghum silage per head and 1 oz. meatmeal. Despite drenching for worms they steadily lost condition over a 12-weeks period and many died. Investigations failed to show the presence of parasitism or infectious disease. The silage contained 3·5 per cent. protein on a dry-matter basis. It was determined that this silage should be supplemented with grain and that the protein supplement be increased.

Salmonellosis was diagnosed clinically in a group of 1,400 sheep being held at a Brisbane slaughterhouse. Twenty sheep died and others were scouring. Salmonellae were isolated from several internal organs.

Malignant oedema was diagnosed in lambs at Augathella. Deaths were occurring a few days after marking. *Clostridium septicum* was isolated from pipettes of scrotal fluid.

Pigs

Salmonellosis.—Of the infectious diseases recorded this year, salmonellosis again was the most common, 28 outbreaks being confirmed in the laboratory.

Septicaemic Erysipelas.—Two outbreaks of this disease were confirmed by the isolation of the causative organism from the tissues of the affected pigs.

Oedema Disease.—Following the first recorded case in Queensland last year, seven outbreaks were diagnosed this year in widely separated areas, viz., Brisbane, Maryborough, Rockhampton, Toogoolawah, Boonah, Cooroy and Kilcoy districts. In one outbreak near Brisbane, 7 baconers were lost in two days. After an interval of two months, three weaner pigs were placed in the pen previously occupied by the bacon pigs. Two of them became severely ill a fortnight later. Necropsy and bacteriological examination of one, presented for examination, showed that the trouble was again due to this disease. It was of interest that in this case lesions were seen for the first time in the stomach wall. (In our previous cases, the lesions were located in the mesocolon although they are commonly found in the stomach in overseas outbreaks.)

Cardiac Haemorrhage.—Sudden death due to cardiac tamponade occurred in four suckers, three weeks of age, in a litter of 10 following rupture of the aorta close to the aortal valve. A similar trouble was recorded some three years previously on another property where two litters of weaner pigs were lost within a few weeks. However, the pigs in the latter case showed multiple fine "cracks" in the lining of the arterial wall about the area of rupture, but no such lesions were seen in the current cases.

Terminal Ileitis.—This condition occurred in two weaner pigs simultaneously at one property. Both showed diffuse fibrinous peritonitis, perforation and pipe-like thickening of the lower small intestine.

Locomotory Diseases.—Specimens from 10 outbreaks were examined. In three instances, spinal demyelination (two of three probably due to copper deficiency) was diagnosed microscopically. In two further outbreaks, streptococcal polyarthritis and erysipelas arthritis was the cause of the locomotory disturbance. The cause of the remaining cases was not determined.

Inclusion Body Rhinitis.—During the year specimens from 10 outbreaks of disease in young pigs manifested by sneezing, snuffles, nasal discharge and mortality were examined. The number of pigs involved varied from a few to 40. Mortalities were quite low in some but up to 50 per cent. in other outbreaks. The age of the pigs has been up to three months but in most outbreaks the pigs have been about three weeks old or less.

Atrophy or necrosis of the nasal structures was seen in four of the cases examined. The remainder showed subacute or chronic rhinitis only. In nine outbreaks, no inclusion bodies could be demonstrated by examination of histological sections and the cause in these cases is not clear. In the tenth outbreak, inclusion bodies were seen for the first time in Queensland. These specimens were submitted from the Rockhampton area. These findings establish the presence of still another new disease in this State.

Poultry

A total of 2,039 birds was autopsied, including 1,044 from field specimens, 424 experimental birds and 471 from the Animal Husbandry Research Farm, Rocklea.

The expansion of the broiler industry was reflected in the increase in the number of birds submitted from broiler flocks. The diseases causing most wastage in this industry are respiratory disease, fowl pox, coccidiosis, leucosis, staphylococcosis and coliform infection.

Avian streptococcosis due to *Streptococcus zooepidemicus* was diagnosed for the first time in Queensland. There are no records of its occurrence in other parts of Australia but there are infrequent reports of the disease from other parts of the world. Severe mortality occurred in the outbreak, approximately half of the flock of 1,400 birds dying during a course of several weeks.

Fowl cholera was more prevalent than it has been in other years, 9 outbreaks associated with severe losses being confirmed at the Institute during the year. Outbreaks were also confirmed in baby chickens.

The respiratory disease complex is still not completely sorted out and in an attempt to differentiate the various causes more rapidly, birds immunised against fowl pox and I.L.T. are inoculated intratracheally with suspensions of tracheal exudate from field cases. The results of these tests are then uesd in conjunction with the bacteriological findings to obtain a diagnosis.

RESEARCH

Tick Fevers of Cattle

To be sure of the validity of the results of much experimental work it is necessary to repeat experiments. Much of the work in this field during the year consisted of repeating and attempting to tidy up previous findings.

Natural History of Infection.—Previous experiments showed that larval ticks transmit *B. argentina* and infection followed if they were allowed to attach to a bovine for four days. Further experiments designed to obtain data on the minimal period of attachment necessary for transmission have not been successful. In one experiment six cattle were heavily infested with larval ticks carrying *B. argentina* infection. Two were thoroughly sprayed after the larval ticks had been attached for two days. Two others were sprayed three days after infestation and the ticks on the remaining two allowed to develop normally as controls. In this experiment no transmission occurred in animals sprayed two and three days after infestation but reactions were obtained in both control animals.

In a second experiment, again using six animals, no transmission occurred in the control group but one of the two animals sprayed three days after infestation developed a typical fever reaction. The animals failing to react were susceptible when subsequently challenged with *B. argentina* by blood inoculation.

Studies with *B. bigemina* confirmed the previous work in showing that nymphal and adult *Boophilus microplus* transmit the infection but larvae do not. The organisms appear in the blood usually at 14 days after infestation but have been seen as early as the eleventh day. It has also been shown that the next generation of ticks developing from those which infect a bovine animal are in turn capable of infecting susceptible cattle. Apparently the adult ticks become reinfected from the animal which they have infected as nymphs or adults.

Other experiments have shown that "clean" ticks regularly become infected with *B. bigemina* if they are in the late adult stage of development while the host is reacting to the disease. On the other hand, if the animal has reached the carrier state infection does not always take place. Alternate batches of ticks collected at approximately weekly intervals from a carrier animal may thus be infected or non-infected. However, when a number of infestations with infected ticks are made, the ticks collected from the carrier will all be infected.

A considerable number of immunised cattle were challenged with *B. bigemina* and *B. argentina* and although parasites appeared in the blood and fever occurred, no visible illness occurred. In other words, it has not been possible to break through the immunity produced by vaccination. Moreover, in the case of *B. bigemina,* if the immunised animal is

sterilized of infection by treatment with drugs or has achieved "self-cure" without treatment, a subsequent inoculation with the same strain of this organism will not always set up infection readily.

Known infective ticks were placed on animals previously immunised for tick fever and the progeny of these ticks checked to see if they became reinfected with *B. argentina.* In the majority of immune animals the tick infestation did not produce any observable reaction. In a few animals a slight temperature reaction could be noted and a few parasites could be detected in the peripheral blood for 1-2 days. The progeny of these ticks were checked for transmission with the following results. Positive transmission was obtained with one out of two lots of ticks that matured on separate animals that showed parasites in the blood for two days. Ticks matured on the animals that did not show parasites failed to transmit *B. argentina* in the next generation. It would appear as though infective ticks matured on a totally immune animal would cleanse themselves of *B. argentina* and they would no longer be able to transmit infection. However, if even a slight parasitaemia occurs ticks may become reinfected and consequently transmission could be continued. These partially immune animals are not clinically sick and would not be detected in the field.

In last year's report the persistence of *B. bigemina* organisms in ticks fed on other than bovine hosts was mentioned. On repeating this work it was found that feeding for their entire parasitic life on a goat and on three of four sheep tested did not render the next generation of ticks free of infection. The blood of the goat, sheep and a horse on which infective ticks were feeding produced infection in cattle into which it was injected. However, no organisms were seen in the peripheral blood of the non-bovine hosts.

Effect of Low Temperatures on Transmission of B. argentina.—The effect of low and moderate temperatures on the transmission of *B. argentina* was investigated by subjecting engorged infected female ticks, their eggs and larvae to various temperatures and then checking the larvae for possible transmission. The various treatments may be summarised as follows:—

A—Controls held at 86°F. for laying of eggs, hatching and storage.

B—Held at 86°F. for laying of eggs and hatched at 70°F.

C—Held at 70°F. for laying of eggs and hatched at 86°F.

D—Held at 70°F. for laying of eggs and hatched at 70°F.

E—Females in refrigerator for 7 days at 34-43°F. and then at 86°F. for laying and hatching of eggs.

F—Laying and hatching at 86°F. and larvae held in refrigerator for 7 days at 34-43°F. before storage at 86°F.

G—Laying at 86°F.; eggs in refrigerator for 7 days at 34-43°F. before hatching at 86°F.

Two out of two animals reacted following infestation with larvae from treatments A, B, C, D and G. One animal reacted following infestation with larvae from treatment F. Heavy infestations with larvae from treatment E failed to produce any reaction in two animals.

Apparently low temperatures have no effect on eggs or larvae if the females lay the eggs at known favourable or moderate temperature. In this experiment the effect of cold on the engorged female (treatment E) was sufficient to prevent transmission of *B. argentina.* It was not possible to check the effect of moderate temperatures approximating the developmental minimum of ticks on transmission of *B. argentina.* So far as *B. bigemina* is concerned, only a few larvae of an infected batch are necessary to initiate infection. Under laboratory conditions three months is the maximum length of time for which the larvae can still attach. However, the *B. bigemina* present in these larvae can still induce infections as long as the larvae can attach.

Blood Vaccine.—Large-scale investigations are being made into factors influencing the virulence and infectivity of the blood vaccine. As a prelude to this it is necessary to be able to estimate the number of organisms present in blood. A method is being developed for this.

Passive Immunity to B. bigemina.—Previous work showed that calves born to cows with immunity to *B. argentina* had a passive immunity to this infection of about six weeks' duration. In an experiment nearly completed at Oonoonba, immunity to *B. bigemina* infection has been examined in much the same way. The experiment comprised three groups of seven cows. One group, used as controls, was kept free of infection during pregnancy, another group was infected by inoculation with blood containing *B. bigemina,* and a third group was infected by infesting with ticks carrying *B. bigemina.* After calving, all cows and calves were challenged with infected ticks. The results showed that most of the calves from mothers infected during pregnancy with ticks carrying *B. bigemina* had some degree of immunity. Calves from mothers immunised with the blood vaccine strain of the organism were not protected against the tick-borne strain. The immunity conferred by blood inoculation was weaker in the mothers than that from the tick-borne strain of the organism.

Other Tick-borne Parasites.—Further studies on the spirochaete locally transmitted by the cattle tick suggest that this organism is not *Borrelia theileri,* but one much shorter in length. Transmission tests showed that nymphal and adult stages of the cattle tick transmit the spirochaete but it is doubtful that larvae do. Sheep can be infected with the organism.

Horse Diseases

Equine infectious anaemia was not confirmed in specimens from any suspected cases during the year. A satisfactory procedure for confirmation of this disease has now been worked out. Foals are used when available. Pre-inoculation temperatures and haematological data are recorded. A dose of 10 ml. of the suspected serum is injected subcutaneously. Daily temperatures and weekly samplings of blood are made for 90 days thereafter before the results are regarded as negative, in which event a challenge injection of known infective serum is made.

In addition to examination of material from field sources, an experiment was made with six horses which had been inoculated with blood from field specimens at varying times previously without having given positive reactions. On challenge with known infective serum, four of them had severe reactions. One died on the 40th day after infection and three others suffered several relapses of fever with reduction in red blood cells of 5-6 million/cmm. Siderocytes were frequent in smears prepared from white blood cells in all four. A fifth horse showed a febrile reaction with a fall in red blood cells but no siderocytes were seen, and the sixth showed no febrile reactions but siderocytes were present from the 70th day after infection.

Data are being accumulated on diseases likely to be confused with this infection.

Leptospirosis in Pigs

The results of the vaccination trial mentioned in last year's report were unsatisfactory. In one group, two vaccinated sows gave birth to dead litters 10 days after term, and in another group no leptospiruria developed in one of the unvaccinated sows when challenged with live *Leptospira pomona* culture.

The serological tests showed the appearance of *L. pomona* antibodies in the vaccinated sows 14 to 35 days after vaccination. The titres, however, were low and did not rise above 1 : 100. In some of the sows the titres disappeared after seven months, but in others they were still present from 10 to 12 months. Two animals were revaccinated 10 months after the first vaccination at weaning. Titres were present in these after two weeks and rose to 1 : 300 and 1 : 100 respectively. After challenging the vaccinated animals with live *L. pomona* culture, the titres showed only a slight rise to 1 : 300. In contrast, titres in unprotected sows reached 1 : 3,000 16 days after infection with *L. pomona* organisms.

Sheep Blowfly Experiments

Experiments to determine the relative efficiency of new organic phosphorus insecticides in preventing body strike in sheep were continued. One experiment that had to be terminated before the test insecticides had lost their efficiency showed that jetting with 0·02 per cent. diazinon, 0·1 per cent. "Montrel" and 0·05 per cent. S1751 prevented the development of blowfly larvae for at least 13 weeks.

In a further trial the following insecticides and concentrations were used:—"Elliotts P.A.C. 20" at 0·1 per cent., "Ethion" 0·1 per cent., "Montrel" 0·1 per cent., "Nankor" 0·05 and 0·1 per cent., S1751 0·05 and 0·1 per cent., diazinon 0·026 per cent., and 0.methyl-0, 2,4,5, trichlorophenyl phosphoramdothioate 0·05 per cent.

The last-mentioned insecticide had completely lost its efficiency when first checked 14 weeks after treatment. "P.A.C. 20" was not efficient beyond 15 weeks after treatment and started to break down from about the 10th week. "Ethion" behaved in a similar manner and started to lose efficiency about the 13th week but did not break completely till the 18th week after treatment. "Montrel" gave erratic results but did not completely lose its efficiency till 22 weeks after jetting. "Nankor" at 0·05 per cent. lost its efficiency 24 weeks after treatment and the higher concentration of 0·1 per cent. was near to breaking point at this time. S1751 was efficient for 17 weeks and the higher concentration is still effective 24 weeks after treatment. The reference insecticide diazinon is still effective 24 weeks after jetting. Such a long period of protection had not been obtained with diazinon in any of the previous experiments. The results obtained in the recent work must therefore be treated with reserve as they may not be repeatable in further experiments.

Ovine Infertility

Investigations into epidemiological features of epididymitis due to *Actinobacillus seminis* were intensified. Repeated efforts were made to produce epididymitis in clean rams by using routes of infection other than by direct inoculation into the genitalia. Rams were exposed to infection by intravenous, rectal, oral and preputial routes. Inocula included bacteria cultured from infected Border Leicester rams and infected semen from these natural cases. No evidence was produced to show that this organism is virulent when introduced by

these routes. Study of the infected flock included monthly bleeding of all sheep and semen examination of selected rams. Infection was again demonstrated in a number of young virgin rams (six cases). One of these rams became acutely affected but in the other cases clinical lesions were not marked. Infection was recognised by serological examination and confirmed by bacteriological examination of semen.

Several sheep in the infected flock had small subcutaneous abscesses around the angle of the mandible. *Actinobacillus lignieresi* was isolated from two cases. This organism is being studied as it is possible that it is responsible for transient titres to *A. seminis*.

Five infected rams received from the field in June 1960 have been sampled every fortnight. All have given a persistent serological reaction and appear to have active infection, with the exception of one ram which recently gave a negative result to a bacteriological examination of semen.

The evidence points to the fact that this disease does not follow the pattern found with ovine brucellosis.

Ovine Myopathy

During the year special techniques were developed to examine neuro-muscular junctions. These techniques were used to follow up the work on the muscle disease of sheep from Goondiwindi. No lesions could be demonstrated in the neuromuscular junctions. The condition can therefore be described as a muscle dystrophy and not a neurogenic atrophy. This work concludes the pathological investigation into this disease. A number of affected sheep have been held at Yeerongpilly. There are four ewes amongst these and efforts have been made to breed from them.

Bent-leg Disease

During the year two further bent-leg lambs were submitted for examination. In one the bowing was distributed over the whole length of the forelimbs. In the second the changes were only obvious in the distal region of the metacarpals. No abnormalities were seen by microscopical examination of selected bone sections.

Humpy-back

This problem is again being investigated and affected sheep were studied in the Blackall area. A full-mouth wether carrying 7 months' wool was fed 49 lb. *Solanum esuriale* berries in 31 days during March and April. The sheep was exercised regularly but no sign of humpy-back was noted.

Melioidosis in Animals

During the year 17 strains of *Pseudomonas pseudomallei* were isolated. Twelve were recovered from pigs and three from sheep. Two were obtained from swamp water. The strains recovered from pigs and sheep were cultured from abscesses in apparently healthy animals. No clinical cases of the disease were seen. Some measure of the incidence of *Ps. pseudomallei* infection in pigs slaughtered at the Townsville District Abattoir can be obtained from the following records of organisms recovered on bacteriological examination of abscesses in the organs: *Ps. pseudomallei* 12, *Pasteurella multocida* 6, *Brucella suis* 4, *Mycobacterium tuberculosis* 3, *Erysipelothrix rhusiopathiae* 2, *Corynebacterium pyogenes* 2, haemolytic streptococci 2, and *Corynebacterium equi* 1.

The isolation of *Ps. pseudomallei* from muddy water in a paddock where infected animals had been kept is of particular significance when considered in relation to the finding that the organisms can live at room temperature in local pond water for at least nine months. It seems likely from these observations that animals are infected indirectly from their environment rather than directly from animal to animal. The recurrence of the disease in a new replacement flock of sheep, drawn from a disease-free area, after all of the previous flock had been slaughtered further supports this suggestion. Since contaminated water or mud can apparently be a fertile source of infection for animals, it seems likely that humans might also be infected from a similar source.

Sixty-nine strains of the organism were subjected to detailed bacteriological examination during the year. Little variation between the strains was noted. However, serological examination by the complement fixation test showed that strains isolated from two sheep were antigenically different from the others. These are being investigated further to see if they also behave differently when subjected to other tests.

The Branch collaborated with the Queensland Institute of Medical Research in the application of serological tests in a survey of the sera of humans and native animals.

Respiratory Diseases of Fowls

For some time a respiratory disease in fowls from which none of the recognised bacterial or viral agents can be isolated has been recognised. It resembles chronic respiratory disease and is most prevalent in broiler flocks, in which it infects each batch of birds from a few weeks of age onwards. Studies of two outbreaks of this type of disease revealed the presence of an infective agent which passes through bacteria-retaining filters and which readily infects experimental birds when they are exposed to aerosols of tracheal exudate. An agent lethal for chick embryos was also recovered from the tracheal exudate. The disease experimentally does not produce many deaths but it persists for up to two months, causing loss of weight and poor growth.

TICK FEVER IMMUNISATION

A total of 406 cattle was immunised, 174 at Oonoonba and 232 at Yeerongpilly. Cattle at Yeerongpilly are now immunised with pure strains of *B. bigemina* and *B. argentina* drawn from reacting calves. The blood is stored in the refrigerator for up to three weeks before use. It is anticipated that immunisation procedures at Oonoonba will be brought into line with this method very shortly.

VACCINES

The numbers of doses of the various vaccines supplied by the laboratory are set out in Table 2. Infectious laryngotracheitis vaccine is no longer prepared at the Animal Research Institute, vaccine from a Queensland strain of virus now being prepared by the Commonwealth Serum Laboratories.

TABLE 2

Vaccine	Yeerongpilly	Oonoonba	Total
Bovine contagious pleuropneumonia ..	206,700	329,650	536,350
Infectious laryngotracheitis	122,400	..	122,400
Brucella abortus (Strain 19)	7,916	..	7,916
Tick fever blood	54,978	17,423	72,401

A total of 152 bleeders for production of tick fever vaccine was supplied to stock owners during the 12 months.

HUSBANDRY RESEARCH BRANCH

The year under review saw marked progress in the development of facilities for artificial insemination and the expansion of certain aspects of other work of the Branch.

The Branch is responsible for the collection and distribution of semen used in the two bull-proving projects, the training unit at Samford and a small disease control unit at Beaudesert. Expansion to provide semen to farmers' groups for more widespread use of artificial insemination of cattle is not possible until a self-contained collection centre is available. It is pleasing to record that progress to this end was made during the year. Considerable assistance was given to architects in the Public Works Department in planning the laboratory, bull accommodation and ancillary facilities for the centre at Wacol. Plans for the major requirements have now been finalised and development of the 70-acre site was recently commenced. The extension of water and electric power to the site, the formation of an entrance road and the construction of a house for a resident officer are in progress. An officer was appointed in February to be responsible for this aspect of the Branch's activities. This should ensure that a nucleus of trained staff is available, when the centre becomes functional.

Major expansion of research on ruminant nutrition must await transfer of the bulls from Rocklea on completion of the A.I. centre at Wacol.

The only facilities for research on pigs at Rocklea are for digestibility studies. However, with the co-operation of the Pig Section, some additional work has been possible at Hermitage Regional Experiment Station. The digestibility, palatability and utilization of sorghum has been the main study.

INVESTIGATIONS

Drought Feeding Studies

Experimental work to study the survival requirements under pen conditions of pregnant heifers, lactating cows and young calves was continued, using sorghum grain as the sole feed.

Pregnant and Lactating Cows.—In this experiment, 28 Hereford heifers, pregnant for a mean period of 171 days, were allotted to three groups. They were changed from a roughage to an all-grain ration of 6 lb. per head per day over a period of 2 weeks and then allotted to the following treatments:

Group I—6 lb. crushed sorghum grain per head per day fed daily.

Group II—6 lb. crushed sorghum grain per head per day fed twice-weekly.

Group III—10 lb. crushed sorghum grain per head per day fed daily.

Ground limestone (1 per cent.) was added to the grain. Feeding of grain continued for 24 weeks. Some relevant data are given in Table 1.

TABLE 1

RESULTS OF FEEDING RESTRICTED RATION OF SORGHUM GRAIN TO PREGNANT AND LACTATING CATTLE

—	I	II	III
Number of animals	8	9	10
Number of cows calving at term	8	8*	10
Mean body-weight at commencement of all-grain feeding (lb.)	815	842	827
Mean body-weight change prior to calving (lb.)	−61	−79	+81
Mean birth weight of calves (lb.)	57	55	68
Number of stillborn calves	2	0	2
Mean weight gain of calves—birth to 28 days (lb.)	17	14	33
Body-weight change in lactating cows after 24 weeks (lb.)	−212	−265	−95
Number of cows withdrawn because of weakness	1	1	0

* One cow had premature twin calves at 253 days.

The main findings of this experiment can be summarized as follows:

(1) Pregnant and lactating cattle can be fed for survival on grain alone.

(2) Introduction from roughage to a sole ration of 6 lb. of grain per head per day can be accomplished in two weeks without visual evidence of metabolic disturbances. Increasing from 6 lb. per head to 10 lb. per head in one day resulted in some inappetence and evidence of grain engorgement. A more gradual increase in the amount of grain fed is likely to overcome this digestive upset.

(3) Animals fed 10 lb. per head per day gained weight during the last third of pregnancy, but much of this increase would be accounted for by the developing foetus and associated fluids and membranes.

(4) At the feeding rate of 6 lb. per head per day, twice-weekly feeding appeared slightly inferior to daily feeding, but the differences recorded in weight loss and milk production of the cows, and birth weight and growth rate of the calves, are not likely to be significant.

Any consideration of the amount to feed in practice would obviously depend on a number of factors, such as condition of the stock at the commencement of feeding, class of animal and amount of feed available. The wide differences in the amount of grain fed were deliberately chosen to obtain maximum information from one experiment. Although it is not possible to make sound conclusions from a single experiment, it would appear that the weight of pregnant heifers could be maintained with an amount of grain intermediate between the 6 and 10 lb. used in this experiment.

Early Weaning.—At the conclusion of the experiment reported above, the 20 surviving calves were weaned and used to study the feeding of early-weaned calves as a drought relief measure. The average age at weaning was 70 days. Those from the groups in which the cows received 6 lb. per head per day fed daily or twice weekly were poorly grown and averaged 72 lb. Those from the cows receiving 10 lb. of grain per head per day averaged 96 lb.

The calves were retained in their original groups and fed crushed grain sorghum containing 1 per cent. added limestone *ad lib.* for a period of 6 weeks. The body-weight gain was similar in all groups, being approximately 0·5 lb. per head per day, which is much lower than the 1.1 lb. per head per day recorded last year for similar calves weaned on a ration of equal parts lucerne chaff and crushed sorghum grain. The mean consumption of grain per head per day during the first week was as follows:—I, 2·5 lb.; II, 2·0 lb.; and III, 2·4 lb. Consumption increased gradually and during the sixth week the comparable figures were: I, 4·5 lb.; II, 3·9 lb.; and III, 4·2 lb.

The youngest two calves in Group II died during the experimental period. They had failed to gain weight after weaning and had low liver vitamin A reserves. At the conclusion of 6 weeks' feeding, 5 of the 18 calves were night blind and had vitamin A plasma levels between<4 and 8 micrograms vitamin A per 100 ml. This possibility was anticipated as the calves had suckled dams with poor milk production in which the butterfat contained low levels of vitamin A and the sorghum grain contained no carotene.

In order to study the response to vitamin A supplementation, 16 of the calves were divided into two comparable groups of eight. One group was drenched with a single dose of 375,000 I.U. of vitamin A and the other remained untreated. Feeding of sorghum grain continued for a further 4 weeks. At the end of this period the treated calves had shown a mean gain in body-weight of 22 lb., compared with a gain of 12 lb. in untreated calves. The supplemented calves also had a higher grain intake, mean consumption per head per day being 5·5 lb., compared with 4·2 lb. in the untreated group.

Supplementation of Weaner Cattle

The poor growth rate in calves after weaning in some of the dairy areas of the State results in delayed mating. A series of three experiments has been carried out during the last two years to study the effect on growth rate of supplementation of weaners on predominantly paspalum pastures at Rocklea. In all experiments the supplemented animals received 2 lb. per head of a mixture of 75 per cent. crushed sorghum grain/25 per cent. linseed meal and were fed for 22 weeks. The treatments, periods of supplementation, and body-weight changes during and after supplementation are shown in Table 2.

TABLE 2

RESULTS OF SUPPLEMENTING WEANER CATTLE

Experiment	Group	Period of Supplementation	Body-weight (lb.)		
			Initial	Gain during Supplementation	Gain Post* Supplementation
I ..	Supplemented (daily)	June 1959—Nov. 1959	231	134	170
	Control	Nil	233	70	194
II ..	Supplemented (daily)	Dec. 1959 — May 1960	256	154	243
	Control	Nil	258	87	293
III ..	Supplemented (daily)	July 1960 — Dec. 1960	298	124	207
	Supplemented (twice weekly)	July 1960 — Dec. 1960	294	113	210
	Control	Nil	296	35	235

* Period of study of post-supplementary growth rate was 52 weeks in Experiments I and II and 26 weeks in Experiment III.

In all experiments a good response to supplementation was obtained. Twice-weekly supplementation appeared little inferior to daily feeding. The animals in the control groups showed a variable compensatory gain in the post-supplementation period, but they had not attained the weight of the previously supplemented animals after a further year. Studies with supplements of grain and grain plus urea are planned.

Rotational Grazing Experiment

This experiment was completed in October 1960 after four years. Two groups of cattle grazed comparable areas of pasture. One area was grazed on a fixed system, while the other was subdivided into 4 paddocks and managed on a rotational system. Pasture was conserved as silage from the rotational paddocks in the summer of the first year. An equal number of animals in each group was maintained copper-adequate by intravenous injections of copper sulphate, while the remainder showed a low liver copper reserve, which is typical of cattle grazing the pastures at Rocklea. The stocking rate was one beast to the acre.

The mean growth of all sub-groups over the 4-year period was 0·69 lb. per head per day. This low rate of gain was due partially to periods when an insufficient quantity of pasture was available. There was no significant difference between groups except during the period May-December, 1957, when silage conserved from the rotational paddocks was fed back to this group. The rotational group had a mean advantage in body-weight of 72 lb. per head at the end of this period. There was no marked response to copper therapy. Neither the botanical nor the chemical composition of the pasture was affected by the grazing management. Grazing behaviour observations over ten 24-hour periods gave an average grazing time of 8·6 hours for the rotational group and 9·6 hours for the fixed group.

The findings of this experiment indicate that with the stocking rate and system of rotation practised, rotational grazing without conservation had no advantage over set stocking.

Studies with Molasses and Urea

An experiment is in progress to investigate under yard conditions:—(a) the effect of spraying mature grass hay with molasses upon feed intake, and (b) the effect of providing a molasses/urea/salt block to cattle being fed mature grass hay *ad lib.* Six pairs of twins with a mean age of 13 months were allotted to three groups of four and fed as follows:

Group I—Hay *ad lib.*

Group II—Hay *ad lib.* sprayed with 12 per cent. by weight of molasses.

Group III—Hay *ad lib.* plus access to a molasses/urea/salt block containing 40 per cent. urea.

The experiment is being replicated with six pairs of older twins (mean age—26 months).

Progress results can be summarised as follows:

(1) Spraying of hay of the quality used (3·0 per cent. crude protein) with 12 per cent. molasses does not appear to result in higher hay consumption or a response in body-weight.

(2) The provision of the molasses/urea/salt block resulted in an increased hay consumption of 33 and 39 per cent. in the older and younger animals respectively.

(3) After 16 weeks, the older Group III animals had a mean body-weight gain of 23 lb., compared with a loss of 48 lb. in Group I.

(4) After 12 weeks, the animals in the younger Group III gained a mean of 21 lb. per head, compared with a mean loss of 24 lb. in Group I. The younger animals in Groups I and II had to be withdrawn after 14 weeks because of weakness, but Group III is still continuing after a further 6 weeks.

(5) Mean daily intake per head of urea from the block is satisfactory at 2·9 oz. and 1·8 oz. in the older and younger animals respectively. The rate of intake recorded during several observation periods indicates that the block used allowed animals to consume a satisfactory amount in a relatively short time.

Provided similar results can be obtained under grazing conditions, the use of blocks appears to offer a satisfactory alternative method of supplementing cattle with urea in the field.

Performance of Brahman/Hereford Cross

An experiment was undertaken to compare the performance of Brahman/Hereford first-cross steers with Hereford steers when fed in bare yards on mature pasture hay. Two-year-old crossbred steers were compared on both *ad lib.* and restricted feeding of hay with 3-year-old Herefords of similar initial body-weight, and with 2-year-old Herefords, of lower body-weight but similar age. The hay averaged 3·7 per cent. crude protein on an air-dry basis. Duration of the experiment was six months.

Both on a shrunk and non-shrunk basis the crossbred steers lost significantly less weight (approximately 85 lb. per head) on both feeding regimens than the Herefords (approximately 125 lb. per head). However, most of this difference occurred in the first three weeks and any difference in body-weight loss between class of animal after that period was not significant. The recorded difference in weight in the early stages of the experiment may be associated with "fill" rather than actual body-weight. Under the conditions of this experiment there was therefore little difference between breed types in ability to resist loss of body-weight on a poor-quality ration. Mean feed intake of the older Herefords on the *ad lib.* regimen was markedly higher at 16·4 lb. per head per day than that of the younger Herefords (14·1 lb. per head per day) or the crossbreds (14·5 lb. per head per day).

Respective mean water intakes were 4·4, 3·8 and 4·1 gal. per head per day respectively.

The opportunity was taken to study the behaviour of the animals in this experiment. Steers in all groups organised themselves into relatively stable "bunting orders." Measurements of feeding behaviour showed that steers high in the order spent longer, and were less disturbed, at feeding than their subordinates. The crossbreds engaged in higher bunting activity, fed less stably, and consumed more of their feed at night than did the Herefords of either age. The lower consumption of feed during the day by crossbreds reflected their greater reaction to farm activities.

Hormone Implantation of Cattle

A study designed to measure the effect of hormone implantation on growth rate of cattle grazing good paspalum pasture during summer, and to compare the effect on growth and carcass composition of two implants of different composition was completed. Twelve 3-year-old and twelve 4-year-old Hereford steers were assigned to four treatments on the basis of age and body-weight. One group was slaughtered at the commencement to obtain pre-experimental carcass data. The other three groups grazed in the same paddock. One group was implanted with tablets containing 200 mg. progesterone + 20 mg. estradiol; the second group received an implant of 200 mg. progesterone + 20 mg. estradiol + 25 mg. cholesterol + 4·9 mg. hydrocortisone; and the other group was untreated. Both the implanted groups gained weight at a mean rate of 2·8 lb. per head per day during a 14-week period from January to May. The rate of gain in the untreated group was 2·2 lb. per head per day. Thus there was a body-weight response following implantation, but no difference between the two implants used. Analytical work on carcass samples is not yet completed.

Utilisation of Sorghum Grain by Pigs

Digestibility.—Results of comparisons of the digestibility of wheat with sorghum when fed alone and when fed in a balanced ration with meatmeal were presented in previous reports. The work was extended to compare wheat with sorghum when fed in combination with skim-milk powder, a protein concentrate of high biological value.

The results of the comparison were similar to those reported in previous years, viz. that the digestibility of the crude protein in wheat appears higher than that of sorghum, while the digestibility of the nitrogen-free-extract indicates that sorghum is at least comparable to wheat on a digestible energy basis.

Palatability.—There are indications from field reports that there may be differences in palatability between the different varities of grain sorghum. Experiments were therefore commenced to study the palatability of some of the common varieties and recently developed hybrids of sorghum. In each experiment pigs were allowed access to three self-feeders each containing a different variety of grain sorghum. The positions of the feeders were changed weekly. In the first experiment, Early Kalo, Alpha and Martin were compared, while in the second, Early Kalo and the Texas hybrids T610 and T630 were studied. The experiments continued for 6 and 5 weeks respectively. The mean consumption of each variety expressed as a percentage of total consumption is as follows: Experiment I—Early Kalo 86·5 per cent., Alpha 11·3 per cent., and Martin, 2·2 per cent.; Experiment II—Early Kalo 28·3 per cent., T630 69 per cent., and T610 2·7 per cent. Results from the two experiments suggest that of the varieties tested the hybrid T630 was the most palatable, with Early Kalo in second position. This finding may require modification after further study, as soil type and other factors may influence palatability of the different varieties. It is planned to continue this work and extend it to study the effect on feed intake of rations containing sorghums of differing palatability.

Pen Trials.—A pen trial, using 4 pigs in each group, was undertaken to compare wheat with sorghum as the grain component of rations. Skim-milk powder was used as the source of animal protein. An additional group received a ration of wheat and soybean oilmeal. The pigs were fed the experimental ration from 10 to 20 weeks of age. The mean weight gains per head per day were similar, being as follows:—Wheat/skim milk 1·49 lb., sorghum/skim milk 1·51 lb., and wheat/soybean oilmeal 1·45 lb. The respective feed conversion ratios were 2·80, 2·91 and 3·17. This experiment will require to be repeated a number of times, as pigs become available, before firm conclusions can be made.

ARTIFICIAL INSEMINATION

General.—The bull-proving projects continued on a basis similar to that reported in previous years. The insemination period for Jerseys at Nambour was from September 26, 1960 to January 27, 1961, and for A.I.S. at Kingaroy from September 26, 1960 to February 10, 1961. Semen was also supplied to the Samford training unit and to the disease control unit at Beaudesert throughout the year. The Beaudesert unit commenced on June 6, 1960.

Numbers of cows inseminated with semen from Rocklea and conception rates for the 12 months ending February 28, 1961, are given in Table 3.

TABLE 3

INSEMINATION DATA FOR YEAR ENDING FEBRUARY 28, 1961

Location	Volume of Semen Despatched (ml.)	First Insemin-ations	Total Insemin-ations	First Insemination Non-return Rate (%) (60–90 days)
Nambour	4,280	1,154	1,619	61·0
Kingaroy	5,135	1,166	2,361	39·6
Samford	5,835	1,293	1,862	69·3
Beaudesert	1,575	261	501	60·9

Chilled semen was used exclusively at Nambour and Kingaroy, but a small amount of deep-frozen semen was used at Samford and Beaudesert.

The conception rates at Nambour, Samford and Beaudesert are considered to be satisfactory, particularly as no semen is used at Nambour and Beaudesert until the day after collection. The conception rate with the young A.I.S. bulls at Kingaroy is very low, even after making allowance for the use of second, third and fourth day semen. There is now an increasing amount of circumstantial evidence that many A.I.S. bulls do not reach the maximum fertility for artificial insemination until after 18 months of age. Only one of the four bulls used this year had a satisfactory conception rate, and it became necessary to withdraw the other three for the last month of the insemination period.

Daughters sired by the Jersey bulls used in 1955-56 and 1956-57 have now completed their first lactations. The production data, obtained by the Herd Recording Section of the Division of Dairying, were analysed by the Cattle Husbandry Branch. On the basis of the results obtained, two bulls used in 1955-56 and one used in 1956-57 have been retained. Additional deep-frozen semen will be prepared from these bulls and their use on selected cows to obtain sons for proving is being considered.

Experimental.—Prototypes of equipment for storage and transport of deep-frozen semen have been constructed in order to provide assistance with design of equipment to farmers groups wishing to form units for artificial insemination.

The young bulls that are obtained for bull proving are being used in a long-term study on comparative sexual maturity of bulls of the A.I.S. and Jersey breeds. To date,

results are available for 8 A.I.S. and 9 Jersey bulls. The mean age at first ejaculation was—A.I.S. 44 weeks (range 40–48 weeks), Jersey 36 weeks (range 24–44 weeks). The mean body-weight at this time was:—A.I.S. 624 lb. (range 588–655 lb.), Jersey 459 lb. (range 344–616 lb.).

An experiment has commenced to study the effect of tick fever on semen quality. As it is planned to use the bulls that are to be discarded after bull-proving results are available, it will be some years before numbers sufficient for accurate conclusions are studied.

BIOCHEMICAL BRANCH

The provision of ever increasing diagnostic services, the greater demands by field Branches for biochemical assistance, and the continuously expanding research programme have necessitated the appointment of additional staff and concurrently some reorganisation in administration. The Branch now consists of three sections—Toxicology, Nutritional Biochemistry and Clinical Biochemistry. Toxicology is responsible for the analysis of specimens where poisoning of livestock is suspected. A further service by this section is the analysis of fluids from dipping vats to ensure economic and effective use of tickicides in the control of external parasites of livestock. Nutritional Biochemistry is concerned with all types of stock food analyses, including both macro- and micro-nutrients. Clinical Biochemistry functions to provide exact data where nutritional or clinical disorders in livestock are suspected. In addition to its diagnostic role each section has a research function and either initiates or collaborates in investigations on problems of major importance to the livestock industry in Queensland.

Some details of the analyses of diagnostic specimens and their interpretation and on current research studies are presented below in the reports of each of the three sections.

TOXICOLOGY SECTION

Diagnostic Service

Specimens were received from 431 cases where poisoning of livestock was suspected. Analyses confirmed arsenical poisoning in 43 cases, lead in 15, phosphorus in 4 and strychnine in 1. Once the cause of death was established, subsequent investigation enabled the source of the poison to be identified on a number of occasions. Arsenical poisoning was usually associated with "empty" tins on a rubbish dump, unlabelled powders stored in outbuildings or pasture growing in areas adjacent to dips. Paint containing lead was the usual source of lead poisoning.

Stock losses, from fodder crops or herbage plants containing nitrate, were prevalent during the first half of 1961. Serious losses in the Cunnamulla district occurred in sheep on predominantly *Portulaca oleracea* herbage which was found to contain 11·9 per cent. potassium nitrate and 9·8 per cent. anhydrous oxalic acid on a moisture-free basis. The nature of the mortality suggested nitrate rather than oxalate poisoning. Another major loss of sheep in the Blackall area was associated with *P. oleracea* which contained 8 per cent. potassium nitrate on dry matter. *Wedelia asperrima* was incriminated as the cause of death of some 1,000 untrucked sheep in the Richmond district. This plant was found to contain 9·7 per cent. potassium nitrate but symptoms in this case and information from a subsequent feeding test suggest that some toxin other than nitrate was responsible for stock losses. In the Boonah district high levels of nitrate up to 16 per cent. potassium nitrate were found in maize crops which had been responsible for deaths in dairy stock. On the basis of available information it would appear that the high nitrate levels recorded in these maize crops were the result of the unusual pattern of intermittent and largely ineffective rainfall throughout the whole of the growing season. Grassy lucerne hay from the southern area of the Darling Downs was suspected as the cause of stock losses and was found to contain 2·9 per cent. potassium nitrate. It is of interest that all botanical species in this grassy lucerne contained appreciable levels of nitrate. *Sorghum almum* from the Goondiwindi area contained appreciable levels of both nitrate and HCN, the levels tending to be higher in samples taken from areas where soil moisture appeared to be limiting the growth of the crop.

The total of 887 samples submitted from dipping vats located throughout the State is even greater than in previous years and indicates the satisfactory nature of this service to producers. Of these samples, 76 were arsenical preparations, 176 were based on organic phosphorus compounds and the remainder on chlorinated hydrocarbons. Such figures indicate a marked increase in the use of tickicides based on organic phosphorus and a decreased use of proprietaries based on arsenic. From the chemical standpoint this has meant also the adaptation and development of analytical methods which are suitable for rapid routine analyses of these relatively new insecticides. Most methods are now based on ultra-violet spectroscopy.

Investigations

Selenosis.—Studies either completed or in progress indicate that there are three selenosis problems in this State. The first is a chronic and seasonal disorder of horses in the Cape York Peninsula associated with the selenium accumulator plant *Morinda reticulata.* The second is an acute toxicity problem responsible for deaths in horses and sheep in a small area in the vicinity of Richmond. The third is a potential problem, as the occurrence of selenium is associated with the Tambo formation of marine limestone of the lower Cretaceous age, a vast formation underlying some 35,000 square miles of the western downs.

From all data now available it would appear that the occurrence of the acutely toxic strip in the Richmond district is due to two factors. The first is its location as a small fenced grazing area on an outcrop of the selenium-containing Tambo formation. The second is the introduction of agricultural practices in this small area which have encouraged the growth and distribution of selenium-accumulating plants, particularly *Neptunia amplexicaulis.*

The potential selenosis problem associated with the vast Tambo formation requires further investigation. Outcrops are evident along the northern boundary and restrictive grazing and agricultural practices could give rise to a number of acutely toxic strips. The large-scale intermittent outbreaks of fleece shedding could well be "alkali"-type selenosis in sheep induced by changes in botanical ecology with seasons which favour the growth of selenium-accumulating plants. Pen experiments at the Animal Research Institute certainly indicate that selenium in the diet of sheep causes damage to the wool follicle.

Poison Plants.—The toxic principle in the seeds of *Acacia georginae* has been identified as the fluoracetate ion. This characterisation, following extraction and purification, was by conversion to the butyl ester and the use of gas chromatography aided by an authentic specimen of butyl fluoracetate. Infra-red absorption spectra confirmed the identification. Present work is concerned with identifying the form in which the toxic principle occurs in the seed, the development of a quantitative analytical procedure, and the examination of seeds, pods and leaves from toxic and allegedly non-toxic areas.

NUTRITIONAL BIOCHEMISTRY SECTION

Diagnostic Service

Partial or complete stock-food analyses were made on 506 samples submitted by field officers from the Extension Branches. These included pasture and crop silages, fodder trees, feed concentrates, rations used in feeding experiments with pigs and poultry, miscellaneous fodders such as windfall or cull fruits fed to pigs, and a wide variety of both native and introduced pasture species at different stages of growth.

Silages constituted a major portion of the fodders analysed and totalled 140 in the year under review. In addition to the proximate analysis for stock-food value, quality tests are made routinely on all silage samples. Such tests include pH, total acidity, ratio of lactic acid to acetic acid and ratio of amino acids to volatile bases. On the basis of these tests failure to obtain optimum quality may be explained and advice is offered on silage conservation techniques which should give a better quality product in subsequent years.

Drought conditions in western Queensland placed increased importance on the stock-feed value of leaves of fodder trees. Through the collaboration of the Government Botanist a number of species which had not been analysed previously were obtained. Such analyses are difficult to interpret in terms of stock-food value and species of major economic importance should be evaluated by digestibility trials.

It has become a standard practice to analyse all ingredients and subsequently all compounded rations used in feeding experiments by the Pig and Poultry Sections. This is time-consuming but ensures satisfactory experimentation.

Investigations

Conserved Fodder.—Experimental tower silos of about ¾ ton capacity were used to evaluate and compare silages made with and without molasses from predominantly *Paspalum dilatatum* pasture harvested by either the flail type or cutter-bar type of commercial harvesters. Essential findings preliminary to evaluation of digestibility data are:—(1) fermentation losses were least in the silages containing molasses; (2) the best quality silage was the product from the cutter-bar harvester ensiled with 40 lb. molasses per ton; (3) the worst quality silage was the product from the flail harvester ensiled without molasses; (4) although all silages were readily eaten, the product from the cutter-bar type ensiled with molasses was more palatable when offered free-choice to sheep.

A further study is in progress to evaluate the need for molasses as an additive for silage from paspalum pasture harvested with the two types of commercial harvesters from

an unfertilized area and an area treated with ammonium sulphate equivalent to 75 lb. nitrogen per acre.

Food-faecal Relationships in Grazing Cattle.—Regressions have been developed relating the protein, phosphorus and calcium levels in food and faeces for grazing dairy cattle in south-eastern Queensland. These relationships are being applied to compare the diets selected by Hereford cattle in two native pasture management studies, one at "Brian Pastures" in the Gayndah district and the other at the Animal Husbandry Research Farm at Rocklea, in the Brisbane district.

In the "Brian Pastures" experiment the treatments under comparison include set stocking, two systems of rotational grazing, pasture renovation, and supplementary grazing on lucerne. Analytical data are available for the period December to April inclusive. These data indicate that protein levels in the selected diets tend to be lowest in the intensive system of rotational grazing and highest in the pasture renovation treatment. No lucerne supplement was made available during this period. However, the indications are that only in late April was the protein level in the selected diet likely to be limiting production in any treatment. This study will be continued for at least 12 months.

In the Rocklea experiment the treatments under comparison include a moderate and a heavy stocking rate on predominantly paspalum pasture with and without fertilization with ammonium sulphate in two applications per annum each at the rate of 75 lb. N per acre. Findings at this stage indicate that the protein level in pasture is higher in the nitrogen-treated paddocks, that in all paddocks the protein in pasture selectively grazed is much greater than that in total available pasture, that initially when ample feed was available the protein in the pasture selected by cattle is slightly higher in the unfertilized than in the nitrogen-treated paddocks, and that in winter when the total available feed was limited the protein in selectively grazed pasture is highest in the nitrogen-fertilized moderately stocked treatment.

CLINICAL BIOCHEMISTRY SECTION

Diagnostic Service

Blood inorganic phosphate analyses were made on 959 samples representing 205 different properties. On 60 of the properties a diagnosis of phosphate deficiency was confirmed, while on a further 16 properties the phosphate status was marginal.

Liver copper analyses were done on 59 samples representing 40 different properties. A diagnosis of copper deficiency was confirmed on nine properties. Blood copper levels were determined on 538 samples representing a further 86 properties. A diagnosis of copper deficiency was confirmed on eight of these properties.

Liver vitamin A analyses confirmed the field and pathological diagnosis of vitamin A deficiency in fowls from two properties and pigs from three properties. A marginal vitamin A status was indicated on a further five poultry farms.

Suspected metabolic disorders involved the analyses of 198 sera for calcium and 149 for magnesium. Hypocalcaemia was confirmed on 12 occasions, five times in association with hypomagnesaemia. There were three instances of hypomagnesaemia and two cases of hypermagnesaemia where the calcium levels in blood were normal.

Of the 5,300 miscellaneous samples analysed, some 250 were concerned directly with the diagnostic service and the remainder with field investigations by husbandry branches. Analyses included blood haemoglobin, haematocrit, glucose, copper, inorganic phosphate, ammonia and urea; plasma chloride, sodium and potassium; serum calcium, magnesium, total protein, albumin and globulin; liver glycogen, copper and vitamin A; blood volume, plasma volume and extracellular fluid volume; rumen fluid volatile fatty acids; semen fructose; urine samples for a variety of tests; urinary calculi for complete analysis; and bones for ash and fluorine content.

Investigations

Copper.—The Branch is associated with two investigations on copper deficiency in cattle. One is an intensive study on the cause of a low-copper status in cattle grazing predominantly paspalum pastures at the Animal Husbandry Research Farm at Rocklea, near Brisbane. The other is in association with the Cattle Husbandry Branch and is concerned with two extensive field trials to evaluate the effect of copper and cobalt therapy on the growth of weaners on coastal plains in the Rockhampton and Townsville districts.

Essential findings from the Rocklea experiments have been submitted for publication. They include a comparison of the copper status of sheep and cattle grazing the same pasture; studies on the copper status of both calves and lambs at birth and changes in liver copper levels during their first six months of life; studies on the copper-molybdenum-inorganic sulphate relationship in the diet of sheep and cattle and the influence of this relationship on the copper status in livers of both species; and analytical and experimental data supporting the conclusion that paspalum pasture contains a factor other than molybdenum plus inorganic sulphate which interferes with the metabolism of copper by grazing stock.

The field studies at Rockhampton have shown a significant growth response in weaners from cobalt but not copper therapy. However, failure to establish a significant growth response to copper therapy may have been due to the excessively dry season. In the Townsville district there was a marked growth response ot copper but not cobalt therapy. In both localities the investigations are continuing and have been extended to evaluate the effect of copper and cobalt on cattle during both pregnancy and lactation.

Drought Feeding Studies.—The Biochemical Branch continued its collaboration in drought feeding studies conducted by the Husbandry Research Branch by obtaining biochemical data on changes in the composition of blood and in the vitamin A content of liver. The drought feeding studies have presented the additional opportunity of obtaining biochemical data on cattle under a number of physiological conditions. These data include changes in blood constitutents in cows at parturition, the vitamin A content of butterfat from cows on a diet supplying neither carotene nor vitamin A, night blindness in relation to plasma vitamin A levels in calves, and basic metabolism in the non-ruminating ruminant as related to volatile fatty acids in rumen liquor, glucose levels in blood and glycogen concentrations in liver, Findings are being assembled for publication.

Normal Biological Values for Beef Cattle.—In collaboration with the Husbandry Research Branch, blood samples are collected on three successive days at 2-monthly intervals from Hereford cattle grazing predominantly paspalum pastures at the research farm at Rocklea. This is a 3-year study, the objective of which is to establish normal biological values and to study changes in these values with seasonal conditions and with age of cattle.

Protein Quality.—Experiments were completed to evaluate meat, blood and bone protein fed to chickens on production rations containing 18·8 per cent. crude protein. The indices of protein quality were feed conversion ratio and the growth rate of chickens fed to 8 weeks of age. Essential findings are:—(1) levels of bloodmeal up to 12 per cent. in meat-and-bone meals are not detrimental to the quality of the product; (2) the higher the bone content of meat and bonemeals the poorer the growth rate and the higher the feed conversion ratio; and (3) a high bone content decreases the energy content of a ration and raises the feed conversion ratio.

On the basis of these findings analytical limits have been suggested for protein, fat, ash, calcium and phosphorus with the object of defining protein quality in meat-and-bone meals.

SHEEP AND WOOL BRANCH

EXTENSION

Field extension has continued to stress the importance of prevention of disorders of sheep due to lack of adequate feed, parasites, and micro-organisms. This, together with accurate selection and the use of rams from a stud which is genetically progressing, gives the grazier his best present production and the basis for improved production in the future.

In the past year the more widespread adoption of the Mules operation as a routine prevention against blowfly, and, particularly in Darling Downs flocks, a better appreciation of the value of timely drenching and supplementary nutrition during pasture scarcity to effect control of sheep worms, have indicated some measure of response to this type of extension.

There was no evidence of any new development of resistance by the external parasites to the insecticides at present in use or of any resistance by internal parasites against the anthelmintics in use.

A dissection of field officers' activities for the year is as follows:—

Subject	Advice and Demonstrations	Percentage of all Demonstrations
Sheep breeding and flock management ..	1,888	37·4
Sheep feeding	997	19·7
Marketing	283	5·6
Parasite control	1,640	32·5
Land utilization	243	4·8
	5,051	100·0

Sheep breeding, flock management and parasite control were again the main aspects on which advice and demonstrations were sought, 70 per cent. of all extension work being occupied with these subjects. Feeding and nutrition occupied

19·7 per cent. Extension media such as radio broadcasts, Journal articles, news articles, film showings, meetings, and show exhibits were widely used. A school for graziers was conducted by Branch officers at the Toorak Field Station. Twenty-one graziers attended this school, at which the factors known to influence the fertility of sheep were stressed and discussed.

An indexed property card system for use by field officers, to facilitate recording and reference to property contacts and follow-up work, was designed during the year and is at present being circulated.

The first meeting of the Toorak Field Station Technical Committee was held at the station in June, 1961. This committee, comprising sheepowners from the United Graziers' Association and Departmental representatives, discussed improvements, management and the programme of scientific work for the station. Provided that the type of staff required can be obtained, an extension of work can be undertaken in the future. The continued interest and support of the industry members of the committee will greatly aid the development and work of the station.

The Branch was represented at the first meeting of the Technical Sub-Committee on Wool Production, a sub-committee of the Animal Production Committee, which was held in Brisbane in March.

INVESTIGATIONS

Bent-leg.—Following field reports that have emerged since 1954 into the bent-leg syndrome, officers at Cunnamulla and at Charleville are undertaking a long-term investigation into this localised sheep disorder. Field trials to explore the possibility that "bent-leg" might be alleviated or prevented by the administration of calciferol (vitamin D_3) were commenced. Intensifying drought conditions largely prevented adequate conclusions being arrived at in these observations.

There appear to be two manifestations of this disease:—(1) adult sheep during muster fall out, collapse and die from suspected cardiac incompetence; and (2) lambs and weaners, 2 weeks to several months old, suffer skeletal malformation. Both forms of the disease cause serious losses from death, and in sheep which do not die production of wool or meat and sale value are affected.

Manifestations of the adult and the lamb form of the disease occur seasonally in widespread areas over the red mulga country within 100 miles of Cunnamulla. They are invariably found in conjunction with profuse growth of the herbage plant native parsnip (*Trachymene glaucifolia*) during spring months, particularly September and October, but may occur earlier if winter rain produces stands of the plant.

Results of field observations suggest a correlation between percentages of affected sheep and (1) percentage of red country in paddock; (2) abundance of native parsnip; (3) parsnip of matured stage of growth in lightly stocked paddocks; (4) plant growth of approximately 60 days after winter or spring shooting of plant.

Long bones are affected; in some cases both long bones of front legs may be bent one way, in other cases in opposite directions, giving a bandy appearance, and in some cases twisted pasterns. Post-mortem examination shows skeletal deformities, arthritic erosions of articular surfaces, apparently due to altered weight distribution, and severe kidney changes.

Humpy-back.—There has accumulated some suggestive, but far from conclusive, evidence that ingestion of a herbage plant, *Solanum esuriale,* and/or heat exhaustion are contributing factors to this disease. Field tests carried out by the Branch during January to March, 1961, yielded negative results. Six sheep confined on half an acre of profuse paddock growth of *Solanum esuriale* at Toorak Field Station in January and periodically subjected to violent exercise demonstrated no symptoms typically associated with humpy-back.

On two Blackall sheep properties during February and March, 1961, sheep hand-fed in yards on *Solanum esuriale,* and periodically subjected to violent exercise, showed no symptoms except tongueing and exhaustion that are normally associated with advanced humpy-back. Paddock outbreaks of humpy-back during mustering occurred in Blackall area properties concurrently with these trials.

Time-of-Year Joining Trial.—On a Morella district property, 70 miles south-east of Winton, observations were made during spring and autumn to determine how many Merino ewes were marked by rams carrying Sire-sine harness and raddle blocks during mating. Of 240 ewes mated with six rams on September 26, four were marked during the first 14 days and none during the subsequent four weeks. This suggests a very low incidence of oestrus in ewes from September 26 to November 8. The paddock was 900 acres, with good shade and water, and Mitchell grass and other grasses were of good quality, but dry.

In a continuation of the trial in April-May, 200 of the ewes used in the previous year were mated and 62·5 per cent. of the ewes were marked over a period of six weeks, 60 in the first 14 days, 46 in the second 14 days, and 19 in the third 14 days.

Time-of-Year Joining and General Lambing Trial.—In a more comprehensive trial in the Barcaldine district, in which general factors relating to mating and lambing were studied, a high degree of oestrus in maiden ewes joined in early winter was suggested. Of 279 ewes joined with 6 rams for 6 weeks (June 17 to July 29, 1960), 272 (equal to 97·5 per cent.) were marked. Marking for various periods was as follows: —

——	Days	Number Marked	Percentage of All Ewes
1st Period	10	146	52·3
2nd Period	7	105	37·6
3rd Period	7	10	3·6
4th Period	7	8	2·9
5th Period	7	2	0·7
6th Period	4	1	0·4
	42	272	97·5

In the general lambing trial, 6 ewes in which the oestrus pattern was not observed were added to the other ewes and 289 lambs were born from the 285 ewes joined. The main observations were:

(1) 260 lambs survived the first 3 days following birth, the percentage of deaths being 10.

(2) 238 lambs (84 per cent. of ewes mustered) were marked at an average age of 47½ days, the loss from 3 days to marking being 8 per cent.

(3) 225 lambs were weaned at an average age of 129·5 days; deaths between marking and weaning were 4 per cent.

Classing Accuracy.—The accuracy of selection of ewes contributes both to the wool production of the present flock, by the nature of the repeatability of wool cuts in future years by these sheep, and to the genetic potential for wool production in their descendants. A sheepowner in central-western Queensland wished to cull 20 per cent. from a flock of 1,827 2-tooth Merino ewes. The method of half classing—culling for wool and conformation faults prior to shearing followed by weighing the fleeces—was adopted. The sheep were thus accurately classed and the lowest wool producers culled. To compare the efficiency of this method with that of visual classing, the sheep were visually classed for low wool production by a grazier before shearing. In this instance the visual method was only half as efficient as the weighing method. With further refinements of this technique it will be possible for sheepowners to accurately class their own flocks at low cost and so increase their returns from wool production.

WOOL BIOLOGY LABORATORY

The Wool Biology Laboratory has been active for eight years in providing a fleece measurement service to stud and flock masters in Queensland. Numbers and identities of studs and flocks using the service remain fairly constant. The number of samples received in the past year declined somewhat to 3,005. Samples for clean scoured fleece weight, percentage yield determinations, fibre diameter, crimps, and staple length were correspondingly fewer.

During the year producers, through the medium of field officers, sought confirmation of diagnoses and definitions relative to wool faults and fleece irregularities such as copper deficiency, nutritional deficiency, fleece rot, mycotic dermatitis and mosaicism. Information was also sought relative to fellmongering procedures.

The principle underlying the provision of fleece measurement services is based on sound scientific grounds. It suggests means to provide ultimate profit to the industry through the quantitative and qualitative improvement of the national wool clip. It would be remarkable if it were accepted with unqualified enthusiasm as a highly desirable adjunct to standardised methods of selective breeding used by studs. To initiate and build up interest in fleece measurement as a technique which promises ultimate profit through improvement of the national clip is not simple where there exists an adequate return to that section of the industry which breeds rams acceptable in appearance and commanding a price adequate to make stud breeding a most profitable undertaking.

The period to date during which fleece measurement has been presented to the industry might be regarded as little more than a testing period, an era in which both studmasters and flockmasters have had the opportunity to be, and in many cases have become, more enlightened as to its uses and value. The studmaster using it can feel that he is still able to run a profit-making venture, at the same time contributing to the future national profit of the industry. The flockman can feel that he is obtaining more intrinsic value in his rams, since the rams he is buying (if the studs he buys from practise fleece measurement sincerely) not only look good but have the inherent capability to continue to reproduce more economically valuable stock.

If the advantages of fleece measurement are regarded as a simple commercial proposition, the customer is the flockowner,

the general standard of improved clean scoured fleece weights in his flock is the product, and the studmaster, who wants his product to be comparable to anything that his competitor studs can offer, is the retailer. National and individual benefit from fleece measurement can only come, however, if the customer (flockowner) insists that the product (improved rams) he purchases come from retailers desiring to sell a superior product (studmasters using fleece measurement to produce superior type rams).

TOORAK FIELD STATION

Conditions during the year were very variable. Owing to the patchy distribution of rain on the Station during January-March, 1960, the feed available on the northern, north-eastern, and western portions, though not good, was of fair quantity and quality, while the smaller trial paddocks near the homestead contained only a small quantity of low-quality feed. It was, therefore, fortunate that the experimental ewe breeding flock had not been joined during the autumn of 1960. Of the main ewe flock which was held in the larger paddock, 1,427 ewes had been joined and 44 per cent. of lambs were marked.

Ram Semen Examination.—Because of the drought it was necessary to stop the ram semen examination trial in September, when the trial paddocks were completely eaten out. The only pattern which has emerged after two years is a falling-off in semen quality during the time of nutritional stress —spring and early summer. There was much variation between rams, particularly during the spring/early summer period, when some rams continued to produce semen of good character. This trial will be recommenced after shearing in midwinter.

Joining and Lambing Trial.—Because of unfavourable feed conditions in the trial paddocks during late summer and autumn, the nucleus flock was not joined in 1960, and consequently there was no lambing trial. Seasonal conditions in the 1961 late summer and autumn were somewhat better than in the previous year and this flock was joined for six weeks during April and May.

Ewes marked by teasers were mated, by hand service, with selected rams which had been bred within the flock. During the three weeks following service the ewes were run with teasers to attempt to determine the conception rate. As previous records from joinings had indicated the deleterious effects of skin-folds or wrinkles on fertility, the flock was joined in three groups—one group chosen at random, another for low wrinkle score, and the third for high wrinkle score. The rams used were chosen on their own wrinkle score and regard was paid to the wrinkle score of their parents. Half of each group of rams was 1½ years old and the remainder 2½ years old. Only rams which were apparently fertile as judged by semen examination and manual palpation were used. In previous years the percentage of ewes showing oestrus had been high, but this year the percentage was only 70. The reason for this is not yet known.

As Merino sheep in the north-western environment are subjected to high temperatures and a variable plane of nutrition, a small experimental flock was joined in late winter with teasers, then rams and subsequently reteased after the ram joining was completed. The teasers were run with the ewes after shearing in July 1960 and the rams joined for 6 weeks immediately the teasers were withdrawn. The rams were 1958 spring drop and were tested and adjudged to be fertile immediately before joining. Only poor native pasture, mainly Mitchell grass (*Astrebla* sp.) and Flinders grass (*Iseilema* sp.), was available to the ewes and rams during joining. The incidence of oestrus in these ewes was as follows:

Total ewes	98
Ewes showing oestrus during prejoining teasing (26–7–60 to 8–8–60)	62
Ewes showing oestrus during the 6 weeks' joining (9–8–60 to 20–9–60)	84
Ewes first showing oestrus during final teasing period (20–9–60 to 11–10–60)	5
Ewes which failed to show oestrus at any period ..	8

Of the 84 ewes served by fertile rams, only 66 lambed—42 to service during the first 14 days, 22 to the second 14 days and 3 to the final fortnight. The lamb survival rate to 14 days was 47 per cent. This trial will be repeated after next shearing and the joining should be on dry but better native pasture.

Repeatability and Heritability of Wool Characters.—Estimates of phenotypic and genetic relationships among a number of wool characters, body-weight and fold scores were obtained for a flock of Medium Peppins running on the Toorak Field Station.

Phenotypically, clean wool weight was related positively to greasy wool weight (= +0·84), per cent. clean scoured yield (= +0·56), staple length (+0·49), fold scores (= +0·20) and body-weight (+0·13). There was little relationship between clean wool weight and fibre diameter (= +0·05), but a pronounced negative relationship with crimps per inch (= −0·45). The repeatability of most characters was in the range 0·6 to 0·7. The estimate for body-weight was higher (0·80) and that for fibre diameter somewhat lower (0·53).

Fibre diameter, staple length, crimps per inch, and body-weight were highly heritable (estimates respectively 0·55, 0·53, 0·48 and 0·44), but the estimates for clean wool weight (0·23) and fold score (0·24) are lower than anticipated. In particular, the heritability of wool weight is much lower than the published figures for Trangie and Gilruth Plains flocks and lower than a previous Toorak estimate based on a smaller group of sheep. Among the genetic correlations, clean wool weight (but not greasy wool weight) was negatively correlated with fold score (−0·3) and positively with body-weight (+0·3). The negative correlation between clean wool weight and crimps per inch was extremely high (exceeding −0·9).

If these figures are accepted, the progress to be expected from fleece measurement in this environment is less than in other areas and any increase in cut per head will have to be at the expense of a lowering in quality as assessed by crimping.

In this analysis, only sheep with complete records were used. However, the full range of measurements has not always been applied each year and considerably more extensive data are available on clean wool weight and crimps per inch. It is proposed to analyse these data to confirm or refute the present estimates of heritability and correlation.

CATTLE HUSBANDRY BRANCH

Two properties administered by the Branch are being developed to the stage at which research programmes can be undertaken. The Cattle Field Station, Swan's Lagoon, Millaroo, comprises some 30 square miles of open-forest grazing country in the Burdekin basin which was practically unimproved when acquired in 1959-60. Completion of a fencing contract will permit stocking with a foundation herd of beef breeders to be used in a programme of research into management and breeding practices. The Cattle Field Station, Ayr, is the property formerly operated by the Plant Industry Division of the Department as a Regional Experiment Station. A programme of crossbreeding of European dairy breeds with animals of the Sahiwal breed has commenced on this property. The additional improvements and the re-design of the property required for execution of a programme of dairy husbandry research are now in progress.

EXTENSION

During the second half of 1960 pastoral conditions were poor in many parts of the State and numerous enquiries were received from beef producers for advice on methods of reducing losses in cattle due to the adverse seasonal conditions. Again in 1961 large areas of the State were affected by dry weather and similar requests for advice were received.

In recent years the Department, through this Branch and the Husbandry Research Branch, has conducted research into methods of improving performance of cattle under drought conditions. This has included studies on full hand feeding of cattle on rations based on low-quality roughage and on methods of supplementing cattle grazing on pastures of low quality. Under both systems of feeding it has been found that performance of cattle has been markedly improved by supplementation with relatively small amounts of a protein-rich concentrate or of urea, which acts as a source of protein for ruminants. Urea is a cheaper source of protein than other protein-rich concentrates. However, its use is attended by some risks of toxicity. Research work has been undertaken to devise methods of use of urea which reduce these risks.

A method of use of urea which has attracted considerable attention has been the spraying of dry standing pasture with a urea-molasses mixture. While results from this method appear to have been variable, some producers claim worthwhile results.

Reports from field officers in areas affected by drought in 1960 indicate that supplementary feeding of beef cattle was practised much more widely during that year than in previous drought years. The methods used varied considerably, depending on availability and cost of various feedstuffs in the district concerned. The results of the research projects of this Department over recent years proved an invaluable aid to extension officers in providing advice for producers on the methods of supplementary feeding most appropriate to their situation.

Another field in which considerable interest is now shown by graziers is feed-lot fattening of beef cattle. The cultivation of extensive areas for grain crops, particularly sorghum, is now an established practice in areas such as the Central Highlands, Maranoa and western Darling Downs. In the case of some graziers, the use of grain for feed-lot fattening is considered to be a profitable alternative to marketing it as

a cash crop. Through co-operation with a number of graziers who have engaged in feed-lot fattening ventures, the Department has obtained data which can be used as a basis for advice on rations and methods for others contemplating this system of production.

BEEF CATTLE INVESTIGATIONS

Time of Calving of Beef Cattle.

Reference was made in the report for 1958-59 to a trial initiated at "Brian Pastures" Pasture Research Station to study the effect of variations in time of calving on the performance of beef breeding cows. The trial involves three groups each comprising 22 females which entered the trial as maiden heifers in the 1958-59 mating season. The groups are mated at the following period:—

Group 1—8th October to 7th December
Group 2—8th January to 9th March
Group 3—8th April to 7th June.

The performance of the calves of the 1959-60 calving is shown in Table 1:—

TABLE 1

PERFORMANCE OF CALVES FROM 1959-60 CALVING

Group	Number and Sex	Average Birth Date	Average Birth Weight (lb.)	Corrected Weight at		
				90 Days (lb.)	180 Days (lb.)	270 Days (lb.)
1	8 Male	13–8–59	60·7	149·1	279·2	364·4
	9 Female	4–8–59	56·2	143·8	286·6	381·0
2	8 Male	3–11–59	64·7	183·2	280·7	267·0
	11 Female	1–11–59	63·2	187·4	294·0	272·6
3	9 Male	28–1–60	63·8	183·5	221·7	254·0
	8 Female	26–1–60	63·4	185·9	233·9	260·1

The calves of the early-mated group were lighter at birth than the calves of the other two groups and they had a lower rate of gain up to 90 days of age. Thereafter, their rate of gain was better than that of the other two groups so that by 270 days they had a weight advantage of approximately 100 lb. per head over the other groups. The greater weight of the calves of the early-mated group at 270 days is attributed to the fact that milk production of cows and growth rate of calves decline in the autumn as pastures mature, irrespective of the stage of lactation of the cow. Because of this, calving in the period July to September gives a longer effective lactation than a later calving period. To date there is no evidence of difference in fertility between groups attributable to different periods of mating.

Milk Production of Beef Cows.

A comparison was made between the milk production of Zebu x Hereford cows and Hereford cows on a property in the Rockhampton district measured by the amount of milk harvested by their calves in two sucklings on the test day. Both groups of cows had been mated to Zebu x Hereford ("Braford") bulls, the calves being, as a consequence, of mixed proportions of Zebu and Hereford blood. After six months' lactation, the average amount of milk produced per day by the Herefords was 5·5 lb., while that from the crossbreds was 9·5 lb. The calves suckling the Zebu-Hereford cows gained correspondingly well, being 394 lb. at six months, compared with 326·5 lb. for the calves from the Hereford cows.

A similar trial to assess the milk production of Poll Hereford cows in the Burnett district was carried out at "Brian Pastures" Pasture Research Station. In this trial, the Poll Hereford cows were producing 5·25 lb. milk at six months' lactation and their calves weighed 300 lb.

Fertility of Beef Cattle.

During the year, two officers of the Branch attended the Beef Cattle Infertility School organised by the University of Sydney under the auspices of the Beef Cattle Research Committee and presented results of a number of studies into beef cattle fertility and survival carried out by the Branch.

An investigation of the fertility status of beef cattle herds in North Queensland showed that the branding figures of a sample of 11 properties varied between 40 and 70 per cent., with an average of 58 per cent. Calving percentages were from 60 to 90 per cent. and averaged 72 per cent. An analysis of these figures indicated that the interval from birth to first calf was approximately three years for a breeding cow and the average cow lived for 8-10 years and produced three calves during her lifetime.

The venereal disease status of a sample of herds was also investigated. Out of 17 properties where samples were taken for the mucus agglutination test for vibriosis, 15 were positive and the conclusion was drawn that the disease is enzootic throughout the beef cattle population of North Queensland. Brucellosis was diagnosed on only five properties out of 28 sampled. Samples were also taken for leptospirosis on 15 properties; seven herds showed positive agglutinations to *Leptospira pomona* and 10 to *L. hyos.*

Bull fertility was examined extensively, the conditions encountered including one similar to *impotentia coeundi.* Clinical testicular hypoplasia was observed and posthitis and prolapse of the prepuce was also encountered frequently. In addition, individual cases of broken penis, locomotor injury, and general infections affecting fertility were encountered.

Circumstantial evidence was obtained suggesting that seminal degeneration may occur in British breed bulls during the hot dry months. There also appeared to be a general absence of ovarian activity in the breeding cows during the dry summer months. Reliability and occurrence of rainfall therefore dictate management methods to control and enhance fertility. Sufficient subdivision is necessary to enable complete segregation of the various classes of stock, particularly weaner heifers. Then, if breeders are confined in smaller paddocks, more information will be available to the owner on conception rates achieved by certain bulls or groups of bulls. No definite recommendations could be made on the time to mate cows and the length of the mating period.

The percentage of bulls used was 2–6 per cent. In general, the rougher and/or larger the breeding paddock, the greater the number of bulls required.

Records that have been studied to date indicate that calving percentage can be increased by culling cows that do not calve at least every second year.

An investigation was made of the herd fertility and calf survival to 18 months of age in the beef cattle herd at "Brian Pastures" Pasture Research Station. The period 1954 to 1960, during which 1,291 matings of Hereford and Poll Hereford cows were made to Poll Hereford bulls, was reviewed. The number of calves produced and surviving to two weeks of age in any one year expressed as a percentage of the cows mated to produce them showed marked fluctuation. Calving percentages during and following drought were lower than in the normal years. The overall average calving percentage was 75 per cent., and a comparison of the calving percentages of single-bull paddocks and multiple-bull paddocks indicated that there was no difference in their average calving percentages. However, a much greater variation in the percentage of calves produced was apparent in the single-bull groups.

Age of bull appeared to have a variable effect. Some young bulls used in the herd for the first time had very low calvings whereas others had calvings of the same order as the mature bulls. Age of dam appeared to have little effect upon the number of calves produced, there being no markedly lower calving percentage in any age group.

An examination of the rate of calf drop indicated that 85 per cent. of all calves were produced during the first six weeks of the calving season, so little improvement in the calving percentages could be expected by extending the mating period beyond 10 weeks. In the single-bull matings, the young bulls which had low calving percentages were found to produce calves later in the calving season than those having normal calving percentages.

During the drought years of 1957 and 1960, there was a marked increase in mortalities during parturition and the first two weeks of life and these were largely responsible for the reduced calving percentage. The low calving percentage in 1958 was considered to be due to a lower conception rate after the 1957 drought. Calf mortality between two weeks and six months of age (18 mortalities) was lower than that during the period up till two weeks of age (43 losses) but nevertheless in some years contributed significantly to the wastage rate. During the period from 6 to 18 months there were quite considerable losses in calves. In all, 66 calves died during this stage of life, the majority being the victims of predators.

These results indicate that the use of branding percentage and weaning percentage as indicators of the calving percentage is only very approximate and may not represent a true assessment of the fertility status in the herd. However, in this herd, while mortalities during parturition and up till 18 months of age were quite appreciable, the failure of cows to produce a calf either alive or dead was the major factor contributing to the number of calves alive at 18 months per cow mated.

Use of Synthetic Hormones in Fattening

Since data on the use of synthetic hormones for stimulating growth in fattening beef cattle were presented in the 1957-58 report, further trials have been conducted and the data available from 15 trials involving 367 cattle treated with hexoestrol and 285 untreated cattle have now been submitted to statistical analyses. The trials were carried out with cattle under a variety of feeding conditions, including native pastures, improved pastures, grazing crops and feed-lot.

The main results emerging from these trials are summarised:—

(1) In 12 trials out of 15 a significant response to treatment was obtained. In the remaining three trials the response was not significant.

(2) In most trials the response was in the range 0·20–0·40 lb. additional liveweight gain per day over the period from treatment to final observation, which was generally 75–120 days.

(3) In trials where different levels of hormone treatment were applied there was no significant difference in response to levels varying from 15 to 60 mg. hexoestrol.

(4) There was a significant positive relationship between the response to treatment and the rate of liveweight gain of the control animals. This accounted for approximately 60 per cent. of the variation in response between trials and indicates that response is positively related to plane of nutrition.

(5) There was no significant difference in dressing percentage (chilled carcass weight to liveweight) between treated and control animals.

(6) Analyses of the pooled data from all trials indicated that in treated animals depth of eye muscle was significantly greater and depth of fat cover over eye muscle was significantly less than in the control animals.

(7) Carcass appraisal by measurement carried out in three trials did not indicate a significant effect of treatment on points scored on appraisal.

Bovine Ocular Squamous Cell Carcinomata

A factor contributing to a variable culling rate of beef cows in Queensland herds has been "cancer-eye" or ocular squamous cell carcinomata in Hereford and Poll Hereford cattle. Some breeders report annual culling rates of between 1 and 4 per cent. of their breeding cows. Any factor for which culling must be practised automatically reduces the number of cows which can be culled in a selection programme. For this reason, and because of the reduced market value of affected cows, this condition represents a form of economic loss to the beef cattle industry.

An investigation into this condition was commenced in co-operation with the Pathology Branch and using the "Brian Pastures" beef cattle herd. In general, eye cancer varies somewhat according to the site on which it occurs. It usually occurs on the eyelids, eyeball or nictitating membrane. When it occurs on the conjunctival margin of the eyelid, which is the commonest site, it is most often found on the lower lid. The most common position on the eyeball is on the lateral limbus. Carcinomata occurring on the nictitating membrane are not nearly as common as those on the other two sites.

There is a well-defined series of precursor lesions which allow the identification of susceptible cattle at an earlier age than if carcinomata alone were the index of susceptibility. There was a negative association between the incidence of lid precursor lesions and the degree of lid pigmentation but there was no association between eyeball precursor lesions and lid pigmentation. There appeared to be no association between the incidence of eyeball precursor lesions and pigmentation of the white of the eye about the margin of the iris (coloured part of the eye).

Of 186 cows which were examined on each visit, 39 animals had fully pigmented margins of the lids of both eyes and 50 had no pigment on their eyelid margins. The intra-class correlation between eyelid pigmentation of the two eyes of the same animal ("repeatability") was 46 per cent., suggesting a moderate heritability of lid pigmentation. It indicates that phenotypic selection for eyelid pigmentation should be reasonably effective.

Precursor lesions of the eyelid in the breeding cows occurred approximately three times as frequently as those on the eyeball. Precursor lid lesions were found to occur as early as two years of age but no definite precursor eye lesions were found until three years of age. The greatest incidence of lesions occurred in animals over four years. While fewer eye precursor lesions were found than lid precursor lesions, they appeared to be more carcinogenic since about twice as many eye carcinomata as lid carcinomata were observed.

Copper Therapy

Copper therapy trials on the marine plains of Broadsound Peninsula and at Cromarty on similar classes of country were completed. In both instances, the main vegetation was marine couch (*Sporobolus virginicus*) and para grass (*Brachiaria mutica*).

In the trial at Kunwarara on the Broadsound Peninsula, 54 steers and 57 heifers, all Herefords, were randomised into three experimental groups, namely a control group, a group given a subcutaneous injection of copper glycinate every three months, and a group given an intra-ruminal cobalt bullet every six months as well as the three-monthly copper glycinate injection. A response to treatment over the 12-month period was shown by the copper plus cobalt group but not by the copper only group. An examination of the growth response on a seasonal basis indicates that from June to September there was a significant growth response to copper only and a further lift for copper plus cobalt over copper alone.

At Cromarty, 92 Shorthorn heifers were split at random into four treatments, three as in the above trial and a fourth group treated with cobalt bullets at 6-monthly intervals without any copper therapy. In this trial there was no response to cobalt at all but a significant response to copper over the 12-month period. On a seasonal basis, the copper therapy elicited a growth response in the period July 1960 to March 1961.

The Division of Biochemistry and Nutrition of C.S.I.R.O. sampled animals from these two trials and performed assays for vitamin B12 on their blood and liver. These assays yielded no differences in level between cobalt-treated and non-cobalt-treated groups. This information suggests that caution should be exercised in the interpretation of the response to cobalt therapy.

The general interpretation of the response to copper glycinate therapy is that in both cases there was a response during the period July to September. In the Kunwarara trial, drought conditions then prevailed and may have masked a possible response in the subsequent period. Further trials are in progress at both properties.

DAIRY HUSBANDRY

Farm Resources and Production Methods Survey

This project is financed from funds contributed jointly by the industry and the Commonwealth Government and administered by the Australian Dairy Produce Board Research Committee. Its object is to assess the resources available on dairy farms and the extent and manner of their use in relation to output in order to provide (1) a description of the current situation on dairy farms, including an indication of the most likely avenues for improvement, so that extension work can be appropriately planned; (2) performance standards which may be used as a basis for assisting farmers with management decisions; and (3) a quantitative background so that more detailed investigations, to determine optimum resource use for farms in various situations, can be made effectively on much smaller groups of farms.

Collection of information was commenced with the farms of co-operators in the Bull Proving Scheme situated in the Kingaroy and Nambour areas. A preliminary analysis indicated that further farms will have to be included so that a sufficient number will be available to represent each of the diverse situations which occur. Information has been collected from a random sample in the Oakey area, considered to be representative of eastern Darling Downs dairy farms, but processing of these data is not yet complete.

The survey of farms which supply milk directly to the Brisbane milk market was completed. The following are some of the outstanding features of this group of farms:—

(1) Land is very unevenly distributed, 16 per cent. of farms having less than 100 acres of usable land, while 12 per cent. have over 400 acres, the average being 240 acres. The land is also very variable in quality, but generally poor, 52 per cent. of the aggregate area being classed as inferior forest land. Considerable areas of available land are not used (e.g. heavily timbered) or are capable of more intensive use (e.g. land suitable for cultivation still in grass). It appears that the land is being used to only about 65 per cent. of its potential.

(2) Farming plant is inadequate to make use of the available arable or irrigable land on many farms. Only 70 per cent. of farms have tractors, 4 per cent. combines or seeders and 4 per cent. fertilizer spreaders.

(3) Despite the apparent need for increased land development and additional farming plant, only 25 per cent. of farms were stated to be affected by inadequacy of finance.

(4) Although sidelines occur frequently—cash crops, grown on 44 per cent. of farms, being most important—dairy produce accounts for more than 80 per cent. of gross output on 78 per cent. of farms.

(5) The large expenditure on purchased fodder by most farms (approximately £560, or 20 per cent. of gross farm output) suggests that net profits may be increased by making better use of available land to supply stock feed.

Infertility Survey

The analysis of the survey data for the years 1953-1956 was completed and some interesting conclusions can be drawn from these results. In general, it may be stated that three classes of cows were considered, namely, those calving normally, those aborting and those which had a dead calf.

The conception rates to first service of cows after calving normally was 58 per cent. in a total of 21,691 cows. For the 323 cows which had a dead calf, the subsequent conception rate was 45·5 per cent. A conception rate of 46·1 per cent. was recorded for the 716 cows which had previously aborted. The overall conception rate of all cows examined (22,730 head) was 57·5 per cent. This indicates that the two abnormal conditions of aborting or having a dead calf lowered the conception rate to a similar extent.

When one considers the different combinations of these three conditions at two consecutive pregnancies, there then emerge nine different categories of interval between calving or abortion and the subsequent calving or abortion. In summary the data indicate:—

(1) *Calving to Calving.* The average calving interval between two normal parturitions was 381·5 days. As the gestation length of A.I.S. cows is 282 days, the average cow did not go into calf for approximately 100 days post-calving, or about five heat periods. The conception rate to first service in these animals was 61·8 per cent. out of 17,093 cows examined.

(2) *Calving to Abortion.* In all, there were 880 cows in this category, of which 58·9 per cent. conceived at first service. The interval between calving and abortion was 311 days. If these cows could be considered to have taken as long to conceive post-calving as the calving-to-calving cows, then the average time when a recognisable abortion occurred was at the seventh month of pregnancy.

(3) *Calving to Born Dead.* There were only 176 cows in this class. Their calving interval was 381·9 days, which is not different from that of cows having a normal calf. The conception rate for first service of these cows was 55·1, which may not be significantly lower than in the cows calving normally because of the smaller number of cows in this class.

(4) *Abortion to Calving.* Of the 446 cows in this group, 53·9 per cent. conceived to first service; this is not very much lower than the conception rates of the previous classes. This would suggest that cows which aborted could be expected to conceive almost as readily as those calving normally. The interval between abortion and calving was 392·2 days, suggesting that farmers tended to hold back a cow which aborted until the time she would normally be mated.

(5) *Abortion to Abortion.* This category comprised 67 cows whose conception rate to first service was 49·2 per cent. This is slightly lower than the preceding class but the difference may be due to chance. The interval between abortions was 327·8 days. Allowing the farmer to withhold these cows from service for the same time as class 4, it may once again be calculated that these abortions occurred about the seventh month of pregnancy.

(6) *Abortion to Born Dead.* Very few cows were in this class. Of these 11 cows, 36·4 per cent. conceived to first service and the average interval between the abortion and calving was 401·5 days. This would again result from the cow being held to mate at the normal time and the consequent low fertility of these few cows.

(7) *Born Dead to Calving.* There were 205 cows in this class, 52·7 per cent. of which conceived to their first service, giving a conception rate of similar order to that achieved by the cows mated after an abortion. The calving interval was 404·5 days, which suggests that the farmer held these cows back for an additional heat period longer than cows calving normally.

(8) *Born Dead to Abortion.* Of these 25 cows, 48 per cent. conceived to first service and the interval between the two events was 363·8 days. The small number of cases observed in this class precludes any valid interpretation.

(9) *Born Dead to Born Dead.* As in the above class, the 12 cows observed represent too small a sample for satisfactory conclusions to be drawn. Their conception rate to first service was 58·3 per cent. and the interval between calvings was 395·6 days.

The overall conception rate of all cows in this second dissection was 61·2 per cent.

Artificial Insemination.

Two young Guernsey and Friesian bulls were bought for the A.I. Centre at Kairi Regional Experiment Station, which has been supplying A.I.S. and Jersey semen to the Tablelands Co-operative Artificial Breeding Association for the past three years. The membership of the Association grew from 92 members at the end of 1958 to 283 at March 1961.

The figures on conception rates to first insemination, based on 60-90 day non-return rate, are as follows for the first two full years' operation of this service. They indicate a highly satisfactory standard.

	1958–59	1959–60
No. of 1st inseminations	4,395	5,623
Conception rate (%)	69·9	66·8

During 1960-61 an artificial insemination service was commenced in the Wide Bay area by the Nestle Co. (Aust.) Ltd. This service utilises semen obtained from the N.S.W. Milk Board. Co-operative organisations of dairyfarmers in the Dayboro and Beaudesert district have also taken similar action, commencing services early in 1961.

The Department maintains in the Samford area a small A.I. service which is used primarily for training of A.I. technicians. During the year training was provided for personnel nominated by all of the above A.I. organisations as well as for several Departmental officers.

Proving Dairy Bulls.

While the immediate and short-run advantages of A.I. to the individual dairyman lie principally in the better control of breeding and thereby in the better control of reproductive diseases, the long-term possibility of the genetic improvement of the State herd remains an ultimate goal. The accomplishmen of such a long-term plan is dependent on the use, through A.I., of bulls adequately proven as capable of achieving this genetic improvement.

Since 1955 for the Jersey breed, and since 1958 for the A.I.S. breed, there have functioned two field units each of about 45 dairymen in whose herds proof on successive drafts of bulls is being obtained. During the past year additional evaluation of the 1955 Jersey bull group was obtained, in the Nambour unit, on daughters completing lactations, as well as a preliminary evaluation of the 1956 bull group. The comparative rankings of these bulls, based on their daughters' butterfat production, is presented in Tables 2 and 3.

TABLE 2

COMPARATIVE RANKING OF JERSEY BULLS USED IN 1955*

Sire	1959		1960		1960	
	No. of Heifers	Rating (lb. b/fat)	No. of Heifers	Rating (lb. b/fat)	Total No. of Daughters	Rating (lb. b/fat)
Bull A	22	+ 6·8	18	+22·4	33	+21·7
Bull B	16	− 9·0	14	−47·3	29	−19·6
Bull C	25	+ 1·4	14	− 7·1	27	+15·6
Bull D	31	−10·7	18	+12·9	41	−12·0

* The figures for heifers relate to heifers calving at two years of age in 1959 ; heifers calving at three years of age in 1960 ; and all daughters calving in 1960.

TABLE 3

PRELIMINARY COMPARATIVE RANK OF JERSEY BULLS USED IN 1956

Sire	No. of Heifers	Rating (lb. b/fat)
Bull E	33	−16
Bull F	25	+ 4
Bull G	42	− 8
Bull H	32	+22

The use of bulls with the highest rating for purposes of breeding sons for A.I. use and, in turn, the evaluation of these sons within the framework of a widespread artificial breeding service, are in the best long-term interests of the State's dairy industry.

A significant variation in the procedure of bull selection was made during the year. Representatives of the Breed Societies now participate with Departmental officers in the inspection and selection of the bulls that are available for purchase.

Inseminations in the Jersey (Nambour region) and A.I.S. (Kingaroy region) proving units commenced on September 20, 1960, with new drafts of young bulls. In Kingaroy especially, early breeding was rather slow due to anoestrus caused by the prevailing seasonal conditions. The total first inseminations in each unit and the overall fertility of bulls are as follows:—

	No. of 1st Inseminations	Fertility (%)
Kingaroy	1,166	39·6
Nambour	1,154	61·0

The low fertility of some of the young A.I.S. bulls, as tabulated below, is a matter of some concern, and investigation of performance suggests that age and sexual maturity of this breed, relative to the Jersey, is the main factor. The performance of individual bulls of each breed do not suggest any breakdown in technique or in competence of operators.

Sire No. and Breed	Fertility (%)
Jersey 1	62·1
Jersey 2	59·2
Jersey 3	66·1
Jersey 4	56·1
A.I.S. 1	42·1
A.I.S. 2	52·6
A.I.S. 3	15·6
A.I.S. 4	33·6
A.I.S. 5*	59·7
A.I.S. 6*	62·8

* Substitute bulls.

It was found necessary to withdraw three of the A.I.S. bulls and to substitute two older animals still retained and available from a previous year. Prior to the next breeding season preliminary fertility tests will be made in the field to supplement available laboratory semen appraisals.

PIG SECTION

A very cold dry winter in 1960, followed by months of inadequate rainfall, led to feed shortages. The fall in prices offered for pigs early in 1961 added to the difficulties experienced by many producers in securing feed at economic prices. Towards the close of the year some lack of confidence was evident amongst producers, particularly those dependent on purchases for an appreciable proportion of their feed needs.

Dairy by-products were barely adequate throughout the year, and on a number of farms could not meet the demand for animal protein at times. Skim-milk supplies were almost 30 per cent. less than the previous year in the north, and mainly available in the period January-April; reasonably satisfactory supplies were available in the Central and Burnett districts; and well below average volumes were available on the Downs. Dried milk products were scarce throughout the whole year.

Protein concentrates barely met the demand. Meat-and-bone meal generally was readily available in the northern and southern districts, but restricted in the Central District. Liver-meal was generally in short supply or unprocurable. The lower grade meat-and-bone meals, of less than 50 per cent. crude protein content, continued to be a problem in the industry. Insufficient supplies of better quality meals forced farmers to use the lower grade meals, and their use has indicated that they are not satisfactory as the sole source of animal protein in pig rations, especially for younger pigs.

Small quantities of soybean meal and fishmeal became available. The latter is proving a much better source of protein than the local meat-and-bone meals, and more economical. If world marketing of fishmeal permits regular importation at economic prices, fishmeal could help the pig industry in more than one way. A quantity of whale meatmeal and whale solubles was placed on the local market in June.

Feed grains fluctuated in supply during the year. The sale of considerable quantities of grain to New South Wales added to the general shortage of grain on the markets. Mill offals also were scarce for most of the year. Consequently prices for all grains were higher than in the previous year, and progressively firmed to levels leaving little margin of profit where most feed was bought.

Green feed was not plentiful, due to dry weather, and for considerable periods none was available. The few irrigated green feed plots in each district proved invaluable, and there is an increased interest amongst producers in small irrigation plants to ensure adequate green feed.

Production was maintained at levels approaching that of the previous year, despite shortages of various feeds, but the average weight of carcass marketed showed a downward trend. Decline in production eased in North Queensland, while the steady increase in Central Queensland eased. Elsewhere total production in actual numbers should be slightly below the previous year's figures, but weight of pork produced will probably be lower. The trend towards pork production continued, and when feed supplies decreased porker numbers increased.

For several months the price per pound offered for baconers exceeded that offered for porkers, the reverse of the usual trend. With the marked increase in porker numbers during late summer and autumn, values of all slaughter-weight pigs were depressed. By the end of the year values for baconers were again rising. In North Queensland the Northern Pig Marketing Board continued its policy of paying the highest possible first advance price without fluctuations. First grade payment has stood at 2s. 5d. per lb. since September, 1959. Fluctuations in prices at auction sales, particularly Cannon Hill, gave rise to discontent. Weaner and store pig prices varied according to rainfall and the availability of feed. Except for a few short periods following useful rains, the market for these pigs was generally depressed.

DISEASE

The dry year caused a drop in the incidence of some diseases and increases in others. Leptospirosis was not so prevalent. A number of producers now vaccinate breeding stock. Erysipelas was more prevalent, and an increasing number of farmers have commenced vaccinating to combat the disease. More use was also made of vitamin A supplements during shortages of green feed. Parakeratosis was more prevalent, due to greater dependence on meat-and-bone meal to supply protein. Virus pneumonia appeared to have increased in incidence. A number of producers have become interested in developing virus pneumonia-free herds, and a Society has been formed with that object as its aim. Photosensitisation in white pigs was common at times on the Darling Downs, and interfered with breeding programmes when severe in breeding sows. The common diseases and parasites were also reported from all districts, but producers appeared to be making some effort to control these complaints by direct treatment and preventive measures.

The Certified Brucellosis Free Tested Herd Scheme for stud herds was continued in conjunction with the Veterinary Services Branch. One hundred and thirty-nine herds have been issued with appropriate certificates and placed on the list published in the *Queensland Agricultural Journal* each month. A further 11 herds have entered the scheme, but still have to complete the necessary tests.

REGIONAL EXPERIMENT STATIONS

The piggeries were maintained in good order at Kairi, Biloela and Hermitage Stations, and various improvements effected also.

Sow performance trials and litter recording continued on all Stations. At Biloela the sows on the lowest plane of nutrition in the trial averaged 10 pigs reared per litter at the last farrowing.

Due to lack of staff at Kairi little trial work was done. Two creep-feeding trials on a farm at Malanda were successful in demonstrating the value of creep feeding, and a number of farmers are now creep-feeding litters with good results.

A number of trials were conducted at Biloela, with emphasis on protein supplements. In one trial 15 per cent. of cottonseed meal was fed as the sole protein supplement without harmful effects. Locally grown black cowpeas were fed in another trial at 20 per cent. of the ration, and without the addition of meatmeal in the rations for pigs over 100 lb. weight. The cowpea meal replaced meat-and-bone meal satisfactorily. Other trials were conducted to investigate the practicability of grazing oats and hogging down sorghum crops.

One interesting point arising from sow performance studies at Hermitage is the fact that the sows, on a full diet and consequently over-conditioned, lose weight for about a month after weaning, whereas the lighter fed sows at Biloela gain weight during this period. In progeny feeding trials, Berkshire pigs were marketed at 19–22 weeks of age, with satisfactory gradings, on a maximum of 4½ lb. feed per head daily. A series of sorghum palatability trials were conducted and whole sorghum is being tested against kibbled sorghum.

PIG TESTING STATION, ROCKLEA

At the beginning of the year, 18 pigs were in the Station, and 100 were received during the year. Of these, 52 were purebred pigs from breeders, and 48 were sent from the Regional Experiment Station piggeries to test rations and conditions at the Station. During the year four teams from each of three boars completed tests, and teams from two further boars were being tested. Health of the pigs has been of a high standard and growth rates satisfactory. From the pigs tested during the year, it appears there are strains capable of producing good quality baconers at 200 lb. liveweight on full feeding, while others matured earlier and were consequently overfat at these weights.

GENERAL

The demand for advice from Branch officers in country centres was high, and in most districts the existing staff could not cope satisfactorily with all the enquiries. This was particularly evident on the Darling Downs. Pig raisers continued to show interest in better accommodation and management practices. As a result there were a considerable number of building improvement and rebuilding programmes under way, in spite of restricted credit. The value of good husbandry practices has been realised by many farmers also, and better management of their pigs has led to improved returns.

Bacon competitions at local shows were better supported by farmers, and some very good carcasses were displayed. Several entries scored 90 per cent. or higher.

Field days were organised in various districts. In those districts where Regional Station piggeries exist local officers made very good use of the facilities to show organised farmer groups what was being done to improve housing, feeding and management practices.

The Landrace breed has spread throughout the State. Values for this breed, especially poorer quality animals, have decreased.

A conference of all Branch officers was held in Brisbane for two weeks during May. A wide programme was arranged, and the lectures and following discussions among staff members and lecturers proved most valuable in resolving a number of individual problems.

Another weakness shown up by the dry weather is the lack of adequate grain storage facilities on many farms. Many producers have recently shown interest in providing adequate storage for grain, and these facilities when provided will do much to even out the present seasonal production fluctuations.

POULTRY SECTION

EGG PRODUCTION

Egg production in south-eastern Queensland as measured by intake at the Egg Marketing Board was 20 per cent. higher during 1960-61 than in the previous year. Despite every effort by the Board to increase local sales, these did not keep pace with production, the result being that a considerable volume of eggs had to be converted into egg pulp. This had an effect on the net return to growers, which was nearly 12 per cent. lower than in the previous year. Had feed prices remained at the same level as in 1959-60, the lower return from the sale of eggs would not have been so serious; unfortunately higher feed costs, dictated by shortages of grain sorghum due to drought conditions during the year, added greatly to the concern of the poultry farmer. In Central Queensland, a similar situation was also apparent, but in this area, production far in excess of local needs and without the competition from outside traders was responsible for lowered net returns. In North Queensland, the slight increase in producion was easily absorbed in that area.

TABLE POULTRY PRODUCTION

Twice as many table chickens were processed in the Brisbane Metropolitan and Gold Coast areas during the year under review as in 1959-60. In the country districts considerable expansion was also noted. From information derived from poultry slaughtering returns, production in country districts was nearly half of that in the Brisbane-Gold Coast area. During the year a large company with considerable financial resources for investment in table poultry production commenced operating in the Brisbane area. This firm has already invested in excess of a quarter of a million pounds in plant and is now geared to produce a million table chickens (broilers) during 1961 and could double its output if the local and interstate markets can absorb its production. It has the largest plant of its kind in Australia at the present time. It would appear that contract growing of broilers for large-scale processors will be an important feature of the industry. The number engaged in full-time production is not large by comparison with the number produced. Already the pattern of fewer growers with larger outputs is very evident. At the present time two companies account for more than half the total number produced in Queensland

The year was not a lucrative one for broiler growers, for liveweight prices declined substantially whilst feed costs rose. In both Queensland and New South Wales (which has offered a profitable outlet for table poultry) production rose by leaps and bounds without due regard being paid to the development of marketing outlets, with the result that the Australian market was oversupplied from January to March. Prices to producers fell to as low as 1s. 10d. per lb. liveweight and some processors, unable to clear stocks held in cold store, ceased buying. The temporary slump had a salutary effect, for it has jolted growers into the necessity for efficiency in production and processors into the urgent need for better presentation at a competitive price.

The number of hens processed was not much greater than in the previous year despite the known increase in the number of laying birds on farms. It is likely that, due to a fall in market value for hen meat, farmers are retaining a number of layers for a second year of production.

During the year, administrative control of poultry slaughtering passed from this Section to the Veterinary Services Branch.

Table 1 sets out the total number of poultry slaughtered in the Brisbane-Gold Coast area.

TABLE 1

POULTRY SLAUGHTERINGS AT ABATTOIRS IN THE BRISBANE-GOLD COAST AREA, 1956-57 TO 1960-61

Year	Chickens (Broilers)	Hens	Total Slaughtered (including ducks, turkeys, &c.)
1956–57	348,922	400,105	734,952
1957–58	362,713	377,105	779,090
1958–59	552,794	345,992	928,654
1959–60	829,946	384,443	1,248,964
1960–61	1,843,769	434,078	2,311,840

DAY-OLD CHICK PRODUCTION

The total number of chickens hatched in Queensland in 1960 was 6,678,924, and the number sexed (4,376,708) was 4 per cent. higher than in 1959. It is of interest to note that 20 per cent. of day-old pullets sold by hatcheries went to farmers in other States, mainly New South Wales. Over two million unsexed chickens were supplied to broiler growers by registered hatcheries, mainly during the period January to April and October to December, when day-old cockerels were not available.

REGISTRATION OF STOCK SUPPLIERS

During the year 31 stock suppliers registered under the *Poultry Industry Acts,* 1946 *to* 1959 did not renew their registrations. These included 12 engaged in the business of hatching chickens for sale, 4 in the business of supplying fowls eggs for hatching and 15 in the business of a Poultry Dealer. New registrations effected were 8 for the business of hatching chickens for sale, 6 for the supply of fowls eggs for hatching and 6 for the business of a Poultry Dealer. The number of stock suppliers now stands at 171.

POULTRY ADVISORY BOARD

This Board met on two occasions. The business dealt with included the amount of precept to be levied on Marketing Boards, consideration of proposals for marketing and grading eggs, registration of poultry farms, and reports on the experimental programme being conducted by the Poultry Section.

QUEENSLAND POULTRY IMPROVEMENT PLAN

The Queensland Poultry Improvement Plan has now been operating for four years. The genetic gains in terms of increased egg production which it was expected would be apparent in consecutive random sample test results are not as yet very evident. Statistical examination of the results does show an improvement in some flocks, but the rate of improvement is not as great as was anticipated. This may be due to the fact that the sire family method of breeding used by the majority of co-operating breeders is not as efficient in practice as in theory. To speed up breeding progress it will be necessary to replace the present system with the more comprehensive method based on single-bird recording in addition to recording on a family basis. Whether all of those breeders presently engaged in breeding will have the facilities, finance and labour to do this work is open to conjecture. It is likely that only the larger breeding establishments will be able to continue, for the general depressed level of profitability at the present time in the industry will determine whether some of the co-operating breeders will be able to afford the change-over in breeding method.

The third random sample production trial terminated on December 17, 1960. Table 2 sets out the more important data obtained from this test as compared with previous tests.

TABLE 2

COMPARATIVE DATA—RANDOM SAMPLE PRODUCTION TRIALS NOS. 1, 2, AND 3

Test	Hen Housed Production per Bird (eggs)	Pounds Feed per doz. Eggs	Average Net Return per Bird Housed (£ s. d.)	Average Egg Weight (oz.)	Mortality (19 to 66 weeks) (%)	First Grade Hen Eggs (%)
1957–58	160·83	6·04	1 18 4	2·07	12·31	75·63
1958–59	171·52	6·07	1 19 11	2·05	8·75	73·46
1959–60	162·39	6·27	1 7 9	2·03	9·00	69·71

Of particular interest in this table is the margin of profitability, which is calculated by deducting the cost of feed from the gross return obtained for eggs produced and the sale of carcasses at the end of the trial. It does not represent the net profit, for labour changes, depreciation, etc., are not deducted. While the wide fluctuation in "profitability" is influenced to some degree by levels of production and mortality, "in between" and "within" year variations in feed and egg prices are the dominating factors. It serves to demonstrate the need when evaluating "profitability" to use average production costs and returns over several years for comparative purposes.

The fourth random sample production trial which commenced on December 24 was altered somewhat to conform with the recommendations of the Poultry Technical Sub-Committee of the Animal Production Committee. The sample of hatching eggs for this test was derived from the general hatchery flock on breeding farms instead of the breeding nucleus. The sample was enlarged from 180 to 270 hatching eggs so that there are now 72 pullets housed in three replicate pens of 24 in place of 40 pullets in two replications of 20 as in previous tests. The groups in the present test have been in production for six months. Unfortunately, an outbreak of encephalomyelitis (epidemic tremor) occurred in a group of chickens from a breeder whose flock was transmitting the disease and others in the same hatch were affected. Losses to 17 weeks of age were 7·44 per cent. and were much higher than in previous years. Age of sexual maturity did not appear to be affected, for the average age at first egg was 134·5 days (138 days in Test 3) and the age to reach 50 per cent. production was 166 days (166 days in Test 3).

EXTENSION

Despite staff shortages and an increase in the number of birds submitted for blood testing, the number of visits paid to farms was comparable with that of previous years. Many

enquiries were received for information on commencing egg production and broiler growing regardless of the fact that both occupations were less remunerative than in the previous year. It was found that, in most cases, the enquirers did not have a true appreciation of industry costs, their interest being evoked by the ruling retail prices for eggs and poultry meat. Both egg producers and broiler growers were catered for in radio talks and in articles in the *Queensland Agricultural Journal* on poultry feeding.

EGG QUALITY SURVEY

At the request of the Egg Marketing Board further checks on the accuracy of candling methods of grading were carried out in July and September 1960. Checking was done by measuring the interior quality based on a correlation between egg weight and albumen height. In these surveys samples were taken of eggs graded as First and Second Grade for all five Egg Board districts, the size of the district sample being governed by the volume of eggs derived from each district. It was very evident that the average quality of eggs handled by the Board is greatly influenced by prevailing temperatures. In the warmer months of the year, the average quality falls, as does efficiency of grading by candling methods. While the Egg Marketing Board has taken very positive action to maintain quality while eggs are on Board premises by air conditioning its grading floor and during distribution by the use of insulated delivery vans, two other links in the merchandising chain are vital to ensure good average quality. They are (1) prompt cooling of eggs on the farms and fast transport to market, and (2) proper holding conditions for eggs in retail stores, particularly where they are to be held for periods of up to a week. Farm cooling can be costly, for cheap evaporative-type coolers are not effective in the coastal districts where much of the egg industry is located.

RESEARCH

Grain and Meatmeal Feeding to Layers.—This trial at the Kairi Regional Experiment Station was a repetition of an earlier trial conducted in 1958-59 concluded during the year under review. The results obtained confirmed the original findings inasmuch as the all-mash ration composed of equal parts of maizemeal and sorghum meal with the addition of meat-and-bone meal, salt and vitamin and mineral supplements was the most efficient method of feeding in terms of production and the quantity of feed required to produce a dozen eggs. It was very noticeable, as in the previous work, that the quantity of meat-and-bone meal eaten was far greater in the free-choice whole maize and free-choice whole sorghum rations. Expressed as percentages of the total food intake, the percentage quantities of meat-and-bone meal eaten were:—whole sorghum free-choice ration (15·8), whole maize free-choice ration (25·6) and all-mash (12·5). This method of feeding does not improve production and is very wasteful, particularly in regard to animal proteins. It is not recommended as a feeding method.

Winter Lighting on the Atherton Tableland.—The results obtained from this trial, which commenced with day-old chickens hatched in June 1959 and concluded in 1960, show the advantage of higher winter production to be obtained from laying flocks hatched prior to July in any year on the Atherton Tableland when given early morning lighting during autumn and winter. The increased production noted in favour of lights is very similar to the favourable differences found in the southern areas of the State.

The trial was somewhat marred in the early stages by disease outbreaks two months prior to commencement of lighting in March 1960. From the period of commencement of lighting in March until the termination of the trial in October, average production per bird on early morning lighting was 8·3 eggs better than the unlit group. Early morning lighting is now being used by large-scale commercial farms in North Queensland coastal districts. While some benefit is derived directly from light "stimulation," another advantage is that layers and broilers feed more readily during the cooler hours of the day, thus assisting in the maintenance of production.

White French Millet in Chick Rations.—A further trial on the use of whole and crushed white French millet in chick starter rations was carried out early in 1960-61 at the Poultry Section of the Rocklea Animal Husbandry Research Farm. The design of this trial was similar to trials carried out in the previous year. The results confirmed the findings that white French millet is a very suitable grain for inclusion in chick mashes and hence in other poultry rations. Efforts have been made through the Agriculture Branch advisory service to popularise the growing of this grain on the Darling Downs. An article based on the results obtained was published in the *Queensland Agricultural Journal.*

Bloodmeal in Poultry Rations.—As a follow-up to the work reported in 1959-60 on the use of bloodmeal in chick rations within the range of 2·5 to 10 per cent., further investigations of the effect of bloodmeal added within the range of 1 to 5 per cent. to chick rations were carried out. The meat-and-bone meal used in these rations was guaranteed to be free from added bloodmeal, so the effect of additional bloodmeal would be due mainly to the level used. This trial lasted for eight weeks and confirmed the previous finding that chickens can tolerate the addition of 5 per cent. bloodmeal provided that the meat-and-bone meal used in the ration does not contain added bloodmeal.

In this trial bloodmeal was used in conjunction with a meat-and-bone meal of reasonable quality. A further trial was carried out using bloodmeal added at 1, 2, 3, 4 and 5 per cent. levels to a chick ration containing a meat-and-bone meal which was low in total crude protein and with a high bonemeal component. Bloodmeal did not improve the growth rate when used in conjunction with average or poor quality meat-and-bone meals. From the trials carried out, bloodmeal would appear to be of little value in chick rations.

Egg Pigmenter Trials.—Because of the widespread use of vitamin A supplements in poultry rations, the use of green feed as a source of vitamin A has declined. This has resulted in many eggs having very pale yolks which, while not lacking in nutritive value do not have aesthetic appeal to the consumer. A synthetic carotenoid has been developed by one of the leading vitamin manufacturers for addition to laying mashes to improve yolk colour. At the request of the Egg Marketing Board, trials were carried out at the Rocklea Poultry Section on the effect of adding various amounts of this yolk pigmenter to laying rations fed to layers housed in cages. The levels used were 10 grams, 20 grams and 30 gram respectively of egg pigmenter to every 2,000 lb. of mash. Yolk colour was judged by reference to a colour-fan provided by the manufacturers. A satisfactory yolk colour was obtained at the highest level of supplementation within 10 days of commencement of feeding. However, the cost of the material would add considerably to the total ration cost and hence it may not be economical to use. The basal ration used was composed of wheat, which has very little carotenoid pigment. It is intended to repeat this work as soon as the layers reach a satisfactory level of production after their winter pause.

At the same time the opportunity was taken to evaluate the yolk colour of eggs derived from groups of layers housed also in cages and fed rations containing 10, 20, and 30 per cent. maizemeal respectively. No synthetic egg pigmenter was added to these rations. It was found that the addition of 20 per cent. maizemeal produced a yolk colour similar to that provided by the addition of 30 grams of egg pigmenter per 2,000 lb. of ration.

Broiler Breeding Investigations.—A dominant white strain of meat-type bird based in repeated test matings of White Leghorn and Indian Game has been established. This strain will be evaluated for growth rate on the basis of performance of progeny derived from this strain mated with heavy laying breeds such as Australorps and New Hampshires. Cross matings were also made between light Sussex males and Indian Game females. The progeny were far superior in growth rate and conformation to all other broiler crosses at Rocklea. However, this cross is far too costly to produce because of the poor rate of lay of Indian Game females. The crossbred progeny will be inbred during the coming year and tested for silver dominance. If this can be established, a dominant silver male based on the Light Sussex-Indian Game cross may make an ideal meat-type male to mate with heavy-breed egg layers.

PULLORUM TESTING AND ACCREDITATION

The pullorum testing figures for the year are given in Table 3. It will be noted that the total number of birds blood-tested was considerably higher than in 1959-60 although the number of registered suppliers' flocks was similar. This increase in blood testing was due to the big expansion in several flocks to cater for the production of chickens for sale to broiler growers.

TABLE 3

——	1958–59	1959–60	1960–61
Total number of fowls tested	225,484	258,583	291,118
Number tested for registered stock suppliers	219,920	253,226	284,067
Number of registered Stock Suppliers' flocks tested	131	118	118
Number of flocks with no reaction at test ..	78	73	78
Percentage reaction for State	·13	·16	·11

Of the total number tested, 64 per cent. were Australorps, 19·6 per cent. were White Leghorns and the remainder were New Hampshires, Rhode Island Reds and meat-type breeds supplied to franchised hatcheries in Queensland from parent breeding organisations in New South Wales.

The number of stock suppliers who were accorded "Pullorum Free" accredited status for their flocks in 1960 was 16, while a further 35 were granted a "Pullorum Clean" classification. Pullorum accreditation is voluntary and a number of stock suppliers whose flocks were eligible either for "Pullorum Free" or "Pullorum Clean" status did not

apply. Pullorum Accreditation for 1961 is now under way and already 15 have been granted "Pullorum Free" and a further 15 "Pullorum Clean" status.

DISEASE CONTROL

An outbreak of stickfast flea in the Beachmere area, where it has been present for several years, occurred on a broiler farm. Prompt action was taken to contain this outbreak and chickens were treated and inspected before sale to abattoirs. A recent outbreak occurred in the Brisbane bayside suburb of Manly. As some poultry farms are located in this district, a survey was made of the extent of the infestation and all poultry, dogs and cats were treated on the infected properties.

Disease problems in laying flocks were similar to those encountered in previous years. Hatchery born diseases such as encephalomyelitis (epidemic tremor) and omphalitis were of considerable importance. For the broiler grower, disease problems were of even more serious consequence because of the effect of wastage on an already reduced margin of profit. Nephritis and chronic respiratory disease were common but it would seem that the use of broad-spectrum type antibiotics has not given the good results of previous years. Staphylococcal infection was prevalent in the last few months and there seemed to be a greater incidence in stock housed on wire floors.

DIVISION OF DAIRYING

The Division's programmes of extension and research were continued with the objective of assisting in the production of high quality milk, cream and manufactured dairy products and the production recording of dairy cattle. They have been concerned with projects which help towards economic, efficient practices on farms and in factories and the diversification of products. The administration of the Dairy Produce, Margarine and Filled Milk Acts is another major feature of Divisional work.

Emphasis has been placed on attaining the objectives to the maximum extent possible by co-operation with the industry, and in relation to the Dairy Produce Acts by the implementation of programmes of advisory services rather than by the regulatory powers. It is pleasing to report that the desired results have generally been achieved.

In projects connected with the Commonwealth Dairy Industry Extension Grant and the Dairy Extension Advisory Committees considerable headway was made, and it is clear that the link which has been forged between industry organisations and Departmental officers in connection with these activities is leading to a strengthening of the extension programmes of the Department.

There was a considerable expansion in the research programme within the Division, partly from funds made available under the Research and Promotion Scheme for Dairying.

Following approval for the establishment of an experimental pilot plant for dairy research, plans are now being finalised for the erection of the necessary building and equipping of this plant and ancillary laboratories. The necessity for this building is emphasised by the expanded research programme of the Branch, additional staff and increased orbit of responsibilities.

In conjunction with the Butter Marketing Board, experiments in the production of butter with an enhanced flavour made from cream to which starter culture is added were continued. In a consumer preference trial, an appreciable number expressed a preference for the fuller flavoured product. Shipments of the unsalted product to the United Kingdom have been most favourably commented on. By the inclusion of a specially treated salt, it is hoped to produce a good keeping quality cultured butter for export purposes.

The development of butterfat spreads has now reached a stage where commercial production is expected to begin in the near future. Apart from use as a spread, the product can be used as cake fillings, toppings or frostings, and, after adjustment in composition, may also be used in milk drinks and ice cream. Its use in cake mixtures and shortenings is also under investigation. This research has as its aim the increasing of the consumption of butterfat in new dairy foods.

Research in conjunction with a dairy machinery firm and the Butter Marketing Board has led to the development of a method of removing weed taints from butter-oil. The process enables seriously weed-tainted butters to be reclaimed for producing butter-oil for the manufacture of ice cream and recombined milk products. Resulting from this work, the Butter Marketing Board has installed plant which will enable all second-grade butter to be removed from the market; this is a most important step towards enhancing the reputation of Queensland butter.

During a period of 20 years, Queensland cheese quality has been raised from a low to a very satisfactory standard, but there was a slight decline during the last two years. The incidence of a defect described as "fermented" was partly responsible. A determined effort was made to restore cheese quality, emphasis being placed on intensive testing of the quality of milk supplies, coupled with follow-up advisory farm visits by field officers. It is gratifying to record that, as a result, the specific defect mentioned was almost eliminated, and cheese quality showed a marked improvement.

Although mainly cheddar cheese is produced in Queensland, some other varieties—Roman, Gruyere and Red Malling—have been produced for many years at one factory. However, in recent years other factories have embarked on the production of several other varieties; they are of sound commercial quality and their sales are increasing steadily. Following successful experimental work by a Divisional officer who some two years ago visited Europe to study cheesemaking techniques there, the manufacture of blue vein cheese was undertaken at the Toowoomba factory. A good quality blue vein cheese is being produced, and commercial production will be expanded when the consistent production of cheese of uniformly good quality is assured.

Rindless cheddar cheese, now made in 15 factories, has met with consumer appeal, as evidenced by increasing sales. Favourable reports have been received on the quality and packaging of rindless prepackaged cheese exported to the United Kingdom. The price premium is encouraging enough to ensure expansion of this trade. During 1960-61, 31,911 cases were exported, an increase of 185 per cent. on the previous year's supply.

The first commercial manufacture of hydrochloric acid precipitated casein in Queensland was commenced by the Maleny Co-operative Dairy Association Ltd. in September. From an initial daily intake of 1,000 gallons of milk for treatment, supplies increased to a maximum of 3,000 gallons daily during the summer months. Casein of edible quality was manufactured and the small quantity produced was exported to the United States. The total cost of the packaged plant was £36,500. The system of manufacture and washing is the prototype of modern manufacturing plants being established in the southern States.

Most milk factories supplying Brisbane with market milk have now installed bacteriological equipment for thermoduric testing and as a result there was a noticeable improvement in the quality of milk at such factories. The chemical quality of milk was also satisfactorily maintained.

Herd production recording schemes, their ancillaries such as sire surveying and merit registers, and surveys of data from recorded herds have continued to play an important part in improving productivity in production-recorded herds, and in providing information which is of benefit to dairy farmers generally.

The laboratory quality control schemes for market milk, butter and cheese, always an important function of the Branch, were expanded. The establishment of milk quality control laboratories by the industry on a State-wide basis is assisting the improvement in pasteurised milk. Encouragement has been given to dairy associations to establish their own plant control factory laboratories and the Division has assisted in planning and equipping factory laboratories and training of key personnel for factory laboratory work. Sixteen such laboratories are now operating. Three Associations, under Departmental guidance, have also extended their laboratory activities to assist the improvement of butter and cheese quality and the efficiency of factory processing. This is indicative of the increasing importance being placed by the industry on laboratory quality control services.

Greater importance has been placed on the bacteriological quality of dairy produce for export purposes. High bacteriological standards of purity are now being demanded by many countries to which Queensland dairy produce is being exported. To assist the development of these markets the laboratories are testing large numbers of samples submitted for analysis.

Technical advice has also been given towards the establishment of dairy processing plants in the Far East, Philippines and Japan, which process raw materials supplied from Queensland.

At an Australian butter conference in Melbourne, the Queensland Butter Improvement Service was accepted as a pattern suitable for application throughout Australia.

The Divisional extension programmes were actively pursued towards assisting farmers and factory personnel in increasing the efficiency of their operations, the quality of

their products, the development of new products and processing techniques and co-operating with industry organisations in training programmes. Supporting these projects has necessitated the co-ordination of the efforts of field and specialist officers, and all forms of extension media from individual contacts, press releases, publications, group and mass methods were widely used. Over 69,000 contacts were made with farmers through various extension media and, in addition, hundreds of factory personnel were contacted during visits to factories by officers.

The several Dairy Extension Advisory Committees rendered valuable assistance to producers in association with Departmental extension programmes. By associating themselves with functions such as the Toowoomba Farmers' Festival, farmers' schools, and other group extension activities the flow of the findings of research to the industry was speeded up. By sound planning at the beginning of each year and the adoption of a district programme these Committees are now working on a sound basis. Farmer members appreciate having a stake in extension planning.

FIELD SERVICES BRANCH

EXTENSION WORK

All Branch Officers have now attended an Extension School and this training is facilitating the transmission of information on improved techniques to both farm and factory personnel.

Extension was directed mainly towards an intensification of the quality improvement programme, the development of herd recording and the adoption of recommended practices in factories. An additional Branch programme featuring the important subject of milking management was launched with the object of obtaining worthwhile increases in milk production.

The programme on modern milking methods is based on Departmental recommendations and on methods used in New Zealand, where an average increase in milk production of 18 per cent. is being obtained by simultaneous stimulation and washing of the udder in contrast to no udder washing at all.

One important extension event of the year was the third Farmers' Festival held at Biddeston, near Toowoomba, and organised by the Eastern Downs Dairy Extension Advisory Committee and the Department of Agriculture and Stock. The attendance for the two days was 20,000.

The four film projectors operated by Branch officers in the main dairying areas were used to good effect. Educational films dealing with the production and manufacture of dairy produce, herd recording, the operation and care of milking machines, etc., were shown to appreciative audiences in several centres. Several dairy hygiene method demonstrations attracted good attendances. More factory managers are now attending those field days and method demonstrations which feature quality improvement and the increase of milk production. An increasing interest in the supply of advisory material to producers was evidenced by factory managements. Several short monthly news-sheets were prepared by them, in conjunction with Departmental officers, for distribution to their suppliers.

Farm visits and attendances at field days, etc., were as follows:—

	Farm visits	Attendances at field days, etc.	Total
1959-60 ..	25,230	30,739	55,969
1960-61 ..	27,248	32,029	59,277

In addition, approximately 10,000 calls were made by farmers to the offices of country staff for information and advice.

A second special technical training school for senior butter factory operatives conducted at the Queensland Agricultural High School and College by the Department of Agriculture and Stock in association with the Australian Society of Dairy Technology, the Australian Dairy Factory Managers and Secretaries Institute and the College authorities attracted 15 students, and seven students attended an Advanced School for Cheesemakers held at the College under the aegis of the same bodies.

QUALITY OF DAIRY PRODUCE

A noteworthy achievement was performed during the year when field officers, in collaboration with officers of the Dairy Research Branch and with the assistance of cheese factory managers, attacked the problem of fermented defect in cheese, which had become a matter of deep concern to the cheese industry.

Surveys were carried out at all cheese factories at least once per month throughout the greater part of the year and comprehensive reports on over 28,000 tests made by Field Officers were submitted to managers. As a result of a combined effort by industry and Departmental personnel and the steps taken on the farms to overcome this problem, a big improvement was effected, resulting in cheese quality reaching its highest peak to date. Further improvement in cheese milk is necessary, however, before it can be said that the quality is satisfactory, while the effect of antibiotics on milk quality has yet to be fully determined.

A cream quality improvement drive initiated in April 1959 contributed to a rise in percentage of choice grade butter from 33·81 to 40·63 per cent. in 1959-60 and to 46·12 in 1960-61. Thus for the past two years there has been an upward lift in quality of 12·31 per cent.

Laboratory and commercial trials demonstrated that the addition of salt to butter increased the organoleptic perception of inherent weed-tainting substances. In butters which graded 93 and 92 points in an unsalted condition, insignificant changes in quality were evident in salted samples from the same butter grain when brine concentrations were maintained below 5·0 per cent. However, at levels of "normal" salting (i.e., a brine concentration of 9·60 per cent., representing a 1·52 per cent. salt content in a 15·80 per cent. moisture butter), a loss of one grade point occurred in the salted compared with the unsalted butter. When brine concentration was increased to a level of approximately 14·0 per cent., quality deteriorated by a further ½ point. This degree of quality deterioration at higher salt concentrations was constant for butters of differing initial quality.

DAIRY FARM FACILITIES

The dry conditions which operated during several months of the year were responsible for a shortage of water supplies with a consequent bad effect on hygiene in some areas. Fewer new dairy premises were erected, mainly because of the dry conditions and the difficult financial position. The increasing extension of electricity into rural areas has resulted in the substitution of electric water heaters for copper boilers in considerable numbers. Approximately 400 dairy refrigerators were installed, bringing the total to 4,200. The increasing practice of individual farmers installing refrigerators and taking their own cream to the factory once per week must inevitably jeopardise the future of some cream carriers. A small number of farmers in one district have ordered bulk tanks in preparation for the introduction of the first milk tanker pick-up in Queensland.

DAIRY FARM MACHINERY

The delivery of 13 additional air flow meters and Ruakura vacuum recorders brought the total now used by officers to 43, and 1,429 machines were examined, compared with 905 in the previous year. Only 7 per cent. were found to be faultless but officers were themselves able to repair 29 per cent. of the faulty machines. It is anticipated that next year between 3,000 and 4,000 machines will be tested.

During the year a series of five planned experiments on the effect of cow preparation methods in production, maximum milking rate and overall milking rate were carried out by Branch officers using the facilities at Gatton College. More than 500 cow graphs were made by the milk recording apparatus designed and constructed by the Senior Adviser conducting this work. When definite recommendations on milking methods are available, the information will be used in a properly prepared programme designed to cover the whole of the State.

The first survey of its kind in Queensland was carried out to determine the butterfat losses during farm separation. A total of 198 farms was selected throughout 27 dairying districts. On the basis that a fat content of less than 0·10 per cent., as estimated by the normal butyl alcohol test, is satisfactory, the study revealed that only 15 per cent. of the separators examined were providing inefficient removal of butterfat from milk. Since this work was completed the two major separator firms have reported a big increase in the amount of reconditioning work coming forward.

Steam sterilizers for dairy farm use have become unpopular on account of their high price, a typical unit now costing about £150 installed. During the year an electrically heated dairy steam sterilizer was marketed, installation costing about £130 complete with wash-up trough, piping, valves, steam trip valve and freight. Electric dairy water heaters are very popular.

Items submitted for trial by dairy machinery manufacturers included a fibre-glass milk vat, an aluminium milk vat, an oil extractor and muffler for vacuum pumps, welded stainless steel milk tube, and a plastic milk bucket. The first two were found to be unsuitable and the other three items are still on trial.

COMMONWEALTH DAIRY INDUSTRY EXTENSION GRANT

Despite the poor season good results were obtained on several demonstration projects. Sod-seeding of oats into established irrigated pastures during the period of slow clover growth was demonstrated with excellent results. Silage-making demonstrations continued to stimulate interest in fodder conservation. Over the past decade silage-making in the main dairying districts of the State has increased from 10,000 tons to 50,000 tons annually.

On the Darling Downs it was shown that by grazing the dairy herd on cowpeas in early autumn it was not only possible to arrest the normal decline in production but to obtain outstanding rises. Bloat control by the use of the tallow spray method and later by the use of a special cold-mix anti-bloat preparation was effectively demonstrated. Another demonstration which attracted much interest was a farm-built 2,000 gal. plaster concrete water tank.

At the beginning of the year there were 111 active farm demonstrations. Thirty-seven projects were cancelled during the year and 29 new ones approved, leaving 103 at the end of June.

A show exhibit depicting cheese was prepared from Grant funds for the 1960 Royal National Exhibition, and was later displayed at the major country shows.

HERD PRODUCTION RECORDING

Without herd recording no farmer knows just how profitable each of his cows is. Therefore it is disappointing that only 7 per cent. of dairy farmers in Queensland use the herd recording service provided.

A pilot survey conducted during the year amongst former members of herd recording groups to ascertain their reasons for ceasing to use the service indicated that the low price received for dairy produce, the uncertainty of the overseas market, the cost of herd recording and adverse seasonal conditions were the main reasons. Forty-three per cent. stated that the production of their herds had increased while being recorded; 85 per cent. considered the service was satisfactory. Field officers co-operated in an endeavour to obtain a greater membership of recording groups, but the seasonal conditions were unfavourable.

Pure Bred Production Recording.—Following a conference of representatives of the Stock Breeders' Association, dairying organisations and Departmental officers in June 1959, the official length of lactation was reduced from 300 to 270 days on July 1, 1960.

The various Dairy Cattle Associations use arbitrary standards of butterfat as a basis of eligibility for cows to enter the Advanced Register of their herd-books. Such standards are based on the age of the animal at the time of calving and are common to the whole State. In view of the varying seasonal and environmental conditions which exist from district to district, the representatives of the Stock Breeders' Association were asked to agree to the deletion of the age production standards from the rules governing the Pure Bred Production Recording Scheme. They decided against this request, and as the length of lactation period had been reduced, a new set of standards, based on the results of a survey of production records over a period of five years, was introduced on July 1, 1960. As shown below, the standards are lower than those previously in force, but are more in keeping with conditions prevailing throughout the State.

Under 2 years	210 lb.	(No former standard)
2 years and under 2½ years	220 lb.	(260)
2½ years and under 3 years	240 lb.	(280)
3 years and under 3½ years	260 lb.	(300)
3½ years and under 4 years	280 lb.	(320)
4 years and under 4½ years	290 lb.	(330)
4½ years and under 5 years	300 lb.	(340)
5 years or over	310 lb.	(350)

The method of supplying information to stud herd owners was improved during the year by making greater use of punch-card equipment. They now receive each month a record sheet showing the monthly yield of each cow and a report showing each animal's production and the length of her lactation to date. When each animal dries off or completes a 270-day lactation the owner receives a detailed statement of monthly and total yield, stamped to indicate whether the butterfat standard was reached.

Because of adverse seasonal conditions, the number of pure bred herds recorded was reduced from 153 to 150.

Recorded lactation periods of 270 days or less were completed by 3,092 cows, the average yield being 6,093 lb. milk and 258 lb. fat. The average fat content of the milk was 4·2 per cent. The average production for cows of the various breeds is shown in Table 1.

TABLE 1

AVERAGE YIELD OF PUREBRED COWS ACCORDING TO BREED

Breed	Number of Cows	Average Yield		
		Milk (lb.)	Test (%)	Fat (lb.)
A.I.S.	1,294	6,952	3·9	274
Ayrshire	86	6,953	4·1	287
Friesian	155	6,558	3·3	216
Guernsey	322	5,907	4·5	258
Jersey	1,235	5,092	5·0	253
Total	3,092	6,093	4·2	248

The recorded yields of all cows recorded under the Pure Bred Scheme are included in an annual publication which is distributed to interested dairy farmers. This information is valuable for persons desirous of improving the production of their herds by judicious selection of suitable bulls and female cattle. In order to supply full information on the productive ability of each animal an "expected level of production" for each animal in each herd has been compiled and is shown alongside her recorded production.

Total Solids.—With the increasing demand for milk for liquid and manufacturing purposes, consideration may have to be given in the future to recording for total solids content as well as for yields of milk and butterfat. In order to obtain information to evolve suitable techniques for field testing and recording, a pilot test is being conducted on one herd.

Sire Surveying.—The results of 137 surveys on bulls used in stud herds were published, compared with 97 for the previous year. Summarised results appear in Table 2.

TABLE 2

SIRES SURVEYED ACCORDING TO BREED AND THEIR PERFORMANCES

Breed	Number of Bulls	Number of Bulls		
		+Rating. Increasing Production	− Rating. Decreasing Production	o Rating. Maintaining Production
A.I.S.	58	26	30	2
Ayrshire	4	2	2	..
Friesian	6	2	4	..
Guernsey	13	8	4	1
Jersey	56	30	24	2
Total	137	68	64	5
Percentage	..	49·6	46·7	3·7

Register of Merit for Dairy Cows.—Eleven cows, equal to the total number of entries up to the beginning of the year, qualified for entry into the Elite section, which requires an animal to produce a minimum of 3,600 lb. fat in not more than 10 lactations.

The large number qualifying is due to a realisation by breeders of the value of lifetime production records for assessing the capabilities of the cows as compared with the prevous practice of using one lactation record only. The number of cows of each breed which qualified for entry during 1960-61 is shown in Table 3.

TABLE 3

NUMBER OF COWS ADMITTED TO THE MERIT REGISTER IN 1960–61

Breed	Section of Register		
	Elite	Lifetime	Inter-mediate
A.I.S.	8	30	43
Ayrshire	1	2	3
Friesian	..	..	1
Guernsey	..	2	12
Jersey	2	34	28
	11	68	87
Total entries in Register to date	22	201	571

Merit Stud Register.—In order to focus attention on herds with a large percentage of merit register cows, a Merit Stud Register was introduced in July 1960. In merit stud herds at least 40 per cent. of the cows over the age of four years at the end of the recording year must be entered in the Register of Merit. This information indicates to commercial dairymen the studs which should have bulls from merit cows available. A total of nine herds qualified as a result of last year's recording—five A.I.S., two Jersey, one Ayrshire and one Guernsey herd.

Group Herd Recording.—Adverse seasonal conditions resulted in a reduction in the number of herds being recorded and necessitated the amalgamation of some groups. At the end of the year, 63 recorders were servicing 70 groups.

In the 1959-60 recording year, ended on September 30, 1960, a total of 47,607 cows from 1,287 herds completed recorded productions for an average yield of 403 gal. milk

and 169 lb. fat. Despite the less favourable season, the average production of butterfat was only 1 lb. fat below that of the previous year. The average length of lactation remained at 243 days.

The highest average yield for districts was recorded by the Eastern Downs, where an average of 500 gal. milk and 207 lb. fat was obtained from 6,050 cows in 208 herds. The Mackay area showed the lowest returns, with 312 gal. milk and 129 lb. fat.

The percentage of cows in various ranges of butterfat production is shown in Table 4.

TABLE 4

PERCENTAGES OF COWS IN VARIOUS PRODUCTION RANGES

Production Range of Fat	Percentage of Cows
Under 100 lb.	14·3
100–149	27·6
150–199	29·1
200–249	17·3
250–299	7·6
300 and over	4·0

Calf Identification.—During the year 7,544 heifer calves from 901 herds were ear tattooed by recorders to provide a permanent identification for the owners.

Sire Surveying.—This feature of herd recording continues to expand. Although many of the bulls are dead or sold by the time they are surveyed, the information as to their capabilities is still valuable as the results show whether an owner should persevere with or discontinue using bulls of that particular strain. Surveys were carried out on 400 bulls, compared with 350 during the previous year; 37 per cent. were raising production, 35 per cent. maintaining it and 28 per cent. lowering it. Plus or minus ratings were introduced into the surveying of bulls under the Group Herd Recording Scheme. This enables the owners to assess the value of the bull more readily than previously.

Effect of Month of Calving on Production.—Data accumulated over a period of 12 years have been surveyed to ascertain the best months for calving cows to obtain maximum production. A survey covering the period 1948 to 1954 showed that the favourable months for all Queensland were July, August and September. However, during the period 1955 to 1960 the period was June, July and August. This can be attributed to changes in farm management which provided greater quantities of fodder.

An interesting point is the alteration in the percentage of cows which calved in each month of the year. In 1948-1954, 19·3 per cent. of the cows calved in the first quarter, which is the least favourable period. In 1955-1960, this percentage had decreased to 13·7. Similarly, for the favourable third quarter, the percentage of calvings had increased from 30·6 to 38·0. This change in calving pattern in recorded herds has been achieved as a result of extension work which emanated from the Herd Recording Section.

Production According to Breed.—A survey revealed that there is little difference in the production of butterfat by cows of various breeds in defined districts. There is, however, an appreciable difference in the yield of milk, an important factor where milk is purchased for the liquid milk trade on a gallonage basis.

The average yield of the two main breeds in selected districts is depicted in Table 5.

District	A.I.S. Cows		Jersey Cows	
	Average Milk Yield	Average Fat Yield	Average Milk Yield	Average Fat Yield
	Lb.	Lb.	Lb.	Lb.
Atherton Tableland	4,400	165	3,480	161
South Burnett	4,550	172	3,530	167
South-East Queensland ..	4,345	163	3,460	163
Eastern Downs	5,210	203	4,185	205

Distribution of Breeds.—In group recorded herds Jersey cows comprise 41 per cent., A.I.S. 38 per cent., Guernsey 3 per cent., Friesian 2 per cent., and Ayrshire 1 per cent. The remaining 15 per cent. is comprised of crossbreds. In areas which supply milk for the liquid milk trade there is a trend towards the use of cows of high-milk-yielding breeds.

Analysis of Herd Records.—Successful extension work was carried out on several farms by staff using a detailed analysis of the records of each particular herd over a number of years as a basis for improvement in management practices. By this means it was possible to draw up culling and breeding programmes for the herd owner. The optimum months for calving on that particular farm were determined. The periods between calvings of cows and lengths of lactation indicate the effectiveness of the herd management. By using the findings of sire surveys in conjunction with the results of the analysis of herd recording results, a comprehensive management programme can be prepared each year.

Extension.—During the year officers of the Herd Recording Section collaborated with Information Branch officers in preparing a film strip for extension purposes. This strip, the first to be prepared by the Department, features the use of herd recording during drought periods and is operated in conjunction with a tape recorded commentary.

DAIRY RESEARCH BRANCH

RESEARCH

Good progress was made with projects financed by the Australian Dairy Produce Board under its Research and Promotion Scheme. Approximately £12,000 was provided for this purpose during the year.

Pilot-Scale Manufacture of Butterfat Spreads.—Flavoured butterfat has met with good consumer acceptance in consignments sent to America and gives promise for other flavoured butterfat products.

Cake toppings have been prepared by the Branch with butterfat contents ranging from 37 down to 9 per cent. Although consistently good products were produced at fat levels above 25 per cent., a 9 per cent. butterfat preparation was favoured so as to keep down the cost to the consumer. However, in a consumer trial, conducted by an organisation interested in the marketing of the products, the low-fat-percentage products were criticised because of stickiness and the presence of black spots. Treatment of the cans reduced the incidence of black spot, while the lower butterfat preparations proved most suitable for use as flavoured milk drinks. With further adjustments in the composition of the product, stickiness was reduced and a preparation obtained with improved whippability, good texture and desirable physical properties. Efforts are now aimed at determining the most suitable method for commercial manufacture.

The most effective method of stabilising butterfat emulsions, the effect of different cooling temperatures in relation to the physical characteristics of the products, and problems of keeping quality are also receiving attention.

The experience and knowledge gained in this work suggest that the process will have further application in the preparation of other recombined milk products utilising butterfat and milk protein.

Alleviation of Weed Taint in Butteroil.—Previous work had shown that it is possible to free the substances responsible for weed taints from the fatty fraction of dairy products. The principles of the process are governed by the fact that the weed-tainting substances, such as indole and skatole, can be reduced by water-washing, while the more difficult tainting substances, such as benzyl mercaptan and other isothiocyanates, must first of all be released from the fat emulsion by treatment with an appropriate acid or alkali and then separated.

Initial trials using caustic soda and sodium chloride proved too slow and costly for commercial use and resulted in high fat losses. However, separation problems have now been overcome by treatment of the concentrated substrate with phosphoric acid incorporated by in-line dosing and mixing, followed by water washing through an hermetic separator. This process is now being adapted for commercial use. The rapid short process has permitted the production in experimental batches of ice-cream grade oil from second-grade weedy butter. Analysis of these samples in conjunction with the C.S.I.R.O. showed no evidence of indole and skatole in the treated fat. In future trials it is hoped that larger samples will enable any particular tainting substances to be characterised with the aid of gas chromatography. It is also intended to examine the effects of ultra-pasteurisation temperature and pressure on weed taint removal without destabilization of the emulsions concerned.

Reducing Weed Taint in Milk and Cream.—No method has yet proved successful in removing weed taint from milk or cream in processing for butter manufacture. Efforts have therefore been concentrated on determining possible ways of reducing such taints on the farm. Contrary to the previous theory that weed taints persist in milk and cream for several days after ingestion, observations show that the morning milk supply is seldom affected, while the afternoon milking is severely tainted. Because of this, it has been considered possible to shed weed taint by grazing cows on some weed-free pasture and conserved fodder between the morning and afternoon milkings. In a trial on one farm with irrigated pastures, controlled grazing on the weed-free pasture between the morning and evening milking during the 1960 weed season markedly reduced the incidence of weed taint in milk supplies as compared with previous years. The significance of the practice is now being further examined in association with Agriculture Branch. The proposal is to ensure limited weed-

free grazing between the morning and the afternoon milkings and, with adjustments in grazing practices and the feeding of some conserved fodder, ascertain the effect in reducing weed taint. If promising, the practices will later be extended to non-irrigated pastures.

In the meantime, in collaboration with the University of Queensland and the C.S.I.R.O., an examination of the tainting substances in weeds and the possible effect of certain precursors in causing taints in milk is under way. The accurate identification of weed taints in cold cream at the factory during the winter months is difficult and results in much degrading of butter, so studies have continued with a view to developing a weed taint detector.

Improved Butter Flavour by Cream Culturing.—The object of this work is not to produce a Danish-type butter but rather one which, while possessing an attractive flavour, is suited to Queensland conditions of production and marketing.

In addition to using cultures of *Streptococcus diacetilactis,* a large number of flavour-producing organisms were isolated from naturally ripened cream and used, singly and in mixtures, for flavour production in cream and butter, both in the laboratory and in factory trials, with promising results.

Trials with buttermilk for bulk culturing were continued because of the difficulty in obtaining fresh skim-milk in some butter factories and the results have been published. Following the satisfactory results obtained in the laboratory, buttermilk has since been used successfully in large-scale trials.

Extensive studies have been carried out on the factors involved in flavour production in cream. It has been found that maximum diacetyl production always occurs within the same pH range, irrespective of the conditions of experimentation or the culture used. Over 1,000 distillations for diacetyl and acetylmethylcarbinol were made in the course of these studies. At the same time 65 experimental butters were made. Adjustments with caustic soda to a constant acidity after ripening and just prior to churning did not effect the improvement desired but further trials are proposed.

Bacteriology of Butter.—The effect of psychrophilic organisms on butter quality is being studied and psychrophiles were found in 29 of 78 butters examined. Of the 66 cultures isolated, 7 were species of *Pseudomonas,* 26 had lipolytic properties and 24 were caseolytic. When the survey of the incidence and types of psychrophilic organisms has been made, it is proposed to investigate their biochemical activity and effect on the quality of butter during cold storage. The results of investigations on proteolytic organisms in butter have been prepared for publication.

Development of Continental Types of Cheese.—As a result of collaboration between Departmental officers and the Downs Co-operative Dairy Association Ltd., experimental batches of blue vein cheese were manufactured and the product made available to consumers. Some progress was also made in mechanising methods of manufacture.

Surface Defects of Cheese.—It is clear that the most important point in waxing of cheese to prevent mould development is the dryness of the rind. Drying must be carried out quickly enough and at a relative humidity low enough to prevent mould development. A drying time of 3–5 days has been found desirable for the purpose. Other aspects such as finish of the cheese, waxing temperatures and wax formulations are under investigation. The use of polyvinyl acetate coatings for cheese has been studied. However, the necessity for a second coating of these preparations containing sorbic acid as a fungistatic agent would make the cost of treatment prohibitive.

In trials, the superiority of metal cheese shelves over wooden shelves has been demonstrated. A further study is now being made as to the efficacy of ultra-violet lights installed in cheese factories for the control of mould populations. As a result of the work to date, surface defects in export cheese have been considerably reduced. A paper on this project is now being prepared for publication.

Delayed Acid Development in Cheese.—A study has been made of the slowing-up in cheese starter activity during the later stages of manufacture with a view to improving uniformity of flavour development. The results of earlier work provided an indication that the problem of fermented flavour in cheese could be associated with the slowing-up or cessation of acidity production in late manufacture or early storage. Some progress has been made towards the study of three factors believed to be associated with the problem, namely bacteriophage, presence of traces of antibiotics, and changes in the inherent vitality of starter cultures.

Surveys were carried out to assess the incidence of antibiotics in cheesemilk supplies. In order to aid this work a cheese starter inhibitory test sensitive to 0·5 I.U. of penicillin per ml. of milk was devised which can be performed by factory staff and field officers with equipment normally available. It has now been extensively used in conjunction with other tests in a survey of cheesemilk quality in Queensland. Over 300 samples showing low acid development in the inhibitory test were cross-checked with penicillinase, and only 14 per cent. contained penicillin. The conclusion to be drawn is that antibiotics other than penicillin are present in the milk and also that other inhibitors may also be present.

The role of bacteriophage is also being studied, commencing with the examination of curd and green cheese for bacteriophage titres and the correlation of these titres with starter rotations and vat behaviour. Bacteriological analyses have also been carried out on the same samples and the bacterial populations categorized into starter and non-starter counts.

The inherent vitality and compatability of various starter strains is also being studied from the viewpoint of acidity production.

In many cases the fermented flavour of cheese has been associated with decreasing numbers of starter population, accompanied by an increase in total contaminant count as the cheese ripened. All cases of typical fermented flavour were associated with lower activity of starter organisms which showed up either in the vat or in the green cheese. A number of agencies, including bacteriophage and antibiotics, appear to be involved, causing sufficient starter suppression to allow contaminating organisms from the milk supply to multiply and produce flavour defects.

Trials have now been arranged aimed at studying the secretion of various antibiotics in cheesemilk, the detection of traces of antibiotic residues and the influence of traces of residues on milk quality tests and cheese quality.

Lipases in Cheddar Cheese.—Why some cheese ripens more attractively than others is the subject of close study. In this regard, the effect of enzymes such as lipases in fat breakdown is being examined. Methods of extracting such enzymes, measuring their activity, bacteria producing them and effect on cheese flavour development are also receiving attention. The preliminary work on the development of a method for measuring lipase activity directly has been done and this work has been prepared for publication.

Fat Losses in Farm Separation.—At the request of the Queensland Dairymen's Organisation, the efficiency of farm separation and average fat loss in skim-milk were investigated. In collaboration with officers of the Field Services Branch, the number of separators tested was 198, the number of skim-milk samples examined 792, and the number of skim-milk tests 1,584. Only 15·3 per cent. of the bulk samples exhibited a fat content of 0·1 per cent. or greater. Such results do not indicate any great fat losses in separated milk. No extreme losses of butterfat were encountered and the majority of farmers appear to have their separators well adjusted. The highest percentage of fat losses was recorded in the commencement samples as compared with the middle and completion of separation and of the bulk skim milk. There appears to be a time lag before a separator achieves maximum operational efficiency. A further follow-up and re-check has been planned.

Cheaper Farm Refrigeration.—A comparatively cheap refrigerator has been constructed at a cost of approximately £100 and is now undergoing trials in the Beaudesert district. In previous trials with five immersion units, it was shown that the immersion principle of cooling is quite sound without the necessity for shock-cooling devices. The problem of can corrosion has continued to be overcome by treatment of the chilled water with sodium silicate at small cost. A cheaper farm refrigeration unit which has been devised embodies a farm-built concrete tank with two small drop-in reconditioned compressor units. These cheaper forms of immersion type refrigeration units are proving popular with farmers and requests for plans for 30 units in one district have been received.

Other Investigations.—The results of work on improved dairy detergent and sanitizer trials are now being collated and a technical paper prepared for publication. Collaborative work with officers of the Field Services Branch has continued with trials on milking rates. A cheap, convenient detection test for the estimation of fat in milk is also under trial. A survey of farm and factory water supplies was continued.

Because of a decline in the solids-not-fat percentage of milk in some sub-coastal districts, a survey is being conducted on the composition of Brisbane milk. Constituents being examined include lactose, total protein, calcium, ash and fat. Trials are also continuing with a view to determining cheaper methods of reducing the seasonal variation occurring in the fat and solids-not-fat percentage in milk. A paper on some aspects of this problem is being prepared for publication.

LABORATORY QUALITY CONTROL SERVICES

Laboratory services for the control and improvement of quality of dairy products were continued, covering raw and pasteurised milk, table cream, butter, cheese and cheese starter cultures.

Market Milk.—A summary of milk and table cream examinations is set out in Table 1. All milk-receiving depots are required to regularly sample and test raw milk supplies by means of the methylene blue test for hygienic quality and

the Babcock test for fat. In addition, increasing attention has been paid to the testing of raw milk supplies for thermoduric organisms, and factories have been encouraged and assisted in setting up their own laboratories to carry out this work.

TABLE 1

SUMMARY OF MILK AND TABLE CREAM EXAMINATIONS

—	1959–60	1960–61
Bottled Pasteurised Milk—		
Plate Counts	1,646	1,929
Over 100,000 per ml.	640	676
Coliform Tests (10 ml. and 1 ml. levels)—		
Number	2,774	3,107
Per cent. positive in 1 ml.	10·5	8·6
Phosphatase Tests—		
Number	1,561	1,604
Per cent. positive	..	0·2
Keeping Quality Tests—		
Number	773	1,189
Per cent. failure	0·9	1·5
Fat Tests—		
Number	1,310	1,501
Average per cent.	3·8	3·8
Solids-not-fat Tests—		
Number	1,305	1,635
Average per cent.	8·6	8·7
Freezing Point Tests	810	2,023
Factory Surveys	34	82
Raw Milks—		
Raw Milks from Country Depots—		
Methylene-blue tests	291,431	265,067
Fat tests	122,413	122,210
Bulk Tanker Samples Tested in Laboratory—		
Methylene-blue tests	790	885
Fat tests	808	899
Raw Milk Vendored—		
Methylene-blue tests	244	373
Fat tests	244	384
Thermoduric tests on raw milk	3,897	11,363
Microscopic Examinations	2,986	1,547
Cream—		
Bottled Pasteurised Cream (42% Butterfat)—		
Plate Counts	261	435
Over 100,000 per ml.	61	75
Coliform Tests—		
Number	534	519
Per cent. positive in 1 ml.	3·7	17·8
Phosphatase Tests—		
Number	275	296
Per cent. positive	5·8	31·8
Fat Tests—		
Number	279	296
Average per cent.	42·9	43·8
Bottled Pasteurised Cream (18% Butterfat)—		
Plate Counts	241	265
Over 100,000 per ml.	136	110
Coliform Tests—		
Number	486	512
Per cent. positive in 1 ml.	37	41
Phosphatase Tests—		
Number	255	291
Per cent. positive	12·5	2·1
Fat Tests—		
Number	259	290
Average per cent.	20·5	21·9
Total Number of Tests in Branch Laboratories	54,816	41,266
Tests on Raw Milks by Factories—		
Methylene-blue Tests—		
Number	291,431	265,067
Per cent. below 4 hours	2·5	1·5
Fat Tests—		
Number	122,413	122,210
Per cent. below 3·3%	1·6	3·5
Total	413,844	387,277

Fewer methylene blue tests were carried out at pasteurisation plants and country receiving factories, but the large number of tests done (over 260,000) indicates the control being exercised. The quality of raw milk improved, only 1·5 per cent. of milks failing the 4-hour methylene blue standard as compared with 2·5 per cent. during the previous year.

An increasing number of samples of bulk tanker milk were taken and examined, due to the increasing proportion of city milk received chilled in tankers from country milk-receival factories. There was a slight deterioration in the chemical composition of raw milk, the percentage of milks failing the 3·3 per cent. fat standard increasing from 1·6 to 3·5 per cent. This was due to drier seasonal conditions prevailing in most dairying districts during a great part of the year.

The count of thermoduric bacteria in raw milk has been regarded as supplementary to the methylene blue test in determining the quality of raw milk. Over 11,000 such counts were performed, compared with fewer than 4,000 during the previous year.

The quality of pasteurised milk was well maintained, only a very low percentage (0·2) failing the phosphatase test for pasteurisation efficiency and only 1·5 per cent. failing the revised keeping quality test. In addition, there was a reduction in the percentage of pasteurised milks containing coliform organisms (8·6 per cent., compared with 10·5 per cent. during the previous year).

A total of 3,864 milks was chemically examined for fat, specific gravity and total solids content. The chemical composition of milk has been maintained at a satisfactory level. The average fat content was 3·8 per cent. and the solids-not-fat content 8·7 per cent.

Of 2,325 freezing point determinations made, only six showed evidence of adulteration. The thermistor cryoscope is being examined with a view to enabling a more accurate estimation of the minimum freezing point depression of milk.

Over 700 samples of 42 and 18 per cent. fat content creams were examined, compared with 502 for the previous year. There is much room for improvement in the quality of market cream. The results of heat treatment on the bacteriological quality of pasteurised market cream have been collated and a paper prepared for publication. The results obtained also assess the possibility of using keeping quality tests for cream.

Butter.—Examination of butter samples was continued to provide information for both control and advisory services. A total of over 25,000 tests was performed on almost 5,000 samples of butter. Moisture and salt determinations were carried out on 1,985 samples, of which only 22 (1·1 per cent.) were found to be over-moisture. The average chemical composition was—Moisture 15·66 per cent.; salt 1·41 per cent.; curd 0·86 per cent.; fat 82·07 per cent. pH determinations on 1,186 samples gave a mean serum pH value of 7·48 as compared with 7·61 for the previous year.

The bacteriological quality of butter as determined by the bacteriological quality index has steadily improved over the past three years. The average index of 326 from 1,928 samples examined is the best result since the inception of the Butter Improvement Service. Installation of new equipment (especially stainless steel churns) contributed much to the all-round improvement in bacteriological quality.

As a result of the investigation on proteolytic organisms in butter, alterations have been made to the testing of butters under the Butter Improvement Service. The casein digester count has been omitted and a new system of points allocation introduced.

Assistance given factories in the control of *E. coli* has aided in the development of butter markets in South-east Asia and Japan.

Microscopic examinations were carried out on 1,984 samples to check the standard of working as determined by the size and distribution of water droplets in the butter. Eighty-six per cent. of the samples were classified as "well worked" or "fairly well worked", compared with 72 per cent. last year.

The testing of butters for extraneous matter continues to assist factories to overcome the problem of dust and other extraneous matter in butter. The importance of the work is appreciated by factory managements and many varied types of filters have been installed. Only 4·2 per cent. of extraneous matter tests on 1,970 samples were "dirty" or "very dirty".

The results of bacteriological and chemical analysis on butters in keeping quality competitions have been collated and are being prepared as an advisory publication for the information of factory managers.

Cheese.—A comprehensive technological, bacteriological and chemical service has been provided the cheese industry. In addition to carrying out routine laboratory examinations of samples obtained, specific factory problems have been investigated on request.

A total of 670 starter cultures was distributed to the various cheese factories. There has been a trend away from single strain starters to mixed cultures as a reaction to the occurrence of a relatively high proportion of cheese with fermented flavour in the previous year. However, it is felt that this is a passing phase and that following further research and more intensive selection of single strain starters they will regain their popularity.

The paucity of serious occurrences of bacteriophage trouble indicates a continuation of improvement in starter culturing methods at factories. Further investigations have shown that fairly high titres of bacteriophage are common in the cheese from some factories. This would indicate that greater care is necessary to avoid contamination with phage during cheese manufacturing operations.

Although the incidence of fermented flavour was only slight in cheese manufactured during the year, an intensive investigation of this defect was carried out. The results indicated that fermented flavour is generally associated with a lowered activity of starter organisms, either in the vat during manufacture or in the green cheese after manufacture.

In a survey of the incidence of antibiotics in the milk supplies to seven cheese factories, of 388 milk supplies tested by the disc assay technique, only 8 showed inhibitory properties.

With the increased number of cheese analyses being carried out, advisory standards for cheddar cheese composition have been drawn up based on the results of previous research work. The relationship between actual composition and the advisory standard is indicated with each analytical result forwarded. The results of analyses of over 200 samples showed that good control of the moisture content is being achieved by cheesemakers. However, there was a small

increase in the proportion of samples analysed which failed to meet the requirements of not less than 50 per cent. fat in the moisture-free substance. The rather dry year, resulting in milks of a high casein/fat ratio, was responsible for the lower fat content.

Guidance was given to factories wishing to export rindless cheese. Eight factories are now suitably fitted to provide rindless cheese for export. London reports of the results of inspection of experimental shipments of rindless cheese have generally been very good, with little evidence of mould growth. However, isolated batches with mould infestation due to faults in packaging and surface oxidation, liquefaction and gas production are still under examination. Trial shipments of rindless cheese with cheaper types of containers were initiated. Designed as a pressure pack, some containers reduced the incidence of mould growth.

ANALYTICAL

A total of 7,303 samples was submitted to the laboratory for examination. They included brines, butter, cheese, cream, casein, detergents, egg pulp, milk, milk powders, skim-milk and buttermilk powder, salt, margarine and farm and factory waters. The analytical work carried out on the samples received involved the performance of over 14,000 individual tests. Advice was given on all samples not conforming to the desired standards of composition.

DAIRY GLASSWARE

Almost 3,500 pieces of dairy glassware were tested and 21 per cent. were rejected for non-compliance with standards under the Dairy Produce Acts. Australia-wide efforts have continued towards the adoption of a standard for Babcock testing and dairy glassware proposed by the Standards Association of Australia.

STATISTICS

Table 2 summarises the expansion in services performed in all laboratories as compared with the previous year.

TABLE 2
SUMMARY OF TESTS PERFORMED

	1959–60		1960–61	
	No. of Samples	No. of Tests	No. of Samples	No. of Tests
Butter Improvement Service ..	2,500	23,000	5,000	29,000
Analytical	9,500	18,500	14,000	32,000
Analyses associated with various research projects	25,000	55,000	30,000	65,000
Laboratory quality control and market milk	46,000	56,000	35,000	41,000

DIVISION OF MARKETING

The Division of Marketing is concerned chiefly with the development of organised marketing of farm products, the administration and determination of standards for agricultural requirements and farm produce, and the investigation of economic principles as applied to rural production. These functions were carried out satisfactorily during the year.

A plan drawn up by the Pineapple Sectional Group Committee, with a view to stabilising the pineapple industry, was not proceeded with because of legal obstacles, and a committee was set up under the chairmanship of the Director of Marketing, to devise a stabilisation scheme within the framework of existing legislation which would be acceptable to both the growers and the Government. The Committee reported that it was not possible to reconcile the current ideas advanced on behalf of the Cannery subscribers with the requirements of the Fruit Marketing Organisation Acts and the Cannery Agreement.

The Brisbane Markets Trust, on which the Director-General is represented by the Director of Marketing, held meetings regularly throughout the year. The activities of the Trust were concerned with the planning of the design and lay-out of the site of the markets and the projected buildings thereon. In these matters the Trust has the advice and assistance of an engineer of the Department of the Co-ordinator-General of Public Works, which is the constructing authority for the new markets.

Tenders for the removal of the buildings already existing on the site had been accepted by the end of the year, and preparations were in hand for a start on levelling and draining the area. Negotiations were completed for an initial loan of £30,000 for road reconstruction, water-main diversion and administrative purposes.

Following upon a meeting in May 1960 of representatives of the grain marketing boards, a Grain Handling Advisory Committee was set up to advise the State Wheat Board on matters pertaining to the handling of grains, and the Director of Marketing was elected Chairman of the Committee.

COMMODITY MARKETING BOARDS

A detailed description of the activities of the marketing boards operating in Queensland will be given in the Annual Report of the Director of Marketing to the Minister for Agricultural and Forestry, as required under *The Primary Producers' Organisation and Marketing Acts,* 1926 *to* 1957.

Although The Onion Marketing Board was set up in 1959 at the express request of growers, the Board failed to receive adequate support, as a large proportion of growers sold their onions either on the interstate market or on the local market through "pseudo" interstate channels. Conferences held between the Board and other organisations of onion growers to resolve the problem proved abortive, and the Board had no alternative but to grant a general exemption, until the end of February 1963, absolving all onion growers from their obligation to deliver onions to the Board. It would appear that history is repeating itself. The previous Onion Marketing Board, constituted in July 1949, went out of existence after one term of three years. Extension of its term was refused because of the failure of the growers to support the Board and adhere to the marketing scheme.

AGRICULTURAL STANDARDS

Action taken under the *Fruit and Vegetable Grading and Packing Regulations* resulted in considerable improvement in the grading and presentation of fruit and vegetables at the retail level. The campaign initiated several years ago with respect to the inspection of hay, chaff, and grain at the Roma Street railyards was continued during the year and resulted in marked improvement of quality. In this connection, officers of the Standards Branch conducted a series of meetings with growers in the producing districts, to advise them regarding the regulations prescribed for hay, chaff, grain, potatoes, onions and pumpkins. These meetings were well attended by farmers, and a noticeable improvement in the quality of these materials has been observed in the markets as a result.

Exports of fruit and vegetables from this State reached a new high, and totalled over 160,000 packages, including 52 bulk bins. Most of these exports were to United Kingdom and continental destinations.

The Standards Officer was a delegate to an interstate conference on seed certification and varietal registration, and he was appointed Queensland representative on the Technical Committee for Seed Storage, established with the approval of the Standing Committee of Agriculture.

The Standards Branch was concerned in organizing and conducting a course of instruction for Asian representatives in seed and crop improvement, under the World Seed Year Campaign instituted by F.A.O. Five students visited Queensland and were given instruction in all aspects of the testing, certification and marketing of seed.

ECONOMICS RESEARCH

The attention of the Economics Research Branch was mainly focussed on the dairying and poultry industries. In co-operation with the Dairy Extension Advisory Committees a study was conducted into the economics of the application to the dairy industry of various production techniques considered practicable after discussion with farmers and appropriate field officers. The poultry management investigation was planned on a smaller scale. Ten farmers co-operated in a detailed study of the economics of management, and the data from this study will lend themselves to the use of econometric analysis to find the most profitable way to apply the results of the latest research in poultry management.

In view of the importance of farm records and accounts, preparation was commenced of a serious of booklets, and the first of these was ready for publication by the end of the year. These booklets will supplement the assistance, given by personal discussion, to farmers and other Departmental officers.

MARKETING BRANCH

MARKETING ORGANISATION

The triennial election of growers' representatives on The Tobacco Leaf Marketing Board was held during the year. An amendment of the Board's constitution redefined the Board's electoral districts, with the principal object of giving separate representation to tobacco growers in the Near North Coast and Bundaberg-Miriam Vale districts. At the close of the year elections were in progress to select a representative for the new district and also to fill a casual vacancy arising from the resignation of one of the members for District No. 2. A proposal to empower The Tobacco Leaf Marketing Board to make a levy on tobacco growers for the purpose of establishing a Hail Insurance Scheme was clearly defeated at a ballot of the growers concerned.

The operations of the Queensland Dairymen's Organisation were extended for a period of three years from July 1, 1961.

To enable The Central Queensland Egg Marketing Board to exercise better supervision over its marketing functions, additional powers of inspection were given to the Board by Order in Council. These powers were similar to those already given to The Egg Marketing Board (South Queensland).

In preparation for the triennial elections of the various C.O.D. Sectional Group Committee members, boundaries of electorates were revised and qualifications of candidates for election were clarified.

PRIMARY PRODUCERS' CO-OPERATIVE ASSOCIATIONS

The registration during the year of two new associations under the Primary Producers' Co-operative Associations Acts could open up a new field in primary producer co-operation, particularly in respect to the dairying industry. Both Associations—Dayboro and District Co-operative Artificial Breeding Association Limited, and Beaudesert and District Co-operative Artificial Breeding Association Limited—have been formed by dairymen for the purpose of establishing artificial insemination distribution centres in their respective districts. In order to enable registration of these associations to be effected, the controlling regulations were amended to include additional objects which permit, through artificial insemination, more effective control of diseases which cause infertility of livestock and improvement of the type, production and yield of carcass of livestock.

MARKETING INTELLIGENCE SERVICES

During the year the Branch published 43 reports and forecasts covering 12 crops. Total circulation was nearly 26,000. The reports, which were designed to provide reliable and up-to-date information on crop progress and markets, were supplied to farmers, financial institutions, oil companies, machinery manufacturers, merchants and business houses supplying farmers' requirements. Copies were also mailed, on request, to overseas buyers of Queensland agricultural products.

Forecasts were issued on wheat, barley, oats, linseed, canary seed, grain sorghum, maize, white French millet, setaria (panicum), peanuts, potatoes and onions. Quarterly reports were also issued on the poultry industry in south-eastern Queensland. During the year the forecasting system was strengthened by the appointment of additional correspondents. Because of the rapid development of agriculture on the western Darling Downs and in the Dawson-Callide districts, officers of the Branch visited these areas to interview prospective correspondents. New correspondents were appointed and the cover was widened to give a more complete picture of the situation in these areas. Similar development was also carried out on the southern Darling Downs.

The system of forecasting relies upon Honorary Crop Correspondents to supply information, and is based upon a grid sampling technique. The method of sampling is still incomplete in some areas, requiring further field work and the appointment of additional correspondents in the coming year. Aproximately 600 farmers co-operated in this work and their assistance is to be commended.

Monthly *Reports on Production Trends,* giving an up-to-date picture of the state of agricultural, pastoral and dairying industries in Queensland, were published regularly. The demand for these reports continued to increase and nearly 800 copies were distributed each month.

The demand from farmers continued for up-to-date information on the overseas market situation in regard to grains and seeds, and also on oil crops and factors affecting these crops. This demand was met by the monthly publication *Grain Abstracts.* These reports were again drawn upon by most newspapers circulating in the grain-growing areas.

The fruit and vegetable industries play an important part in the production pattern of this State and growers of these commodities are vitally interested in the ruling prices for their produce and in the supply situation. The regular publication of the daily market reports covering trading on the fruit and vegetable and farm produce markets in Brisbane was continued to provide this information for growers and other interested persons. As has been the practice in the past, the reports were issued within a few hours of the close of sales. They had a daily circulation of some 500 copies, were published in all daily newspapers of the State, and broadcast through metropolitan and country radio stations. At a conservative estimate they provide a service to 16,000 producers in this State, not to mention the many wholesale agents, merchants, retailers, public and private institutions, packing and transport agencies, etc.

About 150 copies of the weekly market report were circulated, the object of the report being to summarise market movements during the week.

In accordance with arrangements made with the Fish Board in 1957, a daily report on fish prices realised at the Brisbane Fish Market was despatched with the daily market report, the number of copies circulated being about 100.

In addition to preparing these regular reports and forecasts, officers of the Branch were called upon to supply a wide variety of information on marketing and economic problems, including estimates of rural income and production, and trends in particular industries. As in previous years, numerous requests for marketing information were received from marketing boards, farmers, banks and businesses.

ECONOMICS RESEARCH BRANCH

INVESTIGATION OF DAIRY PRACTICES

The major project undertaken during the year was an investigation into the economic problems of dairy farm management. This work was requested by the Wide Bay and Eastern Downs Dairy Extension Advisory Committees. The narrowing of the gap between costs and prices in butter production has accentuated the difficulties of managing a dairy farm in such a way as to permit adequate use of modern techniques. Many farmers are reluctant to adopt recommended practices because, having to borrow finance, they desire assurance that the additional investment will be profitable and the considerable extra effort worthwhile. The enthusiastic co-operation of the Committees, the field officers, and the collaborating farmers enabled good progress to be made.

A farmer who desires to increase the profitability of his farm always has a number of different courses of action from which to choose. There may be alternative methods available to him for the provision of extra feed, e.g. irrigated pasture or sown fodder crop. He may have to decide whether investment of land, labour and capital should be concentrated on the dairy enterprise or on some other form of production such as crops or beef.

The initial problem which presented itself in planning this investigation was whether to conduct a general survey of a large number of farms or to make a detailed examination of a smaller number over an extended period of time. The latter course was decided upon, it being considered that the investigation of a number of typical situations "in depth" would give more reliable data. This was considered particularly desirable as this approach has not previously been used in Queensland in the many surveys that have been made of the industry. A review of the procedure adopted is outlined below:

Firstly, it is desirable to emphasise that these procedures were not designed to provide immediate advice to co-operating farmers on their economic problems. There is a possibility of misunderstanding on this point. The work is essentially research. Of course, the farmer is helped considerably in his own thinking by the discussions he has with the investigators and by the thorough analysis that is made of his business.

A sample of 100 farmers was selected by the Dairy Extension Advisory Committees of Wide Bay and Eastern Downs. These were selected on the basis that they represent typical farm situations found in these areas. Each farm was treated as a case study to ascertain the economic implications of various farm practices, particular emphasis being given to the need to provide economic data for use by farmers and field officers when considering possible changes to increase profitability.

A method of budgeting has been elaborated which enables the economic impact of recommended farm techniques to be shown in terms of £ s. d. For this purpose a series of visits is made to each farm by an Agricultural Economist over a period of 12 months, the number of visits depending

on the individual farm and the nature of the changes being examined. Before the actual budget analysis is made, the farmer is interviewed to obtain a complete schedule of data about his farm. From these data is obtained a general idea of economic strengths and weaknesses in the farm business structure. This information is of considerable interest in itself and a report is being prepared to cover these initial data in respect of the Wide Bay district.

The next step is for the economist to consult with those field officers who are concerned with the enterprises on each farm, when a review is made of possible lines of development for the farm. The conclusions reached are discussed with the farmer and a plan of development, or various possible different plans, are then tested by the budget method. Data collected from the farmer and the officers during this visit cover physical inputs and outputs, and the costs and prices to be used in the budget.

The actual preparation and analysis of the budgets are done in the office. The next step is to develop from the results of the budgets a co-ordinated picture of the possible lines of profitable development open to the farmers in the district. Each individual plan will be a practical line of approach with its probable results established in monetary terms. The economic analysis of the plans in relation to all factors which might affect them, such as rainfall probabilities, irrigation development and so on, will provide a more informed approach to the significance of differences in farm business structure and situation than is now possible.

This general analysis of each district will provide the starting point for a continuing investigation of certain aspects of development that are found to be of special importance in each district.

SUPPLEMENTARY FEEDING PROJECT

The winter supplementary feeding project was completed during the year and was of great interest to the co-operating farmers in the Beaudesert district. In collaboration with the Cattle Husbandry Branch, detailed records were kept relating to production, feeding, labour use, etc., for the 12-month period.

POULTRY MANAGEMENT INVESTIGATION

In view of the importance of technical developments now taking place in the poultry industry, it was decided to undertake a study of management problems on up-to-date poultry farms, in the Brisbane area, and field work commenced in September 1960.

Farmers included in the study were confined to egg producers (excluding hatcheries and broiler producers) with more than 1,000 birds. Information was collected on a monthly basis from 10 farms for the year 1960-61, and information for the same year is to be collected from a further two. Physical and financial data collected from each of the farms will be analysed to find the extent of the variations in financial performance and the reasons for variations. This analysis will include examination of costs, particularly feed costs, the timing of production and gradings of eggs, replacement of flocks, rates of laying and capital structure.

ECONOMETRIC ANALYSIS

The data collected in the Poultry Farm Management Study will be used for a more detailed analysis than in other work by the Branch. This will be effected by the use of analytical statistics, which have been found of considerable value in other countries in respect of this industry.

It is proposed to examine the application of linear programming and optimisation methods in the analysis of the individual farm. Linear programming is being used in the development of least-cost feeding rations. This investigation is made more challenging by the large size of feed costs compared with net profits per dozen eggs. A decrease in feed costs would give a more than proportionate increase in profits. The least-cost ration would change under changing prices and availability of the components of the ration, so the problem is a complex one and findings need care in their practical application.

Research will also be carried out into economic time series, trend fitting, seasonal and cyclical determination, and auto-correlation. Cyclical fluctuations are very evident and have a marked effect on the profitability of egg production. Analysis will also be undertaken of the inter-relationships between the industry as a whole and the individual farmer, with reference to optimum farm size and the timing of production.

APPLICATION OF ECONOMIC ANALYSIS

The nature of farming, which is essentially a biological process, presents an inherent difficulty in the planning and programming of a farm business. Unlike a factory, where there is a high degree of control over each operation and its resulting product, the farm is concerned with living and growing plants and animals. This creates special problems in applying economic and cost accounting concepts to agriculture, a fact widely recognised; but in Queensland the difficulty is made even more acute by reason of a high degree of uncertainty, particularly as regards climate.

An examination was therefore begun of experience in other countries to determine what principles should be formulated as a guide in applying research results to the actual farm situation. There is plenty of literature on farm economics research, although this particular problem is not specifically dealt with because it is not so acute elsewhere. However, it has received consideration in the context of other research. In view of the growing demand for economic information from all parts of Queensland, work along these lines is essential.

Queensland agriculture is not only varied in its scope but, apart from some particular industries such as sugar, for instance, there is a wide variation of conditions even in the one district. Farms differ considerably as regards soil, topography and enterprise pattern and this complicates the application of research results. When the nature of the uncertainty in which farming is carried out in Queensland is superimposed on such variations, it is clear that careful consideration will need to be given to how the results of research are to be used.

CONTINUOUS RECORDS

One line of work which is especially needed, although present staff could not cope with it, is that of continuing records. Many investigations into particular farm economic problems lack the element of continuity. However, in countries where this work is established there is usually provision for the keeping of records over a long period of time, the records being analysed annually. Changes in farm structure, in investment patterns and labour usage, &c., can be best brought out clearly by such methods. Work of this kind could well be allied to the assistance now being given to individual farmers who show a particular keenness for business analysis and have requested that record systems be set up suitable for their farms.

GENERAL

During the year, a number of requests was received from field officers and farmers for assistance in drawing up record systems, budgets and partial budgets. This work is of value and merits expansion. Contact with field officers in this way showed that a considerable "spread" of sound economic thinking is made possible. Many extension officers face economic problems with inadequate training in economic principles and experience in their practical application, and it is considered that they have been helped by their discussions with the staff of this branch.

It was found necessary to suspend the work on soil conservation initiated last year because it was not possible to provide the personal attention to supervision of the field work required, due to staff limitations. The need for this was not anticipated when the survey was initated and, in view of the complexity and the importance of this phase of agricultural development, it was considered wise to wait until more staff is available to make the investigation.

The need for increased staff is also becoming evident from enquiries made by individual farmers for assistance, and from requests by field officers and farmers' organisations for particular investigations. As the value of the work is becoming more widely known this is to be expected.

STANDARDS BRANCH

The year under review, though a busy one, was one of consolidation rather than development of new activities.

SEED TESTING

Due to the dry conditions existing in most parts of the State, commercial seed sales were slow, the overall number of samples examined by the Seed Testing Section being almost 1,000 less than in the previous year. There was, however, a small increase in the number of grass seed samples handled and the difficulties of analysing these small seeds, to some extent, counter-balanced the reduction in number. Details are given in Table 1.

A storage trial of sorghum and French bean seed commenced in 1956 was concluded during the year. Over the period of 3½ years it was found that germination of seed stored in sealed drums, polyethylene containers, or in jute bags in cold storage conditions of 40°F., was maintained at a very high level. Under atmospheric conditions seed stored in sealed drums retained germination reasonably well for the entire experiment but seed stored in jute bags or polyethylene containers under atmospheric conditions declined in germination to such an extent that such storage conditions could not be recommended on a long-term basis. The report on this trial will be published at an early date.

TABLE 1

SUMMARY OF SEED SAMPLES EXAMINED

Source of Samples	1959–60	1960–61
Inspectors of the Branch	2,962	2,911
Seed certification	283	307
Experimental projects	941	629
Submitted samples—		
(i) Merchants	5,830	5,389
(ii) Farmers	171	193
(iii) Government Departments	1,496	1,290
Total	11,683	10,719

SEED CERTIFICATION

Certified grain sorghum seed production fell during the 1959-60 season due to a reduced planting brought about by the anticipation of a large carry-over of certified grain sorghum seed at the time of planting the 1959-60 crops for certification. The carry-over of 11,000 bus. and the 1959-60 production were disposed of in the 1960-61 season. Production during the 1960-61 season, although not expected to be high, will, to a certain extent, be supplemented by a quantity of hybrid grain sorghum seed produced outside the scope of certification.

Certified sweet sorghum seed production in the 1959-60 season was negligible, only 3 bus. of the variety Italian being salvaged from an area of 30 acres ruined by hail.

Certified Sweet Sudan grass seed production now seems to be well established. In the 1959-60 season approximately 120,000 lb. were produced by two growers, an increase of almost 50 per cent. over the already high production figure of the previous year. This is gratifying to both the growers and Seed Certification Officers concerned in its production.

Production of certified hybrid maize, as reported last year, was severely curtailed, and all stocks of seed, including carry-over of approximately 4,600 bus., were sold. Approximately 14,000 bus. of hybrid maize seed are expected to be certified in the 1960-61 season.

Certified bean seed production was satisfactory, and the rust-resistant variety Redlands Green Leaf was introduced during the year. Additional seed firms are participating in the Department's bean seed production scheme in which certified bean seed is used to produce disease-free commercial bean seed.

TABLE 2

PRODUCTION OF CERTIFIED SEED

Crop	1958		1959		1960	
	Certified	Refused	Certified	Refused	Certified	Refused
Hybrid maize (bus.)	15,556	218	11,107	341	6,540	17½
Grain sorghum (bus.)	23,765	3,684	28,686	6,015	16,766	..
Sweet sorghum (bus.)	..	723	1,692	45	3	..
Sudan grass (lb.)	..	225	83,532	1,350	120,066	..
French beans (bus.)	387	93	371	28	504	6½
Tomatoes (lb.)	..	..	466	..	109½	9½
Buffel grass (lb.)	2,476	1,568	..	640	25	..

Certified tomato seed production fell due chiefly to a carry-over of seed from the previous season.

Only 25 lb. of buffel grass seed were submitted for certification, but at the end of the year about 800 lb., produced in the current season, were being tested for germination, &c., prior to certification.

During the year samples of all certified seed being carried over for sale for sowing in the 1960-61 season were obtained by Standards Branch Inspectors. Of this carry-over, 284 bus. of certified hybrid maize seed germinated below the minimum prescribed standard of 80 per cent. and were destroyed. In addition, the germination of 1,350 bus. of certified grain sorghum seed was found to have fallen to between 70 per cent. and 80 per cent. The minimum germination for certified sorghum seed is 80 per cent. and the certification labels and seals were removed from the seed containers. Because the germination of the seed complied with the minimum of 70 per cent. prescribed under *The Agricultural Standards Act of* 1952, sale was permitted as uncertified seed.

REGISTRATION OF AGRICULTURAL REQUIREMENTS

The number of applications for the registration, re-registration or extension of registration of agricultural requirements rose from 3,331 last year to 3,528 this year. At 20 meetings, the Agricultural Requirements Board considered the claims made by the manufacturers regarding the efficacy of 1,241 preparations following applications for their registration or re-registration. Of these, 767 were veterinary medicines and 474 were pest destroyers and on the recommendation of the Board 6 veterinary medicines and 25 pest destroyers were refused registration.

During the year a supplementary list of registered pest destroyers was published, giving a coverage of all pest destroyers registered up to the end of November, 1960, for the period January, 1958, to January, 1961.

The registration of several preparations was cancelled because they contained quantities of benzene hexachloride in excess of that required to control the specified pests. This action should result in fewer beneficial predatory insects being killed and should also minimise tainting by decreasing the quantity of undesirable residues left in the soil.

INSPECTION—AGRICULTURAL STANDARDS

A vigorous inspectional programme was continued during the year and an increased number of establishments were visited. Inspections were made in 125 towns, a total of 1,461 inspections being made with respect to agricultural requirements.

There was an increase in the quantity of sub-standard seed dealt with and details of action taken on unsatisfactory seeds are set out in Table 3.

TABLE 3

ACTION TAKEN ON UNSATISFACTORY SEEDS

	1959–60	1960–61
Agricultural crop seeds cleaned under supervision or by instruction	632 bags	3,177 bags
Destroyed or otherwise rendered unsuitable as seed—		
(i) Agricultural crop seeds	353 bags	501 bags
(ii) Vegetable seeds	1,176 lb.	1,432 lb.
(iii) Packeted seeds	2,437 pkts.	242 pkts.
Processed for stock foods—		
(i) Agricultural crop seeds	475 bags	625 bags
(ii) Vegetable seeds	1 bag	510 lb.

During the year, talks on standards laid down for the sale of hay, chaff and feed grains were held in the form of evening meetings at nine centres in the main production areas, and they were well attended by growers. These discussions created a growing awareness amongst growers of the need to market better quality produce and the effect of this extension work is reflected in the reduced number of consignments seized, as set out in Table 4.

TABLE 4: SUMMARY OF ACTION ON MATERIAL OTHER THAN SEEDS

	1959–60						1960–61					
	Fertilizers	Lime	Pest Destroyers	Veterinary Medicines	Stock Foods	Total	Fertilizers	Lime	Pest Destroyers	Veterinary Medicines	Stock Foods	Total
Samples received from—												
Inspectors	69	11	77	4	400	561	65	7	176	9	838	1,095
Buyers	3	..	10	..	19	32	..	..	..	..	34	34
Seized	..	..	..	..	325 (*a*)	..	..	..	..	..	1,499 (*a*)	..
	..	..	3,107 (*b*)	157 (*b*)	1,196 (*b*)	..	4 (*b*)	..	1,316 (*b*)	53 (*b*)	3,467 (*b*)	..
	..	..	..	..	2,259 (*c*)	..	..	..	..	..	941 (*c*)	..
	..	..	..	..	1,498 (*d*)	..	..	..	..	..	2,046 (*d*)	..
	..	..	..	..	151 (*e*)	..	..	..	..	..	174 (*e*)	..
Reconditioned, relabelled or deficiency rectified	..	..	..	..	314 (*a*)	..	..	..	..	..	1,499 (*a*)	..
	..	..	2,654 (*b*)	..	1,196 (*b*)	..	..	..	967 (*b*)	23 (*b*)	3,467 (*b*)	..
	..	..	..	..	785 (*c*)	..	..	..	..	..	398 (*c*)	..
	..	..	..	..	1,498 (*d*)	..	..	..	..	..	2,046 (*d*)	..
	..	..	..	..	13 (*e*)	..	..	..	..	..	31 (*e*)	..
Destroyed	..	..	..	..	11 (*a*)	..	..	..	..	..	..	..
	..	..	37 (*b*)	15 (*b*)	..	..	4 (*b*)	..	349 (*b*)	30 (*b*)	543 (*c*)	..
	..	..	..	..	1,474 (*c*)	..	..	..	..	..	..	..
	..	..	..	..	138 (*e*)	..	..	..	..	..	143 (*e*)	..
Withdrawn from sale	..	..	..	..	..	..	..	..	..	..	..	..

(*a*) Bags of prepared stock foods. (*b*) Packages, tins or bottles. (*c*) Trusses of hay. (*d*) Bags of grain. (*e*) Bags of chaff.

During the year 6,776 consignments of farm produce were inspected at Roma Street railhead; they comprised 152,374 bags of chaff, 356,218 trusses of hay, 29,217 bags of maize and 25,973 packages of sundry materials. A scheme was introduced to divert detained hay and chaff to holding yards at the Brisbane Abattoir to be fed to stock awaiting slaughter. This system of disposal of sub-standard produce proved satisfactory to all concerned: 201 bags of chaff and 358 trusses of hay were disposed of through this channel, an insignificant fraction compared with the total quantity inspected.

Particular attention was paid to the quality of prepared stock food (Table 4). Meat-and-bone meal continued to be in short supply but most manufacturers were able to obtain sufficient supplies to maintain the guaranteed formulae of their stock feeds.

Emphasis was also placed on the inspection of pesticides, and the practice of placing unregistered preparations on the market was severely curtailed by these intensified activities.

INSPECTION—FRUIT AND VEGETABLES

During the year inspections of fruit and vegetables were carried out both in the wholesale markets and at retail shops. Inspections on delivery by road and rail to produce merchants totalled 296,636 bags of potatoes, 79,511 bags of pumpkins and 172,439 bags of onions. Of these quantities, 6 per cent. of the potatoes, 3 per cent. of the pumpkins, and 8 per cent. of the onions were found to be faulty (Tables 5 and 6). While this is a decrease on last year's figures, there is still room for improvement in the grading and presentation of produce by the producer.

An extension drive was carried out during the year in the main production areas of heavy vegetables in south-eastern Queensland, the theme being the grading of potatoes, pumpkins and onions. Some improvement has been observed in grading following these series of meetings.

Retail shop inspections made throughout the year involved 1,035 retailers and 3,061 inspections in the Brisbane, Ipswich and Redcliffe areas, compared with 662 retailers involving 1,943 inspection visits during the previous year. Retail shop proprietors continued to co-operate with the Department in the drive for improved quality of fruit and vegetables.

IMPORTS AND EXPORTS

Imports of seed for sowing (Table 7) were about the same as in the previous year, there being increases in some categories such as Centrosema and vetch and a reduction in lines such as velvet beans and garden peas. Centrosema seed was imported only through Brisbane, to meet the needs of the Commonwealth quarantine regulations, and every consignment was found to contain seeds of *Mimosa invisa* and other weeds, which were removed by cleaning under supervision of Inspectors. Seventy-five bags of Guinea grass (*Panicum maximum*) seed were imported by a grazing and meat organization for use on its own properties and not for resale.

Because of the adverse weather conditions in Queensland during the last 12 months, export of grain and seed (Table 8) showed a considerable reduction on the previous year. Exports of fruit and vegetables from the port of Brisbane (Table 9) increased and approximately 161,000 packages of fruit and vegetables were inspected. Inspections of this fruit were intensified at the packing sheds prior to being forwarded to the port. A feature of this trade was the increase in the quantity of apples exported to the United Kingdom and the Continent. It is worthy of note that Brisbane agents participated in a growing export market of fruit and vegetables to New Guinea, Pacific islands and the Far East.

FARM PRODUCE AGENTS ACTS

The main clauses of "*The Farm Produce Agents Acts, 1917 to 1952*" are designed to ensure supervision over farm produce agents in their dealings with consignors of farm produce for whom they act as selling agents and to protect such consignors from any malpractices of agents. During the year under review, routine inspections of agents' books were again carried out. Particular attention was paid to the operation of Trust Accounts and in one instance resulted in legal action being taken. Inspections revealed that agents were correctly accounting to their principals for the sale of farm produce. There were 114 licensed farm produce agents in Queensland as at June 30, 1961, and of these 70 were in the Brisbane area. Country agents were situated in 21 different centres throughout the State.

TABLE 5

MARKET CONDEMNATIONS—FRUIT AND VEGETABLES

——	Pkgs.	Lb.	Doz.	Bun.
Fruit—				
Apples	3,778	..	..	..
Apricots	125	..	..	..
Avocadoes	131	..	..	..
Bananas	126	955	..	545
Cape gooseberries	23	..	..	..
Cherries	374	..	..	..
Coconuts	49	..	..	..
Grapes	177	..	..	..
Grapefruit	127	..	..	..
Lemons	897	..	..	..
Loquats	27	..	..	..
Mandarins	61	..	..	..
Mangoes	138	..	..	..
Nectarines	227	..	..	..
Oranges	298	..	..	..
Papaws	713	..	..	..
Passion fruit	111	..	..	..
Peaches	458	..	..	..
Pears	1,246	..	..	..
Persimmons	5	..	..	..
Pineapples	57	..	409	..
Plums	345	..	..	..
Pomelos	2	..	..	..
Quinces	16	..	..	..
Rockmelons	1,154	..	..	..
Strawberries	103	..	..	..
Tomatoes	5,140	..	..	..
Watermelons	..	12,432	244	..
Total Fruit	15,908	13,387	653	545

——	Pkgs.	Doz.	Bun.
Vegetables—			
Artichokes	12	..	..
Beans	5,616	..	..
Beetroot	31	..	..
Broccoli	..	..	1
Brussels sprouts	81	10	..
Cabbages	1,004	2,465	..
Capsicums	554	..	..
Carrots	619	2	54
Cauliflowers	22	119	..
Celery	21	..	30
Chokos	168	..	..
Cucumbers	3,062	..	..
Egg fruit	55	..	..
Eschallots	..	..	13
Garlic	97	..	..
Lettuce	667	..	..
Marrows	225	..	..
Onions	2,733	..	..
Parsnips	540	..	3
Peas	88	..	..
Potatoes	2,914	..	..
Pumpkins	429	..	..
Radish	1	..	133
Rhubarb	..	..	535
Squash	24	..	..
Swede turnip	108	..	..
Sweet potatoes	116	..	..
Turnips	63	..	463
Total Vegetables	19,250	2,596	1,232

TABLE 6

REGRADING AND RECONDITIONING

Fruit—	
Apples	4,396 cases
Apricots	8 cases
Bananas	564 cases
Figs	2 cases
Grapes	22 cases
Grapefruit	20 cases
Lemons	279 cases
Mandarins	224 cases
Mangoes	67 cases
Oranges	1,717 cases
Papaws	71 cases
Peaches	248 cases
Pears	1,332 cases
Plums	711 cases
Rockmelons	625 cases
Nectarines	49 cases
Vegetables	
Beans	85 bags
Cabbages	19 doz.
Carrots	108 bags
Cucumbers	276 cases
Onions	14,700 bags
Parsnips	39 bags
Potatoes	17,860 bags
Pumpkins	2,451 bags
Squash	1 bag
Swede turnip	119 bags
Sweet potatoes	9 bags
Tomatoes	2,573 cases
Turnips	6 bags
Capsicums	88 cases

TABLE 7

IMPORTS—SEED FOR SOWING

	Bags
Agricultural Seeds—	
Calopo	1
Centrosema	377
Clover	93
Leucaena glauca	2
Mangel	10
Pueraria	2
Rape	171
Sunflower	20
Vetch	133
Miscellaneous (birdseed)	27
	836
Grass Seeds—	
Molasses	22
Panicum maximum	75
Rye	20
	117
Velvet Beans	3,087 bags
Vegetable Seeds—	Lb.
Beet	271
Cabbage	81
Capsicum	25
Carrot	81
Cauliflower	44
Celery	2
Cucumber	152
Herbs	12
Lettuce	112
Marrow	15
Melons (watermelons and rockmelons)	156
Onions	10
Pumpkin	14
Radish	33
Swede	18
Turnip	132
Rhubarb	7
Miscellaneous	62
	1,227
Peas	189 bags
Miscellaneous	151 parcels

TABLE 8

EXPORTS—GRAINS, SEEDS, &C.

Barley	13,317 bags
Beans	126 lb.
Buffel	105 lb.
Canary	11,520 bags
Carpet grass	16,000 lb.
Centrosema	1,120 lb.
Clover	33 lb.
Couch	384 lb.
Cowpea	371½ tons
Green panic	2,063 lb.
Guinea grass	2,471 lb.
Japanese millet	2,608 bags
Lucerne	75 lb.
Maize	3,964 lb.
Molasses	100 lb.
Paspalum	5,275 lb.
Prairie grass	2,800 lb.
Rhodes grass	2,260 lb.
Setaria italica	1,664 bags
Sorghum	224 lb.
Soybean	294 lb.
Sunflower	418 bags
Townsville lucerne	35 lb.
White French millet	87,392 bags
Miscellaneous vegetable seed	336 lb.
Lucerne hay	145 tons

TABLE 9

QUEENSLAND EXPORTS—FRUIT AND VEGETABLES

Apples	126,532 cases 732 cartons 52 bins (approx. 25 cases)
Apricots	57 cases
Bananas	4 cases
Cherries	50 cases
Grapefruit	119 cases
Grapes	173 cases
Lemons	101 cases
Mandarins	312 cases
Mangoes	2 cases
Nectarines	8 cases
Oranges	8,534 cases
Papaws	2 cases
Peaches	106 cases
Pears	5,444 cases
Pineapples	2 cases
Plums	98 cases
Strawberries	20 lb.
Tomatoes	1,611 cases
Beet	12 bags
Capsicums	77 cases
Cabbage	211 bags 60 cases
Carrots	542 bags 200 cases
Cauliflowers	59 cases
Celery	149 cases
Cucumbers	29 cases
Garlic	2,880 bags
Lettuce	487 cases
Onions	5,552 bags 855 cases
Parsnips	160 bags 13 cases
Parsley	32 lb.
Peas	21 bags 9 cases
Potatoes	2,700 bags 2,180 cases
Pumpkins	282 bags
Rhubarb	10 cases
Swede turnips	68 bags 6 cases
Macadamia nuts	1 bag
Total number of packages	160,450
Total number of bins	52
Total number of lb.	52

CLERICAL AND GENERAL DIVISION

The staff of the Department at June 30, 1961, totalled 1,473, an increase of 77 during the year. The additions included 10 clerks and clerk typists, of whom 7 clerk typists were appointed to country centres at Ipswich, Nambour, Dalby, Caboolture, Malanda, Inglewood Tobacco Experiment Station, and Millaroo Regional Experiment Station. The disposition of the clerical staff is shown hereunder:—

——	Brisbane	Country	Total
Clerks	95	4	99
Clerk-Typists	79	68	147
Male Assistants	7	1	8
Female Assistants	4	1	5
	185	74	259

Four new clerks appointed during the year as replacements were subsequently selected for cadetships in technical branches of the Department. These young officers are now undertaking higher studies with the object of qualifying for promotion in the technical spheres in which they have taken up duty. To fill vacancies and provide for current needs, a further seven clerks and seven clerk typists are required for Head Office and country centres.

RECORDS

The volume of correspondence handled by the Records Branch rose considerably during the year, as shown by the following figures for mail registration:—

Year	Inward	Intramural	Outward	Total
1958–59	88,345	10,035	54,581	152,961
1959–60	90,326	12,492	55,930	158,748
1960–61	98,126	14,863	59,631	172,620

The table does not include the many thousands of application forms, returns, &c., which are received, handled and sorted annually.

TRANSPORT

Seventy-seven motor vehicles were purchased during the year. Fifty-nine were replacements for vehicles condemned, 1 replaced a privately owned vehicle which became no longer available for official use, and 17 were additions to the fleet. The Department now has 322 vehicles in its fleet and these are located at over 100 different country centres. Forty-seven vehicles were disposed of during the year after reaching the end of their economical service and 20 more are in the process of disposal. Twenty-five of the new vehicles were purchased from funds provided by the Commonwealth for use on specific projects. Thirteen were bought from the Commonwealth Extension Services Grant, 4 from the Tobacco Research Fund, 1 from the Dairy Promotion and Research Grant and 7 from the National Pleuro Pneumonia Fund. Additional to Government-owned vehicles, 274 privately owned vehicles were used by officers for official purposes on a mileage basis.

HOUSING

During the year, the erection of a Government residence for the Stock Inspector at Miles and also of the purchase of an existing house at Chinchilla were approved. The scheme to erect 50 Government houses for the Public Service at country centres has been gratefully received by officers subject to transfer. During 1960/61, the Department will benefit by the replacement of a residence at Winton and the provision of new houses at Blackall, Ingham, Clermont, Barcaldine, Kingaroy, Miles and Mitchell, at all of which places the accommodation position is acute.

OFFICE ACCOMMODATION

The renovation and painting of the Head Office building is nearing completion. This has brought about more pleasant working conditions and both officers and the visiting public are appreciative of the improvement. The problem of insufficient space, however, is still acute and becoming increasingly more so each year. Many officers now occupy space which is designed for fewer numbers, while the problem of accommodating additional staff is very difficult.

Office accommodation at some country centres has improved and improvements are planned for other towns. At Cooroy, consideration is being given to construction of a Government building for the use of the Department of Agriculture and Stock. At this centre, officers are at present housed in a rented shop. Extensions to the Court House in Gympie have provided much improved working conditions for local officers, whilst at Mt. Isa the erection of the new Court House has provided suitable accommodation for the officers stationed at that centre. Alterations at Warwick and Cloncurry have provided greatly needed additional space, while at Wondai, Wowan, Blackall and Maleny new premises have been leased or rented to provide more suitable conditions for the officers in these centres. Approval has been given for the provision of new accommodation at Toowoomba and in the meantime additional space has been provided for the Soil Conservation Branch at that city.

ACCOUNTS

The total expenditure and receipts of the Department for the year 1960-61, compared with 1959-60, are as follows:—

——	Expenditure		Receipts	
	1959–60	1960–61	1959–60	1960–61
	£	£	£	£
Consolidated Revenue	1,400,884	1,633,329	223,911	252,110
Trust and Special Funds (includes Sugar Bulk Handling Facilities Expenditure £740,450 and £1,077,587—Receipts £891,058 and £1,075,466)	1,834,490	2,371,922	1,959,534	2,351,915
Schedule B—				
Salary of Minister	3,702	3,739	..	..
Schedule C—				
Stock Fund	204,924	201,056	..	..
Banana Industry Fund	5,592	7,654	..	..
Total £	3,449,592	4,217,700	2,183,445	2,604,025

Further statistical figures are detailed below:—

	1959-60	1960-61
Receipts issued	21,672	24,430
Vouchers paid	37,242	40,291
Cheques issued	53,189	58,754
Income earning certificates issued	2,002	2,076

EXTENSION SERVICES

Two 12-day in-service schools in extension methods were conducted, with a total enrolment of 64 Departmental officers and 1 officer from the Bureau of Sugar Experiment Stations. Induction training in extension methods was given to a number of new officers, and instruction was also given at refresher schools for Cattle Husbandry and Veterinary Services Branch officers. Several Colombo Plan Fellows also studied various aspects of extension.

Consultation took place between the extension co-ordination staff and production branch officers on a variety of matters, including programme planning, the conduct of schools for primary producers, field days, surveys and leaflet and exhibit designs.

The central tape recording service kept up a weekly supply of tapes to 17 radio stations, thus giving a State-wide distribution of topical items.

LIBRARY AND ABSTRACTING SERVICE

The arrangement whereby the Public Library of Queensland staffs the Department's Central Library continued to give satisfaction. Attention was given by this trained staff to various sectional libraries also. The scientific abstracting service provided a large number of abstracts to officers, resulting in increased demands on the library services.

PHOTOGRAPHIC SECTION

The output of the Section was maintained at a high level. The acquisition of new equipment enabled jobs to be handled with greater speed than previously. In addition to

providing some 20,000 prints for various Branches, the Section made a large number of slides in colour and black-and-white.

The Central Film Library of motion pictures was built up by gifts during the year. All holdings were appraised by technical officers and a number of films considered to have lost their value for local conditions were withdrawn.

Dry conditions interfered with the completion of a film on beef cattle pastures begun in the previous year and with a film on pig production.

PUBLICATIONS

At the close of the financial year, two new editions of the *Queensland Agricultural and Pastoral Handbook* series were on the verge of being printed. These are Volume II. (Fruit and Vegetables), and Volume I. (Farm Crops and Pastures).

The monthly *Queensland Agricultural Journal* continued to show a steadily mounting circulation, and this is a tribute to the many officers who contribute advisory articles in which they take care to produce information in an interesting and readable manner. Of the articles that appeared in the *Journal,* 104 were reprinted for issue as advisory leaflets, being made up as follows: Division of Plant Industry 45, Division of Animal Industry 43, Division of Dairying 15, Division of Marketing 1.

The issue of a special extension publication, *Tobacco Growing in Queensland,* was made possible by funds supplied by the Tobacco Industry Trust Account. Effective use of colour was made in this booklet, of which 7,500 copies were printed. Free distribution was made to all Queensland tobacco growers and distribution will be free also to growers in other States.

The *Queensland Journal of Agricultural Science* handled a large number of scientific papers, indicating the increased number of research projects being brought to fruition.

The Department's Press Release was circulated to more than 100 newspapers and radio stations each week, and a 150-word precis of each item was prepared and forwarded to selected A.B.C. stations. News reports covering current activities of the Department were prepared regularly and released to newspapers, news agencies and radio stations.

Feature articles on special aspects of the Department's work were supplied to selected newspapers and farm periodicals. It is considered that there is scope to increase this form of publicity. The rewards from this type of article appear to lie in the direction of enhanced prestige to the Department and a better informed rural community. Information Branch and Agriculture Branch combined to prepare a series of success stories on crop and pasture production in the 22 in. rainfall country. The articles dealt with Darling Downs properties and were released to newspapers serving that area, as well as to the *Queensland Agricultural Journal.*

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By Authority: S. G. Reid, Government Printer, Brisbane