PASTURE DEVELOPMENT FOR BEEF AND DAIRY CATTLE ON THE SOUTH COAST OF QUEENSLAND FIELD MEETING, APRIL 19 & 20, 1968.

AN INTRODUCTION TO GOLD COAST AND HINTERLAND AGRICULTURE

by

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GEOGRAPHY

For the purpose of this meeting the area dealt with will extend from Oxenford in the north to the Queensland-N.S.W. border in the south. The western boundary is deliniated by the elevated plateaux of Springbrook, Beechmont and Tamborine Mountain. This area covers some 350 square miles lying on or about 28°S. latitude. (See Figure 1).

Essentially the area consists of a narrow strip of coastal lowlands in the east flanked by undulating to steep mountainous country in the south (MacPherson Range) and west (Darlington and Tamborine Ranges). The central part is broken by a series of mountain spurs branching out from the highland ranges. Altitudes range from sea level to about 3,000 feet.

Five main streams dominate the drainage system, all rising in the South-West mountainous region and flowing in a general North-Easterly direction. These are the Coomera and Nerang Rivers and Mudgeeraba, Tallebudgera and Currumbin Creeks. Gold Coast and Hinterland region showing the distribution of the parent rocks from which the principal soils are derived, including a cross section (Mt. Warning-Coast), and the locations of the four sites visited.

Gold Coast City occupying the entire eastern shoreline is the major population centre. Its permanent population (1967) was 52,000 with a total population (permanent plus tourists) of up to 167,000 during the peak tourist season.

CLIMATE

The climate is humid sub-tropical. Mean annual rainfall within the area ranges from over 100 inches at Springbrook down to about 50 inches in the central north. Rainfall distribution is relatively uniform throughout the year with 60% falling in the October-March period and 40% in the remaining six months. The mean monthly rainfall for Southport is shown in Figure 2.

Mean maximum and minimum monthly temperatures are also shown in Figure 2. December, January and February are the hottest months with mean maximum temperatures about 83°. July and August are the coldest with a mean monthly minimum temperature about 45°. Frosts are comparatively mild and restricted to the lower slopes, flats and plateaux. Normally three to five frosts could be expected in the June-August period.

Above the frost line tropical pastures are capable of making growth for about seven or eight months of the year and autumn-saved pasture can be carried well into the winter months.

The high rainfall and its distribution together with only light frosts provides for a lengthy growing period for sub-tropical grasses and legumes. In addition, the climate is more suited to the growth of temperate pasture species than most other areas of Queensland.

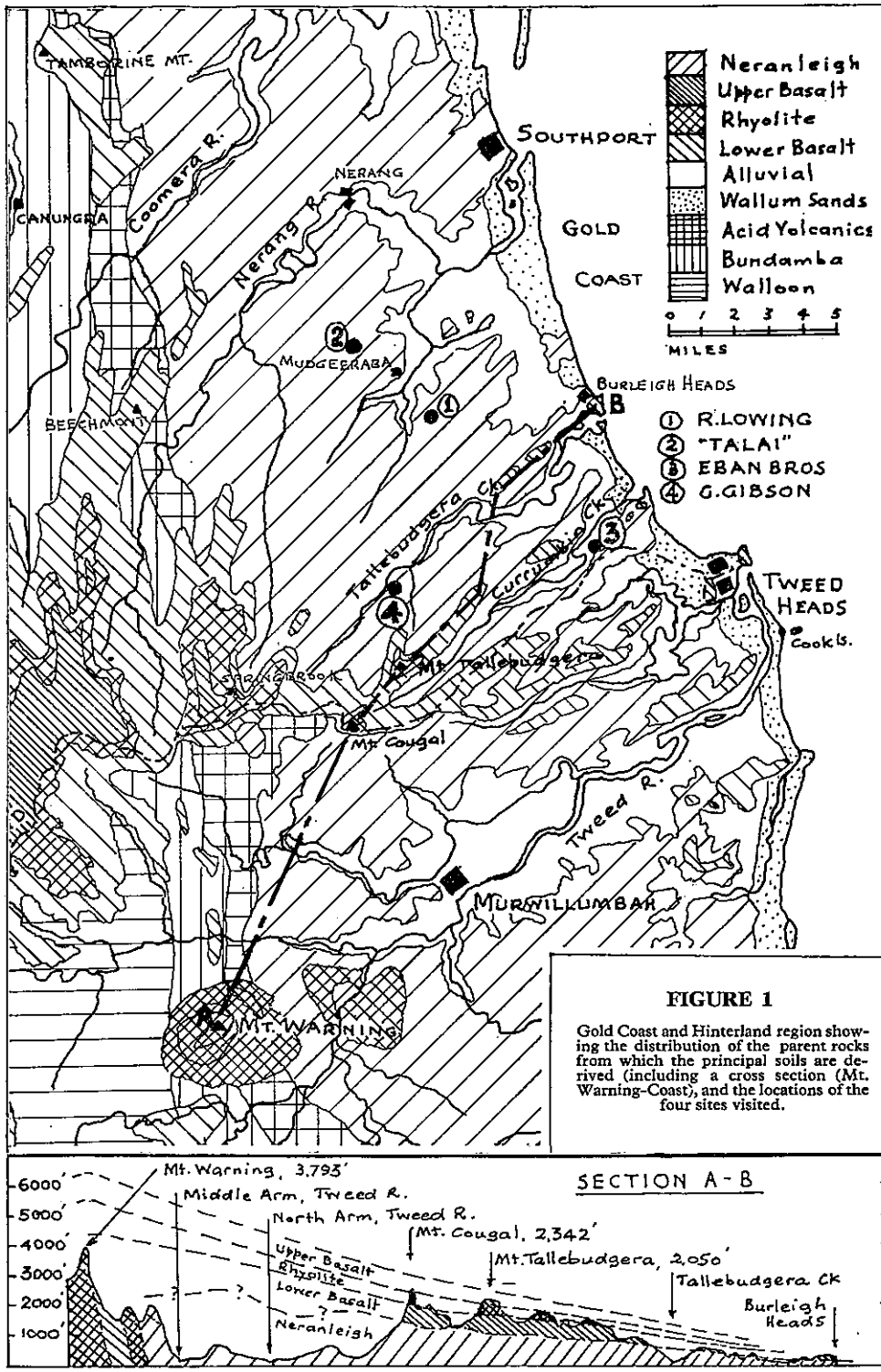

FIGURE 1

Gold Coast and Hinterland region showing the distribution of the parent rocks from which the principal soils are derived (including a cross section (Mt. Warning–Coast), and the locations of the four sites visited.

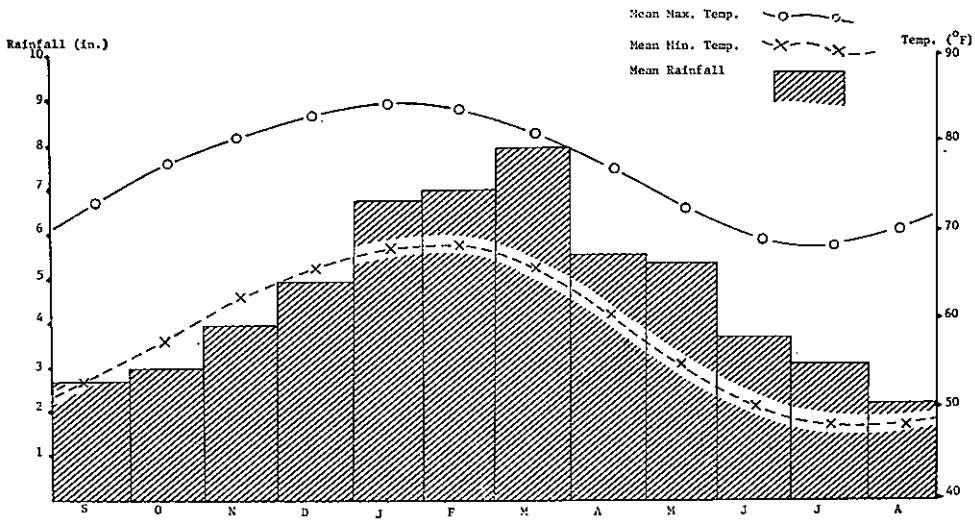

FIGURE 2

Mean monthly temperature and rainfall data for Southport (this represents the driest end of the Gold Coast).

HISTORY

The first early settlement occurred about the 1840's to 1850's when timber hunters from the Tweed River scanned the area for pine and cedar. The timber was cut in the mountains, floated down the rivers and creeks to the coast and then sent to Brisbane.

The earliest agricultural pursuits (1870-1880) included the growing of sugar and cotton and later potatoes, pumpkins, maize and the like. Intensive development within the area did not eventuate until after the railway line from Beenleigh to Southport was opened in 1889. Dairying was the industry mainly responsible for closer development. In the early stages some beef cattle were grown but mainly for tallow. Little expansion in the beef industry occurred until about the 1950's with the major advance only over the last few years.

PRESENT LAND USE

Dairying, banana growing (2,000 acres) and beef production are the major rural industries within the area. In addition, small areas of arrowroot, pawpaws. avocadoes, passionfruit, macadamia nuts and various small crops are grown on a minor scale.

Dairy farmers of the area (approx. 170) supply whole milk to the South Coast Co-operative Dairy Assoc. Ltd. at Southport. Milk intake since 1950 is shown in Table 1.

TABLE 1

Milk intake at South Coast Co-operative Dairy

Year	No. of suppliers	Milk received (gal.)
1950	92	1,270,309
1955	151	1,818,699
1960	180	3,259,844
1965	164	3,004,817
1966	172	3,257,205
1967	173	4,349,416

During the period 1960-66 milk intake remained relatively constant. The large increase shown in 1967 was largely due to favourable seasonal conditions. The 1,500 acres of pasture established under the Dairy Pasture Subsidy Scheme was, no

doubt, also partly responsible for the higher production. The level of dairy cow production within this area is not high. To illustrate this the herd recording figures for two groups (40 herds) are shown in Table 2. For comparison the Queensland herd recording averages are also shown.

TABLE 2

South Coast and Queensland herd recording figures

Recorded Item	1965/66		1966/67	
	Q'ld.	South Coast	Q'ld.	South Coast
Cows	44,125	2,154	45,982	2,122
Average Milk (lb.)	4,614	3,778	5,123	4,582
Average Test (%)	4.2	4.1	4.3	4.1
Average Fat (lb.)	194	150	220	190

The beef cattle industry is at present gaining a strong foot-hold in the area. For example, the beef cattle population of the Albert Shire has increased from about 2,000 head in 1957 to 8,000 in 1967. During the same period the dairy cow population of Albert Shire has decreased from 38,000 to 27,000. Little information is at present available on beef cattle productivity in relation to pasture types being used in the Hinterland area. Much of this development is occurring on the poor, uncleared forest country on which little development has taken place in the past.

GEOMORPHOLOGY

Close to the Queensland-N.S.W. border, the valleys of Currumbin and Tallebudgera Creeks run in a north-easterly direction. Further up the coast the ridges and valleys run in a more northerly direction, with the Nerang River flowing slightly east of north, the Coomera more northerly, and the Albert and Logan Rivers starting off slightly west of north.

This radial drainage pattern has its focus at Mt. Warning in the Tweed Valley, and the same radial pattern is repeated in the Richmond and Clarence Rivers draining to the South.

It has been estimated by Solomon (1959) that in tertiary times the Mount Warning Shield Volcano was approximately 6,300 feet high, plus or minus 500ft., and extended about 55 miles in a north-south direction and 35 miles in an east-west direction. (Figure 1) There were three major phases of volcanic activity. The first basaltic phase probably came from several other minor vents in addition to Mt. Warning. The second phase consisted of rhyolite and the third was again basalt. There is thus a layer of rhyolite sandwiched between two layers of basalt. The rhyolite can easily be distinguished by the steep, light coloured cliffs which it forms. Remnants of all three phases can be seen on Mt. Tallebudgera (2,050ft.) (Figure 1)

The present limits of distribution of the lavas are, roughly, Tamborine Mountain in the North, Fingal and Cook Island in the East, the Richmond River in the South and the upper reaches of the Clarence and Logan Rivers in the West. The sources of all these rivers were originally high up on the slopes of the volcano. Their headwaters have since been captured by the Tweed River as it excavated the erosion caldera which now surrounds the remants of the central complex of the volcano at Mt. Warning (3,793ft.).

In the Mudgeeraba-Currumbin area most of the shield has been eroded away, leaving basalt and rhyolite caps on the tops of the ridges only, and exposing the underlying Neranleigh Series of marine sediments.

The name Neranleigh comes from a combination of Nerang and Beenleigh and is used to describe a group of marine sedimentary and metamorphic rocks which stretch from Brisbane in the North to Byron Bay in the South. They were originally formed on the sea bed in Paleozoic times. Since then they have been subjected to great pressure and are strongly folded. Most of the strata now dip almost vertically with the direction of folding running roughly parallel to the coast.

The group consists of sandstones, shales, greywackes, quartzites and other sedimentary and metamorphic rocks.

The Neranleigh Series does not extend right to the present coastline except in a few isolated spots. The narrow coastal plain consists of marine sands laid down when the coastline was further inland than its present position — due to the rise in sea level at the end of the Ice Age. These sands have since been largely covered by river alluvium and peat, except for a narrow strip of wallum and dune sands along the coast.

To the West of the Neranleigh marine sediments is a narrow belt of volcanic rocks, mainly acid tuffs and rhyolite. This series is known in Queensland as the Brisbane Tuff and in N.S.W. as the Chillingham Volcanics. Further West are freshwater sediments of the Clarence-Moreton Basin known as the Bundamba Sandstone and Walloon Coal Measures.

SOILS

There exists within the area a wide range of soil types, their distribution being far from uniform. It is not uncommon to find three or more different types on the one farm. The Atlas of Australian Soils lists no less than six dominant soils within the area.

In this introductory paper three general areas of soil distribution will be outlined. It should be borne in mind that within each of these areas several soil types other than the dominant soil type frequently exist.

Elevated plateaux soils

The plateaux of Springbrook, Beechmont and Tamborine are typical of this. The dominant soils are the Red Friable Porus Earths, often referred to as krasnozems or red basaltic soils. Mostly they are used for dairying, agriculture and grazing. They were originally covered by dense rain forest and were very fertile when first cleared. These soils, at present carrying Kikuyu and paspalum-based pastures are acidic (pH 5.5-6.2) and generally highly deficient in nitrogen, phosphate and molybdenum. The potassium status is variable but generally adequate at the present time. Some responses to potassium have been observed but mainly on areas with a history of cropping such as with maize. Sulphur may also be deficient while manganese toxicity is becoming increasingly evident in intensively cultivated areas.

In the Mudgeeraba-Currumbin area the volcanic soils are confined to the ridge tops. The soils derived from rhyolite are not as fertile as the basaltic soils and, because of the rough nature of the country, are seldom cleared. The red basaltic soils are usually steep and stony and are used mainly for banana growing.

Undulating to steep hill soils

These are adjacent to the elevated plateaux and extend almost to the coast. Most of the soils in the area are derived from the Neranleigh Series of marine sediments. In the past they were considered too infertile to be worth clearing except on the lower slopes of the valleys. It is on these soils that most of the present pasture development is taking place.

There is a wide range of texture and hardness in the parent rocks. Consequently the soils derived from them vary greatly in structure and depth. Moreover, the individual beds of rock are usually not very thick and, because they dip so steeply, changes of rock may be encountered every few yards, as can be seen by examining the road cuttings. As a result, there may be frequent changes of soil texture and depth throughout a paddock although this may not necessarily be apparent in the topsoil. It is not practical, therefore, to try and map these soils

individually and they are best treated as an association. McGarity (1956) recognised six main soil groups developed on the Neranleigh Series and, of these, the main ones occurring in this area are —

Podsolic (Amphi-podsol)
Yellow earth
Red earth
Meadow soils

The podsolic or Hard-Setting Loamy Soils with Mottled Clayey Sub-Soils are the most predominant. They are usually found in areas of lower rainfall and support dry sclerophyll (eucalypt) forest. They are extremely infertile and frequently exhibit poor internal drainage.

The red and yellow earths are deep and are of fairly uniform colour and texture throughout the profile.

The red earths are formed on iron rich parent material, such as ferruginous sandstone, and frequently have quartzite on the surface or scattered through the profile. They have a much higher proportion of sand to clay than the basaltic soils and should not be confused with them. Both are frequently referred to as scrub soils but the red and yellow earths mostly carried wet sclerophyll (eucalypt) forest and are less fertile than the basaltic red soils which were usually covered with rain forest.

The meadow soils include alluvials and peats. These are naturally more fertile than the hill soils. Their main requirements appear to be phosphorus and molybdenum, with the addition of calcium where clovers or lucerne are grown and nitrogen for high levels of production from grasses such as Kikuyu and setaria or forage crops such as oats and the sorghum and Sudan grass hybrids. Copper deficiency can occur on these soils, particularly in sandy or low lying areas subject to waterlogging. Cattle appear to exhibit deficiency symptoms before they can be detected in plants.

All the soils of the Neranleigh Series are extremely deficient in nitrogen and phosphorus. Potash appears to be generally adequate. Calcium is doubtful, but plant needs are apparently being met in most cases where recommended rates of superphosphate are being used. Molybdenum deficiency is widespread. Magnesium, zinc and boron (?) deficiencies have been reported in bananas and manganese toxicity in beans, but apparently these elements are not limiting factors for pasture growth. pH ranges from about 4.5 to 6.0, with an average of around 5.5. It is usually too low for good growth of temperate legumes but is satisfactory for most tropical species.

Present fertilizer recommendation for pastures on these soils is 4 cwt. of Mo Super 12 per acre at planting, and 3 cwt of Superphosphate annually until a total of at least 10 cwt has been reached. After reaching this total it is thought that it may be possible to reduce the level of maintenance dressings. Molybdenum should be added every three or four years. In addition, it is recommended that trial strips of potash and calcium be laid down to see if any worthwhile response is obtained. Internal soil drainage and surface compaction are problems on some types while on others excessive cultivation causes surface 'powdering' which is potentially hazardous for erosion.

Coastal Lowland soils

The soils of this area are found in a narrow strip adjacent to the coastline. While the area is relatively small the soil types vary greatly. They include the Acid Peats, Siliceous Sands and 'wallum' type sandy soils. In addition, some areas of friable loamy soil exist. Collectively these soils are low lying and usually subject to

periodic flooding and waterlogging. Little is known of the fertility status of the soils in this area. Acidity is common (pH 4.0 - 6.0) and phosphate, nitrogen, potash and molybdenum deficiencies appear to be general. There seems litle doubt that in the sandier types other deficiencies, both within the major and trace element group occur.

This brief outline of the soils indicates that we are dealing with problems of soil infertility which are common throughout the coastal areas of South-East Queensland. For pasture development this general infertility is accentuated by the broken distribution of the various soil types and the frequently difficult terrain of the country.

HISTORY AND FUTURE OF PASTURE DEVELOPMENT

The history of pasture development within the area is similar to most other South-East Queensland areas. The presence of large areas of carpet grass (*Axonopus* spp.) is a constant reminder of the deterioration that has taken place over the last half-century.

The first sown pasture species used were paspalum (*Paspalum dilatatum*), Rhodes grass (*Chloris gayana*) and later Kikuyu (*Pennisetum clandestinum*) and white clover (*Trifolium repens*). Paspalum, Kikuyu and clover have, until this day, remained the basis of improved pastures of the area.

It is only in the last decade that we've seen spectacular advances in the field of pasture improvement. This can be attributed to two main factors — (i) The first has been due to the use of a wider range of summer growing grasses and legumes. We refer, of course, to species of such genera as *Desmodium, Phaseolus, Setaria, Glycine, Panicum, Lotononis* and *Dolichos.*

These new species are being used to supplement and in many cases, to completely replace existing pasture and crops. A major contribution appears to be in their ability to be used to develop that class of forest country which, until a few years ago, was considered not worth developing.

(ii) The second major advance has been the increasing awareness of the role of soil fertility in pasture improvement. In the early days we grew pasture with an almost complete disregard for the decline in soil fertility. We now appear to have reached the stage where merely halting fertility decline is not sufficient. This comes from a better understanding of the degree of soil fertility throughout the area, and the response of pasture plants to improved fertility. This can be illustrated by the fact that some 80% of the farmers establishing pasture under the Dairy Pasture Subsidy Scheme use no less than 4 cwt. per acre molybdenum superphosphate for pasture establishment.

Now what about the future of this area with regard to pasture improvement and the grazing industries. It looks bright at the moment.

There seems little doubt that most of the ingredients for intensive development exist.

★ The area, although comparatively small in terms of acreage, is largely undeveloped.

★ The climate is favourable particularly with respect to the annual rainfall, and its seasonal distribution.

★ A range of pasture species is available to initiate development.

★ Local markets are rapidly expanding.

★ Facilities such as good roads, transport, electricity, schools, etc., are readily available.

Many problems still exist and do doubt many others will arise. High land prices and development costs are potential hazards to economic development.

While pasture establishment costs may become less over the next few years, increasing land values and their side effects may well overshadow this. Apart from this there are other problems to be adequately solved.

How best can we use our present pasture resources to satisfy stock demands throughout the year in the varying farm situations? Have temperate grasses and legumes been largely neglected in the search for pasture types within the area? Will these temperate species play a role as short term or semi-permanent pastures? Will there be more reliable ways of developing the steep slopes in the high rainfall areas where weeds are a real problem?

This is only a modest sample of the problems. The Proceedings over the next two days will highlight some of our problems, and, we hope, answer a few.

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"CLOVER HILL", MUDGEERABA

by

W. R. LOWING

I purchased this property in August, 1967. Previously I had been at Deniliquin, N.S.W., running sheep and cattle and growing grain crops, so tropical pastures are quite new to me.

Some time ago, I believe, "Clover Hill" was a Jersey Stud but, like many other farms of its kind in this area, it gradually declined to the stage where it was no longer good enough for dairying.

Two previous owners ran beef cattle on it. Only about 150 acres out of the total of 534 acres had been cleared, so obviously it could not run enough beef cattle to be profitable.

In the past six months I have cleared and sown this area of 150 acres on which we are standing and a further 100 acres has been cleared ready for burning, ploughing and sowing next season.

There were 50 Hereford steers and 70 head of mixed cattle on the place when I bought it but as I improve it with fertilizer and sown pastures I intend to change over to vealer raising.

DISCUSSION

With respect to the importance of the tourist industry in this region, do you consider it generally desirable that eventually so much forest will be felled for pasture development?

Mr. Roberts: In this country there will always be a lot of timber left in spite of all the pasture development that could take place. There are considerable areas of steep country which will probably never be cleared. In fact, I feel that once you have developed your pastures you should then develop these timbered areas by planting them with commercial species of timber such as slash pine.

How does frost affect your established pastures of tropical species?

Mr. Roberts: You will see this afternoon areas planted to tropical pasture species three years ago in country I thought would be too cold for them. Up till now they have survived the winters very well. I am not suggesting you should disregard the special conditions of cold situations but it is fair to say that with the short duration frosts we get close to the coast the tropicals are not unduly affected.

What is the market value of the timbered land?

Mr. Roberts: It is hard to say because it is changing so rapidly. It also varies according to steepness, accessability and proximity to the coast. I would estimate that timbered country might average $40 to $60 per acre at present.

What were the methods of land preparation which you used?

Mr. Lowing: The forest was pushed, windrowed and raked, taking in all 386 hours of work at a cost of $38 per acre. The area was then ripped with a three-pronged ripper behind a Caterpillar D6 Tractor, the ploughing time being 115 hours at a cost of $8 per acre. Seed cost $17.40 per acre and superphosphate $8 per acre. In contrast to these costs on virgin forest country it cost approximately $30 per acre on regrowth country. The result was, of course, very much cleaner than the timbered country.

What is the timing of these operations?

Mr. Lowing: There seem to be differences of opinion about this. What happens in practice is that the planting is done when possible, preferably in early spring or early autumn. In this case it happened to be early autumn. Since planting, this pasture has had five inches of rain and a further 25 points. I consider it to be sufficiently well germinated to provide an adequate pasture next season.

What subsequent treatments do you carry out? Do you stick rake again?

Mr. Lowing: There is maintenance fertilizing and sucker control. I don't see anything to be gained by further stick pricking. Sooner or later they are pushed back into the soil.

Do you favour pasture slashing as a regular part of pasture management?

Mr. Lowing: Yes. However, much of this country is too steep for that and on these areas sucker control must be achieved by napsack spraying. I am not concerned by uneveness in these new pastures, that soon disappears through the action of rain, building up of humus, etc. At Talai the pastures were initially very rough and now can be driven across by car. The cost of extra seed bed preparation and the erosion hazard is not worth the risk or cost.

How was the seed and fertilizer sown?

Mr. Lowing: Both were sown from the air, the seed first inoculated and mixed with sawdust as a carrier, and then the superphosphate. Harrowing after sowing was not necessary since 160 points of rain fell the day after. This was followed a few days later by a deluge of four inches in two hours.

Do you consider your beast area cost to be economic?

Mr. Lowing: The land cost approximately $70 per acre, development costs a further $70 per acre with water and subdivision a further $10 per acre. At one beast per acre this makes the beast area cost about $150. I think one could go to $180 per beast area.

PROPERTY DEVELOPMENT ON "TALAI", MUDGEERABA

by

C. R. ROBERTS, J. H. WILLIAMS AND SONS PTY. LTD., MURWILLUMBAH, N.S.W.

Towards the end of 1964, Mr. Allan Wall, of Adelaide, purchased "Talai", a 2,600-acre property near Mudgeeraba. The area included most of the Talai Range and its eastern foothills. Worongary Creek and most of its tributaries rise on the property. The whole area was timbered except for about 50 acres of pasture on the southern boundary, mostly mat grass and paspalum and about 50 acres high up on the range which had been cleared for banana growing in the 1930's and had reverted to weeds and sucker growth with small patches of Kikuyu and Rhodes grasses. The rest of the area carried dry sclerophyll forest (grey gum, spotted gum, broadleaf ironbark and some red oak and bloodwood) with patches of vine scrub and wet sclerophyll forest (mahogany, tallow wood and flooded gum) along the bigger creeks. This type of country was mainly used for carrying dry stock through the winter months and stocking rates were probably about one beast to 20 acres on a year round basis. Most of the feed came from Kangaroo grass and native legumes growing under the open forest.

Clearing commenced in November, 1964, at first with a caterpillar D4 and later with an Allis Chalmers HD.11. Since then the size of tractors used has steadily increased. 240 acres was cleared and sown by the end of March, 1965. Planting commenced on the lower slopes, using three-point linkage seed drills, but as the country got steeper and rougher this method had to be abandoned and fertilizer and seed was mixed together and broadcast by hand. Wherever possible the hand broadcast seed was covered by a small crawler tractor dragging a chain or a light scarifier. These methods proved to be slow and expensive and, as germination appeared to be almost as good in the areas where the seed had not been covered, it was decided to try aerial sowing in the following spring.

An attempt was made to classify the soils and select the legume which was considered most suited to each soil. Thus, two to three pound Siratro was used on the hard ridges, one to two pound Desmodium along the creeks and on small flats, one pound glycine plus two pound Siratro on areas of red earth, etc.

Two pounds of molasses grass and two pounds of green panic were used on most areas, except for a few places where one pound of either Nandi or Kazungula Setaria replaced the green panic. Sowing was completed by the end of March but no worthwhile rain was received until June. This brought up a few plants but the majority of the seed did not germinate until the following spring. Despite this bad start and the low seeding rates, all these pastures are now well established.

The original estimate of cost was $30 per acre for clearing and preparing a seed bed and $30 per acre for seed and fertilizer. It was estimated that carrying capacity would be about a beast to two acres one year after sowing. However, establishment costs in the first year exceeded the estimate. The exact figure is not known but would probably be in the vicinity of $80 per acre including sucker control. Since then costs have been reduced, particularly for seed, and would now average about $50 to $70 per acre. Cost of clearing and preparing a seed bed is the greatest variable, ranging from about $30 to as high as $50 per acre.

In the following year a further 245 acres were established, all aerially sown. This will be more fully discussed later. By the end of 1966 the property had been developed to the stage where management required more time than Mr. Wall's business interests in Adelaide permitted him to devote to it. He therefore decided to offer it for sale and it has now been divided into four sections.

Mr. Tom Lobban owns 90 acres of fully developed pasture in the South-East corner, Mr. Ron Lee recently purchased the central block with about 400 acres developed. Mr. Arthur Hall of Port Pirie, S.A., bought about 1,700 acres of undeveloped country, of which he has since cleared and planted about 300 acres. The remainder belongs to Messrs. Ian Blake and Keith Harth, of Dalby, who have established a further 150 acres of pasture. This makes a total of 935 acres developed in the past three years.

At this stage I would like to pay tribute to the courage and foresight of Mr. Wall in undertaking the development at a time when tropical pastures were largely an unknown quantity and this particular class of country was considered to be practically worthless. The project came in for a great deal of criticism and few expected it to succeed but at no stage did he lose faith or complain when results were slower than expected.

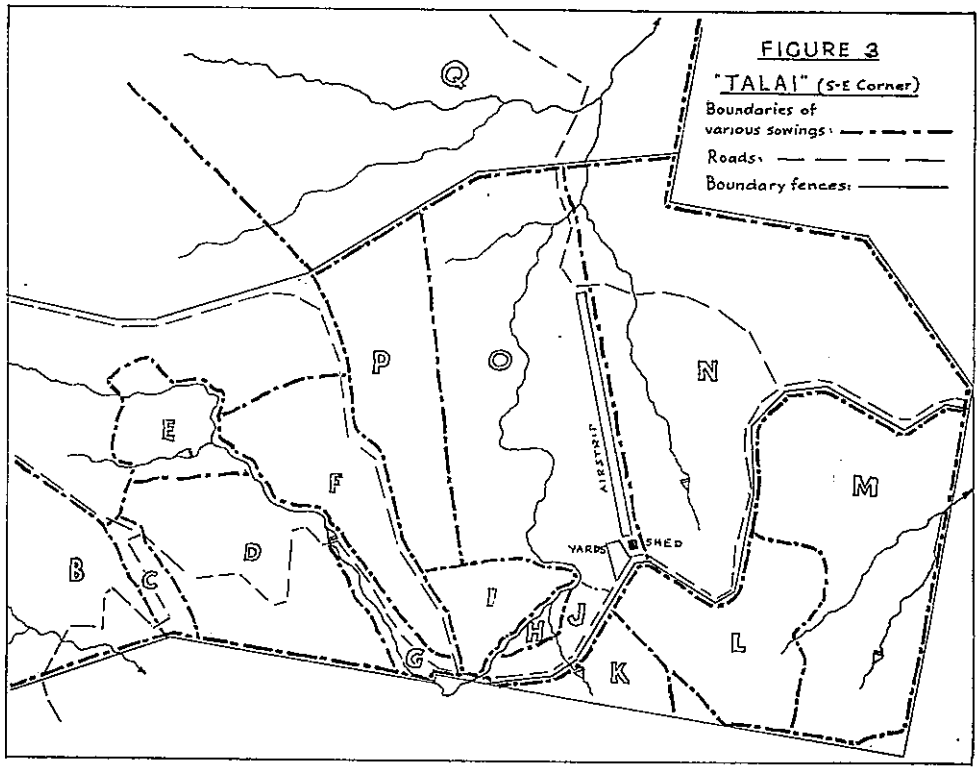

FIGURE 3

Paddock plan for "Talai".

PASTURE MIXTURES

The rates of seed and fertilizer used on various parts of "Talai" are shown in Table 3.

Seed Rates

In 1965 simple mixtures and low seeding rates were used. Generally the cost of seed was kept to about $20 per acre. This was possible because the main species used were Siratro, green panic and molasses grass and prices of these were about

	R. LEE										T. LOBBAN		R. LEE				A. Hall	R. Lowing
Key	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	–
Date Sown	← February/March 1965 →												Nov. '65	Apr. '66	Dec. '66	Dec. '66	Jan. '68	Mar. '68
Area (acres)	50	35	10	30	12	30	2½	1½	14	4	8	30	50	90	70	30	300	150
SEED (lb/acre)																		
Greenleaf Desmodium											1.3	.03	.36	.36	.33	.33	.5	1.0
Silverleaf Desmodium							2.0	2.0		2.0		.6	.36	.36	.33	.33	1.5	2.0
Siratro	2.0	2.0	3.0	3.0	2.0	2.0			3.0			2.0	2.0	2.0	2.0		.66	.5
Tinaroo Glycine	1.2	.5														3.0	1.0	
Cooper Glycine																	1.0	
Clarence Glycine		.5			1.0	1.0											1.0	
Lotononis																	.25	.25
Lucerne																		2.0
Molasses Grass	2.0	2.0		2.0	2.0	2.0	1.0	1.0	2.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0		1.0
Nandi Setaria						.25	1.0	2.0		1.0	1.0							
Kazungula Setaria	.4	.2			.5	.25							.5	.5	.6	.5	.5	1.0
Green Panic	2.0	2.0		2.0	2.0	2.0			2.0			2.0				1.33	2.5	
Demeter Fescue																	1.0	
Approx. cost seed – per acre	22	19	14	19	23	23	36	48	19	36	31	23	25	23	19	20	15	19
FERTILIZER (cwt./acre)																		
At Sowing	2 cwt Mo Super .06%												3 cwt Mo. 12				4 Mo. 12	
November, 1965	2 cwt Super																	
December, 1966														2 Super				
January, 1968											3 cwt Super							
April, 1968	2 cwt Super													2 Super	4 Super			
Total to 19.4.68 – cwt /acre	6	6	6	6	6	6	6	6	6	6	7	7	6	7	7	7	4	4

TABLE 3
Seed and fertilizer rates on "Talai"

the same then as they are now. In the few places where desmodium or setaria was used the cost per acre rose to about $30 to $35 per acre, with one small area of 1½ acres costing $48 per acre for seed.

Since then the cost per acre has come down but, more important, is the fact that seeding rates have been steadily increased as the price of seed has been reduced. The exception to this rule has been Siratro. This year, demand exceeded the supply and in most cases only half a pound to one pound per acre could be used. Silverleaf and greenleaf desmodiums have been increased to compensate for this and it is hoped that the proportion of Siratro in the pasture will gradually increase due to its habit of setting seed right through the warmer months. Of all the legumes species being used Siratro seems to thicken up best from its own seed, particularly if the pasture is given a thorough renovation in early spring.

When it was decided to try aerial seeding in November, 1965, it became obvious that the seed mixture could not be changed to suit each change in soil type within the area to be sown. A mixture had to be selected which would allow at least one legume and one grass to establish on every part of the paddock. The trend, therefore, has been to more complicated mixtures, particularly in larger paddocks where a great many differences in soil fertility, amount of soil moisture available, and susceptibility to frost may be encountered. This is particularly true of the legumes which seem to be far more sensitive to environment than the grasses. It is anticipated that in time the legumes will sort themselves out into colonies, with each species dominating in that part of the paddock which suits it best.

A second reason for using several legumes in the mixture is to try and spread the growing season over as long a period as possible to provide a continuity of high quality feed. Thus, an early legume such as one of the desmodiums is combined with a later legume such as Siratro or Tinaroo glycine and a frost tolerant species such as lotononis, white clover or lucerne. Clover has not been used in any of the mixtures at Talai because the policy has been to allow pastures to remain long in the establishment phase to encourage seeding and build up organic matter. It was considered that clover could not persist under this system of management. As fertility builds up clover will probably be oversown into all paddocks, but particularly the low lying areas which are subject to frost.

It should be remembered that this property has practically no land on it which is suitable for cultivation. Consequently, in the original planning no provision was made for winter feed other than that which could be provided from autumn-saved tropical pastures. This concept was based on work done by Milford and Haydock (1965) at Lawes, which showed that tropical pasture legumes had the ability to retain high protein levels, even when not grazed for long periods. So far this system has worked satisfactorily and, on stocking rates used to date, no great shortage of winter feed has been experienced. Admittedly the held-over grass is only standing hay towards the end of winter but, if it is combined with a suitable proportion of legume, it still provides a satisfactory ration for beef cattle.

The tendency has been to decrease the variety and amount of grass seed used in the mixtures, whilst the legume seeds have been increased. The reasons for this are: firstly, legume dominance has been aimed at in the early stages of development to try and build up soil nitrogen and organic matter as quickly as possible; secondly, the grasses thicken up quickly from their own seed, so costs can be

reduced by keeping initial seeding rates at a low level; thirdly, the legumes suffer less competition from the grasses and are able to establish more quickly.

As the cost of setaria has come down it has been used in preference to green panic. Kazungula setaria has proved to be easier to establish and more persistent than green panic, particularly on poorer soils. Nandi setaria does well on the better soils but is still much dearer per acre than Kazungula because of its lower germination rate. Consequently, the grasses mostly used on this type of country are one pound of molasses grass and half to one pound of Kazungula setaria. The setaria is expected to gradually replace the molasses grass as fertility builds up and grazing pressure is increased.

Fertilizer Rates

Rates of fertilizer application have also been increased over the past three years, as awareness has grown of the essential role which superphosphate plays in pasture development in this area. Three years ago two or three cwt per acre at establishment and one or two cwt maintenance dressing per annum was considered adequate. Now, a base dressing of four cwt of Mo Super and a further three cwt Super for the next two or three years is regarded as the desirable minimum, and economic responses to much higher levels have been demonstrated by research workers.

It should not be forgotten that a few years ago this country was regarded as being not worth the cost of clearing. Its greatest assets are high rainfall and freedom from frost, but advantage could not be taken of these until the introduction of suitable legumes plus superphosphate.

DISCUSSION

For drilling seed can you get the cost down below about $5 per acre?

Mr. Roberts: You can, but with machinery it might take you at least eight weeks to do the work, against a few hours by air.

Can you clarify a beast area please?

Mr. Roberts: I work on a bullock as a beast and then make allowances for vealers or cows and calves.

Were there any areas of substantially higher seed rate?

Mr. Roberts: Yes, the highest seed rate we used would be this one adjoining here of about 300 acres which has about 6lb of legume seed and 4lb of grass seed.

Is there any correlation between the amount of seed used and grazing turnoff?

Mr. Roberts: With higher seed rates you get an extra return in the early years. If you are prepared to be patient and manage it properly, light seeding rates will eventually build up into good pastures, but the lighter the seeding rate the longer it will take.

Your $90 per acre cost; does that include seed? What about the danger of weeds?

Mr. Roberts: That is another very important reason for using higher seeding rates. The more seed you sow the less trouble you will have with weeds. This is particularly important as you get into the more fertile country. Fortunately, in this country, we do not get a lot of weeds, mostly eucalypt suckers and blady grass and fern, blady grass being the biggest enemy. But generally speaking, weeds are not a great problem here as the soil is too poor to grow them.

What about glycine?

Mr. Roberts: We have had quite good results with glycine in some paddocks. With the cost of glycine at only 60 cents per pound this year it was worth throwing in three pounds to see what would happen.

Did different species hold their proportion?

Mr. Roberts: I think they are starting to sort themselves out. Here we had 1/3rd of greenleaf, 1/3rd silverleaf and two pound Siratro. The greenleaf is dominating. I thought earlier in the season that this was only because the greenleaf was coming away earlier and by this time of the year Siratro would be ahead of the greenleaf. But this has not happened. These are things that we can only find out within the course of time. This might be a very good argument against using mixtures. Depending on management one might push out the other. Personally, I would not care very much which one I had as long as I have one.

Was this country difficult to chisel plough?

Mr. Roberts: The part we are on at the moment was chiseled but that 300 acres over there was disced.

Mr. Ron Lee: I can't give you much information regarding development because as you know my son and I bought in here. We have lived in the Surat area for the last 30 odd years and things are quite different out there. We have developed land in that area but not here.

As regards a beast area — In different areas according to land values beast areas cost quite different amounts of money. Here I would think that you allow $40 an acre for your virgin land and can get it pushed and raked for about $24, and a cost of about $15 to $17 an acre for seed and about $8 for fertilizer, putting on about 4cwt to the acre, that would run out at $80. Well supposing you run a beast to two acres. That would be $160 for a beast area. I think that is quite conservative here. You would do that in the early stages and I have looked at pasture improved properties between here and Gympie in the last 12 months and it is quite obvious to me that after the pastures are allowed to develop with adequate fertilizer the carrying capacity will rise. I think every property in the area is being under-fertilized. I know this one has been. This property has had no fertilizer on it for over 12 months but now has 40 tons of fertilizer spread on the ground here waiting for rain. That fertilizer should have been put on last year and there should be another 40 tons waiting on the ground now to be watered in. With plenty of fertilizer and good management this country will carry a beast to the acre.

Is it more for cost of fencing, water, house, etc.?

Mr. Lee: I think any one here would be just as happy to live on the coast. Water is of minor expense here as we have plenty of rain, fast running gullies, springs and what not. Here 500 yards appears to me to be quite a big dam. Regarding fencing for cattle — it is a small area — there are 400 acres on this place and I suppose six miles of fencing would be needed, only a minor cost in my opinion. As far as I can see the best type of fencing for this areas is probably the suspension fence.

What about stocking rates?

Mr. Lee: I will say something about stocking rates here. Well this paddock is about 90 acres. I had 130 cows and 120 big calves on here for a month, which is about equal to 130 cows and say half as many for calves. That is over 200 head. They have just recently gone off it and it is ready for quite a bit of stocking again in spite of the dry weather. The rainfall for Southport is over five inches for April and likewise for May and so far we have had 14 points this month.

You say this pasture is underfertilized?

Mr. Lee: Well it's not growing as it should be. Unless you fertilize this country to correspond with your rainfall your feed is no good. I have heard people in this area say that their cattle just will not finish off. As far as my observations are concerned I would say they are not putting enough fertilizer on. If you are going to put on 2cwt of fertilizer every year that costs you about $4 and if you are turning off a vealer worth $80, what's $4 out of it? Nothing is it?

You had the equivalent of 200 head for one month. What do you expect over 12 months?

Mr. Lee: I could only speculate because I've only been here three or four months and the property is not fertilized sufficiently. Give me another 12 months or two years and I'll be able to answer that question.

Would Dr. Humphreys care to comment on his experience at Mt. Cotton?

Dr. Humphreys: The amount of legume that you get is certainly very closely controlled by the amount of phosphate you put on and if you were seeking protein in the early years then certainly you will get this from high fertilizer rates.

Mr. Roberts: It has been measured that a good tropical pasture will add about 100lb. of nitrogen/acre as a rough approximation. If that is true and if you can get that by putting on 3cwt of super which costs you say $6 an acre, you are getting 100lb. of nitrogen for $6 an acre. I do not know of any other way you can get that much nitrogen for $6. It works out to about between $11 and $14 if you are going to use 100lb. of nitrogen in the form of urea or sulphate of ammonia.

If you want to run two beasts to the acre won't you have to use artificial nitrogen?

Mr. Roberts: What are we aiming at? Maximum production per acre or maximum profit. I started off wondering if it was an economic proposition putting this much super on. I'm convinced now that it is, but I'm not so sure about the economics of applying nitrogen for beef production.

Mr. Pulsford: If you've got these beasts you can't afford not to. You can go up to Mr. Des Shaw's in Central Queensland and develop country at $50 a beast area. If you are going to stay here and scratch about on the sand and the sun you just have to pay $200 an acre and you can't afford to pay that unless you are prepared to put money into it.

Do you get cases of bloat?

Mr. Roberts: As far as I know there has never been a recorded case of bloat from tropical legumes. I think it is generally fair to say there is no bloat problem.

Dr. Davies: Lablab will do it, occasionally*.

How grossly deficient in nitrogen are these soils? There is no indication that artificial nitrogen is being used on them. Pastures establish more quickly with it.

Mr. Roberts: There has been some work further south where quite small amounts of nitrogen have been used to try to get the grasses away quicker, and with good results. We've not done it here mainly because of cost and also the only way we can fertilize this country economically is by air. In this climate I am not game to put bulk nitrogen on the ground. It's bad enough with bulk super. You're likely to get five or six inches of rain while you're waiting for the aircraft to come and spread it. What would happen if nitrogen was lying on the ground in these conditions, I'd hate to think.

So we are prepared to spend plenty of money on seed and superphosphate but not on nitrogen. I'm worried about losses in the heap not on the ground once it's spread.

AERIAL SOWING OF TROPICAL PASTURES

As a result of delays experienced when sowing with seed drills during February and March, 1965, it was decided to try aerial sowing the following season.

Enquiries were made but only two areas could be found when this had been attempted before and, due to exceptionally dry conditions, both had apparently failed.

SEED BED PREPARATION

Experience gained with the previous sowings showed that seedbed preparation was the most important single factor affecting establishment. Too much cultivation of the light sandy soil resulted in a complete breakdown of the structure, leaving a fine dust which would not absorb moisture. After eight inches of rain in July, 1965, moisture had only penetrated about an inch. The surface had then formed a crust and all the rest of the rain had run off, leaving dry powder underneath. This was accentuated wherever the surface had been harrowed and left smooth.

It had been proved that seed could remain in dry soil for considerable periods and still germinate when suitable conditions occurred. Some Siratro seedlings emerged after the heavy rain in July. After that, whenever there was enough rain to keep the surface damp for three or four days, a fresh batch of seedlings emerged and most of these seemed to survive, despite many prolonged dry spells. On some of the drier ridges there were virtually no plants to be found in August, 1965, six months after sowing. Yet by May, 1966, all these areas had reasonable cover although only 28 inches of rain had been received for the ten months period from October to April inclusive, against an average of 55 inches for this period.

In view of the foregoing it was decided to keep cultivation to a minimum, just enough to break up the surface crust and to eliminate blady grass (*Imperta cylindrica* var *major*) and other undesirable species. The cultivation was carried out on the contour wherever possible and the surface was left rough to facilitate moisture penetration and minimise erosion.

PELLETING SEED

In previous sowings seed was inoculated and then lime pelleted to protect the *Rhizobium* from contact with superphosphate. The successful establishment of areas where the seed could not be covered was attributed to the fact that the lime pellet had protected the bacteria from direct sunlight. This did not explain how plants which emerged more than six months after sowing still managed to nodulate but, for the small cost involved it was considered to be a worthwhile precaution.

Since then Norris (1956) has demonstrated that lime can be harmful to the alkali-producing strains of *Rhizobium* which are associated with tropical legumes and in some later sowings rock phosphate dust has been used instead of lime. However, it is very difficult to produce a satisfactory pellet with rock phosphate and most of the coating usually breaks off before the seed reaches the ground, thus exposing the *Rhizobium* to direct sunlight, which may do more harm than the lime.

Under field conditions it is difficult to tell whether one type of pelleting material gives better nodulation than another, but as results with lime pelleted seed have always been satisfactory there has been a gradual swing back to using lime in preference to rock phosphate.

It is important, however, to bear in mind that seed has always been sown within 24 hours of pelleting. This alters the conditions of Norris' experiment (1967) in two ways. Firstly, the pellets soon come in contact with acid soil which may reduce the alkalinity of the coating before it has harmed the *Rhizobium*; secondly,

* See HAMILTON, R. I. and RUTH, G. (1968) — Bloat on *Dolichos lablab*. *Tropical Grasslands*. Loc. cit.

dew usually dissolves the coating within two or three days, carrying the *Rhizobium* into the soil. Once in the soil the bacteria can apparently survive for long periods with very little moisture and then effectively nodulate seedlings which may not emerge until many months later.

It is felt that lime pelleting of seed for aerial sowing is not really in conflict with Norris' recommendations (1967) provided seed is sown as soon as possible after pelleting. Nevertheless there is a need for further research to determine if pelleting does in fact improve nodulation of tropical legumes; to compare the effect of various types of pelleting material on the survival of *Rhizobium* under field conditions; and to find, if possible, a better material than those at present in use.

FIRST AERIAL SOWING

A 55-acre paddock (M) in the south-eastern corner of Talai was the first one to be sown from the air, on 29th and 30th November, 1965.

The aircraft arrived at 5 p.m. on the 29th with the intention of spreading the seed at first light on 30th. Weather was overcast and as the legume seed had been pelleted it was decided to spread it straight away in case it should be too wet to fly the following morning. It was split into two equal batches and each batch was mixed with 2 cwt of superphosphate to increase its bulk and make it easier to cover the whole area with the very low seeding rates being used. The grass seed was not spread until the following morning because an easterly wind of about ten miles per hour was blowing at the time and it was not possible to make allowance for a wind of this strength when spreading such light seed as molasses grass.

The aircraft used was a Grumman Ag-Cat fitted with an airfoil-type seed spreader. It was intended to fly swaths of about one chain wide but before the first batch had all been dropped it became obvious that, with the minimum hopper opening which would allow the seed to flow evenly without blockage, it was not going to be possible to cover the whole area and the distance between runs had to be increased. The wind made very little difference to the width of the spread of the legume seeds and strips where there was plenty of legume alternated with strips where there was little or none. This can still be seen in this paddock although the legumes are gradually moving into the strips that were missed.

The grass seed was mixed with fertilizer to improve the "run" of the molasses grass seed and it was spread under good conditions the following morning. Almost as soon as seeding was complete, rain commenced. During that day 52 points fell and in the next three days, 106, 92 and 103 points were recorded. This was followed by 37 points on 6th, 52 on 8th, 28 on 9th and 70 on 12th December, making a total of 540 points in the 13 days after sowing. Under such perfect conditions nearly all the legume seed germinated very quickly. Grass seedlings did not appear for some time and by then the surface had dried out. It was very noticable that the grass seedlings were concentrated in the bottom of the furrows where moisture had collected. Less than half an inch of rain fell during January and rainfall for February to May was only thirteen and a half inches, compared with an average of 34 inches for this period. Despite this, the pasture was stocked at the rate of one beast to three acres early in May. It has been continuously stocked ever since at a gradually increasing rate and this year has been carrying nearly a beast to the acre.

SUBSEQUENT AERIAL SOWINGS

This, and many other sowings since, have demonstrated the value of good seedbed preparation, bearing in mind that in this case a good seedbed does **not** mean fine tilth and a smooth even surface. The objective should be to remove all competition and provide a surface which will allow roots and moisture to penetrate readily, with the least possible amount of cultivation. Tyned implements were used in this case, and they do a good job provided there is not much grass to contend

with. More recently, heavy offset discs have been used with excellent results, especially if there is much grass or fern, but care must be taken to leave the surface rough.

In subsequent aerial sowings grass and legume seed have always been mixed together and much greater amounts of "filler" have been used to enable the aircraft to completely cover the area twice with one chain swaths. It is essential to have still air conditions; light grass seeds drift further in a wind than do the heavier legume seeds and it is not possible to make an adjustment for drift which will suit both.

Advantages and Limitations of Aerial Sowing

To date, over two thousand acres of tropical pastures have been aerially sown in this area, and it is expected that the use of aircraft for seeding and fertilizing must increase, because much of the country is too rough for wheeled tractors. In view of this it is important that potential users should be aware of the limitations as well as the advantages of the method.

Its main advantages are that it is cheap (80 cents to $1.00 per acre) and quick (about 100 acres an hour).

On the other hand it must be remembered that aircraft cannot always be made available exactly when required. In any case it is not a good practice to bring an aircraft in specially for seeding as wind conditions may not be suitable. It is much better to wait until one is spreading super in the area and then it can be diverted to seeding operations when conditions are right. Many attempts have been made to forecast rain and have the seed spread just beforehand but the only time this has happened in practice was on the first sowing, and that was accidental. Since then seed has been sown as early as 20th September and as late as 29th March. It has lain on the surface for periods of up to three months and finally germinated when conditions were favourable.

It is not claimed that aerial spreading can give as even a coverage of seed or as high a germination rate as would be expected from drill sowings. But the saving in cost of application more than offsets the cost of a slightly higher seeding rate and the possibility of having to hand sow a few small areas where seed has been missed.

It is not recommended that areas of less than about 100 acres be aerially sown and, generally speaking, the larger the area the better the job. It is almost impossible to satisfactorily sow small, irregular shaped areas from the air.

One of the most important limitations is availability of airstrips. It is not economical to spread super much more than three miles from an airstrip so, unless super can be applied by another means, there is not much point in aerial sowing beyond this distance. Airstrips are hard to find in this country and anybody who has a suitable site on his property is fortunate.

DISCUSSION

Mr. Roberts opened the discussion by referring to the need for research on pelleting and quoted a small experiment with *Lotus major* in which at two weeks of age seed pelleted with three materials gave the following per cent. nodulated plants (based on germinating seed only):— lime 8.8; rock phosphate 16.7; and kaolin 70.5.

Dr. Norris: With reference to this experiment with *Lotus major*, this particular species has a slow growing alkali-producing type of *Rhizobium* essentially like the tropical species with which we are dealing. It is unlike the ordinary *Lotus corniculotus* which has much more the clover type of *Rhizobium* and these results show quite strikingly what happens when you wrap this kind of inoculant up in a lime pellet and keep it for some time. Dick Roberts of course,

has been doing the intelligent thing with his lime pelleting for aerial establishment on this country. He's been dropping the stuff from the air within 24 hours of pelleting, and as he has mentioned too, he is relying on the fact that dews will knock the coat off that seed and the *Rhizobium* will be deposited on the ground under the seed and will get into the soil, so that the problem of long term survival on the seed does not arise. But he may come up against the situation where the seed has been lime pelleted and he has to keep it for some time before it can go in the ground; and that is when you may get in trouble. These figures showing an 8% nodulation with lime pelleted *Lotus* seed are ideal figures obtained under the protected conditions of culture tubes. But you wouldn't expect to get near that under these harsher field conditions. So I do wish to indicate the extreme danger of the non-intelligent use of a lime pellet for long term pre-inoculation. Down South they have successfully used a lime pellet for pre-inoculating lucerne seed three or four months before it actually went into the ground and obtained quite successful nodulation, but we should not even think on those lines in regard to our tropical species. As far as the kaolin pellet is concerned I think it is just a very preliminary observation at the moment. We know that we need an inert pelleting material rather neutral in reaction which will give us a physical texture something like ultra fine lime but doesn't have the harmful effects of high alkalinity. Kaolin at the moment seems to be such a material but in Brisbane we have had the experience too that kaolin gave opposite results, and we have to look very carefully into this one. I would not like anybody to go off half cocked and rush and buy lots of kaolin and start kaolin pelleting their seed for aerial establishment at this stage. Give us time to do a little investigation on it and find out what is going on.

Why are you pelleting seed?

Mr. Roberts: Mainly because the seed has to lie on the surface and we have been very concerned about the effect of direct sunlight on the bacteria. For the little extra cost involved we are just not prepared to discontinue a practice that has proved successful until we know that it is not necessary. But if anyone can prove to me that it is not necessary I'll be delighted because pelleting large quantities of seed for aerial sowing usually means working until late the night before.

How long does the lime coat take to break down?

Mr. Roberts: If you walked around the paddock after the planes went over you would find white pellets lying all over the place. Two to three days later it is difficult to find any seed because the lime has been washed off and you've just got this brownish coloured seed lying on the ground and it's very, very hard to find. If you look long enough you will find them there, but the lime is washed off and presumably the bacteria have got into the soil. This is the only way we can explain the survival.

Do you suggest giving a light harrowing after the drop?

Mr. Roberts: In one of the early sowings we did this. We intended doing it here only we got rain immediately after we planted. The next sowing we did was at Arthur Earle's, 250 acres around the house. Wherever he could he went over with diamond harrows and in some places he ran disc harrows over it lightly. In the rougher places he just dragged leafy branches tied behind the tractor. I think if you are going to harrow at all this is the best thing of the lot because it doesn't smooth your soil out, but leaves it rough.

Dr. Norris: While on the subject of pellets and stickers, I personally have always favoured Cellophas A as an adhesive for pellets rather than gum arabic. For one thing, it is a neutral and inert material and you can get at the effects of

your coating material rather than the effects of your sticker. The other thing is that it requires only 5% instead of 40% so you only have to buy 5lb. instead of 40lb. of gum arabic to do the same job. In this past season we have been experimenting with *Dolichos lablab* up at Beerwah on a soil where there are in the soil scarcely any native *Rhizobia* which will work successfully on *Dolichos*, and so you can gauge to the full the effects of your treatments. We have compared seed with the peat simply stuck on with 5% cellophas or with lime pellets and phosphate pellets. We have kept the seed in an incubator at a high temperature (a very severe treatment) and taken it out and sown it at weekly intervals. It has been obvious that the bacteria have survived quite successfully stuck on with the cellophas only, without any of the pelleting coats. In addition, I have tried the effects of various strengths of cellophas for sticking the bacteria on and have come to the conclusion that about 2% is an ideal strength to use as a simple sticker for the peat without any pelleting at all. As far as I can see if you are going to use any kind of drilling technique or going to put your seed actually into the ground there is no point in coating it with a pellet at all, just simply stick the bugs on with your sticker.

When you are drilling into the soil, in most cases in practice you are probably going to put fertilizer in the same drill row. Therefore, you may need to put some inert coating around your seed to protect the inoculant.

Dr. Norris: If you drop inoculated seed into a strong band of raw super, of course, this may be a dangerous situation and possibly this may be the answer to a lot of the failures that have occurred in the Lismore country in the past from these tropical legumes, but we are in a situation where they are not going to be dropped onto raw fertilizer and I think you could well forget about the pellet coating.

Mr. Ritchie: One other factor comes in. A lot of farmers prefer a very simple technique of mixing their seed with their fertilizer and putting it out through a spinner. This is good and where I think that some sort of coating is essential. I would like to know firstly whether you thought your cellophas coating would be adequate to give this sort of protection. The second point is that with aerial sowing you need volume in your seed. Dick Roberts has been using sawdust. When it comes to measuring, say out of spinners, unless you are mixing with your fertilizer, the low volume of your seed poses a problem that some sort of pelleting will help.

Dr. Norris: That point of course is perfectly valid. On the first one — the question of mixing inoculated seed with fertilizer — if you want to do this for any reason whatsoever you must protect your bacteria and although I have not done any direct experimental work I do not think a simple cellophas sticker would protect them against an acid fertilizer. I should think that either lime or rock phosphate would do the job. In fact, there is evidence from the work published in the Proceedings of the IX International Grassland Congress in Brazil on aerial sowing in Uruguay, where the rock phosphate pellet did actually give sufficient protection for aerial dropping mixed with fertilizer.

Mr. Ritchie: As a matter of fact, I used pelleted seed sown through a spinner separately and with the fertilizer. Nodulation has been quite good in each case.

It is observed that in most cases where pelleted seeds are coming out through spinners or shakers by the time the seed hits the ground there is very little pellet left on it. Would this still have the protection that you are aiming for? From Bill Ritchie's observation he's still got nodulation.

Mr. Roberts: I think Mr. Autry Hall, at Lismore, found with tares that with low rates of gum arabic he was not getting a hard enough pellet. This is another reason why we went back to lime because it is only with a very strong glue

and fine material like lime which adheres well that you can overcome the abrasive effect of the fertilizer or of the seeding machinery. But this is only important if seed is being drilled in contact with fertilizer. When broadcasting, the pellet is only necessary to protect the bacteria while the seed is in contact with the fertilizer in the hopper. Once it's been through the spinner it's not in contact with the fertilizer any longer and it doesn't matter whether the pellet is still on or not, provided the seed is going to be covered.

Dr. Plucknett: In pelleting seed for aerial sowing in acid bauxitic soils in Hawaii in very rough steeplands, we found that calcium silicate is probably the best pelleting material as far as physical characteristics are concerned. Calcium silicate is a by-product of phosphorus manufacture and comes from TVA phosphorus milling. We use it in the sugar industry to increase sugar yields so we were interested in the material not only because of its physical characteristics but also because we knew we were in a calcium and silicon deficient situation. In doing this we used 5% methyl ethyl cellulose as an adhesive followed by pelleting with an equal weight of calcium silicate to the seed. This makes a very firm hard pellet which does better than rock phosphate under our conditions; certainly better than any other material available commercially. In 1966 we seeded a 40-acre area with 12 different legumes very successfully and in 1967 we pelleted some 4,000lb of stylo seed and flew it on to an area of about 2,000 acres, which had burned over in a forest fire, with excellent results. I think it merits looking at further. A word of caution however, some calcium silicate materials are very alkaline and may be very lethal to rhizobia, hence materials should be carefully tested before use.

If inoculated legume seed is dried and mixed with dry superphosphate, would you expect any deleterious effect on the Rhizobium under those dry conditions?

Dr. Norris: This experiment has been done a number of times and the answer is yes, there is a deleterious effect. But the bugs just don't die as soon as you mix them with the superphosphate. They die over a period of time and the period of time will be longer in the case of complete dryness. I think probably in not more than 24 hours, they would be pretty well all gone.

You got the super at bulk rates and you got it on to the ground. What was the cost per acre of flying it on?

Mr. Roberts: It depends on the distance from the airstrip, but generally speaking Mo super spread on the ground is about $40 a ton. It works out to about $6 a ton dearer than you can land bagged super on the farm.

Mr. Redrup: At 4cwt. to the acre, this is costing you about $1.25 to actually fly it on. You are estimating that it costs you $1 to put your seed on — 80 cents to a $1 — that makes a total of $2.25 — $2.50 to the acre. We've finished sowing 450 acres a mile away from you. This was put on to the ground with the super through the drill at $3.25 per acre. That's the handling of the super, seed and everything else. The difference is $2.50 with two separate operations from the air, and $3.25 to drill the lot in together. What would you feel?

Mr. Roberts: I would drill it in at those prices.

Mr. Lemon: The point is that with this country there is no question of using a drill.

Mr. Roberts: Yes, that's right. We are not advocating aerial sowing in preference to drill sowing. But it is a useful technique for use in country which is too rough for other methods.

PASTURE MANAGEMENT

Pasture management on Talai to date has not been aimed at maximum production per acre but rather at building up soil fertility and increasing the plant population in the earlier sowings when low seeding rates were used.

The project was originally planned on the assumption that the improved areas would be able to carry a beast to two acres. Even through the drought years this rate was exceeded and present carrying capacity, **on a year round basis**, is estimated at about a beast to an acre and a half or a little better. The pastures are still improving, however, and as phosphate levels in the soil build-up, rates of a beast to the acre may eventually be achieved. It is important to realise that full production from these pastures cannot be expected in the first year or two and anybody who stocks them too heavily, too soon, may do irreparable damage.

Jones (1965) has demonstrated that close cutting will greatly reduce the productivity and persistence of Siratro. On this and other evidence it was decided to aim at keeping the pasture at least six inches high at all times and try to graze on a six to eight weeks rotation. To simplify adjustments to the stocking rate in times of feed shortage the breeding herd was kept at a safe figure and extra cattle, that could be disposed of quickly if necessary, were brought in to utilize surplus feed.

The main problem with any rotational grazing system for tropical pastures is the difficulty of adjusting grazing frequency to strike a balance between the quick growing grasses and the slower growing legumes. For instance, with a grass such as setaria Milford and Haydock (1965) have shown that crude protein content declines rapidly between four weeks and eight weeks after cutting. Therefore, if an eight weeks rotation is chosen to suit the legumes, there will obviously be poor utilization of the grass.

For this reason the 90 acres which now belongs to Mr. Tom Lobban is of particular interest. The 50 acres which was aerially sown has now been continuously stocked for two years and the other 40 acres about three months longer.

The Droughtmaster herd was originally put into this paddock as a matter of convenience, because it was close to the yards. At this time (April, 1965) the herd numbered about thirty head, including breeding cows and two generations of their progeny. It was found that at this stocking rate of about a beast to three acres they kept the grass short and palatable while it was growing quickly in the summer months but ate very little of the legume. Because of this preference for the grass while it was in the active growth stage, the legumes were allowed to develop plenty of vine and maintain a complete ground cover. As the palatability of the grass declined in late autumn the cattle ate more of the legume and by mixing the grass and legume maintained a balanced ration through the winter.

This seems a bit too good to be true, but Townsville lucerne pastures act in this way, presumably because the legume is less palatable than the associated grasses during the growing season. Perhaps some degree of unpalatability is a desirable characteristic in a pasture legume if continuous stocking is envisaged?

(In passing, it may be worth mentioning that if cattle do select grass in preference to legume at certain stages of growth, and vice-versa, then this casts doubt on the validity of some research results obtained by mowing the pasture and emphasises the importance of using grazing animals to evaluate mixed pastures.)

Natural increase of the Droughtmaster herd gradually increased the stocking rate and by June, 1967 it was approximately a beast to two acres. At this rate it was understocked but the pasture was thickening up rapidly and a marked improvement in soil texture, organic matter and colour of the pasture was apparent. It was expected that the stocking rate would be increased to about a beast to one and a half acres this year.

When Mr. Lobban purchased the area in September, 1967, he stocked it with 80 Hereford bullocks in store condition which, together with horses and a few other cattle, increased the stocking rate to nearly a beast to the acre. The spring months were unusually dry, and by Christmas there was practically no feed left in the paddock but good rains have been received since then and at present the pastures are in good condition again.

NOTE: Mr. Lobban was not able to be present at the Field Meeting, but he has since given the following information regarding performance of the cattle:

80 head purchased September, 1967	@ $99		$7,920
18 head sold November, 1967	@ $125 average	$2,250	
35 head sold January-May, 1968	@ $131 average	$4,585	
10 head sold June, 1968	@ $125 average	$1,250	
10 head sold July, 1968	@ $135 average	$1,350	
7 head remaining on property at 31-7-68, estimated value $110		$ 770	
			$10,205
Gross Profit on 80 Head			$2,385

A further 20 head were purchased during June, 1968, making a total of 27, head at 31st July, 1968.

At the time of going to press in September, 1968, the pasture was very short, after an unusually dry and cold winter, but was starting to make new growth. There was a good balance of legume and grass and apparently no permanent damage had been done to the pasture under this rate of stocking. Nevertheless, it is considered that the stocking rate should be kept low for the next two or three months to enable the legumes to produce a good growth of vine and re-establish a complete ground cover. If this is done it should be possible to carry a beast to the acre through the summer and autumn with a gradual reduction of numbers through the winter-spring months. This should enable cattle to be turned off at a time of year when prices are usually high.

As far as the pasture is concerned the results obtained here under continuous stocking seem to indicate that this method of management warrants further investigation. Its advantages in savings of time, labour and capital expenditure are obvious. It is usually claimed for rotational grazing that it gives better utilization of feed and higher production per acre. This may not necessarily be true for tropical pastures but, even if it is, maximum production per acre may not give maximum profit per acre. At this stage we urgently need more information on management of tropical pastures and this aspect of it seems to be worth pursuing.

Another management practice which deserves looking at again is renovation. This fell into disfavour here a few years ago because it was being used only to mineralize soil nitrogen and the response was usually good the first time it was done but long term results were disappointing.

The position is quite different with a legume-based tropical pasture. If the legumes are allowed to set seed, a thorough renovation after fertilizing in the spring will bring up a good crop of new seedlings. Because of the deep rooting habit of tropical legumes the existing plants will not be harmed, in fact, throwing soil over them will cause them to root down along the runners and rejuvenate them.

One other question regarding pasture management requires investigation. Is it possible to manage a pasture mixture containing tropical and temperate legumes in

such a way as to produce high quality feed from the tropicals in summer and autumn and the temperates in winter and spring? Or will a higher overall level of production be achieved by separating the two and keeping tropicals above the frost line and temperates below?

Much has been learned in the last three or four years about establishment of tropical pastures on a wide variety of soil types but information on how best to manage them to obtain maximum returns per acre consistent with long term maintenance of the pasture is now urgently needed.

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DISCUSSION

Do you think that reducing the paddock size to below say about 300 acres is going to reduce stock production?

Mr. Roberts: I think some people would contest this and argue that if you restrict the animal's opportunity for selective grazing you are going to interfere with its production.

Even with intensive stocking people here will have to slash their pastures back. Is it really necessary or economic to sub-divide?

Mr. Ritchie: In one experience this year I had a paddock of 100 acres where stock had easy access to water. The paddock was basically two ridges, and when I turned the cattle out, when I reckoned the young pasture had had about enough, the two ridges were in distinctly different stages; one had been more heavily grazed than the other. This poses a management problem. When I put them back, one ridge is distinctly more advanced than the other. I think in a situation like this sub-division would be a very distinct advantage for proper management of the pasture.

Sub-division or more watering points?

Mr. Ritchie: Well, both.

Mr. Redrup: I think it's still very early, Mr. Chairman, in the management of this type of country really to answer this question. It's a very good one and we are all asking ourselves this question. One of the problems is we speak a good deal about the rate of stocking. Now the rate of the growth of the pastures as we all know is very discontinuous. We have our peak between about mid-November, to about the end of March. There is a slow tapering off then and after the middle of May it is a very rapid tapering off. Now, this is varied country, as many of the properties on the coast are, e.g. some of my own have perhaps a couple of hundred acres of hilly country and then run out into 200 or 300 acres of meadow around the fringes of the ridges. We found that we had to sub-divide more with an eye to the nature of the country, even where we distribute the watering points and try and get away from the undeniable pressure that attends the watering point if there is only one to a 300-acre

paddock. We find that in certain months of the year the rate of growth on the flatter moister country is so much greater than elsewhere on the slopes that the cattle do not selectively graze ideally to balance this out. Most of the sub-division that we have been forced to do up to date has been sub-dividing rather the different classes of country. If you manage to get your pastures in by about mid-January you have to be stocking at the rate of up to a beast to 1½ acres if you have had any sort of season in January, February, March and you can carry through the winter on that early pasture quite well at about that rate. Come mid-November you should be putting your cattle on particular classes of country very much more heavily, particularly the lower country which gets away very rapidly. Now we would like guidance on this matter because sub-division is expensive. One of the things that happens as the growth rate really gets ahead of you is that you lose a great deal of feed by trampling. The only way we can seem to overcome this is to sub-divide and get heavier mobs on to smaller areas, and rotate at a much more rapid rate. Now this may be merely a question of adjusting the stocking rate properly over a larger paddock — who knows? It is too early I think to come to finality on that.

Could Mr. Mawson comment on what is the effect of sub-division on individual animal performance?

Mr. Mawson: I can't recall any critical work that relates specifically to this. We can say in general terms that if we allow animals to wander over a large area, that the benefit they obtain from selected grazing seems to be cancelled out by the higher energy cost of getting it, so that from a productivity point of view I think that there are advantages associated with smaller paddocks, provided of course, water is there as well. I think possibly that the question hinges more on pasture management than on animal management.

Do cattle walk up these hills? What is their grazing pattern?

Mr. Mawson: Animals certainly will graze up hill. They will always take the easiest grade but they will graze hills.

Mr. Redrup: We found we had to fence to get good utilization of our higher feed. If they had the choice between hill country and meadow land they tended to keep on the lower grades of the lower level country.

Isn't some form of stock rotation required for tick control?

Mr. Harrison: At this stage it will certainly help to control them.

Mr. D. Shaw: At Rodd's Bay we were in a very heavy tick area and people said to us, when we started getting down to a beast to two acres, you're going to have all the trouble in the world with tick control. Our tick trouble is in the lightly stocked paddocks. We have no trouble in the heavily stocked paddocks.

Do you know why this is?

Mr. Shaw: No. I might suggest that in the heavily stocked paddock there is less grass cover for the tick. It hasn't got any cover from the hot sun.

May I ask if these heavily stocked paddocks are set stocked?

Mr. Shaw: All our paddocks are set stocked. They carry the same number of stock generally all the year round, a beast to two or three acres. You people here are going to use breeders, use the country. If you have got water on top of the hills, I think you will find your breeders will use the hills, especially in the time when you get hot days, but if they have to go down into the valleys to get their water they will tend to stay there, and while there is feed they will eat there. Then the hills will go to seed, I can't see from my experience why there is any need to sub-divide country, if it has been properly stocked. Don't sub-divide for sub-division's sake unless you've got too many cattle running in a paddock to handle conveniently. At Rodd's Bay we've got a paddock of

1,000 acres. We are anticipating that it will carry about 500 head of steers in a few year's time. I've come to the conclusion that we won't get any advantage from sub-dividing it because it is always eaten down pretty well level all the way round. The only thing is that 500 head is an unwieldy mob to handle and we might cut it in half for ease of working. If you are going to sub-divide, sub-divide so that the cattle will use the available country to the best advantage.

Mr. Harrison: On this set stocking basis, beasts normally prefer fresh new growth. Yet, where your stocking rate is set it can't be set to the optimal level for all times of the year and some parts of your pasture are going to go rank, while the stock continually graze the short stuff in other parts of your paddock. Isn't this so?

Mr. Shaw: If you find they are grazing in one part of the paddock you've got to sub-divide and make them use the rest. But my point is if there is even grazing there is no advantage in sub-division.

Mr. Harrison: If you get even grazing you are in the right sized area.

Shouldn't sub-division be aimed at preventing the transference of fertility from your slopes to your stock camps?

Mr. Roberts: All the work that I know, as far as the advantages of rotational grazing are concerned, has been done on temperate pastures and after our experience here I am not at all convinced that this is applicable to tropicals. With tropical pastures we've generally got too much feed of a low quality and with rotational grazing, if you rotate every eight weeks to suit the legume growth which is much slower than the grass, by the time you put the cattle in you've got grass that they won't eat. Under set stocking they are running around and nibbling the grass all the time and not worrying too much about the legume while the grass is nice and sweet. There is very much better utilization of the grass during the summer time and a saving of legume for when you need it in the winter. This is what appears to be happening here and I am quite convinced we have had more beef per acre off these set-stocked paddocks than we have had from those that have been rotationally grazed. This may just be a question of management and we may not have been rotating at the right rate. This is what we want to find out.

SOME ASSESSMENT IN RELATION TO LAND DEVELOPMENT — NERANG AREA

by

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Pasture productivity per acre through animals is the product of two factors, namely liveweight gain per animal and stocking rate. There is one important qualification from a practical view-point in relation to pasture fattening on highly developed areas. This is the need to have available a continuous supply of pasture of adequate quality to produce an acceptable trade carcass without any interruption in the growing and fattening process. Efficiency of utilization required that as much of the pasture as possible be used for productive purposes and this is best achieved by the maintenance of rates of gain as high as practicable.