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GROWTH STUDIES OF BEEF CATTLE IN QUEENSLAND.

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SUMMARY.

A progress report on growth rate studies of various breeds and crosses of beef cattle at several centres is presented.

The data indicate that the seasonal variation common to all centres may be controlled to some extent by the use of winter-growing pastures and forage crops and by using cattle of tropical origin in breeding programmes.

I. INTRODUCTION.

Growth rate studies of beef cattle have been carried out on a small scale by the Queensland Department of Agriculture and Stock over a number of years.

Mulhearn (see Chester 1952) conducted growth rate studies with beef steers from 1936 to 1939 at Charters Towers and Tully. The Tully investigations were directed at studying the effect of transferring young growing stock from the drier inland for quick fattening on introduced grasses on the coastal wet belt of North Queensland. Subsequently, investigations into the coastal fattening of beef cattle were continued at the Bureau of Tropical Agriculture (South Johnstone) and at the Ayr Regional Experiment Station. Progress reports on the investigations at both centres have appeared in the Annual Report of the Queensland Department of Agriculture and Stock for the years 1939–40 to 1954–55 (South Johnstone) and 1946–47 to 1954–55 (Ayr).

Since the initiation of investigations into the growth rate of beef cattle in the southern States of Australia in 1950, a number of weighing centres have been established in Queensland in order to obtain a complete picture of the growth rate of beef cattle under subtropical and tropical conditions. None of these trials have been carried out for a sufficient period to permit conclusive data to be presented. Nevertheless, there is enough information available to show the trend which can be expected.

This review of the present knowledge of growth rates in Queensland beef cattle has been undertaken to supplement the comprehensive unpublished information compiled by Dr. M. C. Franklin on growth rates of cattle in other States.

II. DESCRIPTION OF INVESTIGATION CENTRES AND THEIR RELATION TO THE SURROUNDING BEEF CATTLE DISTRICTS.

Data have been collected from eight centres, the location of which is shown in Fig. 1.

Fig. 1.

Sketch Map Showing the Distribution of the Weighing Centres.

(1) "Texas Station", Texas.

"Texas Station" is a property of about 8,000 acres situated on the Dumaresq River near the New South Wales border. It has an average annual rainfall of about 25 in., and both the summer and winter components are fairly reliable.

Approximately 2,500 acres of the property consist of a freely drained clay loam, representative of the fertile alluvial frontages to the Dumaresq River.

A large area is suitable for lucerne growing without irrigation and a systematic scheme of conservation of fodder in the form of lucerne hay and silage is practised. Improved pastures have also been sown and the paddock on which the cattle under observation were fattened carried a mixture of Wimmera ryegrass, phalaris and lucerne.

The property lies in an area free from cattle tick (*Boophilus microplus*).

An Aberdeen-Angus stud has been maintained on the property for many years, and large numbers of bullocks of high quality are fattened annually.

A large proportion of the Shires of Waggamba and Inglewood, which together have a cattle population of 120,000, has a similar climate to "Texas Station," and some of the region has a similar potential for crop production and pasture improvement.

(2) "Meridan Plains", Landsborough.

This property consists largely of river frontage to the Mooloolah River and comprises 3,000 acres. The area receives a high annual rainfall (about 65 in.), which occurs mainly during the summer.

Much of the property is subject to flooding and is badly drained, the soils below 20 in. being of mottled yellow clay. Most of the soils are grey-brown sandy loams to grey loams of alluvial origin. These run back into low ridges of light-grey sandy loam.

Apparently the river flats originally carried an open stand of *Eucalyptus tereticornis* (blue gum) and some patches of *Melaleuca leucadendra* (tea-tree), with fringing forest along the large streams. The fringing forest extended over portion of the flat to form scrub.

The greater part of the flats carries a mixture of *Carex appressa* (a sedge), *Paspalum dilatatum* (paspalum), *Axonopus affinis* (narrow-leaf mat grass), and *A. compressus* (broad-leaf mat grass), with some *Trifolium repens* (white clover).

The stocking rate on the property is quite high, that on the better flats being in the vicinity of a beast to the acre. However, at least during part of the year the cattle probably suffer from mineral deficiencies, notably of phosphorus and copper, and from time to time they are heavily parasitised by both internal parasites and cattle tick.

A Poll Hereford stud is established on the property.

The property is situated outside the main beef cattle areas, but the growth rates are indicative of those to be expected over most of the near-coastal belt from Maryborough south to the border, the beef cattle population of which is about 30,000.

(3) "Brian Pastures", Gayndah.

"Brian Pastures" is a grazing property of 5,300 acres owned by the Australian Meat Board and operated by the Queensland Department of Agriculture and Stock as a pasture research station. It is situated on the west bank of Barambah Creek, about 10 miles from Gayndah. The average annual rainfall of the district is about 29 in., and some winter rains occur.

The property is covered with ridges of varying slopes, and there are broken areas of levee bank and flood plain regions along the creeks. The soil types are closely related to the parent rocks, basalt areas giving rise to brown and red-brown soils of heavy texture and granitic and acid basaltic rocks yielding sandy soils. A grey clay soil occurs on the creek alluvial flat.

The vegetation was originally an open eucalypt forest. On the alluvial flats the forest is a pure or nearly pure stand of *Eucalyptus tereticornis* (blue gum), with *E. populnea* (poplar box) on the gentler slopes. On the remainder of the property the main trees are *E. dichromophloia* (bloodwood), *E. melanophloia* (silver-leaved ironbark) and *E. crebra* (narrow-leaved ironbark), with occasional trees of *E. tessellaris* (Moreton Bay ash).

The pasture grasses are now mainly *Heteropogon contortus* (black spear grass), with a number of blue grasses (species of *Dichanthium* and *Bothriochloa*).

The property is tick-infested, but tick control is satisfactory.

The breeding herd of approximately 250 cows of Hereford and Poll Hereford origin is being mated to Poll Hereford bulls.

The property is in the centre of the large beef cattle raising district of the Burnett, which has a cattle population of approximately 200,000.

(4) "Eulogie Park", Dululu.

"Eulogie Park" is situated in the Dawson Valley about 50 miles south-west of Rockhampton. The average annual rainfall is about 30 in., of which some 25 in. normally fall in the summer.

There is a diversity of soil types on the property. Those on which the recorded stock were run range from deep red scrub soils of the softwood association to the shallow dark-brown brigalow-wilga soils.

Much of the original softwood and brigalow vegetation has been bulldozed and cleared and the area oversown to Rhodes and green panic grasses. Grasses naturally found in the brigalow area have persisted to some extent.

A Poll Hereford stud is maintained on the property and a large number of bullocks of high quality are fattened each year.

"Eulogie Park" has been developed more than most other beef cattle properties in the area, but the growth rates of the cattle are indicative of those which could be achieved in an area with a beef cattle population of 200,000.

(5) "Belbroughton", Kunwarara.

"Belbroughton" is situated about 50 miles north of Rockhampton and has an average annual rainfall of 35 in. The rainfall is chiefly monsoonal, with storm rains falling in December-March and only scattered unreliable falls during winter-spring. Summer maximum temperatures are usually between 85 and 95 deg. F., and fairly cold winters are experienced.

The soils range from heavy brown to black clays derived from serpentine rocks.

Now extensively ringbarked, the original trees were mainly *Eucalyptus crebra* (narrow-leafed ironbark). The grasses are mainly blue grasses (species of *Bothriochloa* and *Dichanthium*), with small patches of *Heteropogon contortus* (black spear grass).

The breeding herd of approximately 250 head of grade Hereford cows has been mated to approximately equal numbers of Hereford and ¼ Zebu, ½ Hereford bulls.

The growth rates of the cattle are indicative of those of cattle over most of the beef cattle country of the Shires of Livingstone and Broadsound, with a beef cattle population of 250,000.

(6) "Mungalla", Ingham.

This property is situated within five miles of Ingham in an area with an 80 in. rainfall.

The bulk of the property consists of alluvial flats, with grey-brown sandy loams running back into sandy ridges.

The main pasture species on the property are *Cynodon dactylon* (couch grass), *Paspalidium distans* (a brigalow grass), *Paspalum orbiculare* (a swamp paspalum) and *Setaria pallidifusca* (a pigeon grass). *Brachiaria mutica* (para grass) and *Panicum maximum* var. *typica* (guinea grass) have been established over much of the property and in some areas comprise half the sward.

The cattle on the property are mainly Zebu-British breed crosses with varying percentages of Zebu blood.

While the beef cattle population of the area is rather small, being less than 20,000, it is capable of considerable expansion with further introduction of para and guinea grasses.

(7) Bureau of Tropical Agriculture, South Johnstone.

The Bureau of Tropical Agriculture of the Queensland Department of Agriculture and Stock is situated in the wet tropical coastal belt.

The average annual rainfall recorded at the Bureau is 120 in., and the precipitation varies from 80 to 180 in. per annum. Approximately 75 per cent. of the rainfall is received in the period January-July, and by far the heaviest falls are recorded in February and March. From August to November conditions are relatively dry, and variable rains occur in December. The maximum temperature rarely exceeds 90 deg. F. in summer and may fall as low as 40 deg. F. in winter. The humidity, however, is generally high throughout the year.

The Bureau is situated in an area with brown clay-loam alluvial soils of high permeability.

The pastures established on the station are in 2-acre paddocks which are grazed rotationally; they vary in composition but contain *Brachiaria mutica* (para grass), *Panicum maximum* var. *coloratum* (purple top Guinea grass), *Pueraria phaseoloides* (puero) and *Calopogonium mucunoides* (calopo). The stocking rate of the pastures is of the order of 1 beast to 1·25 acres.

The beef cattle population of the district is quite low, being less than 5,000. There are indications that, with widespread use of the pasture mixtures developed at the Bureau, 30,000 head of cattle could be fattened annually on country considered suitable for this type of development.

(8) "Wairuna", Mt. Garnet.

"Wairuna" is situated on the coastal tableland of North Queensland about 50 miles west of Cardwell and 70 miles south-east of Mt. Garnet. The property lies roughly half-way between the Great Dividing Range to the west and the Cardwell Range to the east. It is about 1,800 ft. above sea level.

The average annual rainfall of 28 in. is mainly of summer incidence. Summer temperatures are high, reaching several degrees over 100 deg. F., while frosts are common in the winter.

The country consists almost exclusively of granitic soils with a light sandy surface overlying clay. There are some silt deposits on the flooded edges of the lagoons which support a good body of couch grass.

The main trees are *Eucalyptus crebra* (narrow-leafed ironbark), *E. populnea* (poplar gum), and *E. dichromopholoia* (bloodwood), with *Casuarina* sp. (bull-oak) in the gullies. The most common grasses are *Themeda australis*

(kangaroo grass), *Heteropogon contortus* (black spear grass) and species of *Eragrostis* (love grasses). A blue grass (*Bothriochloa decipiens* var. *cloncurriensis*) is also found in the ringbarked areas.

Crossbred British cattle have been run on this property for many years and a nucleus of American Brahman cattle has been used to supply a proportion of the bulls in the breeding herd.

The property is situated in the centre of a large beef cattle breeding area, with a beef cattle population in the vicinity of 250,000 head. The growth rates observed at "Wairuna" would be indicative of those over the whole of the district.

III. EXPERIMENTAL RESULTS.

This review has been prepared in order that a broad appreciation of beef cattle performance under Queensland pastoral conditions could be readily obtained. Some of the relevant information has already been published.

The presentation of the data is based on that used by Dr. M. C. Franklin in his unpublished reports on the situation in the southern States of Australia, and the histograms and graphs have been prepared in the same manner so that easy comparison may be made.

The data from all weighing centres are presented graphically, and the mean daily weight changes between successive weighings, together with the monthly rainfall, as a series of histograms.

(1) "Texas Station", Texas.

Data on the bodyweight of 32 Aberdeen-Angus steers are summarised in Figs. 2 and 3. They were collected over the period Aug. 19, 1954 to May 20, 1955.

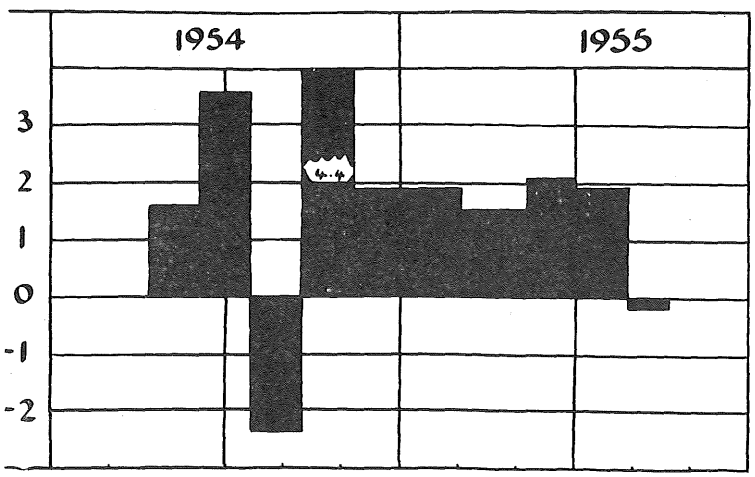

Fig. 2.

Histogram Showing the Mean Daily Weight Change (in Pounds) Between Weighings at "Texas Station", Texas. 32 Aberdeen-Angus bullocks (born 1952) weighed from 19.8.54 to 20.5.55.

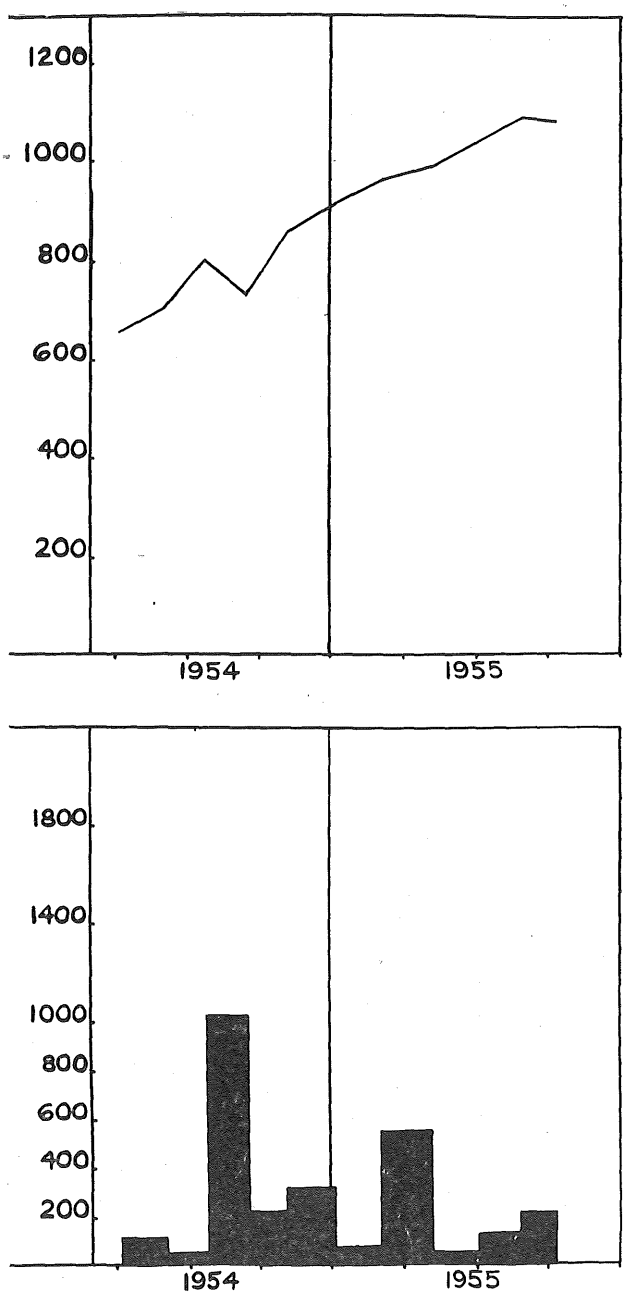

Fig. 3.

Graph Showing Liveweight Changes (in Pounds), and Histogram Showing Monthly Rainfall (in Points), at "Texas Station", Texas. 32 Aberdeen-Angus bullocks (born 1952) weighed from 19.8.54 to 20.5.55.

The stock showed a steady weight gain, except in October, when the paddocks were flooded. The weight gains recorded are in excess of 1·5 lb. daily. This is quite noteworthy, especially for August and September; it may be assumed that these gains are associated with the use of winter pastures.

(2) "Meridan Plains", Landsborough.

The growth studies of three groups of Poll Hereford heifers indicate a steady growth rate during the last three or four months of each year and the first four months of the next year. However, during the period May to August the stock either lost weight or barely maintained it.

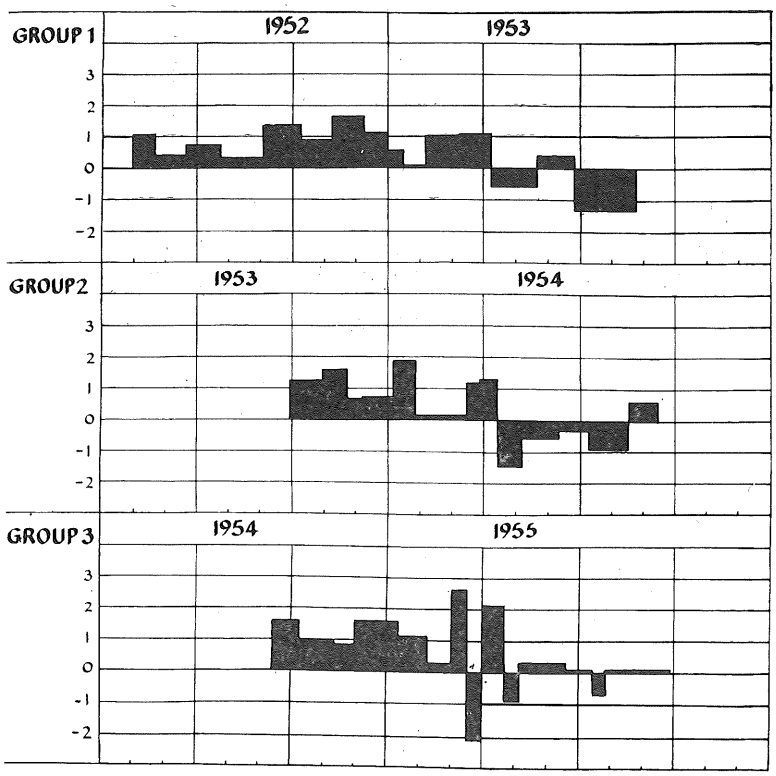

Fig. 4.

Histogram Showing the Mean Daily Weight Change (in Pounds) Between Weighings at "Meridan Plains", Landsborough.

Group 1—14 Hereford heifers (born 1951).

Group 2—12 Hereford heifers (born 1952-53).

Group 3—13 Hereford heifers (born 1953-54).

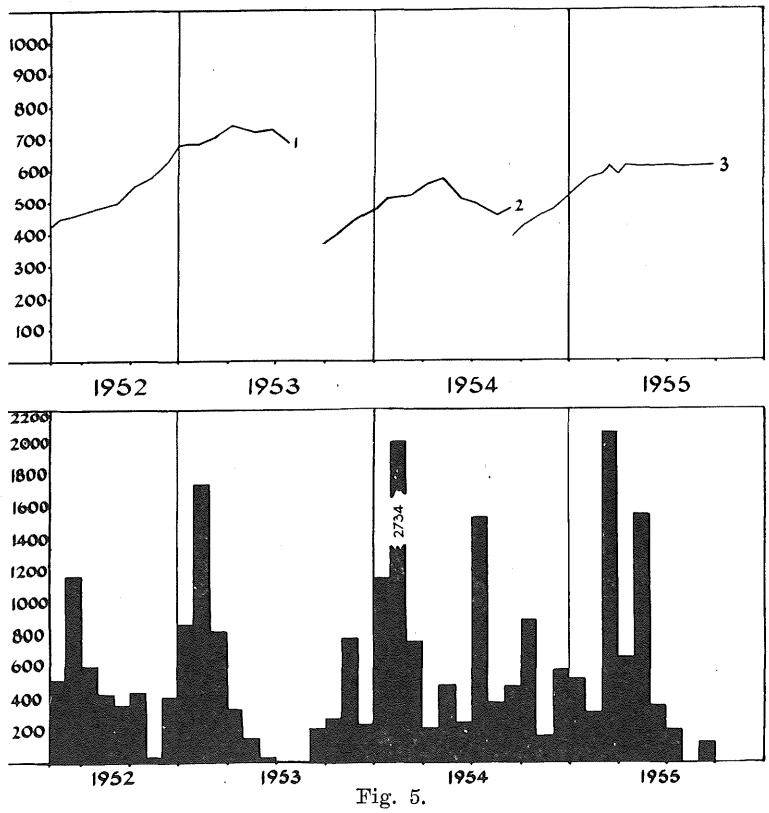

Fig. 5.

Graph Showing Liveweight Changes (in Pounds), and Histogram showing Monthly Rainfall (in Points), at "Meridan Plains", Landsborough.

Group 1—14 Hereford heifers (born 1951).
Group 2—12 Hereford heifers (born 1952-53).
Group 3—13 Hereford heifers (born 1953-54).

The weight gains recorded during the growing season are of the order of 0·5 lb. to 1·0 lb. daily, which is comparable with those at "Mungalla" but is somewhat less than those at the Bureau of Tropical Agriculture, the other high-rainfall centre.

(3) "Brian Pastures", Gayndah.

Weighing of all the cattle on the property, which are of Hereford and Poll Hereford composition, has been conducted regularly since February, 1954. The data presented relate to the growth rate of steers and replacement heifers run on natural pastures. Steers and heifers weaned in 1953 and 1954 and steers weaned in 1955 are included. The first two growth curves are for 25 steers weaned in 1953 and 20 heifers weaned at the same time. The steers represent the lightest of the animals at weaning, while the heifers were the best grown ones. Consequently, the steers are lighter than the heifers at all weighings.

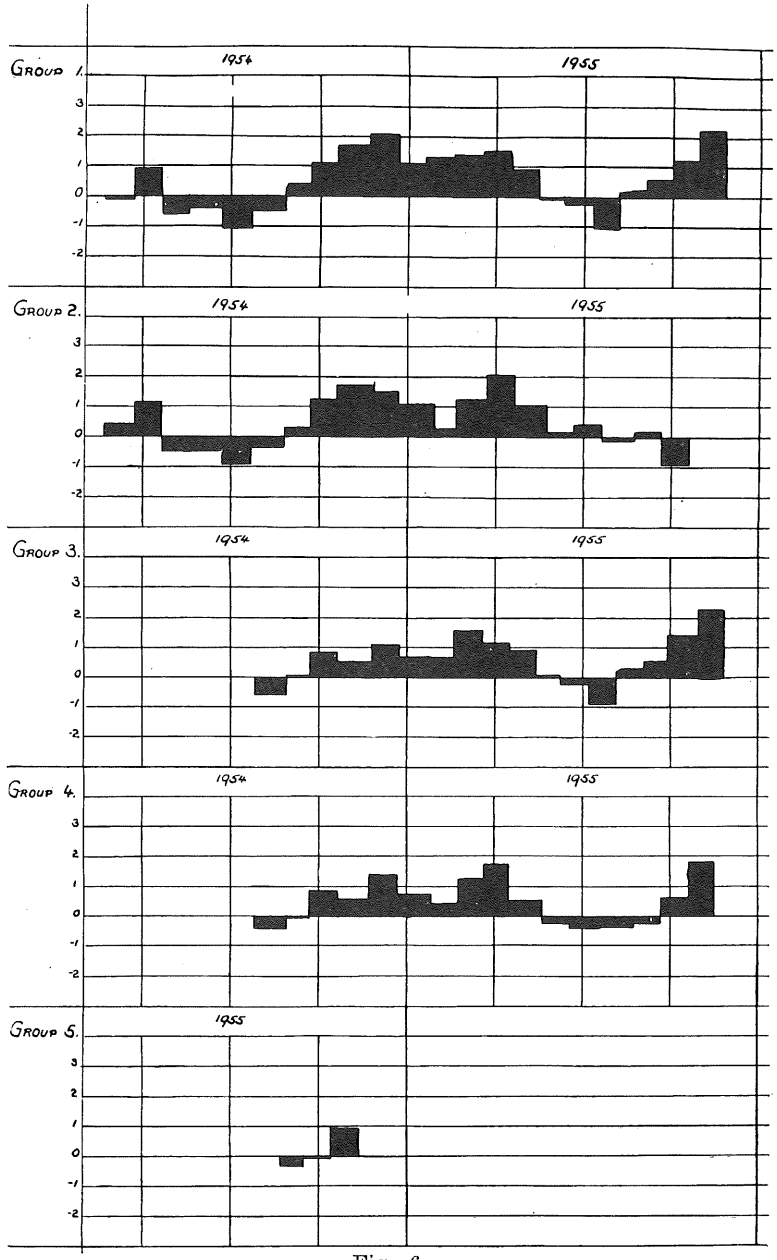

Fig. 6.

Histogram Showing the Mean Daily Weight Change (in Pounds) Between Weighings at "Brian Pastures", Gayndah.

Group 1—25 Hereford steers (1953 weaners).
Group 2—20 Hereford steers (1953 weaners).
Group 3—38 Hereford steers (1954 weaners).
Group 4—21 Hereford heifers (1954 weaners).
Group 5—66 Hereford steers (1955 weaners).

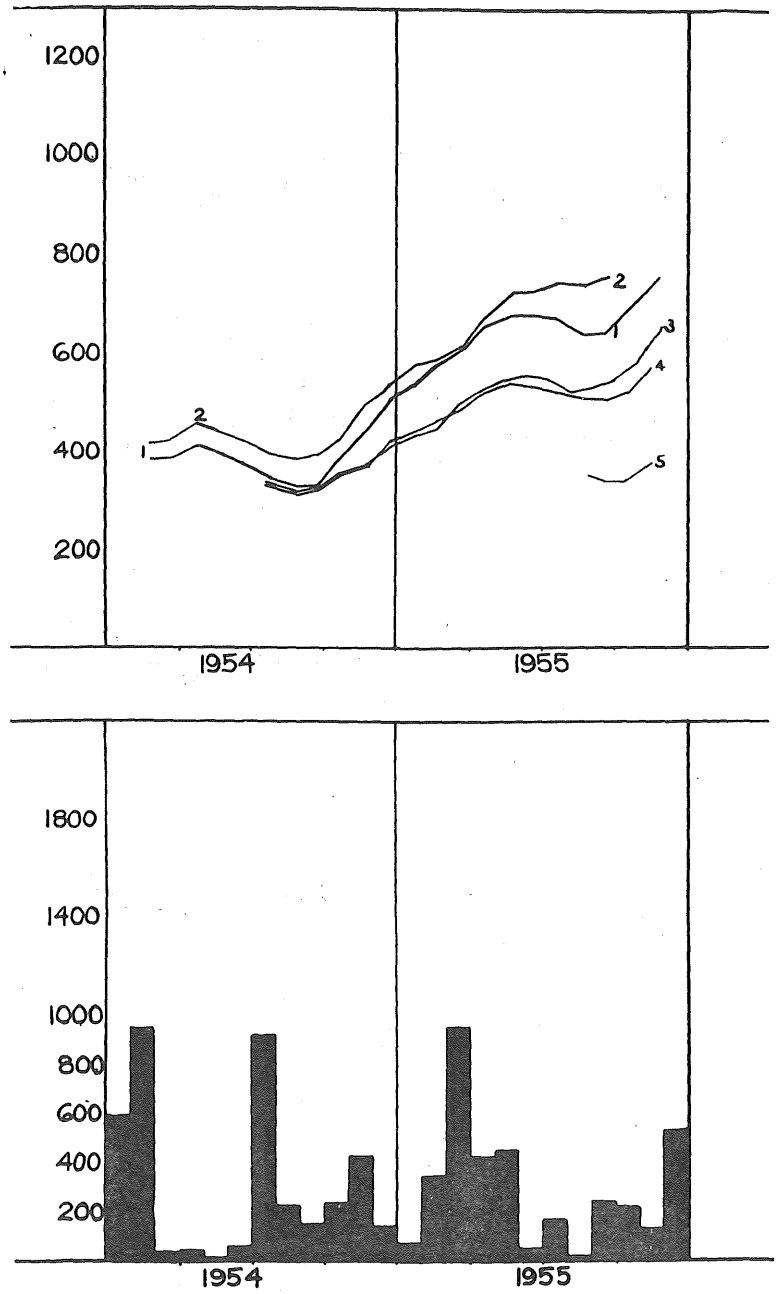

Fig. 7.

Graph Showing Liveweight Changes (in Pounds), and Histogram Showing Monthly Rainfall (in Points), at "Brian Pastures", Gayndah.

Group 1—25 Hereford steers (1953 weaners).
Group 2—20 Hereford heifers (1953 weaners).
Group 3—38 Hereford steers (1954 weaners).
Group 4—21 Hereford heifers (1954 weaners).
Group 5—66 Hereford steers (1955 weaners).

It is interesting to note that the 38 1954 steers and the 21 1954 heifers are more nearly comparable in weight and that they were only slightly lighter than the steers which were one year older at the end of the 1954 winter. In contrast, these 1954 cattle were fully 200 lb. heavier than the 66 1955 steers at the end of the 1955 winter. The 1954 winter was better than average, but that of 1955 was noticeably mild throughout and did not cause any marked weight loss (Fig. 7).

(4) "Eulogie Park", Dululu.

One group of 20 weaner Poll Hereford steers has been weighed regularly since Aug. 25, 1953. Grazing on the natural pastures available on the property, they have shown a seasonal weight fluctuation, with winter weight losses.

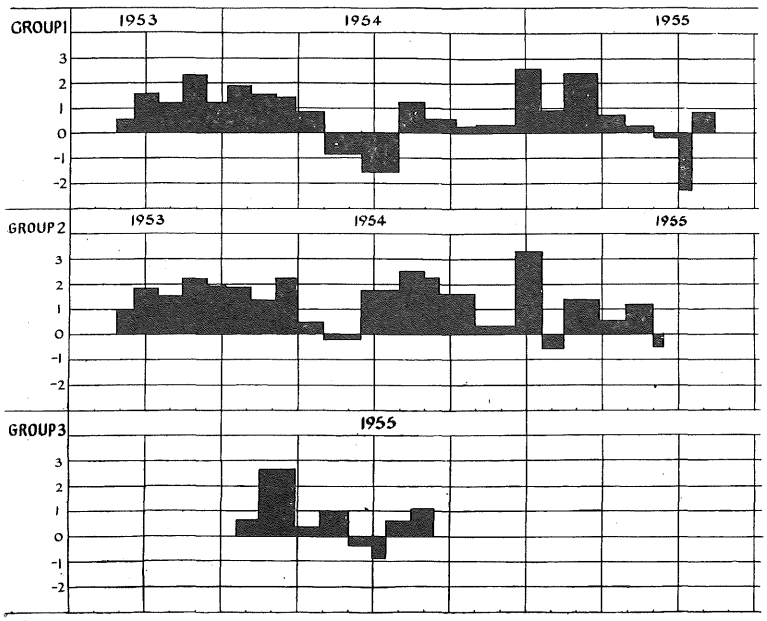

Fig. 8.

Histogram Showing the Mean Daily Weight Change (in Pounds) Between Weighings at "Eulogie Park", Dululu.

Group 1—20 Poll Hereford steers (1953 weaners).
Group 2—25 Poll Hereford steers (1954 weaners).
Group 3—10 Poll Hereford steers (1953 weaners) run on crop from May 1954 to Nov. 1954.

Another group of 25 Poll Hereford steers weaned in October 1954 have been weighed regularly since Jan. 17, 1955, and have exhibited a comparable weight fluctuation.

Another group of 10 Poll Hereford steers were weighed regularly while on pasture from Aug. 25, 1953, until Apr. 30, 1954, when they were turned on to an oat crop with a mob of bullocks. Initially they lost weight on the oats; this may perhaps be attributed to a settling-down period. Subsequently

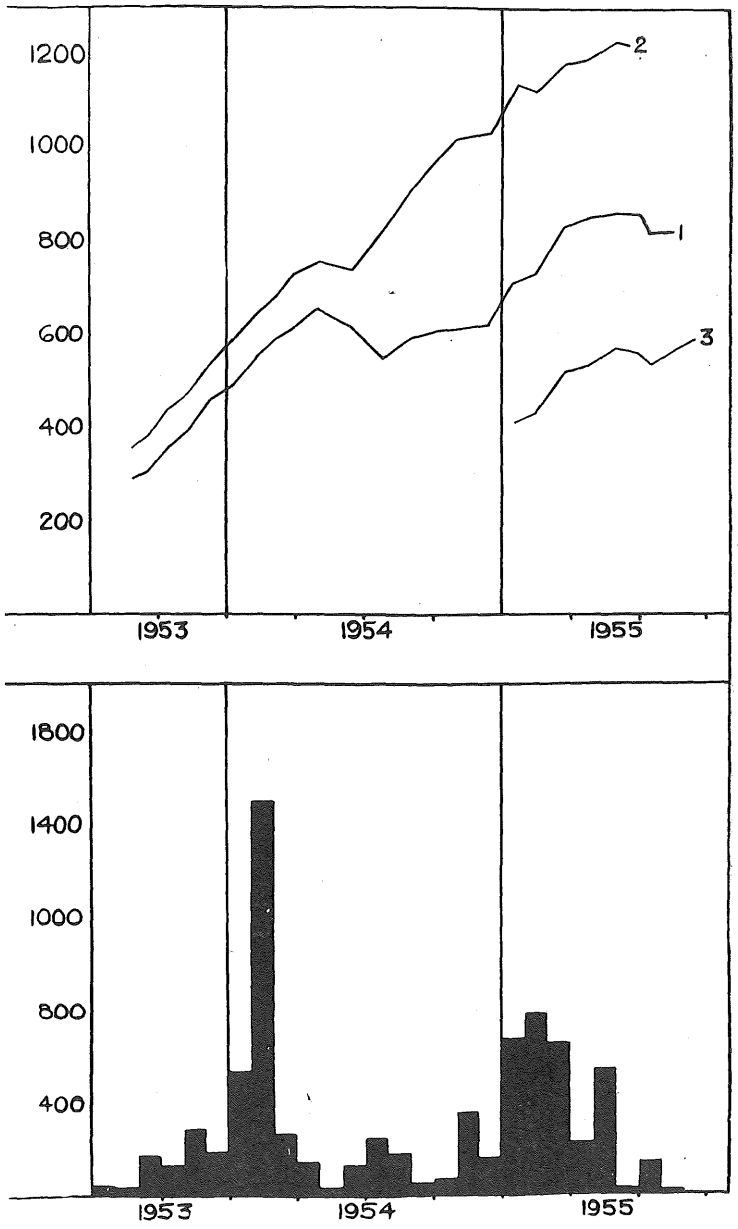

Fig. 9.

Graph Showing Liveweight Changes (in Pounds), and Histogram Showing Monthly Rainfall (in Points), at "Eulogie Park," Dululu.

Group 1—20 Poll Hereford steers (1953 weaners).
Group 2—25 Poll Hereford steers (1954 weaners).
Group 3—10 Poll Hereford steers (1953 weaners) run on crop from Apr. 30, 1954.

they showed gains in the vicinity of 2 lb. daily until November, when they were once again relying on natural pastures. They were kept on natural pastures until turned off on June 13, 1955. Their winter weight gains indicate the improvement which can be expected from winter cropping. The group of steers of comparable age with which they were running initially will not be turned off until June 1956.

(5) "Belbroughton", Kunwarara.

The initial groups of Hereford and Zebu-Hereford weaner steers have been weighed regularly since Nov. 12, 1953.

A second trial was commenced on Nov. 4, 1954, with another two groups of cattle.

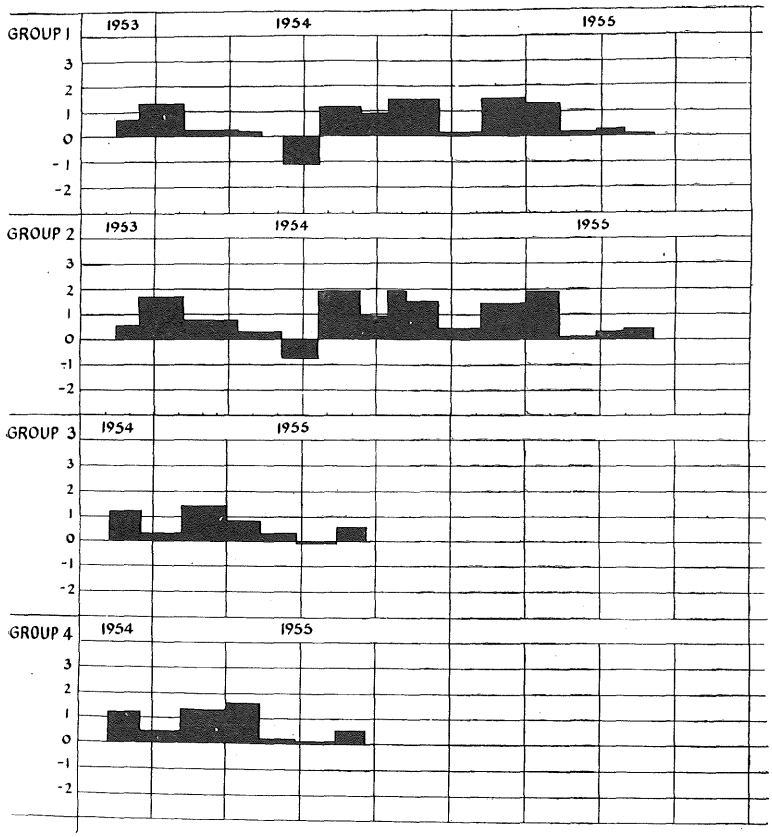

Fig. 10.

Histogram Showing the Mean Daily Weight Change (in Pounds) Between Weighings at "Belbroughton", Kunwarara.

Group 1—20 Hereford steers.
Group 2—14 Zebu-Hereford steers.
Group 3—17 Hereford steers.
Group 4—21 Zebu-Hereford steers.

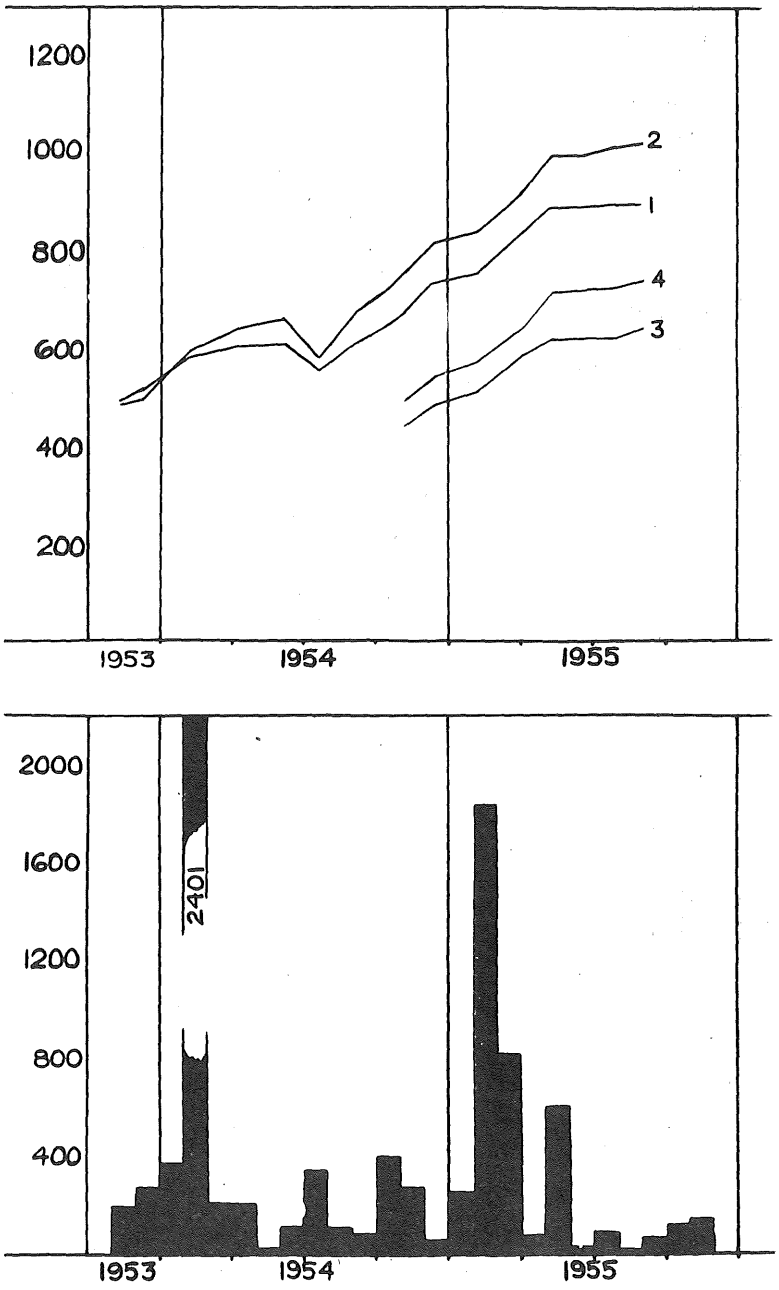

Fig. 11.

Graph Showing Liveweight Changes (in Pounds), and Histogram Showing Monthly Rainfall (in Points), at "Belbroughton," Kunwarara.

Group 1—20 Hereford steers.
Group 2—14 Zebu-Hereford steers.
Group 3—17 Hereford steers.
Group 4—21 Zebu-Hereford steers.

The growth rates of the Hereford and Zebu-Hereford steers followed the same seasonal pattern, but the Zebu-Hereford group was observed consistently to gain more and lose less weight than the Hereford steers. This, allied to their greater weaning weight, has produced an ever-widening margin between the weights at the same age. During the period of maximum growth in the late spring and summer, both groups recorded weight gains in excess of those at "Mungalla" and "Meridan Plains."

(6) "Mungalla", Ingham.

On this property two groups of cattle with varying proportions of Zebu and British breed blood were weighed. One consisted of 25 replacement heifers and the other of 10 steers of comparable age. The growth data obtained gave indications of a similar trend to those obtained at other centres, but the trial was discontinued before the trend was clearly shown.

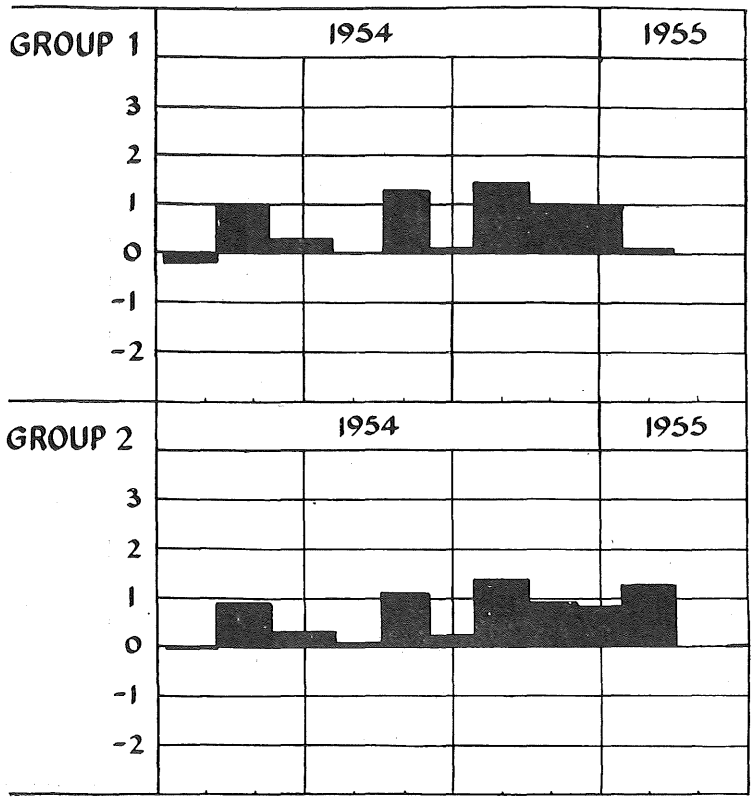

Fig. 12.

Histogram Showing the Mean Daily Weight Change (in Pounds) Between Weighings at "Mungalla," Ingham.

Group 1—10 Zebu cross steers.
Group 2—25 Zebu cross heifers.

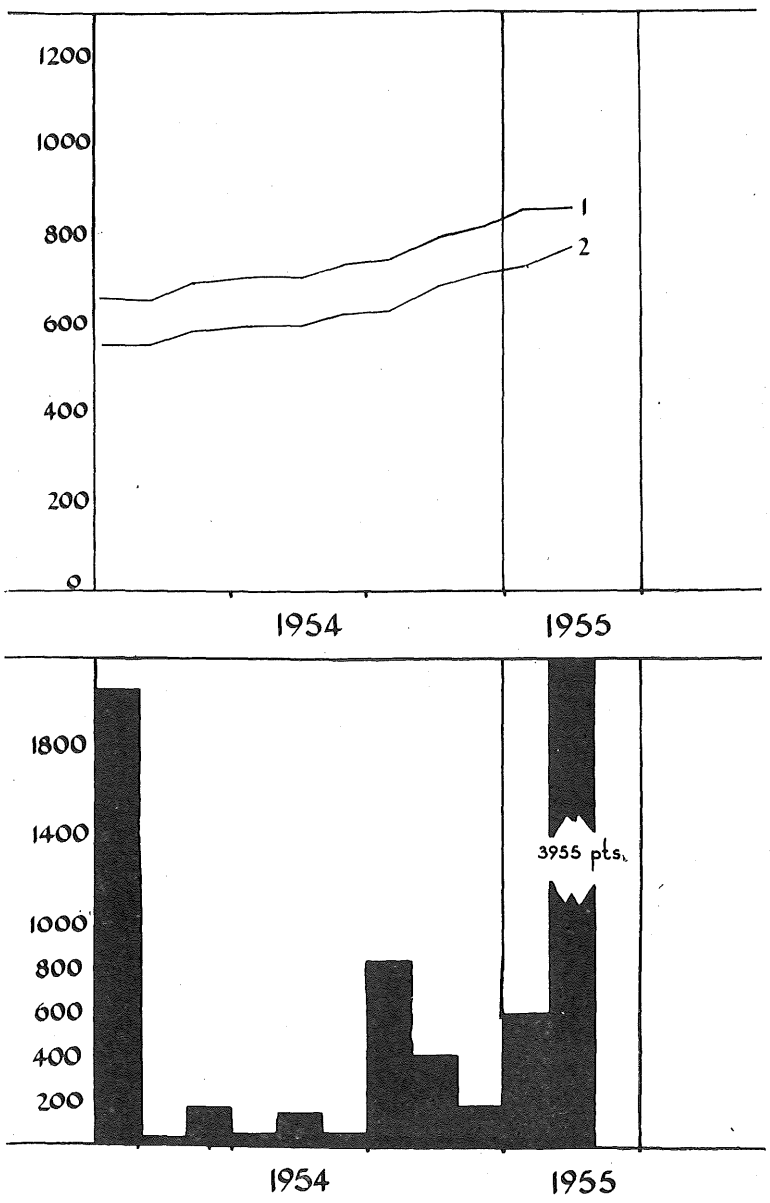

Fig. 13.

Graph Showing Liveweight Changes (in Pounds), and Histogram Showing Monthly Rainfall (in Points), at "Mungalla," Ingham.

Group 1—10 Zebu cross steers.

Group 2—25 Zebu cross heifers.

(7) Bureau of Tropical Agriculture, South Johnstone.

The weight gains from the Zebu cross and British breed cattle, which were rotationally grazed on balanced pastures of high quality, are comparatively high, only tapering off during the spring when the bullocks were "finished." The seasonal weight gains so evident at most of the other weighing centres are not so marked under the conditions at the Bureau. The fattening of beef cattle on these pastures would appear to be quite a sound procedure, as there is little variation in the rate of fattening in the various years. The Zebu cross and British breed bullocks showed rather similar rates of fattening, with the Zebu cross somewhat heavier.

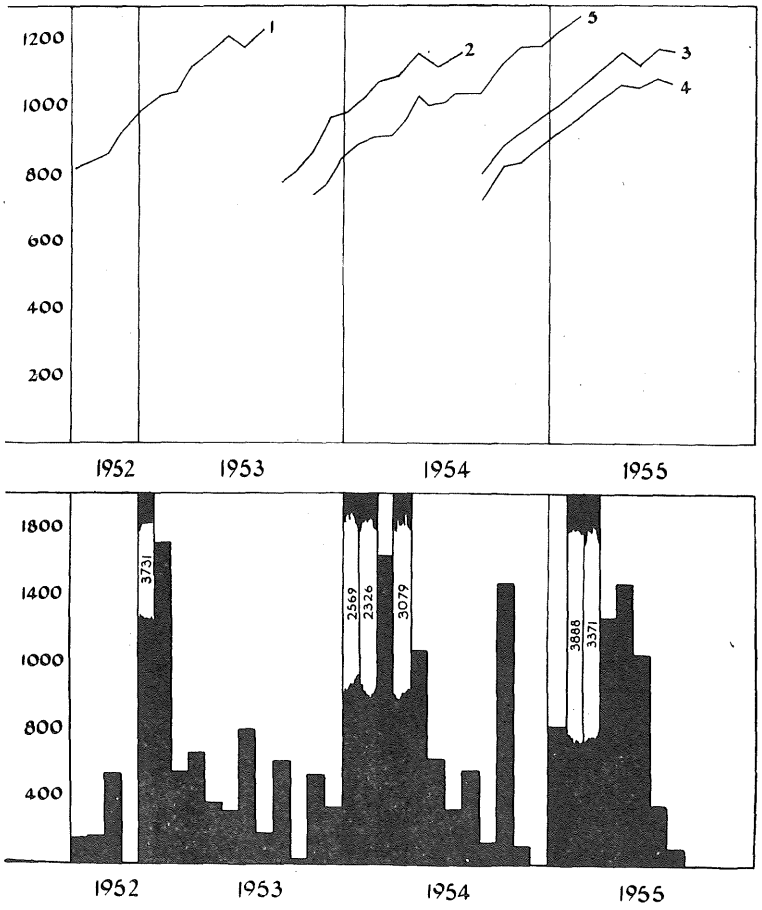

Fig. 14.

Graph Showing Liveweight Changes (in Pounds), and Histogram Showing Monthly Rainfall (in Points), at Bureau of Tropical Agriculture, South Johnstone.

Group 1—16 Shorthorn bullocks (2½-3 years).
Group 2—16 Hereford bullocks (2½-3 years).
Group 3— 6 Zebu cross bullocks (2½-3 years).
Group 4— 6 Hereford bullocks (2½-3 years).
Group 5— 7 Australian Illawarra Shorthorn bullocks (born Jan. 1952).

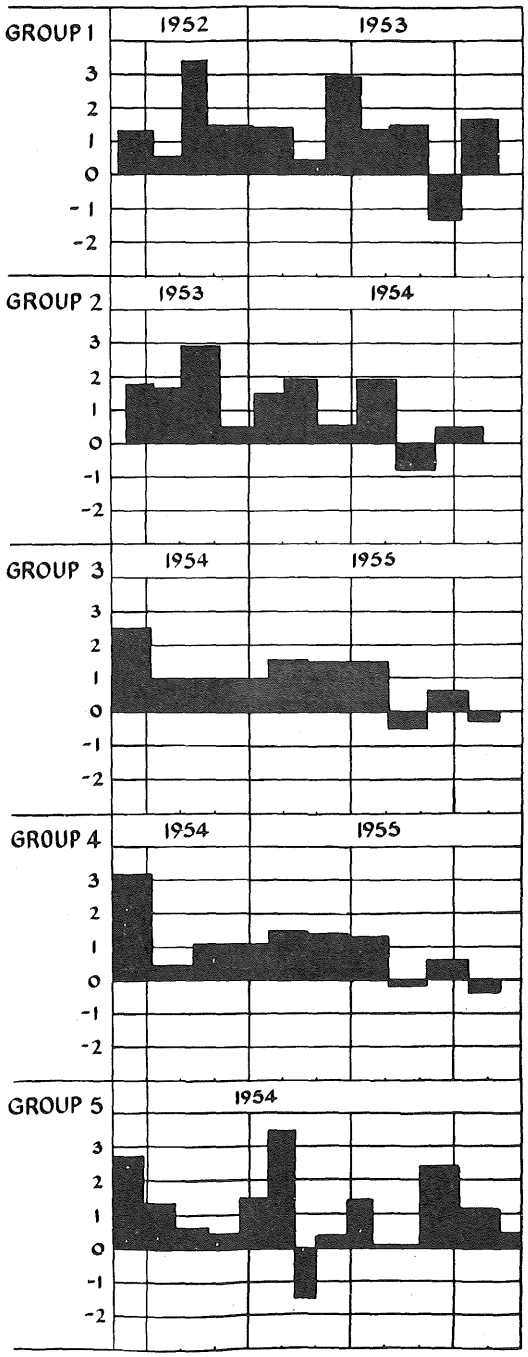

Fig. 15.

Histogram Showing the Mean Daily Weight Change (in Pounds) Between Weighings at Bureau of Tropical Agriculture, South Johnstone.

Group 1—16 Shorthorn bullocks.
Group 2—16 Hereford bullocks.
Group 3— 6 Zebu-cross bullocks.
Group 4— 6 Hereford bullocks.
Group 5— 7 Australian Illawarra Shorthorn bullocks.

(8) "Wairuna", Mt. Garnet.

One trial comparing the growth rates of Zebu cross and British breed weaner steers with 25 in each group commenced in November, 1952, and was completed on May 9, 1955. The growth pattern in each group was similar, with the British cattle gaining 607 lb. and the Zebu cross 698 lb. during the period of the trial. The seasonal weight fluctuations were more severe than those observed at other centres. Rapid weight gains of a high order were recorded during the summer and early autumn, followed by losses in late winter and spring.

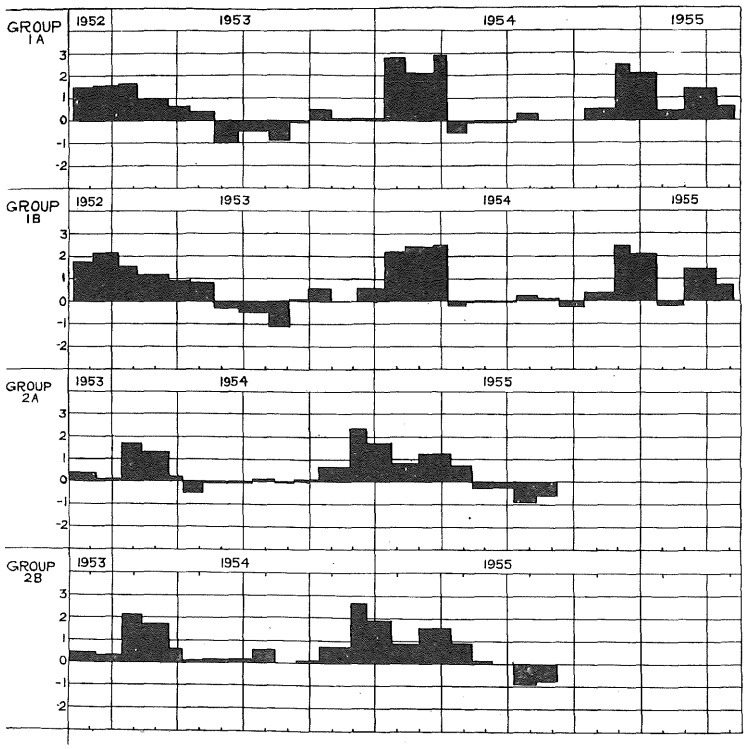

Fig. 16.

Histogram Showing the Mean Daily Weight Change (in Pounds) Between Weighings at "Wairuna," Mt. Garnet.

Group 1A—25 British crossbred bullocks (weaned 1952).
Group 1B—25 Zebu cross bullocks (weaned 1952).
Group 2A—20 British crossbred bullocks (weaned 1953).
Group 2B—25 Zebu cross bullocks (weaned 1953).

A second trial involving 25 Zebu cross and 20 British breed weaner steers was commenced on Oct. 31, 1953. These cattle showed similar weight trends to those in the first trial, with an ever-widening gap between the weights of the Zebu cross and the British breed bullocks.

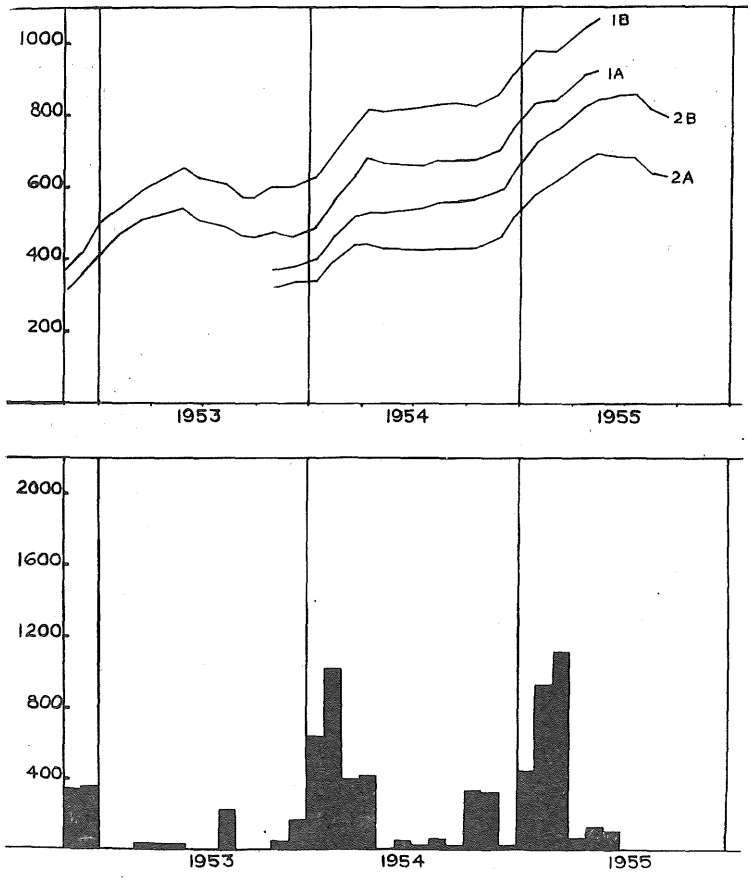

Fig. 17.

Graph Showing Liveweight Changes (in Pounds), and Histogram Showing Monthly Rainfall (in Points), at "Wairuna," Mt. Garnet.

Group 1A—25 British crossbred bullocks (weaned 1952).

Group 1B—25 Zebu cross bullocks (weaned 1952).

Group 2A—20 British crossbred bullocks (weaned 1953).

Group 2B—25 Zebu cross bullocks (weaned 1953).

IV. DISCUSSION.

(1) Seasonal Pattern of Growth.

In considering the growth rates of cattle at "Meridan Plains," "Brian Pastures," "Eulogie Park," "Belbroughton" and "Wairuna," which are centres from which a sufficient volume of information to permit comparisons has been obtained, it is apparent that the seasonal fluctuation in weight is highest at the more northerly stations.

Two of the stations (''Brian Pastures'' and ''Wairuna'') have a rather similar pasture type, one consisting predominantly of *Heteropogon contortus,* a summer-growing species which is not capable of much winter growth; the period of pasture growth is shorter at ''Wairuna'' than at ''Brian Pastures.''

''Belbroughton'', with pastures predominantly of blue grass, is intermediate between ''Wairuna'' and ''Brian Pastures'' in length of growing season. It more closely resembles that at ''Brian Pastures,'' but this may be due as much to the more nutritious pasture species as to a longer period of pasture growth.

''Eulogie Park,'' with predominantly introduced grasses, has a similar growing period to ''Belbroughton.''

''Meridan Plains,'' which is in an area of high and reasonably well distributed rainfall, should present a much better growth pattern than any of the other centres, but the predominance of a pasture of low nutritive value (composed of *Axonopus affinis*) limits the growth rate.

A study of the seasonal fluctuations in weight shows that the low plane of nutrition during the winter imposes a severe limitation on beef cattle production in Queensland. It has the effect of retarding the even development of the animal and produces an undesirable relationship of muscle, fat and bone. Cattle which suffer these seasonal setbacks are relatively old and heavy before they develop a sufficient fat cover to allow them to be turned off for slaughter.

It is in the northern centres that the adverse seasonal effects are felt to their fullest extent; here bullocks are turned off with a dressed weight of 800 lb., when a dressed weight of 550-650 lb. is preferred. This has an adverse effect on Australia's export trade, as the producer is unable to produce, off grass, a carcase possessing the desirable combination of finish and light weight.

(2) Remedial Measures.

Two remedial measures are available to the producer:—

(*a*) He may improve the feeding of the animal so that it is not subjected to any weight loss or at least its weight loss is minimised.

(*b*) He may develop or obtain cattle which are better able to withstand the rigours of the climate than those he has now.

(a) Improvement of Nutrition.

There are a number of ways whereby the nutrition of the cattle can be improved. It will suffice to record those used in association with our growth studies.

Pasture Improvement.—In areas of reliable winter rainfall, the summer-growing natural pasture may be supplemented by areas sown down to winter-growing species. This was done at "Texas Station." Unfortunately, the growth rate of the bullocks recorded prior to being turned on to the improved pasture here was not recorded, but a study of the growth rate data for natural pastures on other properties shows that cattle almost invariably either lost weight or barely maintained their weight in August, whereas cattle given access to winter-growing pastures gained in the vicinity of 2 lb. daily during the August-September period.

Crop Supplements.—Where there is a reasonable winter rainfall, crops can also be used to minimise winter weight losses. This was illustrated at "Eulogie Park," where steers run on oats from April to November, 1954, showed appreciable weight gains until November, when the crop was eaten out and they had to rely on natural pastures. The stock could have been sold at this time but were carried on by their owner for a specific market.

Judicious use of winter crops can result in the production of marketable fat bullocks from August to November, a period when there is usually a short supply of such cattle. This practice is being developed in some parts of the State.

(b) Improved Types of Cattle.

Much attention has been focussed on the performance of Zebu cattle and their crosses in the Queensland environment. The underlying cause of this interest is that from an ecological and broad climatological viewpoint, Queensland should be stocked with cattle of tropical origin. Wright (1954) considered that tropical coastal Queensland should be stocked with cattle comparable in heat tolerance to those of subtropical coastal areas of North Africa (Fig. 18)—i.e. be capable of tolerating, at moderate humidities, variations in temperature ranging from the temperate to the tropical. These conditions are identical with those in Texas, U.S.A.

Inland from the Queensland coast the climate changes; the range of temperature lies higher and the humidity is markedly lower. Here, Wright considered, the type of stock should, on the basis of climographs,* resemble in climatic tolerance the large purebred Zebus of India and Africa.

Still further inland, the climate is such as to require stock resembling in climatic tolerance the medium-sized purebred Zebu inhabiting the coastal desert tracts of India.

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* A climograph is constructed by plotting as a single graph the mean monthly air (dry bulb) temperatures against the mean monthly relative humidities. By this means the combined influence of these two weather criteria for different localities can be studied. Since cattle are affected to a major degree by temperature and humidity, these provide useful guides to the suitability of the environment for any particular class of cattle.

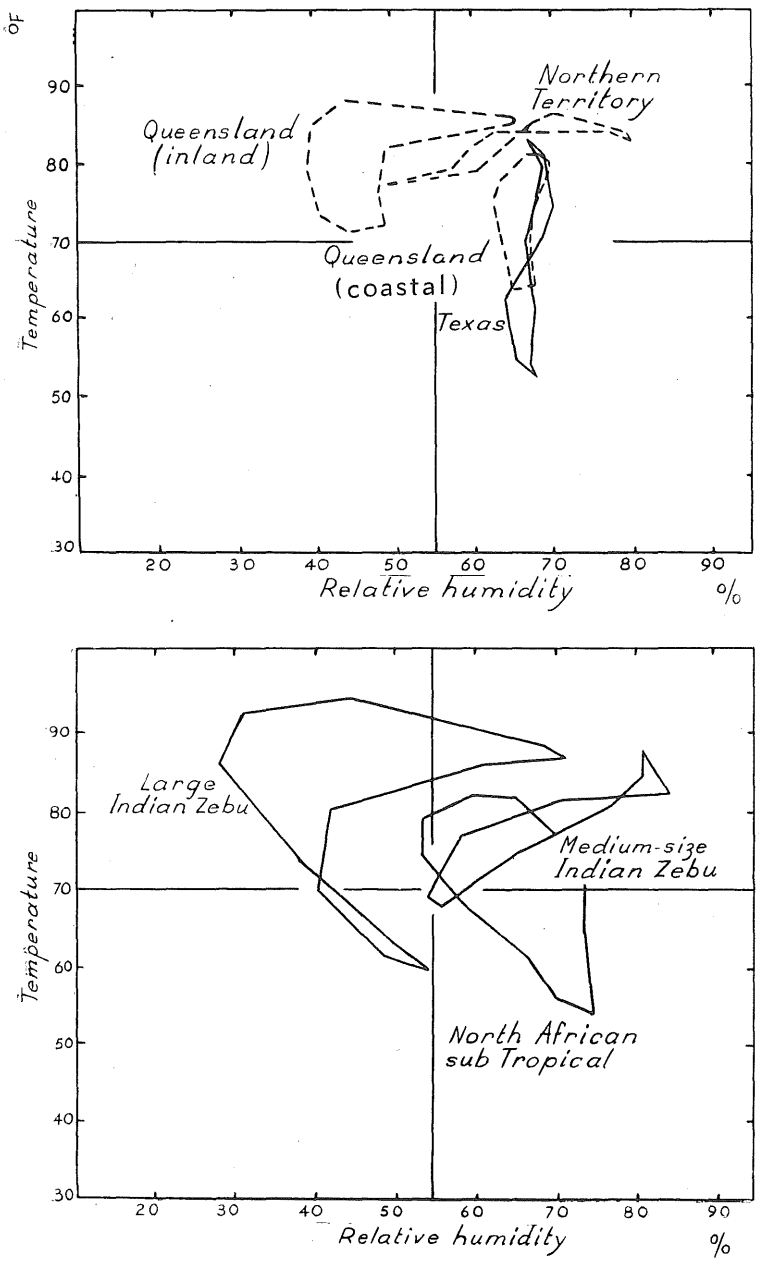

Fig. 18.

Climographs for Various Regions in Which Beef Cattle are Raised. The centres are—Croydon (Queensland inland), Rockhampton (Queensland coastal), Darwin (Northern Territory), San Antonio (Texas, U.S.A.), Delhi (large Indian Zebu), Karachi (medium-sized Indian Zebu), and Cairo (North Africa subtropical).

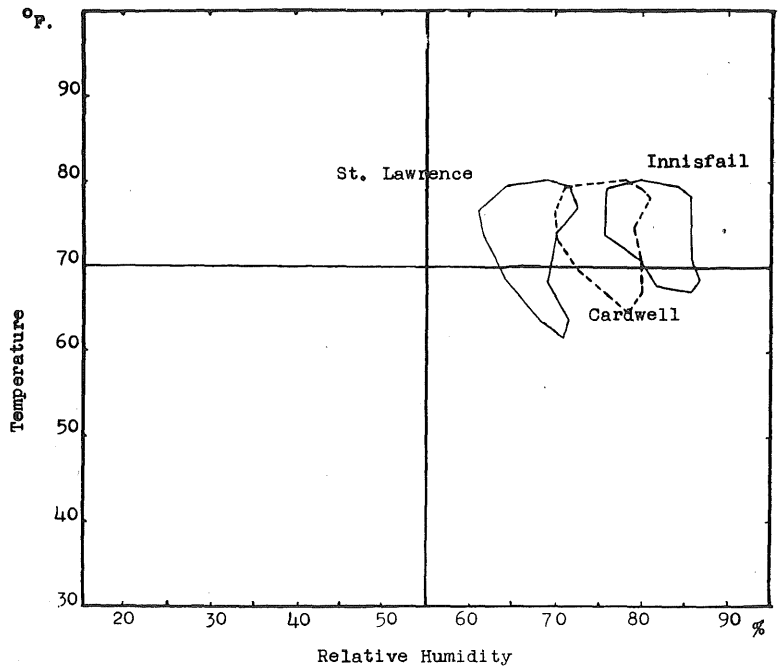

Fig. 19.

Climographs for Recording Stations Near the Tropical Weighing Centres of "Belbroughton" (St. Lawrence), "Mungalla" and "Wairuna" (Cardwell), and Bureau of Tropical Agriculture (Innisfail).

The climographs for the weighing centres in the tropics (Fig. 19) are situated in the top right-hand section of the graph, indicating a hot and humid environment. This is similar to that recorded by Wright for Texas and the North African subtropical area. It is on these data that Wright based his recommendations.

At three of the tropical centres, the growth rate of Zebu-cross cattle has been compared with that of British cattle originating in a temperate climate. These centres are "Wairuna," "Belbroughton" and the Bureau of Tropical Agriculture. The last two come under the general classification of Queensland coastal climate. At all three centres, the data indicate that the Zebu-cross cattle are heavier than British cattle of comparable age. However, they did not gain weight at a markedly higher rate during the summer months, which is the period of climatic stress. There is a slightly greater rate of gain in favour of the Zebu-cross but not sufficient to demonstrate a much greater ability to withstand the stresses imposed by the climate.

One of the causes which may be responsible for this slight difference is altered grazing time. Under the free grazing conditions in Queensland, British cattle seem to have adopted a behaviour pattern by which they can minimise the adverse effects of the climate. Larkin (1954) showed that British cattle

at the Bureau of Tropical Agriculture grazed intensively during the hours of early morning and late evening. Zebu-cross cattle grazed irrespective of the time of day. The grazing time of British cattle was reduced in the summer months but not sufficiently so to reduce growth rate (Fig. 14). The stock at the Bureau were on highly nutritious pasture.

Probably the main reason why there was greater overall growth rate of the Zebu-cross cattle at "Wairuna" and "Belbroughton" was that they did not lose as much weight during the winter period of nutritional stress as did the British breeds. In areas where cattle have to travel greater distances for feed during the summer and where the fodder is less nutritious, the hardiness of the Zebu-cross cattle may show to advantage in the summer months as well as in the winter.

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