A REPORT ON
AN INVESTIGATION INTO THE AGRICULTURE OF
THE ST. AUGUSTINE AREA OF TRINIDAD,
BRITISH WEST INDIES

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**Introduction**

The object of this report is to collect together and present facts relating to the agricultural conditions and practices within the St. Augustine area of Trinidad. In a later section of the report particular attention has been paid to the problem of external parasites of cattle within the area.

The information presented in the earlier sections is scanty because of lack of time, and lack of experience in the method of carrying out a survey of this nature, but it is hoped that the Imperial College of Tropical Agriculture, will, by using this survey as it stands, together with others to be presented at the same time, have a basis for further detailed surveys, investigation, and ultimately extension within the St. Augustine area. The second part of our report is an attempt to indicate the range of one of the detailed problems.

Observations were made during the period October 1948 to June 1949, and records kept of visits to the areas, and contacts with local peasant cultivators and cattle owners, and with local dairies.

**PART 1: Agricultural Factors and Practices**

**NATURAL RESOURCES**

The survey area lies within a radius of three miles of the College at St. Augustine, a residential settlement nine miles east of Port-of-Spain. From the accompanying map, it will be seen that our district lies on the foothills, and in the shadow of the Northern Range; comprising Floradale, Maracas and the Monastery valleys to the north, and St. Augustine and Streatham/
Streatham Lodge estates to the south of the College.

General communication by road and rail links St. Augustine with all parts of Trinidad. Two first class roads, the Eastern Main, and the Churchill-Roosevelt, traverse the area, providing easy access to the markets in the capital, and at Arima, 16 miles to the east, and also to the nearby village marked at Tunapuna.

Internal communications are much more primitive, with pitch roads confined to the residential districts, while the lowland area to the south of the College has cart tracks almost impassable in the wet season. The Northern hill area is even more neglected; trampled footpaths with a few earth cart tracks being the only link between the peasant holding and the consumer.

**TOPOGRAPHY**

The area can be subdivided into three distinct parts, namely:

(i) the Northern Range hill district to the north, (ii) the flat land area to the south, and (iii) the transitional foothill area around the College. The land to the north runs up to the 2,000 ft. contour mark in a distance of about two miles, producing steep-sided valleys and generally inhospitable conditions. The central transitional area consists of shallow valleys and small hills; an area prone to sporadic flooding in the wet season. Approaching the flat land to the south between the 100 ft. and 25 ft. contours we have the detrital material carried down from the Northern Range, while to the south of the Churchill-Roosevelt highway the swamp lands begin, a very low lying district built up of alluvium from the Caroni River and its tributaries. As will be seen later, topography plays an important part in determining the type of agriculture practised.
CLIMATE (1)

The comprehensive records of the Chemistry Department of I.C.T. give an accurate picture over many years of the climate of the St. Augustine-Streatham Lodge area. The Northern hill district, by reason of its proximity to the station, must be considered as covered by the records, except for a fall in temperature of 1°F for every 300 ft. rise, and probably a heavier rainfall.

There is little variation throughout the year from the figures for Mean Annual Maximum Air Temperature of 86°F and the Mean Annual Minimum Air Temperature of 70°F with a total range from 65°F to 90°F.

Mean Annual Maximum Soil Temperature taken at 3" depth is 87°F and Mean Annual Minimum Soil Temperature also at 3" depth is 75°F.

The following rainfall and relative humidity figures show that there are well defined wet and dry seasons, with an average daily sunshine record of 7 hours in the wet season and 8 hours in the dry season.

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<td>Rainfall, 17 years.</td>
<td>2.61</td>
<td>1.05</td>
<td>1.43</td>
<td>1.96</td>
<td>5.60</td>
<td>8.07</td>
<td>8.57</td>
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**D R Y S E A S O N**  * W E T S E A S O N

"Petit Careme"

* Transitional months

The majority of the rain falls around midday, and from May to July there are minor peaks at sunrise. It has been estimated that 20% of the total rainfall is "effective".

(1) The small numerals in brackets refer to a list of references given at the end of the report.
SOILS, TYPES AND PRODUCTIVITY

A great deal of work has been done in classifying the soils of the low lying areas but there is very little information about the Northern Range soils. For convenience we will make three sub-divisions.

(i) Northern Range: Observations here indicate inherent soil infertility, with a very restricted rooting depth, especially on the steeper slopes where the soil can only be described as brashy. Organic matter appears to be low, while a high degree of leaching would suggest a lack of soluble nutrients. In the valleys and approaching the foothills we have a soil formation similar to, if not so highly developed as, that found in the detrital flats to the south. It remains for the soil surveyor to undertake some urgent work to decide if the peasant on the hills is fighting a losing battle. As would be expected soil erosion reaches alarming proportions, and here again investigation is required.

(ii) St. Augustine: Here the soil is derived from the detrital material of the Northern Range metamorphic rocks. It is colluvial material consisting of loose quartz and miscellaneous schist gravel with quartzose sand and silt, a little true clay and some free hydrosis ferric oxide, which colours the material red, orange, or yellow. Deposition was very irregular and some weathering took place before transportation, producing a very porous soil, with a water table 20-30 feet below ground level during most of the year. This detritus passes under the more recent, finer textured marine alluvial deposits of the Caroni plain to the south.

(iii) Streatham Lodge - Caroni: Lying to the south of the Churchill-Roosevelt Highway we have soils of the "young alluvial flats", where the parent material is identical with that of (ii) but water sorting has taken
place. Sand decreases and clay increases in proportion from North to South, as would be expected from the order of deposition. The water table here is very much higher and some areas are entirely waterlogged in the wet season. (3)

Soil formations (ii) and (iii) involve certain recognisable soil types classified by Chenery (4) as follows:

(a) St. Augustine Area, i.e. soils of detrital flats.

Drainage Free - St. Augustine Loam, an Azonal alluvial type

Drainage Slow - Streatham Sand and Loam, an Interozonal planosol and partially impeded - Macoya Sand

(b) Streatham Lodge - Caroni Area, i.e. soils of "young alluvial flats".


Golden Grove Sandy Loam, a zonal yellow Podsol.

Drainage Slow - Pasea Clay; Zonal Yellow Podsol.

Cunupia Clay

Drainage very slow and impeded - Montplaisir Heavy Clay

Although these soil types have great fundamental bearing on the agricultural systems of the district, little can be included here beyond a few words on their productivity. For their derivation, chemical and physical analyses, other reports abound, and a very concise precis is given by Bridgeland (5). Dr. E. M. Chenery's map of 1945-6 is the basis of all soil work in this area.

Productivity and Position of the Soil Types

1) St. Augustine Loam. Present only in small patches just south of the Churchill-Roosevelt Highway, carrying mainly provision gardens.

Professor Hardy (3) records the soil as intrinsically deficient in total N,
available P, and K.

2) Streatham Sand and Loam: Occurs in two main outcrops in the survey area, one just south of I.C.T.A., and the other a mile to the east. The former carries mainly provision gardens and a little rice, while the latter is hardly cropped at all. A very acidic soil (pH 4.8), with a low water table, very poor in organic matter, available P and K.

3) Macoya Sand: Outcrops within the Streatham Sand giving more productive patches with a higher nutrient status, but tending to dry out badly.

4) River Estate Sand and Loam: Two main areas, that enclosed by the Tunapuna River, the Guyabal River and the Churchill-Roosevelt Highway, which is very low lying, and used for rice growing despite its free draining propensities, and to the east and south of this area, where can and provisions are grown. The soil is highly acidic, low in P, very low in K, and very easily eroded.

5) Golden Grove Sandy-Loam: There is one outcrop in the area running parallel with the Highway planted mainly with sugar-cane. A very free draining soil with a high water table, a high percentage of fine sand, mineral status not very satisfactory, but a fairly productive type.

6) Pasea Clay: Comprising the bulk of the rice growing area increasing in heaviness as it reaches the Caroni. Very deficient in P and low in K, acid (pH 6.1) and very clayey (1J= 35).

7) Cumupia Clay: Along with the Pasea Clay, probably the most extensive of all the cultivated soils of Trinidad. Widespread in the Caroni and Woodford Lodge estates, but only a small outcrop in the south of the survey area, once in cane but now in rice. A productive type of soil.
NATURAL VEGETATION

Beard (6) classifies the natural vegetation relevant to the survey area as follows:

(a) Lowland Forest, ascending the foothills of the Northern Range up to 800 ft.

(b) Down Mountain Rain Forest above 800 ft. due to increased precipitation and condensation, particularly during the dry season.

(c) Mountain Rain Forest above 2500 ft., also known as Temperate Rain Forest within the Tropics.

However, more important in the survey area is the Second Growth type of vegetation, known locally as "lastro", and Marshall (7) gives its floristic composition but only in a general manner, since little work has been done.

It is hoped that the recent investigations of Greg-Smith at I.C.T.A. will throw some light on the subject. It is a type of vegetation poorer than the original forest and is floristically different, the seeds being either light and winged or as berries dispersed by the agency of birds or bats. Old shoots and vegetative remains play their part, always assuming that they have not been destroyed by fire.

Species occurring are listed as follows:

Characteristic are Cecropia peltata L. Bois Canon, Ochroma pyrimidale (Car.) Urb.-Balsa, Vismia spp. - Kiskadee, Guazuma ulmifolia Lam - Bois l'orne, Cordia spp - including Cypress wood, Cupania americana L.-Laraquil Heliconia spp., various Helas-tomaceae, and the cocorite palm (Maximiliana) caribaea Gresib et Wendel) is prominent.

Rarely is it that this "lastro" is left undisturbed, and when destroyed either for temporary cultivation or for charcoal burning a much poorer secondary bush develops: the first recolonising species are grasses-corn grass.
grass (*Rottboellia exaltata*) and bamboo grass (*Paspalum Parchigulatum*) and these are followed by shrubs and vines of no economic importance. The vegetation does not develop beyond this stage because of soil deterioration through exposure.

The lowland areas were originally under a type of Low Forest association as in (a) but little or none of this remains now because sugar estates cleared the land completely 2–300 years ago. It is worth noting, however, that the Cunupia Clay Soil type supported a much heavier forest growth than the rest of the lowland area, in those days and this is no doubt correlated with its high productivity rating now. There is an increasing trend towards savanna formation. The controversy over the St. Joseph savanna situated in the middle of the survey area, is still raging, the two views being:

(i) that it is the result of excessive burning and non-cultivation in past years, say 1400–1500 A.D., or

(ii) that it is the natural edaphic climax vegetation since the soil is too thin to support forest growth, although rainfall is sufficient.

We are inclined to the former view, and wish to indicate a similar trend on the eastern side of the Tunapuna Valley, where we know that cultivators within living memory, together with periodic widespread fires, have been responsible for the formation of this Savanna. Areas such as these two, when once established are practically useless agriculturally, and it is an urgent necessity that the factors leading to their appearance should be investigated and if possible corrected.

**WATER RESOURCES AND NATURAL DRAINAGE**

The map shows the named rivers, the general drainage direction being North–South as far as the Caroni which is the main sink for the western end of the/
the Northern Range. It will be noticed that some streams are purely seasonal, particularly in their upper reaches, and it is here that people are dependent on the streams for domestic water supplies, the topography being too steep and the sub-surface soil layers too impermeable to allow of spring formation. The Tunapuna and St. Joseph rivers maintain some flow throughout the whole of the year, and as we shall see later, the agriculture of the St. Joseph Valley is dependent on a dry season water supply, since intense floods occur, with a rise in the water level of up to 20 ft., in the height of the wet season around August.

The Tacarigua river is the main source of irrigation water for the rice area, and it is convenient that the only waterlogging observed occurs in the rice area where it is required.

The digging of wells is practiced in the rice growing area, and the water table remains within easy reach of the surface.

HUMAN FACTORS

POPULATION:

If agricultural problems are to be tackled at their source, there must be a thorough understanding of the people of an area. Population statistics for our area are difficult to obtain but we are concerned with varying proportions of the following official statistics of the Tacarigua ward of the county of St. George. (9)

TABLE II

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<th>Locality</th>
<th>Households</th>
<th>Local Population</th>
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<tr>
<td>Maracas</td>
<td>703</td>
<td>2990</td>
</tr>
<tr>
<td>St. Joseph Town</td>
<td>610</td>
<td>2582</td>
</tr>
<tr>
<td>Curepe</td>
<td>1206</td>
<td>5579</td>
</tr>
<tr>
<td>St. Augustine</td>
<td>273</td>
<td>1274</td>
</tr>
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Tunapuna/
In the Northern sector the West Indian predominates, including immigrants from the smaller hilly islands such as Grenada and St. Vincent. The antecedents of this race were West African slaves imported between 1763 and 1838; they were torn from their tribal organisation, losing their self-sufficiency, language, rites, social organisation and all the restraints and advantages arising therefrom. A new race is in the process of evolution, but it lacks as yet a solid social structure and harbours a morbid hatred of the land as a legacy of the days of slavery. They were never granted land as were the indentured East Indian labourers (see below), and pressure of population has forced them to the hills, first to work on cocoa estates, and after the collapse of the market in the '20's, to work as gardeners. Their religion, if any, is, as their culture, pseudo-European. Some are full-time gardeners, working up to eight hours a day six days per week during the growing season, but the majority are "week-end" gardeners, using the land to supply food to supplement wages earned as, for example, labourers, or lorry drivers.

A few/
A few East Indians live in this sector but the bulk of their work is in the south, where they have rice land.

In the Southern sector, as in the whole of the cane belt, the East Indian predominates, and the few West Indians present have little interest in agriculture, except for kitchen gardens. The East Indian came in as indentured labour between 1830 and 1917; many staying to take advantage of the offer of a block of land instead of the return passage. Transportation and resettlement have caused a great upheaval but not so great as that of the slaves. The East Indians still retain their natural desire to live in compact villages and an overwhelming desire to make money, but they have now no village headman to voice their opinions or to reflect that of authority. Hindu is the main religion, the few Moslems present having little interest in things spiritual.

Amongst these people there are many full-time gardeners cultivating padi, provisions and sugar, but a considerable proportion have seasonal work on the sugar estates. The area is very well served educationally, the majority of the children attending the two schools in Tunapuna, one Canadian Mission and the other Roman Catholic; two at Curepe, one C.M. and one R.C., in addition to schools at St. Joseph. Attendance is theoretically compulsory between the ages of six and twelve, but in practice is irregular. The Mission schools are favoured by the Indians and perhaps there is a need for more Government schools similar to the one found in St. Joseph, to avoid religious strife. One of the positive aspects of government policy is to present the child with a rural background in the form of school gardens, cups and prizes being given for the best efforts. It is claimed that the children are enthusiastic, but too much depends on the teachers and not enough on the Department of Agriculture.

The Education and Social Welfare Departments are concerned with the 4-H. movement in Trinidad, but this has made unsatisfactory progress, mainly due to an attempt to introduce wholesale the U.S. system as it stands.
COMMUNITY RELATIONSHIPS

In the North the population is scattered; dwellings are found in small groups convenient to metalled roads, or isolated along the mountain traces; in the southern section the entire population lives in compact village communities near the Churchill-Roosevelt Highway.

The houses are of three main types, viz:-

(i) All wood, single or double room construction with a galvanized or more recently "Duralumin" roof. The size varies with the family numbers and means. This type is raised on wooden stilts with steps leading to the single door. Common along the traces of the Northern Range.

(ii) Tapia grass and clay construction around a basis of poles not more than 3" in diameter. There is a walled in gallery and the door into the living room is often split transversely like an English stable door to allow ventilation. The roof may be of palm leaves (transported from the North West corner of Trinidad) or galvanized metal. Rarely are these houses raised off the ground and the floor is of beaten earth. Lean-to additions are made as and when the family requirements dictate; and also for use as storage or kitchen space. Houses such as this are typical of the East Indian communities.

(iii) A much more robust wood and concrete structure, often divided into rooms and raised on piles up to 3' high, allowing storage space underneath. This type is to be found in the Freeman Road area.

Water supplies are derived from both natural and piped sources. We have already indicated the natural sources and it remains to record that the villages of St. Augustine - Streatham Lodge have piped water in scattered standpipes, which are however far from satisfactory, both in numbers and distribution.
Sanitation is primitive, consisting almost exclusively of earth closets, in some cases sited near to wells with possible contamination of drinking water.

Social amenities are available to the people of the area with the exception of the isolated villagers of St. John, north of the Monastery of St. Benedict. These social amenities include the stores, rumshops, cinemas, places of worship, and contractors services found in the townships of Tunapuna, St. Joseph and Curepe. We did not observe any instances of peasant houses being fitted with electricity although the lines run along the length of the Eastern Main Road.

Diet and Health

The people are by no means self supporting in foodstuffs (except for rice in the Southern area, and ground provisions generally) since part of the diet is derived from imported foodstuffs, e.g. wheaten flour from Canada, frozen meat from Australia, and also local transactions, e.g. cooking oil from The Coconut Growers Association, and green vegetables from Aranguez estate via the local markets.

Food is prepared by boiling over charcoal or wood fires, and primitive clay ovens heated by charcoal are used in the preparation of baked dishes.

There is no detailed survey available for the area but one (10) carried out over the whole of Trinidad is applicable. In this survey the diet is shown to be deficient in vitamins A, B₁, and B₂, Ca and Fe. The East Indian's diet is better balanced than that of the West Indian, who also have inadequate proportions of protein, carbohydrate and nicotinic acid. There is no significant seasonal variation in the food supply except (i) More Vitamin A in the mango season (April-June) and the orange season (January-February), (ii) scarcity of starchy root crops from May-August. Green vegetables are eaten/
eaten fairly regularly because of proximity to sources of supply.

Health on the whole is good, especially on the hill areas, Tropical ulcer, helminthic diseases (1946 survey showed that 35% had hookworm) and malaria in the low lying Streatham Lodge settlements, were the main sources of trouble.

**GENERAL ECONOMIC CONDITIONS**

We have no means of determining the comparative changes in recent years in the standard of living of the people in the survey area, but it should be pointed out that the cost-of-living index figure for Trinidad as a whole has risen from the base level 100 in 1935 to 227 in 1949 (11) and we know that the economy of these people is intimately bound up with that of the whole island, therefore it can only be concluded that they are undoubtedly suffering under financial strain. This is supported by their own statements regarding the difficulty of "making ends meet". The situation was aggravated during the war when much employment with high wages was offered by the American Bases, and we have met peasants from Streatham Lodge who, having once worked at one of the Bases are now desirous of following the same trade (often tractor driving) since the war, and this generally proves impracticable.

Because of this, and the tendency among the younger East Indians to move away from farming, there is a definite unemployment problem in the Southern area. It is among this class that we find the greatest amount of indebtedness, a state of affairs accentuated by the tendency on the part of the younger generation to borrow money for the provision of the lavish Indian-wedding feasts, in complete disregard of the age-long Hindu principle of never borrowing money for religious purposes. This illustrates the detrimental effect of the impact of modern lines of thought onto primitive cultures.

Indebtedness amongst the Northern Range cultivators is rare and we suggest that this may be due at least in part to their comparative remoteness from "civilization"/
At the moment prevailing high prices for cash crops limits the need for credit, but future development will demand extensive rural credit facilities both for capital and working expenditure. At present there are two sources of credit:

(i) Friendly Societies, popular with West Indians.

(ii) Private money lenders. There is one at Streatham Lodge and others in Tunapuna. Many people turn to this source because they have no security to offer the banks, or an inborn personal distrust of banking systems. Interest charged is up to 21% for loans of up to £100 without security.

A future source of credit may be the Agricultural Bank, which will only advance money to an approved Credit Society of which there are six in the County, being none in the survey area. Loans are based on property mortgage, and the rate of interest is 3% from the Bank to the Society and 7% from the Society to its members.

There are two aids to saving money operating within the area:

(i) Post Office Savings Bank at Tunapuna, which is not well used

(ii) "Su-Su"; a system prevalent among the East Indians, based on a group of 15-20 with a leader who acts as Secretary-Treasurer. Each member pays into the fund a unit sum of money, or multiple of that unit at an agreed interval, and is entitled to withdraw a "hand", i.e. all that paid in by members at each interval. The system encourages saving but lacks the advantage of interest paid by other forms of saving. (5)

LAND TENURE

The greater part of the land in the area is held under leasehold, but there are examples of freehold tenancy and also share cropping.
Leasehold:

(1) The Streatham Lodge Estate, formerly a sugar estate, was leased in small gardens to estate workers after the financial collapse of the 1890's. The tenant can crop his land and dispose of his produce as he pleases, but he has no security of tenure, the holdings being held 'on a year to year basis. The average size of the holdings is two acres, and the rents are stabilised by the Rent Restriction Ordinance and vary with site and fertility, e.g.

- 50 acres house lots - £2.8 / annum
- 119 " padi-land - £10 /acre / annum
- 145 " cane land - £7.50 /acre / annum.

The landlords are absentee and the agent pleads that he is powerless to provide amenities for the estate because of a lack of money.

(ii) St. Joseph River Valley is Crown Land held in holdings of ½ to 3 acres on an Annual Lease, subject to the rules of good husbandry with theoretical supervision. The rent is £7.50 per acre per annum, payable to the Department of Agriculture, and there is a stipulation that the peasant must not live or build on the land.

(iii) To the north of the Santa Margarita Circular Road and along St. John's Road to its confluence with the Tunapuna River we have a series of small estates of 10-20 acres, parts of which are rented to peasants for cultivation. Again there is no security of tenure, the lease being held from year to year, but the tenant is free to crop and dispose of his produce at will.

(iv) In Floradale the rent varies from £5 to £8 per acre/annum for holdings of ½ to 3 acres, one man's lot tending to be fragmented. The land was formerly under cocoa up to 1000 ft, but after the collapse in the 20's most of the land was leased in small holdings, although abortive attempts have been made to establish citrus, especially limes. The type of lease is one of an annual/
annual contract between land agent and peasant, the land being cropped for an
average of 3 years under an iniquitous system of shifting cultivation. Many
owners desire to sell out because of low returns but this is prevented by the
Alienation Act 1936.

It is on land such as this that the Government has made vague
declarations in the last decade on acquiring all land over 500 Ft. to prevent
erosion, fires and shifting cultivation, and to maintain a timber supply for
the island. (12) Little has been done apart from the purchase of the
Providence Estate in 1943, with a view - unfortunately still only a view - to
conservation work and a Land Settlement Scheme.

Freehold:

(i) The St. Augustine Estate was sold outright and purchased by the
former workers in ½ and 1 acre blocks.

(ii) In the north, especially in the region of the Western Boundary and
in the area enclosed by the Santa Margarita Circular Road, a considerable
amount of Crown Land was purchased, as house lots and gardens, after the 1914-
18 war. The holdings are in blocks of 1, 2 and 3 acres and the cost price was
about $60 / acre.

Alienation of all land in the area is now forbidden by Proclamation

Share Cropping:

The sole example of this is found in the extreme north on land owned by
the Monastery on Mount St. Benedict, and cropped under cocoa. The peasant is
responsible for 1 - 2000 trees and the produce is equally divided between the
two parties, with the proviso that the tenant sells his share of the crop to
the landlord. The lease is on a year to year basis and the tenant is not
encouraged to live on his holding, but in this case the Monastery is a very

understanding/
understanding landlord and if the tenant is satisfactory he has no difficulty in renewing his lease. In the present period of attempted rehabilitation of the cocoa, the peasant is allowed the proceeds of the whole of his crop.

**AGRICULTURE IN THE AREA**

**NATURE OF HOLDINGS**

Three distinct yet interrelated types:

(i) Separated from whole of holding

(ii) Separated from none of holding

(iii) Partial separation.

(i) Within the first type we may include the mountain cultivators whose plots of land are purely transitional and are in cultivation for a three or four year maximum period. Originally cultivation began near the houses, but soil exhaustion and pressure of population have caused the people to move further up the slope. These "gardens" vary from \( \frac{1}{2} \) to five acres in size and are delimited by the extent of forest clearance only. Distances from home-steads are anything from 1 to seven miles (an extreme case found in the Monastery nearby) and access is via earth and stone tracks only. House lots can be almost neglected agriculturally, being either on small flat areas partway up the mountain, or clustered in villages with little ground space. Also included in this type are the cacao holdings of the Monastery valley.

(ii) Amongst these we include the St. Joseph river valley cultivators, who, while not being allowed actually to reside on the cultivated land are within a five minute walk of their crops and have quite extensive house lots with rough grazing and provision gardens. Some of these people, however, have rice land in the St. Augustine area and therefore belong to group (iii) below. Acreages in the river valley are rather less than the mountain areas – \( \frac{1}{2} \) – 3 acres, and boundaries are defined by rows of bush clearance debris, and are jealously/
jealously guarded, and are contiguous as opposed to the very scattered holdings on the higher land.

(iii) Partial Separation affects the villagers of Freeman Road, Streatham Lodge Road and some of those of the St. Joseph River Valley, who have rice land which may be up to two miles from the house. This is, of course, the outcome partially of the nature of rice farming, i.e., water requirements, mosquito control, and scarcity of suitable land for rice which would be wasted if used as building land; and partially, one assumes, the desire of the East Indian to maintain himself in a close village community. The unit size of rice land is 1/8 of an acre and holdings vary from this up to 5 acres. House lots are smaller than those of the River Valley people, but do allow the growing of some ground provisions and the erection of cattle stalls. A little unofficial grazing land is found on either side of the Churchill-Roosevelt Highway. Holdings are further fragmented since some of the farmers grow cane, and these lands are grouped on one block, near, or part of, the Caroni and Golden Grove Estates, at distances up to two miles from the residences.

SYSTEMS OF FARMING

We see a definite contrast between shifting and permanent agriculture. The Northern Range hillside cultivator works on the plan of forest clearance by burning, two - three year cropping, and abandonment to secondary bush growth. For this reason and because of ever increasing praedial larceny his plots of land are situated progressively nearer to the summit of the mountain. For instance, one holding was observed in the making at the very peak of the Floradale range. Also, as one approaches St. John's Village, abandoned holdings are in evidence with the remains of the more permanent crops growing now in a semi-wild condition. The position has not yet been reached where the cultivator is forced to return to previously cultivated areas, if indeed
it were possible to do so on account of the extremely sparse soil, and large rock exposures, resulting from erosion during the first cultivation. "Lasstro" remains up to the tops of the hills, except in isolated cases already mentioned, and this will be available for clearing for some tens of years hence.

In the River Valley region agriculture is permanent with livestock, but the system is almost one of monoculture, i.e. tomatoes. We define it as monoculture with livestock because the land receives the benefit of pen manure produced at the homestead. Wet season flooding replenishes low nutrients to a certain extent, but severely restricts the farming practices. These people would like to plant a wet season crop but are unable to do so.

The rice lands present a picture of isolated farming based on two crops per year or one rice crop and a dry season fallow. There seems to be some correlation between the nature of the soil and the ability to grow two crops. No irrigation water is available in the dry season, therefore the farmer is dependent on soil borne water and only the heavier soils (e.g. Fasea clays) can support crop growth during the dry season.

Sugar cane lands are essentially under a monoculture system, with a catch crop of sweet potatoes between the plant cane rows for the first 4 - 8 months of growth.

House lots are cultivated for the production of vegetables and considerable fertility must be accumulating therein, because it is these plots that receive the benefits of pen manure.

Mixed cropping is often described as a form of rotation, and is practised extensively within the survey area, both in the Freeman Road district and in the hills. There are three types of mixtures as classified by Brown (8):

(a) Simple mixtures, the components have similar habits and the crops are mainly for food, e.g., Cassava and Edoce - root crops.

Maize and pigeon pea - erect.

Yams and beans - climbers, which can use the same stakes.
Mixed market garden crops, e.g. peppers, cabbages, eggplants and okra.

(b) Short term food crop grown while the cash crop of sugar cane is at the young stage - maize and sweet potatoes may be included.

(c) Association method - observed to be more common on the hills, whereas (a) and (b) are found more often in the flat land. In this method there is no idea of spacing and haphazard planting leads to low yields.

Livestock in the farming system occupy an ill-defined position. There is no real integration of enterprises, and a large factor in determining whether a peasant keeps livestock or not (we are speaking now of the lowland peoples) is his personal feeling in the matter. Cases have been discovered where the farmer has given up livestock entirely "because they require weekend attention". We regard this as an unusual attitude among farmers themselves, but to be expected only when dealing with hired labour. The position of livestock will be expanded in a later section.

Above all it must be emphasised that rice growing does anchor the peasant to one piece of land and makes him realise its full values and deficiencies, as opposed to the mountain cultivator who is gradually ruining the soil and living on the built-up fertility of the past, which indeed is now as high as might be expected.

One further type of agriculture remains to be mentioned - the cacao cultivator on the Northern Range. Ideally a lower storey forest tree, cacao, if neglected, quickly reverts to forest, and this indeed has happened in many places. The two alternatives after this open to land owners has been either to allocate land to peasants for use as gardens - forest clearance and the wicked cycle of shifting cultivation begins - or to regenerate the cacao, as is being attempted by the St. Benedict Monastery authorities in the hills above.
above St. John's Village. By cleaning operations and a certain amount of cutting out and replanting they hope to have a productive estate again before the anticipated fall of prices sets in.

To summarise we may say that within the survey area there are six distinct types of agriculture: shifting cultivation, plantation monoculture (cacao), monoculture without livestock (some rice land and some cane farmers), monoculture with livestock (River Valley), rotational farming (rice lands) and vegetable gardening with livestock. It must be emphasised, though, that these are practised by only three types of farmers and are therefore to a certain extent concurrent.

**IMPLEMENTS AND THE BASIC CULTURAL OPERATIONS AND TRANSPORTATION.**

(a) **Hand Implements:** First and foremost is the cutlass, and its associate the brushing cutlass. It is a single-edged steel cutting instrument with a blade about 18" long, 3" wide at the distal end and tapering to the handle. The brushing cutlass is lighter in construction, blade of 9 - 12" and set at an oblique angle to the shaft - 2 - 3 ft. long. The cutlass is used with a chopping action and can replace the "billhook" of British agriculture as far as the thickness of branch that can be severed with it. The brushing cutlass is swung with the right hand (a mirror image version for a left-handed operator) the weight of the body being borne by a short staff with a hooked end, also used for clearing away herbage already severed. An experienced operator can produce an effect equal to the best scythe work of British Agriculture.

A further modification of the cutlass is the cane knife - having a blade as long as the cutlass but pointed at its distal end and never so wide in any part, with the blade set at an oblique angle to a short handle - again a mirror image version is made for a left-handed person.

The small sickle is favoured in rice harvesting, especially the variety with sawteeth along its under edge. Also it is especially suited to use by children.
children in gathering herbage, before they are old enough to use the
brushing outlass.

The pick is used by mountain cultivators both in forest clearance for
root removal and in planting operations (see description of cassava planting).

Another important hand implement is the louchette. An iron blade about
6" long, chisel shaped, and up to 5" wide at the cutting edge; it is
attached to a stout haft up to 5 ft. long and is used in to cultivation of
stony land by a straight up-and-down motion.

Various forms of hoe are in use, both in land preparation, ridging
operations, and after cultivation. They are all on the draw-hoe principle
and we have not observed any Dutch hoes.

For land preparation prior to planting, the fork is used. This is a
rather heavier implement than the usual English garden fork and indeed one
firm in England specialises in the manufacture of "Trinidad forks". We have
observed that a peasant cultivator, working under favourable conditions, was
able to produce a tilth in clay soil which was ready there and then, for the
reception of e.g. maize seed, in one operation.

It must be emphasised that there is little or no land preparation on
the hillsides for the reception of planting material. The only basic operation
is to clear off the forest, with or without burning. The larger trees must of
necessity be left standing, and those with girths of not more than 6 ft. are
felled. The stumps of these must remain and indeed it is fortunate that this
is so, because they do have a little soil conservancy effect. Clearing the
land, if done at the beginning of the rains, exposes a soil surface of fine
open texture, which indeed requires little or no cultivation. The fork is
therefore not used here but is confined to the dry season cultivation of the
rice lands, and preparation of sugar cane land - here the land is not quite
so amenable, having been undisturbed, and indeed walked over several times in
the course of harvesting plant and rattoon cane, and therefore a heavier
fork/
fork is desirable.

(b) Animal Drawn Implements: These include a two-oxen furrow plough, generally used by contractors in the rice area, and various harrows, including the heavy board harrow with or without spikes.

We have observed no other form of mechanisation, and hand implements are by far the most important.

(c) Methods of Transportation: Donkey carts are the most popular, and are very simple in construction, the basis being two iron-rimmed wheels 4' in diameter, a solid iron axle, and the shafts and base board made all in one piece. The only sides are thin poles inserted into holes in the continuation of the shafts backwards. Donkey harness is similar to English carthorse harness, but the saddle has more wood in its construction and padding is by loose folded bags.

The mule carts are similar but slightly larger and heavier, and the main advantage of a mule over a donkey seems to lie in the speed of travel. Oxen carts fitted for a pair have a single central pole, and the oxen are double-yoked to this, but oxen carts are not very popular because they are not permitted in the environs of Port-of-Spain.

A modification sometimes seen is the fitting of pneumatic tyred wheels, e.g., from the old back axle of a car. Peasants appreciate the value of the pneumatic tyre in lowering the draft of a vehicle and also the beneficial effect on the driver when long distances have to be traversed.

Donkeys are used as pack animals in the Northern Range by fitting the load over the back with wooden supports; in particular when cocoa is being harvested two boxes are slung along the animal’s flanks and the beans dropped therein.

As a final means of transport there is the head load. Baskets containing up to 60 lb. can be carried with ease, and sacks of corn or pigeon peas are generally brought from the hill gardens by this means.
A great range of crops is grown, and firstly we will classify them according to type and then give a brief outline of the cultivation, usage and yields where known, of the more important ones.

(a) Permanent or semi-permanent crops:

- **Cacao** - *Theobroma cacao* L. Lonastery lands above St. John Village. Old cacao in the process of regeneration.


- **Coconuts** - *Cocos nucifera* L. Old single trees fairly common in the southern area, but no plantations. Value for milk and street hawking in Port-of-Spain.

- **Tree cotton** - *Gossypium arboreum*. A few isolated trees in the St. Augustine estate. Used for stuffing and lamp wicks.

- **Mango** - *Mangifera indica* L. Very common among the Southern people, because of its significance in the Hindu religion. Estimated average of one tree per household. Fruit is a valuable source of Vitamin A. Improved grafted varieties are available at St. Augustine nursery.

- **Avocado Pear** - *Persea americana*. Scattered trees usually of seedling stock, but St. Augustine nursery has budded plants available.

- **Pawpaw** - *Carica papaya* L. Grown in clumps around houses. Valuable fruit.

- **Breadfruit** - *Artocarpus communis*. Widespread over hill and flat areas, and fruit, as its name indicates, is a carbohydrate supplement to the diet. No improved varieties as yet.
Oranges, Grapefruit and Limes. *Citrus* spp. Some planted trees on
Northern Range, but many in the Southern area are
self sown. St. Augustine Nursery is putting out
improved budded varieties sour orange stocks.

Cashew Nut — *Anacardium occidentale* L. Popular among East Indians
both for the nut and the fleshy peduncle which is
eaten like an apple.

Calabash — *Crescentia cujete*. The hard, dry fruit walls are used
as domestic utensils. Readily propagated from seed
and cuttings.

Bananas and Plantains — *Musa* spp. Small clumps for home consumption
and very local sale. Trinidad does not export bananas.

Sugar Cane — *Saccharum officinarum* L. Restricted to the cane lands
and the extreme south of the survey area.

(b) Grain Crops:

Swamp Rice — *Oryza sativa* L. var. *min. (*Hector) We have discussed
its importance in the farming system, and cultural
methods will be described later.

Hill Rice — *Oryza sativa* L. var. *aus. (*Hector) Grown on the Northern
Range where it is becoming fairly popular and important.

Corn — *Zea mays* L. Widespread cultivation on the Northern Range.

(c) Pulses:

Pigeon peas — *Cajanus cajan* L. Of increasing importance as the summits
of the hills are approached, but nevertheless an
important food crop of the lowland too, on the rice
field bunds, and also as a semi-permanent crop around
houses.

Cowpeas
Cowpeas - *Vigna sinensis* L. Have largely been replaced by the next crops, in the southern area, but is retained in the Northern Range gardens.

Wolly pyrol - *Phaseolus munro* A dry season crop for the rice land providing fodder and the pulse grain used as human food.

(d) Vegetables:

Tomatoes - *Lycopersicum esculentum*. Found in all areas and an important cash crop.

Egg plant - *Solanum melongena*. More common in the southern area as a dry season rice land crop.

Okra - *Hibiscus esculentia*. Also a dry season rice land crop.

Pumpkins & cucumbers - *Curcubita* spp. Waste land, manure heaps with or without bamboo support.

Green vegetables - *Brassica* spp. Include cabbage, chines cabbage, and cauliflower, lettuce, *Lactuca sativa*, and *Poi* spinach, *Basella alba*, but as we have indicated, many of these are purchased from Aranguez estate. Lole crickets are a source of trouble to newly-planted out cabbages.

(e) Root Crops:

Yams - *Dioscovia* spp. Mostly *D. alata* (winged yam) but some *D. trifida*, e.i. cush-cush.

Sweet potatoes - *Ipomea batatas* grown in association with sugar cane.

Tannis Dashes Edo - *Xanthoroma* and *Colocasia* spp. Scattered clumps not truly cultivated.
(2) Hill Padi:—The growing of this by the Northern Range Cultivator is a much simpler process than with swamp padi. Seed is simply broadcast or dibbled into the ground at the commencement of the rains, and is allowed to grow for its very short growing season of 60 days. Further treatment is as with swamp padi.

(3) Sugar Cane, sweet potatoes, and maize: These are dealt with together because they are grown on the same land as a mixed crop. Briefly the system involves:

(i) Rough forking over of the old cane beds and setting out with ridges 3' - 4' apart and 1' high, and in November cane setts and maize are planted on either side of the ridge. Cane 3' x 4' and maize 3' x 1\(\frac{1}{2}\)'.

(ii) Sweet potato slips are inserted into the tops of the ridges 1' - 1\(\frac{1}{2}\)' apart in December.

(iii) Potatoes are harvested in April by digging out and the ridges split back over the now established cane, and the cobs are removed from the maize. Trash and debris are dug into the cane field. Pen manure is applied at this time.

In contradistinction to the estate practice, peasant cane is planted in short rows across the beds. During the first growing season pigeon peas are planted as another temporary food crop.

Plant cane is harvested after 15 - 18 months, during which time "trashing" and light weeding take place, the debris being left to rot between the rows. Cutting the cane is done either by the farmer himself, or if he does not possess a cart, by a contractor who does the whole job of cutting and transport to the factory (Orange Grove), at the flat rate of £1.80 per ton. There has been great dissatisfaction amongst farmers and contractors at the long waiting periods necessary at the factory in order to unload cane.

Observations/
Observations made during the present "crop" period shewed that each cart took approximately one minute to pass over the weighbridge and there was on that particular afternoon a queue of some 90 carts waiting. Since much of the cane must be brought from 2 - 3 miles away, it is obvious that each load must take nearly 3 hours to deliver. The factory pays £6.24 per ton for clean cane, with proportionate reduction for thin, and trashy cane. Yields of peasant plant and rattoon cane vary from 10 - 20 tons per acre, compared with an estate average of 30 tons per acre.

Estates are willing to supply free cane setts to their workers, who are often part time cane farmers, or the setts may be purchased at the cost of £1 per 1000. Some farmers use "soldiers", i.e. cane tops, as setts, but this is not satisfactory. Cane is left in the ground for three, four or five rattoons, but the longer period is undesirable, because of fertility decline, excessive stool growth, and the problem of froghoppers and cane borers, which persist from year to year.

4. Tomatoes:— An important cash crop in three parts of our survey area.

(i) Grown on the hills during the wet season because on the lowlands they are subject to aphid attack producing a virus leaf curl. Seeds are sown in a bamboo nursery and planted out at 6" - 8", in a rather spasmodic fashion as the terrain allows. The plants are kept clean weeded and are later staked. Prices are good for tomatoes ripening in December, but yields are low, because of the small fruited hill variety that grows in this area.

(ii) The St. Joseph River Valley cultivators concentrate on tomato growing during the early part of the dry season as soon as the floods have subsided. Nurseries using compost are made on higher ground in anticipation of the drying out of the silt. Normally three varieties are sown,
are sown, viz: Hill tomatoes, local lowland tomatoes (e.g. Aranguez) and imported English "Stoner" variety. One plant of each kind is planted in ridges, a little water being applied to get the plants established, after which they rely on ground water. Three pickings are made, and fruits must be picked green and ripen indoors to avoid bursting, due to rain and sun action. Yields are quite high, being up to 3000 lbs. per acre for an average price of 16¢ per lb.

(iii) As a dry season crop in the rice land, tomatoes could be a profitable sideline, but praedial larceny and lack of water have led many farmers to cease the practice of growing them. Seeds are sown in the nursery near the house and planted out onto forked land after rice clearance, and eventually soil is rounded up around them. Yields are not so high as in the River Valley, approaching 2000 lb. per acre.

5. Other dry season rice land crops:

(i) Okra and Egg plant: The rice straw is left on the beds as a mulch and 2 - 3 okra seeds per hole dibbled in through this. No further treatment is given unless weed growth becomes excessive when slashing may take place.

(ii) Coolly pyrol: Seeds are scattered over the surface after padi has been taken off and left to grow in the wild condition until harvest either green, as cattle fodder, or when ripe as a pulse for porridge making. Theft of the green fodder is common and prevents many farmers from even considering growing a dry season crop.

(iii) Cucumbers, marrows, etc., do not do well because of their high water requirements.

6. Pigeon Pease and Maize: A common mixture on the high slopes of the Northern Range. Land is cleared and maize seeds put into dibbled holes,
holes, and pigeon pea interplanted. Thus a continuous ground cover is obtained and the maize is removed before the pea becomes too rank. Yields are difficult to estimate because picking is as and when required. The pigeon pea becomes a semi-permanent crop, and after cultivation involves only the occasional slashing with a cutlass and cutting back of the shrub each year. Probably two years is the limit of their usefulness before final cutting out or abandonment, but even this period is severely restricted by the fairly widespread occurrence of a "canker" (unidentified) which kills the plant after a year. Pigeon peas in the southern area are grown on occasional patches of waste land, in and around house lots, and on the bunds of the padi fields; thus existing in a semi-wild state.

7. Yams: An important cash crop, and the small and damaged tubers are used to supplement domestic food supplies. A crop that really pays for liberal manuring and the peasant fully realizes this, at least on the lowland. Cut tubers are planted in trenches 4' apart with, e.g. sugar cane trash and pen manure in the bottom. Spacing in the row varies from 2' - 4' and it is often arranged that the two rows of yams shall utilise the same bamboo support by placing it between them. After cultivation consists of training the yams up the supports. Ripeness is indicated by the appearance of brown spots on the leaves and peasant yields are surprisingly high in the order of 20 tons per acre, due in part to the liberal use of pen manure.

8. Cassava: This is planted mainly by the Northern Range cultivators, immediately after bush clearance, by the simple process of making a hole in the soil with a pick, inserting a 4" - 6" length of cassava stem, pressure from the foot above and below and waiting for growth to commence.
to commence before drawing a little soil around the stem to provide cover for the developing tubers. Cassava may be left in the ground for periods from 15 months to two years after which time it begins to degenerate. As with all the Northern Range Crops, yield estimates are almost impossible.

9. Condiments, a few pulses and etc. are grown around the house lots, notably pepper, bodie beans, and Lima beans. Some of these find their way into the local markets and may amount to some source of revenue.

MARKET FACILITIES

In our description of the location of the survey area we have referred to the large town of Port-of-Spain, and Arima, and to the local market at Tunapuna. In its method of operating it is typical of many in Trinidad and very similar to that at St. Joseph, also within the area.

These markets were set up to avoid the road congestion brought about previously by the setting up of roadside pitches for the sale of produce. They are enclosed covered buildings divided into provision, fish, and meat sections, with individual stalls available for hire to the vendors, either on a daily or monthly basis. Both wholesalers, retailers, and produce-retailers occupy the stalls. The local garden's office appoints a clerk to run the market and further supervision is provided by the spasmodic visits of the Marketing Officer of the Department of Agriculture.

Despite the fact that roadside selling is now illegal there are many stalls along the length of the Churchill-Roosevelt highway and also vendors unable to obtain market space will encamp either in the immediate environs of the market (legal, provided a reduced market charge is paid) or a little further afield (illegal but having the advantage of no official supervision).
There are price controls in operation in Trinidad, but these can sometimes be avoided by the sale of produce "on the ground", involving of course an additional risk for grower and buyer but often considered worth it. Wholesale control prices are slightly higher (5% - 10%) in the recognised markets than elsewhere, but there are flat rates for retail prices over the whole Colony. A list of control retail prices is displayed in each market.

The hillside cultivators have the difficulty of transporting their produce from the gardens to the markets, distances that vary, as we have indicated, from two to eight miles. Since one of their main crops is pigeon peas grown to full maturity, we find that often the produce is sent into Port-of-Spain by lorry for disposal there, after head loading from the gardens to the cultivators home.

The present marketing organisation is an attempt on the part of the Department of Agriculture to help the peasant cultivator, but has three deficiencies:

(i) The real reason for its being set up was not agricultural but regulatory.

(ii) There is no attempt at grading of produce, prices below the control level being a matter of bargaining between vendor and buyer, if the latter thinks that the control price is too high for the quality offered.

(iii) Possibly some collection system would be of use to the peasants.

The marketing records give an indication as to the seasonal fluctuations in supply and corresponding price variation. We have already referred to seasonal fluctuations under "Diet and Health", and it must be remembered that the wide range of soil and topography within the area makes for a longer supply period of any one produced than would be the case in markets, e.g. in the Central Plain,
Central Plain, since produce, notably vegetable produce, is not moved over great distances in the island.

WEEDS OF THE AREA

The weeds of the Northern Range gardens are largely those herbaceous species occurring in the "lastro" growth, including *Lantana spp.*, *Sida glomerata*, *Sida acuta*, *Bideus pilosa*, *Cordia macrostachya*, and *Heliconia spp.* Among the grasses present we find *Axonopus compressus*—Savanna grass, *Paspalum fasciculatum*—Bamboo grass, *Rottboellia exaltata*—Corn grass, and *Sporobolus indicus*, Tapia grass (used in house building). Savanna, Bamboo, and Corn grass, together with the young stages of *Bideus pilosa* are useful for cutting as fodder. Weeds are not really a problem on the hillside, because the crops are on the whole large and vigorously growing, e.g. maize, pigeon peas, or Cassava, and cropping takes place so soon after clearing that economic species get away before the weeds.

The following weeds were among those collected from the rice fields during the dry season (13) (14).

- *Stachytapheta cayennensis*—Tall growing
- *Rolandria fruticosa*
  - *Eupatorium microstemon*—Perennial shrub, 3-4'.
- *Euphorbia prostrata*—Low growing herb.
- *Euphorbia hirta*—Milk weed. Asthma cure.
- *Borreria verticillata*—Troublesome in pasture.
- *Achitana trinitatensis*.
- *Jatropha gossypifolia*—Bellyache Bush.
- *Leonotis nepetapholia*.
- *Blechum pyramidatum*. 
Heliotropium inundatum – Garden plant.
Solanum stramonifolium – Troublesome and prickly.
Fleuryia aestiraus – Stinging nettle.
Syndella nodiflora
Sphenodea sp.
Scoparia dolcis
Phenae sonneratii
Jussieae linifolia
Jussieae decarreus
Oldenlandria herbacea

Legumes included:
Cassia tora – possible cover crop.
Cassia occidentalis – Jumbie Coffee.
Desmodium procumbens – Fodder potentialities.
Indigofera suffruticosa
Aeshynome sensiva

Among the grasses were:
Eragrostis ciliata
Eragrostis hyproides
Bluesine indica
Paspalum fasciculatum – Bamboo grass.
Paspalum corigatum
Axonopus compressus – Savanna grass

And on the wetter areas these Sedges occurred:
Fimbristylis sp.
Cyperis ferae
Cyperis ligulae.
in direct contrast to the methods employed in British Guiana.

Rice requires a supply of irrigation water throughout its growing season and theoretically the St. Augustine Estate is irrigated by gravity from the dammed-up Tacarigua River and the water after distribution escapes via the Guyabal River. The Streatham Lodge Estate has no organised irrigation scheme but the peasant who went into the land in the 1890's took it upon themselves to dam the Tacarigua River where it enters the Estate, and this still provides some irrigation water to a small area. The remainder of the rice is dependent on rainwater trapped during the growing season, and this is a most unsatisfactory state of affairs.

There is considerable ill-feeling amongst the cultivators on the Streatham Lodge Estate because they see well irrigated rice plots belonging to the Trinidad Department of Agriculture in the N.-W. corner of St. Augustine Estate, while they themselves are subject to alternative drought and flooding, leading to very poor yields or badly layered rice crops, e.g. the past season.

A scheme has been envisaged by the Hydraulics Section of the P.W.D. to integrate the two irrigation systems, and improve on them by tapping the Tacarigua River east of the Streatham Lodge Estate, and also proposing to use overflow water from the Orange Grove sugar factory to increase the available water supply. Two dams are proposed and water would be collected above each one for a week at a time to serve the two estates. This scheme, if carried out, would be of immense benefit to the cultivators, but they should be educated to expect to pay reasonable charges to maintain the scheme, in contrast to the present St. Augustine Irrigation scheme, which carries no water rate.

Irrigation of tomatoes in the St. Joseph River Valley, and of the few cabbages and other vegetables grown, is by hand, using either a bowl or watering-can/
watering-can. Water is carried from the St. Joseph River and poured between the ridges in which the plants are growing. Water is only used to get the plants established, after this use being made of a soil mulch and the beneficial effect of ridging.

SOIL EROSION

In the Northern Range area the signs of excessive soil erosion are all too evident. They may be listed as follows:

1. Numerous gullies, some approaching 12' in depth, with large rock exposures in their sides and beds.
2. Sheet erosion emphasised by the exposure of tree roots, and gradually merging into the gully erosion.
3. Particularly in the foothills land subsidence exposes the whole profile down to the rock and nothing remains of the removed soil.
4. Accumulation of erosion debris above rock exposures in the gullies and along their whole length during the dry season when lack of water causes deposition.
5. During the wet season streams are coloured by transported material.
6. The very nature of the farming system indicates a rapid decline in fertility.

The one overwhelming factor that has led to this intense degree of soil erosion is the pernicious system of shifting cultivation practised on the hillsides. Removal of the vegetative cover, destruction of the humic layer, and cultivation with consequent soil loosening, are all direct results of the land clearance. Planting up and down the slope of such erosion-forming crops as corn and tomatoes and the tendency to clean weed these crops, aid in the beginning of soil wash, sheet erosion and eventually gully formation.
We did observe two practices which tend to control erosion:

(i) Cultivation of pigeon peas does not usually involve clean weeding, but only cutlassing, which together with the fair cover provided by pigeon pea foliage, tends to break the force of the rain showers and therefore reduce erosion.

(ii) In the Tunapuna Valley, yams were planted in ridges across the slope. Whether this was purely fortuitous or whether planned we were unable to ascertain, but as a practice it must be commended.

Government Recognition and Action: The problem was first recognised officially in 1932 although the situation had been steadily deteriorating since 1830.

(i) Evans' Report 1935: Advised firstly that watersheds must be protected and kept under forest. This would regulate the water supply, encourage the formation of constant flowing springs and reduce the rate of run off; and secondly advocated action to prevent the construction of temporary gardens in these areas.

Assuming that this latter proposal had been carried out, then the further problem of food supply, both for the present cultivators and for those people outside the area fed by their products, would have become acute. This is then the crux of the problem on the Northern Range: balance between continuing erosion and continuing food supplies, or finding alternative food supplies and employment for the cultivators.

(ii) Legislative Council February 1936: Alienation Act prohibiting the alienation of any further land of the slopes of the Northern Range without the prior sanction of the Director of Agriculture and the Conservator of Forests.
(iii) 1939 Conservator of Forests recommended:

(a) Acquisition of all land above a given contour level.
(b) Legislation to allow the Government to control cultivation of private lands.
(c) Prohibition of the cultivation of temporary crops above the defined contour level and below this level to be grown only with adequate control measures.
(d) Improvement of fire protection.
(e) Provision of adequate staff for education propaganda, and the enforcement of the suggested regulations.

(iv) Later it was recommended that:

(a) There be a remission of the Land Tax of 24½ per acre for owners of forest willing to keep it as such.
(b) That the contour level referred to in (iii) (a) above should be 500 ft.
(c) Acquisition of £20,000 by 1941 to erect windbreaks.

(v) It was finally agreed that:

(a) There must be compulsory protection against erosion, and if done voluntarily there should be a remission of the land tax.
(b) Gardens should be laid out on a contour strip system.

(vi) 1940 Lands Advisory Committee:

(a) Layout of peasant gardens on large estates should be arranged in staggered rectangular strips parallel to the contour.
(b) An urgent necessity for advice and demonstrations of the methods of soil conservation.

With this end in view the government purchased the Providence Estate in 1943.
1943, but nothing further has been accomplished.

Almost all the above recommendations and propositions have been made from either the legislative or forestry point of view, and, while the desired end, i.e., to stop the grave loss of soil now going on, is the same, it is felt that a thorough agricultural investigation into the problem together with the urgently needed soil survey mentioned under "Soils", should be the basis for further work and action. This soil erosion problem is the one outstanding in Trinidad in general, and the Northern Range in particular, and does require immediate attention. We feel that the Imperial College, if it is intended to develop this as an extension centre for St. Augustine, should concentrate its energies into this one problem over the next few years, and will then have some tangible evidence of the means, methods and limitations of all the Extension techniques.

Soil erosion does not affect the Southern area to the same extent as the North, but three examples of its effects are seen:

(i) Undercutting of the banks of the Tunapuna and Guyabal rivers.
(ii) Silting up of these rivers and consequent flooding.
(iii) Possible gully formation along those cart tracks which are without pitch surfaces.

Remedial measures in the north would aid the south to a great extent, because then neither would there be silt to cause flooding, nor excessive water flow and transport of abrasive material to cause bank undercutting.

Three factors help to prevent sheet erosion: the very low gradient, the nature of the farming system which ensures that a fairly high O.M. contour is maintained, and the clayey nature of many of the soils.

LIVESTOCK

Distribution of stock in the area depends largely upon two factors:

(i) Race and custom/
(i) Race and custom

(ii) Topography

with a third factor, lack of capital, limiting actual occurrence.

It is found that the East Indians of the flat area have proportionately more stock than the West Indians of the hills, partly due to the more suitable terrain but mainly due to their inherent love of livestock and to their religious beliefs, e.g., the "sacred" cow of the Hindu, and the abhorrence of the pig by the Moslem. Here we find the majority of the cattle 20 - 25% of the peasants keeping at least one cow, and at least one instance was found of as many as 6 cows in milk on one holding. Some working oxen are present, poultry are universal but goats and pigs are not so common as in the north. The peasants have great interest in their stock and some have definite ideas on the type of progeny they desire, but they lack the fundamentals of animal breeding.

The hill cultivators have little capacity for the type of work associated with intensive animal husbandry, and their holdings are on land inhospitable to the larger animals. Thus stock is relatively scarce, more than half the peasants having none at all and those who do keep animals favour the smaller types such as poultry, goats and pigs. Conditions are healthy but fodder is scarce.

Class of Stock:

(1) Poultry:

A cosmopolitan group. The Rhode Island Red and its crosses seem to predominate along with the indigenous "bare neck". Conformation and performance are poor and little attention is paid to feeding; nevertheless general health appears good. Individual flocks are very small but very important.
important domestically. Eggs and fowls sold off the holding are sometimes regarded as an important feature of the income. Internal parasites and lice are important pests, as are the mongoose and the manicon of the hills.

(2) Goats:

Common in both area, although more prevalent in the north. They are kept for milk and meat, the latter being regarded as a great delicacy by the peasant. There is no fixed breed, although British Alpine blood seems common in the milk types. Goats have great possibilities, linked with their inherent capacity to breed regularly, and to produce a yield higher than that of a second rate cow. They are very free from disease, and low in capital cost and upkeep. One great disadvantage is their browsing habit on free range, a factor which accelerates soil erosion. Service facilities are available at the Government Stock Farm at £1.60 per head.

(3) Pigs:

Found throughout the area, but are not very numerous. Their conformation is poor and accounts for the local name of "razor back". One type is nondescript but there is evidence of Berkshire characteristics. Free range is the system in the north while tethering is practised in the south. The lack of concentrates during the war must have had a serious affects on the pig population. Intestinal parasites and malnutrition are the main sources of trouble; swine fever did appear after the war but was controlled by slaughter and compensation. Sires are available at the Stock Farm at £2 per service but are not much used.

(4) Donkeys:

Widely used as pack animals in the north and as shaft animals in the south. The former type is smaller, less heavily built and more suitable for negotiating the rough hill tracks. Transport is an important factor in
the life of the peasant and the donkey cart is a common sight either on the way to market or carting grass for other livestock. Commercial transport is very expensive compared with the capital cost of approximately £220 for a donkey and cart and the cheap maintenance costs for the animal. General health is very good and the working life may exceed 20 years. First class sires are available at the Government Stock Farm at £2 per service.

(5) Work Oxen:

Not found in large numbers and almost entirely confined to the south, especially in the cane areas. They form a very heterogeneous group and Sahiwal blood is common. Those in the Streatham Lodge district appear distinctly heavier than those found in St. Augustine, probably because of the different crops and roads. General conformation is poor with relatively prominent, and they are said to lack stamina which may be a direct reflection of the prevailing random selection of bull calves and the absolute refusal of the peasant to have his cow served by a draft type bull.

Here is must be emphasised that the donkey both in the North and in the South, and the ox in the South are used primarily for transport; there being very few animal drawn implements. The lucky few who do own ploughs and harrows contract out during the work season.

(6) Cattle:

Economically and nutritionally the most important group of stock in the area, especially in the South.

The Spaniards first introduced cattle, probably of the Bos indicus, towards the end of the fifteenth century but since then the blood of many European breeds e.g. Jersey, Guernsey, Red Poll, Devon, Ayrshire, Shorthorn and Friesian has been incorporated by planters with individual tastes.
These later introductions have served to improve the milk and beef propensities of the cattle population. Friesian blood appears to predominate probably as a result of:

(i) The agisting of pure bred sires of this breed on the public Savannahs in the nineteenth century.

(ii) The present Government policy.

In all we find a motley collection predominantly Zebu and Zebu graded with Friesian but with individuals shewing the characteristics of one or more of the breeds enumerated above 5/8 Halstein and 3/8 Zebu has been proved a useful type for the conditions, but the great difficulty is the maintenance of type. The proximity of the Government Stock Farm at St. Joseph should have had a far greater beneficial effect on the cattle population but the profound difficulty of formulating and operating a continuous policy to serve the needs of the peasant proprietor with his small herd has never been adequately met. Although in the South where the cattle numbers are greatest the Indian is inherently a good stockman he needs guidance in breeding, feeding and management to help transform his cows to productive units.

Lactations average 12 months but sometimes last much longer; while yields vary considerably, a cow producing 18 bottles (3 gallons) per day is a rarity and considered exceptionally good and 8 to 10 bottle cows are all too common.

Breeding is haphazard with no recording although many peasants could recite the pedigree on the dam's side for at least two generations and surely it is interest of this nature that should be exploited to further livestock improvement. It was often reported that it was difficult to get cows to hold to the bull, a factor which would seem to warrant further examination; while the preponderance of uncut calves was very disturbing. Castration is against the principles/
the principles of the Hindu religion and many owners hold the belief that uncut calves develop stronger shoulders for draught purposes. Here we have an illustration of the conflict of culture with progress as well as of the difficulty of attempting to produce a triple purpose animal, i.e. draft, milk and beef i.e. a mating to produce heifer calves for milk production, bull calves for beef or draft and leaving animals fit for beef when their productive lives in other directions come to a close. Two great dangers must be stressed (i) without selective castration scrub bulls will be produced capable of ruining a breeding policy at one fell swoop, (ii) any advance in local breeding technique must be accompanied by parallel improvements in feeding standards.

Housing:

The majority, but not all, of the peasants have a small, open sided, thatched roofed shelter for their cattle and donkey. It is usually a make-shift affair, but some do recognise the need for good sheds with concrete floors wherein it is possible to produce clean milk and to conserve manurial residues especially liquid manure which in most cases runs to waste.

The shelters are invariably built near to the house to prevent praedial larceny, a very common occurrence in Trinidad with the result that the peasant may sometimes be seen taking his animal around with him to prevent theft!

Feeding and Management:

Goats, pigs and poultry are the universal scavengers of the district and little attention is paid to their management and nutrition. Pig feeding is difficult at present owing to the lack of concentrates, but as pork commands such high prices will could be used much more widely although a
A great problem may lie in the absence of the essential sterilization facilities. Swine have been seen feeding on mangoes, breadfruit and bananas as well as household scraps, and poultry picking among corn, rice and kitchen refuse.

The majority of the cattle are tethered in the open during the day and housed at night. Sometimes they are allowed free range over the rice lands in the dry season. Fodder consists mainly of grass and weeds together with the by-products of the arable crops such as cane tops in season. Grass is collected from the sides of traces, bunds and from the Caroni River banks and tree plantations by permit. Collection and transport are avid time consuming tasks and it is a common occurrence for the man of the house to be away fully half a day collecting one donkey cart full of grass. Various reasons have been put forward for not growing forage e.g. lack of land, stealing at night; waste of time and money; and the fact that Para Grass, one of the suitable grasses tends to make the land dirty in much the same way as does couch in Britain. One cattle owner in the Streatham Lodge district has a small piece of Para and elephant grass, thus having good food on the spot and more time to look to his crops and stock. The Monastery on Mount St. Benedict at one time gave up keeping cattle owing to the shortage of fodder, but are now investigating the possibilities of growing fodder grasses on the hill sides. Their efforts have not been fruitless if we are to judge by the luxuriance of Guatemala and elephant grass at 2000'. Normally the grass feed varies enormously, both in kind and in quality, some is dirty and withered while some is fresh and green. Some peasants feed rice straw either when they are short of time or more commonly are too lazy to collect grass.

It appears that about 100 lbs. of grass is fed daily along with whatever concentrates/
concentrates are available. It used to be common to feed about 4 lbs. of linseed meal but now this has been replaced by the locally produced coconut meal, which has, however, an unfortunate tendency to go rancid. Peasants working at Orange Grove estate sometimes have the opportunity to buy a bag of coconut meal while others purchase in Tunapuna when available. Rice is fed at times but is considered much too expensive, and some cowkeepers incorporate soya bean meal in their rations.

The significance of feeding for milk production is not fully realised by the peasant and many feed the same amount regardless of yield. Concentrates as well as being scarce are costly and thus the rations tend to be bulky and unbalanced. When concentrates are fed they are prepared in all cases as a liquid swill with approximately 2 lb. meal, \( \frac{1}{2} \) lb molasses and a handful of salt to 4 gallons of water.

Some peasants are very clean practicing clay-washing of the cowshed and even washing of the udder at milking, but even in these cases personal hygiene leaves a lot to be desired, while in other cases the producers are a menace to society, in that they produce milk, some of which is later bulked, under disgustingly insanitary conditions.

Again cattle are often kept in the sun the whole day, a practice which appears to drain their vitality. The tethering system is haphazard and often among shrub, a factor which will be dealt with in Section ii. Pen manure is usually carelessly stored in heaps in the open and its application to the holding seems to depend on the availability of transport; the state of the traces and the state of indebtedness of the peasant, some being sold for ready cash. Only one example was seen of the collection and use of liquid manure, in this case on tomatoes in the Northern sector.
Disease among cattle does not seem to be an important factor, although partial exhaustion and unthriftness are very common, especially among cross-bred stock with long hair and unpigmented skins. The incidence of T.B. is very low, reactions to the Annual Government Test being destroyed, and although mastitis and abortion do occur they are not very troublesome (15) Bat rabies, carried by Desmodus rufus, was common in the thirties but is now under control (Section ii); and greatest losses would appear to be from intestinal parasites although their external counterparts cannot be discounted, as will be discussed later. Imported stock are likely to contract Red Water Fever if not premonised but indigenous stock acquire immunity in their early stages.

CONCLUSIONS AND RECOMMENDATIONS

An account has been given of the various natural and human factors affecting agriculture in the St. Augustine area of Trinidad. We have attempted to bring out the contrast between the two major types of farming i.e. shifting cultivation on the Northern Range, and padi and cane farming in the South; and at the same time to indicate that they are related in many ways as adjacent areas of a small island and require an integrated approach. Many past surveys have gone so far as to make a complete division but we feel our approach to the area as one whole is more appropriate because:-

(i) There is no hard and fast dividing line - in many of the natural factors there is a transitional area approaching the two main areas in size - we refer particularly to soil and vegetation.

(ii) Some problems are correlated e.g. soil erosion on the Northern Range and flooding in the South.

(iii) The whole area presents an opportunity for extending the availability during the year of many crop products because of climatic and topographic variation.
variation.

(iv) Correlated with (iii) is the marketing aspect. The whole area relies on the Eastern Main Road villages to provide market facilities.

(v) Despite the differing cultural and historical backgrounds of the West Indian of the Mountain and East Indian of the lowland, it is to be hoped that eventually these will fuse into one true West Indian race possessing the better practises, ideas and habits desired from all progenitas combined with modern scientific agriculture imperceptibly yet successfully introduced. Thus the peoples should be encouraged to meet one another on all possible occasions and an agricultural basis for discussion should provide an admirable means of promoting friendship and integrity.

In the following paragraphs we attempt to indicate critically the several problems of the area.

(1) Soil Erosion and Conservation in the Northern Range:

Immediate action is necessary to attempt to seal up the gullies already formed and to prevent others from developing. It is suggested that this be carried out by placing cross bunds in the gullies, splash plates at their outfalls and by inducing some form of vegetation to grow over them. Kudzu may prove useful. Again gardens must be separated by uncleared strips, tree felling must be on the contour and all bush debris must be kept in contour windrows.

From a long term point of view it has been suggested that cultivation of temporary crops above the 500' contour level should be prevented, and orchard crop planting encouraged. This is of course the ideal solution but we have indicated the problem of food supplies for an ever increasing population; a population which is expected to double itself within the next/
next forty years (16) and with increased mechanisation on the sugar estates will eventually produce acute food shortage and unemployment. It is under conditions such as these that we will see the people turn once more to agriculture and we will have an ever increasing clamour for land, that can only be satisfied by the land in the northern Range. The whole problem of erosion is an ever increasing one and it is only the relatively low erodability' of the soils in this area that has prevented complete catastrophe but the time has come for positive action before it really is too late.

That some form of land planning will be necessary is fairly obvious; it cannot be too drastic and it is felt that here is a case for the use of all the weapons of a conservation engineer. Degree of slope is more important than actual contour level, and judicious planning on this basis may allow more land for temporary cultivation, and it should be possible to utilize more of the land for the production of fodder grasses leading to an active animal husbandry industry on the hills, thus increasing the supplies of badly needed animal protein. The College is to be commended in starting an investigation in the practicability of a sheep industry in Trinidad, since this is the type of stock most liable to help in an integrated animal husbandry - grassland - soil conservation programme.

(2) Soil infertility in the gardens of the Southern area

The basis of this has been indicated in the section on Soil Productivity and the outstanding nutrient deficiencies are known; but a more detailed soil survey of an "ad hoc" nature, with particular reference to the ecology of the crops grown, is required, to enable allocations of fertilisers and their use encouraged by appropriate extension methods to aid increases in production per acre and per man year to help feed an ever increasing population.

(3) Irrigation/
(3) Irrigation difficulties in the Rice Lands.

We have indicated the scope of this problem and the suggested remedy in the hands of the P.W.D. The matter demands the utmost priority, with a view not only to improving rice cultivation but also to providing small quantities for dry season cropping.

(4) Land Tenure:

Freehold tenure in the area (the St. Augustine estate and the land enclosed by the Santa Margarita Circular Road) has led to appalling land degradation, some subdivision and fragmentation with the result that many of the holdings are of totally uneconomic size.

The prevailing type of leasehold has much the same effect since security of tenure depends on the goodwill of the landlord and there is no compensation for improvements.

It is suggested that freehold be abolished and the type of lease changed. Under the new lease:

(i) The landlord should be responsible for all measures affecting more than one holding e.g. soil conservation measures, roads, and water supplies.

(ii) There must be security of tenure effected by a long lease (e.g. 21 years) with opportunity for renewal after say 11 years of the first lease has elapsed if the occupation has been beneficial and the rules of good husbandry observed. This would give security for at least 10 years.

(iii) The tenant should be entitled to compensation for unexhausted improvements when he leaves the holding.

(iv) The tenant should be responsible for depreciation of the holding on quitting.

(v) The tenant should not be entitled to sub-let or engage in any speculative practice.
This would mean a revolution in Trinidad agriculture and involve terrific capital expenditure. In the survey area the Government would have to buy the whole of the hill district, as has been vaguely recommended by several demi-official bodies in the past. It is impossible to deal here with the factors involved in Government Land Settlement Schemes that any such schemes in the area would involve further survey, fuller investigation and adequate demonstration. In the South the St. Augustine Estate would benefit immeasurably from a Government landlord, and legislative measures must be adopted to force the landlords of the Streatham Lodge Estate to bear their fair share of the responsibility or be liable to eviction as in England under the 1947 Agriculture Act.

The importance of these reforms cannot be overstressed as essential forerunners of any improvement in agriculture and they are intimately bound up with soil conservation in that such measures if they are to be successful must be applied over a large conservation unit. The largest of the peasant holdings found in Trinidad are too small and thus some form of group action is required, best obtained through the Government or the landlord who should apply the conservation measures and proportionately raise the rent. To achieve the ideal a drastic reform in land tenure is indicated as outlined above.

(5) Sugar Cane Yields:

These are low and again a study of crop ecology would be of immense value. The estates are able to carry out their own research work but it should be the concern of the Department of Agriculture to study the methods of betterment of peasant crops; sugar cane in this instance. It is felt that varieties are not the limiting factor but that the fullest possible use is not being made of fertilisers. It requires very localised investigation and experimentation.
and experimentation to deduce the correct treatment for cane especially on the variable soil types found in the Southern area; and again it will have to be established once and for all whether or not cane is an economical crop for the peasant.

(6) Credit:

Adequate credit will be an essential factor in future agricultural development. There must be a popular substitute for the private money lender, and a curbing of the peasant's tendency to put large sums of money to non-productive purposes e.g. wedding feasts. Credit Societies must be encouraged to facilitate loans from the Agricultural Bank. These Societies can be made use of to stimulate group thought which should lead to group action and progress.

(7) Diet and Health:

We are primarily concerned with health as a factor influenced by diet. Increased milk production and consumption will help to alleviate those deficiencies ascertained by the Nutrition Committee in 1939 to the effect that "ill health and disease subject to malnutrition is widespread and that the main cause is a lack of fresh milk, milk products, animal proteins and fats". (17) It also reports a lack of Vitamins A and C which might be corrected by the control of Papaw Mosaic (5), and the growth of more fresh vegetables in the rice area in the dry season, especially if irrigation water were provided.

(8) Praedial Larceny:

This is a problem common to the whole area for varying reasons but mainly because most peasants do not live on their holdings, and the Government seems either disinterested or incapable of producing a solution. It is important not only as an effect of, but also as a partial cause of cropping higher/
higher up the slopes, and the severe restriction of dry season cropping on the rice land. Patrolling the areas is almost out of the question and it is feared that appeals to peoples' honesty would have little effect, thus offenders once caught should be heavily punished and the crime and punishment widely publicised in order to deter as many would be offenders as possible.

Livestock:

Dairy Cattle — "Unscientific feeding and management are the chief causes of degeneration, not climate and it is essential that the ryot should be brought to understand that it is economically unsound to feed his cattle mainly on such inadequate foodstuffs as rice straw and over-ripe grass, and that it pays much better to introduce good fodder crops, particularly legumes into his rotation, than to devote the whole of his land to the production of grain crops". (18) If "peasant" were substituted for "ryot" this quote from St. Arthur Culver might well apply to our survey area. Hammond associated the degenerative changes he saw in European breeds with poor feeding particularly a lack of concentrates and protein combined with too much roughage. He also noted that the Zebu type animal seems to have a more abstractive stomach, better capable of dealing with the usual unbalanced diet. (19) Energy expended in digestive processes, however, cannot be utilised in milk production and thus scientific feeding is just as important for the Zebu as for the European breeds. If we are not to put too great a strain on the cow under tropical conditions improvements in feeding must proceed hand in hand with improvements in breeding. The latter are in the hands of the Stock Farm; a great responsibility, but one which must be met with a set policy, fully proven under peasant conditions to win the confidence of the people; on no account, however, should the peasant be used in the/
in the experimental stage. One would like to advocate compulsory castration of all male calves but if proven sires of a desirable type were readily available, with service fees waived at first and introduced later when the peasant will probably be very willing and able to pay, then any legislation of this undesirable nature will be unnecessary. On the feeding side Paterson has worked on the relative values, height of cutting and grazing qualities of suitable fodder grasses for Trinidad conditions and the peasant must be persuaded that there is a place for one or more of these on his holding (20) e.g. Elephant grass: Guatamala grass: Uba Cane with possibly a suitable legume - Indigophera: Indephyla: Tropical Kudzu. The great shortage of land in the area cries out for a silage policy and conservation of wet season fodder for the dry season, e.g. in a simple pit silo. The College must play its part by many more feeding and digestibility not only on forage crops but also on the available concentrates as for instance the locally produced coconut meal.

PART II: External Parasites of Cattle with particular reference to Boophilus annulatus.

During the course of our preliminary survey of the St. Augustine area we discovered what appeared to be a fairly high tick infestation on dairy cows belonging to peasant farmers. Therefore, partly as a means of determining if this was indeed the case, and also as an illustration of the technique of proceeding from the general to the particular, we have attempted an 'ad hoc' survey into the importance of external parasites of cattle in the area.

While examining cattle for signs of infestation we were afforded an excellent opportunity of making observations regarding the importance, types, management and feeding of these animals. Our conclusions on these points/
points have been dealt with in Part I and this section will deal with the methods of survey, a description of types of parasites found, an account of the factors involved in tick infestation, together with a summary based partly on our own observations and partly on observations gleaned from the Government Stock Farm.

**METHOD OF SURVEY:**

Our procedure has been to visit cattle owners, to examine their cattle and stalls, and to obtain from them verbally and by inspection such information as was possible on the factors affecting external parasite infestation and any control measures in use. In this way we were able to obtain a fair picture and sample of the cattle within the area—not a random sample it must be admitted and not necessarily truly representative but at least some indication of present trends of external parasite infestation.

Specimens were collected and identified with the help of Mr. J. L. Gregory, Colonial Office Probationer in Entomology at I.C.T.A. We also contacted the medium size dairies in the area and the Government Stock Farm where Mr. A. P. Macwilliam Agricultural Officer in charge was very helpful.

An attempt has been made to review the literature of ticks only because, as we shall point out later, this class turned out to be the most important external parasite. The problem of parasites as disease vectors will be touched upon, mainly from the aspect of anaplasmosis and piroplasmosis as being tick borne diseases, and the possible repercussions from the use of the more recent control measures.

Finally we shall suggest the nature of a simple trial to be carried out locally in connection with our conclusions and recommendations.
TYPES OF EXTERNAL PARASITES FOUND IN THE AREA.

Ticks: The only species found was the cattle tick, Boophilus annulatus (Say.).

A member of the Ixodidae, this is a one-host tick and a continuous feeder.

Its life history may be briefly described as follows: The eggs are laid on pasture land or on stall litter and reach the larval stage in 6 -10 days according to climatic conditions. The seed ticks remain on the vegetation until the passage of an animal allows them to affix themselves to the hairs of the legs. After a preliminary search the seed tick settles to feed usually on the less exposed parts of the body e.g. beneath the tail, on the escutcheon, in the ears etc. The adult stage is reached after two month's feeding, when the females are already fertilised and becoming engorged eventually fall off the animal and deposit their eggs in the ground. The whole life cycle takes approximately 60 days and one female can produce from 2 -18,000 eggs.

Of 84 cattle examined on peasant holdings, 56 were infested, 6 showed scars from some previous infestation, 5 had a few scattered ticks, 10 had one localised group, 1 had more than one localised infestation, and 6 cattle were really badly infested.

Our standards of observation have been as accurate and constant as a judgment by eye can be, but there was insufficient time to take detailed counts of numbers of ticks per cow and we were unable to revisit the cattle at later dates: Thus seasonal observations are limited to the cattle owners personal opinions. Admissions of previous infestations were not freely given but the presence of old scars often gave the necessary evidence.

Bats: Considerable deaths among the cattle population from 1925 onwards were proved.
were proved by Captain Ketivier to have been caused by bat carried
paralytic rabies. 413 cases were reported in 1931 and in 1932 a committee
was set up and formulated the following programme of work:

1) Vaccination on an extensive scale (peasants' cattle to be inoculated
free of charge, but estates to be charged).

2) Research into the transmission of the disease.

3) Study of Bats.

4) Recording of deaths.

The disease appeared more prevalent in the wet season.

In 1933 it was proposed to inoculate all cattle in the Colony and to
continue the programme for 3 years. The inoculum then in use was the local
virus attenuated with 33 1/3% brain emulsion (Helse's method).

The frequency and intensity of the inoculation were increased in 1935
following extensive work on the disease in Brazil. Successful auxiliary
control was achieved by painting biting sites on the cattle with strychnine.
By this time, however, the disease had decreased in intensity as a result
of a migration to the North of Trinidad where the cattle population is less.
The Bat Investigation Committee set up bat units to attack the bat
population by poisoning and shooting. The question was raised as to the
possibility of a regular invasion of Desmodus bats from the South American
mainland and investigation proceeded.

217 cases were reported in 1936, the lowest incidence since 1929, and
by 1937 only 57 cases came to official notice. The inoculum now used was
carbolised brain (30%) vaccine; and shooting, trapping and poisoning were
very successful. It was discovered that Desmodus bats having recovered
from "Jurious" rabies become carriers for a long time.

Although/
Although in 1938 infected bats were still widespread there were only 2 deaths from the disease and in 1940 the Island appeared free from the disease. All the bats destroyed and examined in 1941 shewed a complete absence of negri bodies. The disease reappeared in 1944 when 73 cases were reported but since that year the mobile bat units have stamped out the disease and the availability of a successful vaccine precludes the possibility of widespread attacks of paralytic rabies in the future.(15)

The success of the campaign outlined above emphasises the efficiency of the Trinidad Veterinary Department but we must not forget that its task with the aid of the "magic needle" is much easier and tends to achieve more spectacular results than that of the Department of Agriculture.

During the course of our survey we came across three cases of bats biting cattle and also found that some cattle owners keep a light in their byres at night to scare the bats away. Apart from the danger of disease the bite seems to excite the cow with a consequent loss of milk yield.

Lice: In only one case did we find a serious infestation with lice, in a small dairy in Curepe and we regard them as unimportant and their absence as a direct reflection of the overall cleanliness of the peasants' cattle.

Blood Sucking Diptera: Various species of Anophales and Stomoxys were observed in and around cattle standings but in no case did they appear to worry unduly the animals. We shall not consider them further.

We have deduced from our observations that the most important external parasite is the cattle tick Boophilus annulatus and it now remains to determine the factors affecting its incidence.

**FACTORS AFFECTING THE INCIDENCE OF TICKS**

(1) Natural Factors
   (a) Proportion of Bos indicus to Bos taurus blood.
   (b) Seasonal effects/
(b) Seasonal effects.

(c) Age of the animals.

(d) Tick Birds and Hens.

(a) Bos indicus would seem to have an inborn resistance to tick infestation occasioned by the shorter hair of the coat which does not aid the journey of the tick from the ground to its feeding place. Observations on this point are singularly lacking in the West Indies but in Northern Australia "Some observations were made on tick repellance of zebu x European crossbred and European animals. It was observed that, although a small number of halfbreds may be relatively susceptible, most half and threequarter zebus harbour few ticks and seldom, if ever, show tick worry. The repellance of ticks appears closely linked with the length and character of the coat. When the coat was of the long haired British type, tick infestation occurred, and tick worry resulted in some animals. However, tick worry was not as pronounced in animals carrying quarter zebu blood as it was in British-bred cattle under the same conditions. Animals carrying three-eighths zebu blood seldom exhibited tick worry" (21) "we, ourselves, have observed that at one medium sized dairy nearly all the cattle had at one time been tick infested and these cattle were three-quarter or higher grade Friesian stock, whereas the Narrab Water Buffaloes employed at a sugar factory for haulage and also working oxen belonging to peasant contractor showed no signs at all of ever having been infested.

(b) Seasonal effects - according to statements from the cattle owners the greatest infestations occur at the end of the wet season, during which the cattle have been cut periodically to pasture. We are unable to confirm or refute this opinion since all our observations were, perforce, made during the dry season. It was noted, however, that even in this season those/
those animals which were tethered outside for long periods showed much greater tick infestation than stall fed cattle. In connection with this latter point the danger of infestation from carted forage must not be overlooked, as emphasised in the 1933 Veterinary Report which records an outbreak of piraplasmosis in the Fort-of-Spain Dairy, where the cattle had been reared in a paved yard and had never been naturally immunised as calves, but fodder from an infected pasture was fed and 60% of the herd died. (22)

(c) Age of animal - calves usually possess longer coats and softer skins than their elders. The following table would seem to indicate the probability that cattle are tick infested when very young, as the proportion of animals so affected does not increase with age as would be expected if there were later infestations. This should be further investigated by observations on animals of one age group throughout their life history.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>0 - 1 yrs.</th>
<th>1 - 3 yrs.</th>
<th>over 3 yrs.</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>No infestation</td>
<td>13</td>
<td>6</td>
<td>37</td>
<td>56</td>
</tr>
<tr>
<td>Light Infestation</td>
<td>4</td>
<td>3</td>
<td>14</td>
<td>21</td>
</tr>
<tr>
<td>Heavy Infestation</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Total Cattle</td>
<td>20</td>
<td>9</td>
<td>55</td>
<td>84</td>
</tr>
</tbody>
</table>

This factor of early infestation has a direct bearing on the development of resistance to anaplasmosis and piraplasmosis, both tick borne diseases, which are acquired in slight doses while the animals are young with resulting natural active immunity. In turn this again raises a very serious problem, in that if we are to rid of ticks the animal population of an area/
of an area we may lay ourselves open to sporadic outbreaks of the diseases if at any time control measures are relaxed, comparable with the outbreaks occurring in imported cattle. The problem is magnified when we consider the difficulties of complete control measures in a scattered peasant cattle population. Great difficulties in this line arose in Kenya recently when "Gammexane" was introduced and used instead of the proprietary arsenic dip by some cattle owners with little success, at least under local conditions, and outbreaks of the diseases became more frequent. (23)

(d) Tick Birds and Hens - Cattle owners maintain that ticks are removed from cattle by both the domestic hen and the tick bird but we have not observed this. That these birds will pick up hatching ticks from cowpen floors is to be expected and would effect some control, but whether they will remove them from the animal requires to be ascertained by further investigation. Indeed, the effect cannot be greatly different from handpicking as discussed below and the hens probably derive more benefit than the cow by increased protein supply.

(2) Human Factors:

(a) Direct control measures used by peasants.

(i) Bathing (ii) Hand picking.

(b) Indirect control measures.

(i) Stall hygiene (ii) Pasture

(c) Size of herd.

(a) Bathing - The frequency varies from once per day to once per week; 'Joyes Fluid', a carbolic disinfectant is sometimes incorporated in the wash.
The usual procedure is to use cold water applied by cloth to cloth with unfortunate results due to the dislocation of ticks which may give rise to septic sores or the spreading of the infection from cow to cow as in the udder cloth spread of mastitis.

This bathing is not always performed directly against ticks but is part of the normal Hindu care of his cow and if ticks are prevalent some form of disinfectant is added to the water. Some peasants in the Streatham Lodge district complain of the water shortage in the dry season which prevents them from bathing their cows as much as they wish. The shortage complained of, is mainly due to the long distances that water must be carried from the stand pipes which are too far apart.

One local dairy of some 10 cows employed a hose pipe in washing down the cows each morning in association with a hand brush and we were unable to find any sign of tick infestation and the herdsman attributed this to the frequent and regular washing.

The use of proprietary dips such as Cooper's Cattle Spray, an arsenical preparation with proven efficiency in many countries, is surprisingly common but its use seems to be governed by the availability of supplies. Peasants do follow the instructions on the containers regarding the concentrations to be used but continue the application long after the disappearance of the offending ticks, some tending to use the spray each week as part of their normal procedure. Such a procedure appears both unnecessary and wasteful.

Mechanical removal - frequently cattle owners remove visible ticks by hand but this practice is not to be commended because inevitably the mouthparts and frequently the head are left embedded in the tissue leading to ulceration.
to ulceration and the production of scars as already noted. Again hand-picking alone cannot be effective because the small "seed ticks" are almost invisible and can only be controlled by an effective spraying method.

(b) Stall Hygiene - The cleanliness of the staddings has been stressed above in connection with clean milk production but it must also be made clear that the presence of filth is just the encouragement that the external parasite including ticks, need to cause disturbance and possibly disease in the herd. It was often noted that although the peasant found great pride in his animals' personal hygiene he appeared to ignore odd heaps of dung around his byre; one resultant evil of the separation of the house from the holding.

Pasture - To the peasant this invariably means the scrub vegetation along the roads and traces and it was very obvious that tick infestation was greater on animals which were regularly tethered in the open. The cattle are turned out wherever suitable growth of the vegetation occurs, a practice which gives little opportunity for rest, said to be the only palliative for pasture infestation (14) Stall fed cattle, however, are not immune to infestation from vegetation in that many "seed" ticks are transported to the byre in the rough fodder collected from river and road side.

(c) Size of Herd - The following table would appear to indicate that the tick infestation in intermediate sized herds is heavier than in either small or fairly large herds. The explanation probably lies on one hand in the greater personal pride of the small cowkeeper in his small herd, and on the other in the fact that the 9 - 12 class man is either a fulltime cowman or employs a substitute, whereas the 5 - 6 class man tends to miss the happy mean between crop and stock with a consequent neglect of both enterpris...


CONCLUSIONS AND RECOMMENDATIONS

Throughout the Tropics the incidence of ticks is usually associated with the problem of disease, notably the tick borne diseases anaplasmosis and piraplasmosis. Trinidad, however, appears singularly free from these ravages, piraplasmosis occurring only in isolated outbreaks among imported cattle and there is no evidence of anaplasmosis outbreaks in the Veterinary Reports. This absence of the disease factor leaves us with two problems to face.

(1) At present we must regard the tick as disturbance factors in the normal routine of the cow.

(2) In the future we must decide whether or not the widespread use of dips or sprays will increase the incidence of tick borne diseases in that it will no longer be possible for animals to acquire immunity in calfhood.

To guard against this the Island would have to be kept scrupulously free from ticks, which should not be difficult in a well demarcated territory such as Trinidad. Thus we suggest that certain methods of control when proved should be introduced to the peasant. Disease may not show in clinical...
clinical form but nevertheless sub-clinical effects may be reducing the vitality and productive capacity of the cattle. Again the importation of Burus stock to a tick free island would be simplified.

From personal observation the disturbance factor appears very important and we deem it a very worthwhile object to attempt to remove one limiting factor in conditions which are not very conducive to milk production.

Tentative recommendations for tick control, under present conditions cannot be discussed without some reference to the work done at the Government Stock Farms. Prior to 1943 an arsenic spray at 1 to 21 day intervals was applied via the "chute" and gave a fairly good kill (28). The method had, however, certain disadvantages

1) Cattle disturbed
2) Poisonous
3) Skin troubles possible.

Germane was used after 1943, being applied at milking time at a strength of 1 lb. to 40 gallons water. The advantages claimed are:

1) Only selected cattle need be treated.
2) Little disturbance.
3) Dusted material non-poisonous.
4) "Run-off" effective in keeping drains and sewers free from flies etc.

P. Macmillan, the Officer in charge, believes that the Government policy should be to encourage this semi-bathing method with an effective dip such as germane. The advantages stressed were:

1) There is no need for capital outlay, the peasant can easily afford the materials.
2) Damage due to knocking off half fed ticks may be discounted as a very
as a very overrated problem in well kept cattle and is a problem discounted
by (1) and (3).

(3) readily demonstrated by many extension methods and may be a
useful means of establishing lasting personal contact.

Before extension is attempted, however, we suggest that certain trials
should be carried out to ascertain the importance of the newer control
measures and may well involve such "treatments" as

(1) Robu v Grade animals.
(2) Water bathing v "hip" bathing.
(3) Arsenic v Cassanexene Dips.
(4) Cassanexene v D.D.T.

In connection with the last treatment it will be interesting to
discover whether the indication noted in the Veterinary Bulletin (1940-46)
vis. that D.D.T. has greater persistence but not such an instantaneous "kill"
de Cassanexene, is substantiated under local conditions.
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