INVESTIGATION OF THE RUBBER INDUSTRY IN PAPUA AND NEW GUINEA—II

C. E. T. MANN

(Director of the Rubber Research Institute of Malaya)

PART VII.

Processing of the Crop.

(*a*) *Smoked Sheet.*—

At the time of this survey all plantations visited were processing their crop as smoked sheet. During the war years there had been a temporary market in Australia for preserved latex and field latex, preserved with ammonia, had been exported in drums. This business had been discontinued with the reappearance on the market of preserved concentrated latex from other producing countries.

Most of the larger plantations have, since the war, installed modern factory equipment, using standard aluminium coagulating tanks of 200 gallons working capacity, equal to three hundred pounds of dry rubber per tank, and various types of " line-ahead " sheeting batteries. The smaller properties were still using the older type, side-by-side individual rolls and markers, and it is doubtful whether it would pay them to install modern batteries for the manufacture of their relatively small outputs, the simple equipment is quite capable of turning out a first quality product. Some smaller estates were sending their latex to their larger neighbours for processing.

The sheeting batteries seen included the Huttenbach (Malaya), " H. & C." Continuous Sheeting Battery (Malaya), the New Guthrie " Cadet " (Malaya), the prototype " Guthrie Cadet " (manufactured under licence in Ceylon), and the Hore " Cascade" Battery (Ceylon). Except for the last named, all were giving satisfactory service and turning out a very good sheet, the " Cascade " battery was everywhere giving trouble—in principle the battery has good points, in operation it fails to stand up to hard work. Although the modern sheeting batteries in use are capable of turning out a continuous sheet, when operated with coagulating tanks designed to provide a continuous coagulum, none were being used in this fashion, and it is doubtful whether this refinement would prove economical on any of the properties visited. A maximum crop of 4,000 lb. dry rubber per day takes from two to three hours to machine in a modern battery when passed through as single sheets, only a small saving in labour is likely to result from continuous sheeting and cutting on delivery from the marking rolls. Furthermore, in Papua modernization of processing appears to have stopped short at the wet sheet stage. The standard size tank sheet, after passing through the markers, is cut into three or four equal sections, several sheets being cut at once, and the separate sections, sometimes after preliminary dripping, but often without, are man-handled to the smokehouse and arranged on the loose rods (in Malaya " beroties ") on fixed racks. There appears to be greater scope for economy in labour and increased efficiency in this phase of processing than in further refinement within the factory. The principle of a smooth transfer with minimum handling from delivery of the machined coagulum from the markers through the stages of preliminary surface draining and drying under shade, sheets being handled once only from the cutting table to the drying racks mounted on bogies, transfer on trolley line to, and progressively through, a tunnel type smokehouse, thence to the

---

(This is the concluding section of Mr. Mann's detailed report on the Rubber Industry in the Territory. The first section of the report was published in Vol. 8, No. 2, October, 1953.)

sorting and baling room should receive further attention. Two plantations were visited on which this flow line had been established. On the first, a disastrous fire in the early stages of operation of the tunnel type smokehouse had discouraged further development; on the second, the original installation was too small to deal with an increasing daily crop and had been abandoned. It may be that the complete installation presents difficulties in smooth working by the local factory labour that have not been encountered in Malaya, where similar installations are in general operation. It would be worthwhile to make further trials on these lines for it is certain that costs of processing could be reduced, and the quality of the final product improved. The present situation of a high level of efficiency within the factory, with an abrupt change to low efficiency in the second half of the processing line, is not satisfactory.

Curing at present is carried out almost universally in primitive design "Devon" type smokehouses. Sheets handled singly are hung on fixed racks in an upper chamber above a lower firing chamber, often with open fires under metal baffles. Though simple and cheap to build, and reasonably safe in service, given a reliable fireman, this type of installation leaves a wide margin for improvement in efficiency, economy in operation, and in the quality of the product turned out. On one estate a smokehouse of more modern design, but based on the Devon principle, with greatly improved firing arrangements, was turning out first class sheet after five days smoking, but this was exceptional, the smoking time varied from ten to twenty days on most plantations visited. Much heat wastage occurs during charging a large smokehouse of this old design. Fires have to be reduced and the house kept open for several hours daily to receive fresh sheet, thereby increasing the dangers of developing "mould" and "rust" and most other defects known in smoked sheet, with resulting downgrading of the final product.

(*b*) *Treatment of Scrap.*—

Satisfactory treatment and disposal of scrap rubber has always been a problem for Papuan plantations. During low price periods it has not been found economical even to collect scrap, yet valuable market grades of crepe are prepared from scrap in other producing territories. The difficulty appears to lie chiefly in the high cost of a suitable installation for treatment of scrap rubber. Taking for example a large plantation with an annual output of one million pounds finished smoked sheet, reckoning maximum scrap at twelve per cent. of total production, the output of creped lower grades could be about one hundred and twenty thousand pounds per year. It is estimated that a minimum installation for the preparation of a standard market grade of crepe, made from cut scrap, cut lumps and factory scraps, would consist of a battery of creping rolls, comprising three pairs of rolls twenty-four inches wide by twelve inches in diameter, powered by a forty horse-power Diesel motor. Such a battery would turn out about one hundred and fifty pounds per hour of machined crepe, fourteen inches wide. Working time would be about three hours per day to deal with all scrap. A rough estimate of the cost of this equipment, including installation charges based on Malayan current prices, would be approximately £6,000 (Australian). An additional drying house, unheated, capable of drying thin crepe in ten to fourteen days, would also be required, estimated cost £450 to £500.

At the time of this survey there was a fair market for clean unmilled scrap, and some estates were cleaning and smoking scrap and packing in hessian-wrapped bales for shipment. A few consignments of untreated scrap had been sold to Singapore millers at a reasonable price. On three plantations visited attempts to make a saleable crepe from scrap were seen. In all cases the creping rolls in use were too light in construction, roll speeds too rapid and power insufficient to mill this difficult material into thin crepe. Drying time for the coarse crepes produced was too long to give a clean finished material likely to be acceptable to buyers who are accustomed to purchase standard market grades of crepe.

(c) *Grading of Smoked Sheet Rubber.*—

The quality of the product as judged by accepted Singapore standards of visual grading for the market, was somewhat variable. The industry in Papua appeared to recognize two grades only of smoked sheet, R.S.S.1 and R.S.S.2, and the standard of discrimination between No. 1 and No. 2 varied from plantation to plantation. Some claimed as much as ninety-five per cent. of their output, excluding scrap, as No. 1 R.S.S., others were content with seventy per cent. No. 1 and thirty per cent. No. 2. In effect, most producers were not deeply concerned about the accuracy of their grading because in accordance with the current system of marketing, they received the standard market price of No. 2 R.S.S. for their entire output. Some estates were taking great care to grade their product, using small standard market type samples supplied through the Planters' Association, and were packing a No. 1 R.S.S. sheet equal to the best on the market. On other estates grading was sketchy in the extreme ; any sheet that was not at first glance obviously dirty or blemished was packed as No. 1 ; the balance automatically becoming No. 2. Some sheet was being passed as R.S.S. No. 2 that would have been graded No. 3, or even lower, on the Singapore market. The principal reasons for this apparent indifference to correct market grading appear to be two-fold. First the relative isolation of estates makes the operation of a central packing and grading system probably too expensive in transport and handling charges (besides being a most difficult job to operate with satisfaction to everyone), consequently each estate has gradually developed its own individual standard of grading. In the second place, the product is sold almost entirely on the Australian market through the " Papua Pool ", and as the best price (at the time of this survey) was the Singapore mid-month R.S.S.2 sheet price, there was no great incentive to be too selective in grading.

(d) *Baling.*—

" Bareback " bales of one hundred pounds net weight is the rule. The custom of packing in one hundred pound bales appears to have grown up with the industry, this small bale representing a convenient pack for man-handling, as compared with the two hundred and forty pounds bale customary on Eastern markets. Many estates used a battery of hand presses for baling ; on one estate a modern oil-hydraulic press was turning out beautifully pressed and uniform bales, on others baling by hand without pressing was the custom. Bale painting, with a talc dressing, capable of taking clear marks and preventing massing in shipment was seldom seen. In this particular, the absence of any strong incentive to improve presentation was evident. The customary shipping conditions allow seventeen bales (regardless of shape) to the cubic ton, and the freight charge Port Moresby-Sydney was ninety shillings per ton. It would not be unreasonable to ship twenty-two bales to the ton if bales were well pressed and consolidated for shipment.

Part VIII.

Notes on the Principal Planting Districts in Papua.

(i) *Coastal Districts.*—

Within this region are included plantations established on the flood plains and lowland river valleys of the south-east and south-west coastal belt of Papua, the most extensive development having taken place in the Galley Reach area about fifty miles to the west and about five hours by sea from Port Moresby. Detailed observations were made only in this district, but it would appear that terrain and soil characteristics of the Galley Reach area are fairly representative. The major difference between the Galley Reach and Kemp Welch areas and other coastal areas to the east and north-west lies in distribution of rainfall. The mean annual rainfall in the Kanosia and Kemp Welch areas is about sixty inches, to the east the level increases from about eighty inches at Abau to one hundred inches at Samarai and Milne Bay; to the north-west through Kerema with one hundred and forty inches, rainfall increases to Kikori with over two hundred inches annually.

The Kanosia group of plantations lies in a fairly broad alluvial flood valley which extends up the lower slopes of foothills to south and north and drains into streams flowing in the western main arm of Galley Reach. The area is bounded on the south by a typical eucalypt zone on the coastal scarp in the shadow rain belt. Rubber has been planted from the edge of the eucalypt belt on the south, across the valley and up to about five hundred feet on the foothills to the north and west.

Soils in the main valley flats are generally grey alluvial clays, sometimes sandy in texture. At the lowest levels there occurs a curiously compacted subsoil, locally described as " soapstone ", frequently exposed at varying depths along the stream beds. The level of this impermeable layer varies considerably. Where it approaches the surface, drainage is difficult, tree growth is poor, and losses from wind-throw due to shallow rooting are occasionally severe. To the north and west, fanning out from steep valleys between the foothills, are areas of fertile river alluvium consisting of deep yellow to chocolate loams. Rubber on these areas showed excellent growth, with yields at the six hundred pounds per acre level.

On the slopes to the south, bordering on the eucalypt belt, the soils were generally light coloured, sandy loams of good texture but apparently low fertility. Rubber tree development on these slopes was at best only moderate and yields generally low. In the absence of analytical data it is difficult to decide whether poor performance is due principally to soil conditions or to inadequate rainfall, but it seems probable that rainfall is a most important factor. Although the average annual rainfall of the district is stated to be between sixty and seventy inches, local distribution is variable and the range within comparatively short distances may be marked. For example, on one estate, rainfall recorded at a point near the south boundary was some twenty inches less per year than that recorded at a second point about two miles away, near the northern boundary close to the Ranudoka River.

On the rising slopes towards the north soils change in texture, and appear to increase in fertility, from the heavy alluvial clays through deep yellow clay-loams with occasional sandstone outcrops. At slightly higher levels the soil changes again to a medium gravelly, grey-brown sandy loam overlying a stony conglomerate. Rubber on all these soils shows fairly good growth and satisfactory yields for ordinary unselected seedlings. On reaching the crest of the northern slopes are a series of small plateaux broken up by valleys which drain into streams to the north. Again an abrupt soil change was noticed. In one area examined the soil was a deep red-brown clay loam very similar to the basaltic loams of the Sogeri District. A planting on the soil at Moyale, about 100 acres of seedling rubber twelve to fifteen years old, was outstanding, probably the best for age seen in the entire survey of the Territory.

Throughout the district the major part of the older planted area is on the alluvial clay flats. Most of the areas are over forty years old and yields are down to the two hundred and fifty pounds per acre level, and even lower. Of the younger areas, planted since 1917, the major parts are on rising ground on soils of different type from the oldest plantings. Yields are at the four hundred and fifty pounds per acre level, and the best areas are recorded as yielding from five hundred to six hundred pounds per acre. At first sight it may seem that the rising land is capable of better production than the alluvial flat, but this cannot be assumed. A fifty-acre, twelve years old planting on an alluvial flat, alongside old areas yielding not more than three hundred pounds per acre, was producing over five hundred pounds per acre per year despite the fact that the presence of the impermeable clay subsoil, already mentioned, was much in evidence in the younger planting.

Structurally, trees in the oldest plantings show that they have made very satisfactory growth in the past; the present low yields could be attributed to the initial low stand, loss of trees and poor bark renewal due to loss of vigour with age—they do not necessarily indicate poor soil conditions. It is very probable that most of these old rubber areas on the flats could be successfully replanted with improved high-yielding material. There is little evidence of serious trouble from disease; mouldy rot is much less in evidence than in other districts of higher rainfall.

A short visit was paid to the Mariboi River area which occupies the main valley running inland from the eastern arm of Galley Reach. Approximately four thousand acres have been planted in this valley, a small part on alluvial river flats very similar to those in the Kanosia area, but the greater proportion on undulating to steep land rising to nearly one thousand feet, on both sides of the valley. Some two thousand five hundred acres consists of young plantings made from 1938 onwards. Soil conditions and types of soil are very similar to those on the north-western slopes of the Kanosia area, and growth of the rubber is generally good. Part of this area provided, incidentally, a striking example of the damage that can be done, and the difficult and expensive work required to correct it in later years, when young areas fail to receive adequate attention in the first two critical years from planting. An area planted in March-April, 1945, had virtually to be abandoned for two years from October, 1945, owing to shortage of labour. Gradually a new labour force has been built up and reclamation work has been undertaken, but the effects of the early set-back will always be evident in these areas. The strongest trees that survived the period of enforced neglect have made satisfactory supply planting very difficult, meantime much of the area, owing to the lack of shade, requires constant weeding and upkeep, comparable with that of a new planting, if the total mature stand is to be raised to a fully economic level.

Further observations on plantations in the coastal districts were limited to a general sight from the air of smaller rubber plantings on the south-east coast from Rigo to Samarai. From records provided and from the general impression gained from the brief sight of the rubber and the lie of the land, it would appear that considerable areas as yet undeveloped would grow rubber successfully in this belt. Conditions appear generally comparable with those in the Kanosia-Galley Reach area, with the advantage of a somewhat higher rainfall—around the one hundred inch per annum level—generally most favourable for rubber cultivation.

Further to the west some rubber has been planted in the wet delta region. In view of the fact that large areas of rubber have been successfully established on similar terrain in the west of Malaya, it would have been interesting to see a delta planting; however, it seems most likely that the delta region of Papua, with its rainfall of over two hundred and fifty inches, would prove too wet for Hevea. In Malaya the mean rainfall on comparable terrain seldom exceeds one hundred inches a year.

(ii) *The Sogeri Plateau.*—

This area, lying about thirty miles, by a good road, to the north-west of Port Moresby, between the eucalypt country of the coastal scarp and the foothills of the Owen Stanley Range, has proved one of the most satisfactory areas for rubber cultivation. Though the elevation, approximately fourteen hundred feet running up to nearly two thousand feet, is well above the level usually regarded as best suited to Hevea, the combination of climate and soil in this region have proved favourable. Rainfall at an average of about 110 inches per year, well distributed, is almost ideal, and mature volcanic clay-loam soils, believed to be derived from basaltic and lava flows over a basaltic agglomerate, are among the best in the Territory. Certainly rubber has thrived well and produced well in this district. The main planted areas rise from river flats of varying extent through gently undulating to hill land; the highest planted area seen was just below the two thousand feet contour.

As in the Kanosia area the major part of the entire planting is old mature rubber thirty to forty years of age. Stands in the old rubber are down to sixty tappable trees per acre or less, and it was estimated that about two thousand acres of an approximate total planted acreage of 7,000 acres for the district were not being tapped. Shortage of tappers was the principal reason given for this, but it was clear that uneconomic yields from obsolete trees was also an important consideration. Soil erosion was more in evidence in the Sogeri District than elsewhere. The effects are naturally most evident in the oldest mature areas on hilly land, fortunately since a fair proportion of these are out of tapping and virtually abandoned for the time being, a heavy ground cover of weeds and grasses may check further soil deterioration until replanting on contour can be undertaken.

An incidental observation on erosion in general on the Sogeri plateau was particularly interesting. It appears that rubber planters have been criticized at official level on the deterioration that has followed the cultivation of rubber, deterioration that at all events has been checked in recent years by the general system of maintenance by light slashing of natural or mixed ground covers. But several areas were noted where excellent hill land was being developed by Native owners for the cultivation of short term food crops. No anti-erosion precautions were used, heavy erosion was obviously taking place and there seemed to be no check on the practice of abandoning one ruined and wasted hillside to open another piece of first-class land to share the same fate.

Younger rubber areas planted since 1936 are excellent. Growth generally is up to standard and yields range from five hundred to eight hundred pounds per acre. Considering that none of these plantings have been made with modern high-yielding material, the yields provide some indication of the high potential productive value of the soils in this region. A further indication of the high yield levels that might be reached is provided by two plantings made with selected clonal seedlings of proved origin. Based on tapping and yield recording carried out by the Department of Agriculture before the war, a field of fifty-five acres planted with Tjikadoe clonal seeds in 1928 yielded at the rate of over seventeen hundred pounds dry rubber per acre at maturity. A second small area of five acres planted in 1934 with Prang Besar clonal seeds, similarly tapped and recorded, is reported to have yielded over sixteen hundred pounds per acre in a test year. Though these areas are small they appeared to enjoy no special advantages of situation, soil or treatment, and they provide a fair indication of what might be expected from new plantings with the best modern material in such a district. Without doubt, replanting would yield a handsome return.

As a point of special interest, in younger plantings in the district made with seed collected from trees in the two higher yielding areas mentioned above, though yields are relatively good, they do not approach the level of the areas from which the seed was obtained. " Second generation " seed from a clonal seedling planting inevitably contains a high proportion of seeds from the poorest yielders of the collection, it is only by the progeny of the original clonal parents that the high standard will be maintained.

Apart from " mouldy rot ", treatment of which requires constant vigilance, the district appears to be remarkably free from destructive pests and diseases and serious losses from storm damage are rare.

(iii) (*a*) *The Kokoda-Yodda District.*—

Though relatively a small rubber producing area, the Upper Mambare Valley presented some very interesting features. Survey information available describes this district as containing considerable areas of elevated valley and bench alluvial soils. The Kokoda-Yodda District appears to be made up of a series of plateaux separated by deep ravines cut by tributaries of the Mambare River flowing in from the northern slopes of the Owen Stanleys. The oldest recorded planting is on the Kokoda plateau at an elevation of about eleven hundred feet. Records of a planting of some seventy acres of *Hevea brasiliensis* in 1908 were reported and trees of this planting were seen. Though they have suffered much from maltreatment in the past, some magnificent specimens still remain and are still in production. This area, extended to two hundred and forty acres by subsequent small plantings from 1926-1938, and a new planting of sixty acres in 1944, produced over five hundred pounds per acre in 1951-1952. All planting material has been ordinary unselected or good estate seed.

Other younger areas established on identical soils on neighbouring plateau formations between Kokoda and Yodda were visited. The major plantings of these areas began in 1938 and some eight hundred acres were seen. Conditions were excellent, growth good by any standards, and yields, again with due consideration of the quality of the original planting material, satisfactory. Possibly due to the relative isolation of this district and obviously satisfactory employer-labour relations, the standard of work was well above the average seen elsewhere. Tapping was good on all young mature rubber, and upkeep generally of a high standard. There appears to be suitable reserve land for further considerable extensions, possibly up to five thousand acres, within the Kokoda-Yodda circle. A brief air survey indicated further promising looking areas both to the east and west of Kokoda.

As in the Sogeri District, an elevation of eleven hundred to fifteen hundred feet would be considered on the high side for rubber, but there is no doubt that any disadvantages of elevation are offset by other natural advantages in this area.

Rainfall is a little on the heavy side at one hundred and fifty inches a year, and mouldy rot is generally in evidence. Also in this area several cases of a destructive root disease (not identified), were seen. In younger areas there has been a moderate incidence of " white root rot " caused by *Fomes lignosus*. Rubber in this district has also suffered more than in most from storm damage, the effects of which might perhaps be offset by denser initial planting on an avenue system, in preference to square planting that has been the general rule up till now.

An observation of particular interest made in this district in course of an air survey, was the existence of small mature areas of rubber, Native planted and owned, to the east of Kokoda following the lower slopes of the valley towards Sangara and Mount Lamington. These areas were reported to have been planted by Natives under a planting Ordinance about 1920. Further reference is made to similar plantings of the same period in the next section. It seems likely that the seedlings for these plantings came from the original planting of seventy acres made in 1908 at Kokoda in the days when it was a patrol post.

(iii) (*b*) *The Sangara-Awala-Popondetta District.*—

Although it seems to have been convenient to regard rubber developments in the Northern District as a single group, essential differences in terrain, in soils and other local conditions indicate a logical separation.

Survey information provided showed considerable areas of land available for development in the vicinity of Sangara and Awala. A preliminary survey was made by air, followed by as much ground observation as time allowed. The general impression formed was of large areas in this district mainly below the five hundred feet contour, gently undulating to moderately hilly land under a good forest stand, that would be eminently suitable, at least as regards terrain, for the cultivation of rubber. Rainfall is within the one hundred to one hundred and fifty inches annual range, and is well distributed. Although road communications have been temporarily disrupted, there is a good direct road giving access to a port at Cape Killerton.

Soils in this region are described as light pumiceous loams derived from trachytic andesites. They appear to be fairly mature in most parts of the area, with more recent overlays derived from later lava deposits from the activity of the Mount Lamington volcano. The area seen was mainly to the west of Mount Lamington and bounded by the Kumusi River. It includes some thirty thousand acres of state forest land on both sides of the Amboga River.

The Sangara Plantation.—

The Sangara Plantation, of some three thousand acres, developed mainly between 1937 and 1941, is on land said to be fairly representative of the entire area. Rubber has grown normally and yields are well up to standard for age. Though the first impression was of trees below average vigour, it must be remembered that these young plantings suffered from three years neglect during the war period, and since 1945, though better off in this respect than many other estates, there has been shortage of labour. It was stated that since the Mount Lamington eruption there has been a marked improvement in the appearance of the foliage of the rubber trees and in the growth of cover plants. Certainly both were good, the covers especially so in a 1945-planting.

An interesting hedge planting of young rubber, fifty acres planted in 1951, was inspected. Planting was with seedling stumps at sixty feet by five feet, and upkeep was confined to weeding and slashing of grasses along six-feet-wide planting rows, with a minimum amount of slashing of secondary "scrub" regenerating between the rows. If this area were budgrafted with a selection of proved clones, it would provide an extremely valuable source of clonal seeds in the future, as well as becoming a first-class rubber producing area.

Awala District.—

In the Awala District, soil conditions appeared to be very similar to those around Sangara, and rubber was comparable in growth and appearance for age. The writer was fortunate in being able to see a good deal of the district on a sixty-mile tour by road, the tour including visits to several small Native plantings, made in 1920 to 1922. These small, mature plantings, from a few trees to sizeable plots of one to two acres, contained some splendidly developed old trees. There was evidence in a few cases that the original planting had been extended subsequently; in most of the plantings seen there was a dense undergrowth of self-sown rubber seedlings, and on the edges many of these seedlings had developed into well-grown tappable trees. That conditions are favourable for the cultivation of Hevea in this district, observations made on these small Native plantings provide full confirmation. Despite neglect and lack of sustained interest in their development, these small plantings scattered throughout the district amply demonstrate the agricultural possibilities of the crop for this region. It was stated that during 1944, under the supervision of the rubber division of the Production Control Board, tapping of some 250 acres of these small holdings was organized. During 1945, production was over one hundred thousand pounds dry rubber, indicating average yields of about four hundred pounds per acre. Observations made in the holdings visited provided good evidence of a high standard of tapping, and control of mouldy rot, during the tapping of the 1944-1946 period in the smooth renewed bark of the panels tapped at that time. But the trees also showed the marks of a later exploitation during the " boom " period of 1950-1951. During this second period, so it was reported, the owners were invited to produce latex for sale and processing to a neighbouring estate. Without experience or adequate knowledge of correct tapping methods, their tapping has been of the worst quality, and many fine old trees have been mutilated beyond recovery. Apparently the return for this slaughter was also disappointing with the result that, to record the opinion of the village headman, rubber is now regarded with contempt by the people. In comparison with the satisfactory development of rubber as a cash crop by Native landowners in other countries, it seems little short of a tragedy that the well-intentioned efforts to introduce it as a Native culture in this area have come so close to complete failure, whilst the trees remain as a source of discouragement to further development of what may prove to be a worthwhile venture for the landowners of the district.

Part IX.

Hevea in New Guinea.

From available records it appears that Hevea rubber was introduced in New Britain by German colonists in the latter years of the nineteenth century. The original source of the plants has not been positively ascertained, but it seems most likely that the original seeds came from trees of the Wickham collection. It would, however, be interesting to know whether other direct introductions from South America took place. The first recorded planting of Hevea was in the Botanical Gardens at Rabaul, but the original trees were destroyed during the war. It seems highly probable that other plantings in New Guinea Territories were made from seeds obtained from the first trees planted at Rabaul. Records of existing plantings of Hevea in Bougainville, New Britain and on the mainland of New Guinea were provided by the Custodian of Expropriated Properties, from the " Catalogue " of 1926, and from local information. Existing plantings in New Britain and New Guinea were visited.

(i) *New Britain.*—

It is recorded that on the Ravalien-Matanatar property near Kokopo, a planting of seven and a-half hectares of Hevea was made between 1901 and 1905, and a further planting of about thirteen hectares was made at a later date. Part of the original planting on Matanatar was inspected. This planting was made at ten by ten metres, about forty trees to the acre, subsequently the area seems to have been interplanted with cacao, with rain trees (*Pithecolobium saman*, Benth) most probably planted as shade for the cacao, now dominating the area. This plantation has been virtually abandoned for many years, but it still provides most interesting and significant proof of the adaptability of Hevea to local conditions. Early growth of this rubber on a light pumiceous soil characteristic of the Gazelle Peninsula must have been very satisfactory. Among the remaining stand, which was still fairly complete in the section inspected, there are large Hevea trees still healthy and vigorous; one specimen measured over fourteen feet in girth at four feet above ground level. Amongst the undergrowth of shade plants, seedlings of saman and cacao, there are large patches of practically pure stands of Hevea seedlings. Despite competition, many of the self-sown seedlings have grown into vigorous, healthy trees now fully tappable. There was little evidence of root disease or any other disease or pest; foliage of volunteer seedlings occasionally showed traces of " rim-blight " or " leaf-scorch " that may indicate a potash deficiency in this particular site. This planting would well repay closer inspection and study, for it may contain valuable material well worth using in any future selection work on Hevea directed towards developing clones or strains suited to local conditions. No records of yield from tapping were available.

Old Masawa Estate.—

Old Masawa Estate, in the Bainings district on the western shore of Webers Haven, provided a second very interesting example of an old original Hevea planting believed to have been made between 1901 and 1905. A coastal strip, rising to about four hundred feet and planted with coconuts, leads to a river valley running inland towards the south-west. Along the lower slopes of this valley about one hundred acres have been planted with Hevea, again at ten by ten metres, and later underplanted with cacao. Conditions generally were very similar to those on the Matanatar estate. Although the area has been out of production for some years, it is reported to have been regularly tapped during 1940-1941 when yields of about one ton per month were obtained (this works out at about two hundred and fifty pounds per acre, assuming the whole area was tapped). The trees gave evidence of a former good standard of tapping in excellent renewed bark on the old tapping panels. Again there was a vigorous regeneration of young rubber seedlings throughout the sections inspected.

At Keravat, on an alluvial flat forming part of the central site of the Low Level Agricultural Experiment Station, are some twenty Hevea trees, the survivors of a small experimental planting made in 1938-1939 from seeds collected from the highest yielders among the original trees planted in the Botanical Gardens in Rabaul. The trees had had a bad time during the Japanese occupation, when the area in which they were planted was used for food production. Another small area of similar land, originally under coconuts, but cleared during the war for planting food crops, and then abandoned, had been recently reclaimed and planted with rubber. This seedling planting of about two acres, planted at one hundred and thirty six trees per acre, showed moderate growth at two years from planting. It is intended to establish a collection of proved clones in this area. Though growth was fair, and Hevea nursery plants on an adjacent site were healthy in appearance, the flats on Keravat appeared less suited for rubber than the higher valley areas seen at Kokopo and in the Bainings.

General Notes on Other Areas in the Gazelle Peninsula.

Some time was spent in a general tour of the Gazelle Peninsula, and the principal impression gained, so far as they concern rubber cultivation, are briefly recorded. The light pumiceous soils of this region would grow very satisfactory rubber; the climate is practically ideal, and the Native population appears more advanced, agriculturally and otherwise, than in most other districts visited. For rubber, as for any other tree crop on hilly land away from the coastal belt, which in this region is almost entirely under coconuts, special attention to prevention of erosion would be absolutely imperative. The light soils will deteriorate all too easily when forest is removed, and the early stages of land spoilation were already evident in a few areas on sloping terrain, where intensive cultivation of short-term crops, vegetables and ground nuts, have been practised for a few years. From the cursory survey made it appears that in the broad Warangoi-Keravat Valley which lies between the Gazelle and the Bainings there are considerable areas, amounting to at least fifteen thousand acres of good forest land at present practically unoccupied, lying mainly within the two hundred to six hundred feet contours, that appear eminently suitable for rubber planting. Reports from preliminary soil surveys made in this area fully support this suggestion. It is also recorded that between the Gazelle Peninsula and the Willaumez Peninsula (Talasea), on the north-east coast of New Britain, there are some two hundred thousand acres of forest land, mostly below the five hundred feet contour, that would be entirely suitable for development. Exploratory soil surveys in this region have indicated the general occurrence of pumiceous soils older and heavier than those in the Warangoi Valley. A brief sight of sections of this country, seen from the air *en route* from Rabaul to Lae, certainly supported the view that there are large areas of promising new land for future development in this district.

(ii) *New Guinea.*—

Old records contain data of Hevea plantings of some fifty acres at Singawa, on the Huon coast between Finschhafen and Lae; a sizeable area of the old Jomba-Modilon Plantation at Madang; some two hundred acres on Magaria Plantation near Bogadjim, and about one hundred acres at Yalau, about forty miles east of Bogadjim. Of these areas, Magaria and Jomba were visited, Singawa was seen from the air only, and Yalau was not located.

Lae.—

Lae District was visited, though there are no Hevea plantings within the immediate vicinity of Lae, soil conditions in land under cacao at Bubia and under forest to the north-west of Bubia were briefly examined. In appearance the soil resembles that of Papuan conglomerate light sandy loams, gravelly and generally somewhat acid. The rainfall ranges from one hundred and twenty to two hundred inches per year, which is on the high side for rubber. Forest land to the north-west of Lae, running into the foothills of the Huon mountains, but clear of the gravelly areas characteristic of the Markham Valley to the south-west, appeared suitable for rubber, but detailed soil surveys and trial plantings would be required in this area before reliable evidence for large scale development could be provided. It was stated that it would not be difficult to find at least twenty thousand acres of suitable land in this district. The Markham Valley area, by courtesy of the pilot, was seen from the air at low level from fifty miles north of Lae to about "Shaggy Ridge" below the Bogadjim Gap. On the return journey from Madang much of the area was seen, owing to heavy rain and cloud, at even lower level, including a landing at Nadzab. Whatever favourable features this area may have for other crops, it appears to have few to commend it for rubber. From Dumpu to the west, along the Ramu Valley, there appeared to be some very promising areas that would repay closer examination.

Madang.—

Soil conditions typical of the coastal district were examined on the Agricultural Experiment Station, which is a part of the original Modilon Plantation. Generally there is a good loam top-soil, chocolate to dark brown, overlaying a yellow clay subsoil derived from coral. Frequent traces of chlorosis were noted in practically all crops growing in this area, indicating possibly unfavourably high alkalinity in the subsoil. On the Jomba division of Modilon, a small area of rubber was seen, the date of planting was not known, but it was certainly before 1914. Though the area had not been reclaimed since the war, there was a fairly complete stand of trees that had been reasonably good at one time. At present they show dieback and all the signs of the kind of deterioration associated with bad drainage. The undergrowth was composed mainly of a mass of self-sown rubber seedlings, with a mixture of shade plants, mainly ferns and creepers. Severe damage was being done to the trees by termites, not seen previously during the tour. Briefly, this rubber had been quite good when the estate was being properly maintained, and the system of drainage was in full operation—now it is on the way out.

Magaria Plantation.—

Magaria Plantation near Bogadjim has an area of about two hundred acres of Hevea rubber, all of which is believed to have been planted before 1914. The earliest plantings were at six metres on the triangle. Younger areas appear to have been planted at seven metres by five metres, giving original stands of about one hundred and forty trees to the acre. It was stated that trees of the youngest planting, made probably in 1914, were hardly large enough to be tapped in 1926. Magaria lies inland about three miles from the coast, on what appears to be a raised coral shelf. Soil characteristics were very similar to those observed at Modilon, a good looking brown loam overlying a yellow crumby clay subsoil distinctly alkaline. Growth of the rubber generally was, and must always have been, well below average. Reports stated that the last recorded tapping was in 1940-1941, and the old tapping panels showed less than three millimetres of renewed bark. The virgin bark was extremely hard and stony, and latex flow very meagre from all trees tested. Soil pits opened in typical sections showed an abrupt change at a foot to eighteen inches from a dark loam to a yellow clay, and water was present at two feet. The trees were heavily infested with termites and showed very extensive dieback. Whether the poor growth and obvious deterioration was due to enforced neglect and destruction of an originally good drainage system it is difficult to say, but in any event the planting of Hevea on this type of land could not be recommended. There was much evidence of unfavourably alkaline subsoil conditions, both in the rubber and in the coconut plantation adjoining, and Hevea does not tolerate soils in which the pH rises much above 0.6.

General Observations in the Madang Area.—

A brief tour was made through rising country inland and parallel to the coast to Amele. Rubber would grow well on this land. From a few miles beyond Amele, six hundred feet above sea-level, it was possible to get a fair view of the Gogol Valley. The impression was of promising land for development in the foothills; in the bed of the valley heavy drainage would be necessary before much use could be made of the land for any permanent crop.

Generally the Madang District with an average annual rainfall within the one hundred to one hundred and fifty inch bracket, is climatically well suited to Hevea. Rubber on the coastal belt on soils overlying coral was not good, neither would one expect it to be; although there was little direct evidence from plantings on land further inland there is little doubt that rubber would do well on such land.

PART X.

Commentary.

(i) *Location of Existing Plantations with Respect to Terrain, Accessibility and Climate.*

These matters have been discussed in detail in the preceding PARTS VIII and IX. It is sufficient to record here that there is no doubt that Hevea is well suited to local conditions in Papua and New Guinea. Except for small areas on the fringe of the shadow rain belt in Papua, and on unfavourable soils in New Guinea, rubber has grown satisfactorily in all areas visited, and would be expected to thrive in others as yet undeveloped. Terrain and climate are favourable and though accessibility would have to be improved, this would be necessary not only for the development of rubber, but for any other agricultural enterprise in the Territories.

(ii) *Soils, Soil Deficiencies and Manuring.*—

With the exception of small marginal areas in the coastal regions of Papua, and on the coast near Madang in New Guinea, where rubber has been planted on soils derived from coral, no marked indications of malnutrition were observed. On the best soils in the Sogeri district, rubber has grown very well indeed, and it seems certain that it would be at home on the newer pumiceous soils of large areas in the Northern District of Papua, in New Britain and parts of New Guinea.

No manuring experiments on rubber on an adequate scale in the field have been undertaken, therefore it is not possible to comment, except in very general terms on this aspect. There are indications that phosphate manuring would prove beneficial, especially in connection with replanting and the establishment of leguminous cover plants. Evidence from replanting and manuring experiments with rubber undertaken in other countries has shown that early growth can be markedly improved by the use of quite small dressings of phosphatic fertilizers, with or without the costly addition of nitrogen, and the period between replanting and resumption of tapping of the new stand may be reduced by at least one year. The present lack of laboratory facilities to give service to the plantations in this field should be rectified and provision for a small number of well designed field trials on soils typical of the main rubber growing areas is very desirable in order to provide essential information for future replanting, and for any extension of the planted area. Meantime, the general soil surveys now being undertaken by the Department of Agriculture will provide adequate information for the prospecting of new areas for possible development under rubber.

(iii) *Provision of High-Yielding Planting Material, Including Local Selection of High-Yielding Clones and Cross-Breeding.*—

The lack of proved high-yielding planting material has already been sufficiently emphasized. Although nucleus supplies of a selection of high-yielding clones are available, they have not been utilized or propagated for field planting except on a very small scale. The opinion was generally held by planters that the average Papuan labourer cannot be taught the technique of budgrafting, the writer does not subscribe to this opinion. Estate labourers in other countries have not been easy to teach at first, but many of them have become expert; with skilled instruction there is no doubt that a sufficient number of Papuan estate labourers could acquire the necessary skill. Supplies of budwood of many fully proved clones, now being used in large-scale planting in other countries, are available for purchase without restriction by planters in other territories. These clones should be obtained by the Papuan industry.

It takes some twenty years to establish a new high-yielding clone starting from the first selection and passing through the various steps of testing and recording of performance and trial on estates, until a clone can be confidently recommended for planting on a large scale commercially. It will be clear that Papua cannot afford to wait. The urgent consideration is to get the best available budgrafted material established in the Territory and to proceed as vigorously as may be from that starting point. This is not to suggest that no original selection work should be attempted in Papua. There is always the possibility that high-yielding clones may be developed from local material that might be specially suited to local conditions and possibly show better performance than imported material. But to discover and prove these local "winners" would take all of twenty years, for it would be necessary to start from "scratch". In a later paragraph, commenting on the proposal to set up a rubber research scheme, further suggestions on provision of improved planting material are made.

(iv) *Diseases and Pest Control.*—

Whilst rubber throughout the Eastern Hemisphere has not on the whole suffered seriously from destructive diseases or pests, in Papua and New Guinea there is notable freedom even from the troubles that have caused damage elsewhere. Every effort should be made to ensure that things stay this way. In particular, plant pathologists should maintain a constant watching brief on the rubber plantations and, by the enforcement of sound regulations for importation and distribution of new planting material, prevent the introduction of rubber diseases into the Territory.

Particular reference must be made to the potential dangers that attend the introduction of living plant material from the American tropics, where the dreaded South American leaf disease of rubber, caused by the parasitic fungus *Dothidella ulei*, has destroyed entire plantations and prevented the cultivation of rubber on a plantation scale. The tremendous increases in speed and volume of air traffic in recent years have greatly increased the risks and dangers of the spread of destructive plant and other diseases from regions of infection to others that are free. Papua, as one of the outposts of the huge rubber growing industry of the Eastern Hemisphere, on which so many millions of people depend for their livelihood, has a special responsibility in this regard. In order to ensure that no avoidable risks are taken in the importation of living plant material of rubber or of any other crop, and especially from the American tropics, it is strongly urged that the sole right to import such material should be vested in the Government Department of Agriculture, whose duty will be to ensure that all proper safeguards are observed. Such a provision must be entirely helpful and constructive, its sole object being to ensure that the importer shall receive only sound and healthy material.

(v) *Methods of Cultivation, Planting and Harvesting, Including Mechanization.*—

There is little to comment upon concerning methods of cultivation and planting, for cultivation in old mature rubber is quite rightly reduced to a very simple minimum, and no planting to speak of was being done at the time of this survey. Harvesting also is a straightforward operation, and sufficient critical reference has already been made to the unavoidably indifferent performance of unskilled labour in this most important item of production practice. All planters appreciate that their tappings could be much improved. They are doing their utmost to improve it, despite the great handicap imposed by an unfavourable system of employment of skilled plantation workers.

With regard to mechanization in rubber cultivation, although a good deal of work has been done in this field since the war, much of it has been experimental, and conclusions as to its real value have yet to be reached. In the management of mature areas the scope for mechanical cost saving devices is small. The major cost is tapping and collection, and no satisfactory mechanical substitute for a skilled tapper has been, or possibly ever will be, evolved. Mechanical cultivation under old rubber, except perhaps on flat land on very large, easily-worked areas, is not likely to prove economical.

Mechanical methods of felling and clearing have been used in replanting. The results have not been outstandingly encouraging, nor cost saving. Usually better results have been obtained by normal felling and light burning, especially on relatively small areas up to two hundred acres. The cost of heavy mechanical equipment for the average estate is quite prohibitive, and its use can only be made economical if such equipment can be employed to full capacity. For this to be possible a large programme must be assured, and this would be difficult to arrange for the relatively small total acreage likely to be dealt with at any one time in Papua.

(vi) *Factory Techniques.*—

Factory practice in Papua is based almost exclusively on the preparation of smoked sheet rubber, and as described in the notes on estates, the standard of
is room for improvement in curing and in general operation of a more efficient
preparation and factory work has been steadily improved in recent years. There
processing line. Although cost savings on this account are likely to be small they will lead to a better quality final product. The profitable processing of lower grades, scrap and off-quality sheet, presents a difficult problem for small estates

especially those outside the main planting districts. This point is dealt with further in comments below on centralization.

(vii) *Methods of Preparation for the Market.*—

Smoked sheet is the standard product and is likely to remain so for the present. Efficiency in production has clearly been improved in recent years, but there is scope for further improvement in design and operation of smokehouses. These have been fully detailed in Part VII.

(*a*) *Baling in One Hundred Pound Bales.*—

Baling in one hundred pound bales suits local conditions, especially transport and handling, and there are no obvious advantages to be gained by changing the standard pack. However, by improving pressing and consolidation of the bale, by painting with a talc paint to prevent massing in shipment, it should be possible to increase considerably the weight of rubber per cubic ton of shipping space, and this is a matter the Planters' Association should take up with the shipping companies.

(*b*) *Grading of Papuan Smoked Sheet.*—

Grading of Papuan smoked sheet has been the subject of somewhat frequent and occasionally heated controversy. So long as sheet rubber continues to be marketed on a system of visual grading for quality, that is grading solely on appearance and absence or otherwise of visual defects, such as presence of sand, bark, and bubbles, too heavy or too light smoking, " rust " and " mould ", there will remain a multiplicity of so-called defects on which a dealer will cut prices. Reference has already been made to the difficulties of applying a uniform system of grading on estates widely separated. The most practical solution would appear to be the provision by the Papua Planters' Association of a range of standard sample sheets of Grades 1 and 2 R.S.S. to every plantation that packs its own production. The sample sheets should be obtained and certified from a market organization, appropriately the " Papua Pool " in Sydney. Each standard sample should consist of three complete sheets representing the upper, average and lower limits of each class or grade; they could be suitably mounted in frames and kept for reference in every packing and baling store. Constant comparison with the market standards would be necessary at first, but after some practice a skilled grader would develop an " eye " for classification, and the grading standards would gradually become uniform throughout the Territory.

The present system of marketing through a pool, which has been able in the past to obtain the Singapore standard R.S.S. No. 2 price for *all* smoked sheet rubber from Papua, has its advantages. It also has the obvious disadvantage that really first-class No. 1. R.S.S. production may be penalized to give a premium to No. 2 R.S.S. (which may be below even No. 2 standards), and it reduces the incentive to improve quality.

This subject of grading and quality of Papuan rubber was discussed by the writer with members of the Papua rubber pool and also with manufacturers' representatives in Sydney. The Australian market requires largely F.A.Q. rubbers, equivalent to Singapore market grade R.S.S. 3, and remilled crepes. Those who require No. 1 R.S.S. find it most convenient to take Singapore graded R.S.S. 1 because it is generally up to standard. Some manufacturers stated that they had purchased equally good rubber from Papuan sources, and gave the names of the plantations from which it came. Others had purchased Papua rubber claimed to be No. 1 R.S.S. and found it to be badly off standard. These buyers also mentioned the names of the estates from which it had come. One large user complained that even as No. 2 R.S.S., Papua rubber was often below standard, and the writer was taken to a factory to see bales of Papua No. 2 R.S.S. opened and tested. There was no doubt that the rubber in the sample bales examined would have been graded as No. 3 R.S.S. and even lower in Malaya. On the other hand, samples of Papua No. 1 R.S.S. were drawn from another source and airmailed to Singapore for grading. Out of five samples all were reported to be No. 1 R.S.S., one being close to No. 1 X.R.S.S. A further complaint that Papuan rubber was " slow-processing " in manufacture was not substantiated by technical tests carried out on typical samples sent to Malaya. Thus it appears that Papua *can* produce the best quality rubber, if every Papuan producer up-graded his production methods and kept a keen eye on quality, then the efficient " Pool " might capture the Australian market for No. 1 R.S.S. But so long as quality standards of the pool rubber are endangered by a percentage of poorly graded rubber, then an average (No. 2 R.S.S.) price can only be expected, for there is no market for *near* quality clean rubber ; it must be right up to the mark or better. The alternative demand is for grades No. 3 for bulk usage in the large tyre factories.

(*c*) Reference was made to the new system of *technical classification* or grading of rubber on its chemical and technological properties. Such a system is gradually being introduced in the East. Though still in its infancy it is likely to be used on an increasingly large scale.

With respect, it is suggested that before such a system can be introduced or considered for Papua, there are other more important advances that are first required. It is doubtful whether an output of three thousand tons could carry the overheads required to set up a technical classification scheme at the present juncture.

(viii) *Advisability of Establishing a Central (Co-operative or Other) Factory.*—

Centralization of processing of latex into smoked sheet has been developed successfully in other producing countries. It offers good prospects of success in the two larger producing areas in Papua, namely Sogeri and Kanosia. Centralization has been established both for straight-forward smoked sheet processing, and for special processing, e.g. in the preparation of concentrated latex for foam rubber manufacture. Experience has shown that for sheet manufacture, centralization in units with a capacity output of about ten thousand pounds dry rubber per day for conditions similar to those existing in Papua would probably be the economic optimum. This represents the output of about seven thousand acres of average-yielding mature rubber, and assumes planting in fairly compact blocks, with good roads and communications. These conditions appear to be fulfilled at Kanosia and at Sogeri. A suitable installation might be established on a co-operative, or shareholder basis between participating companies. Alternatively, it might be considered by a single large company who could contract for the purchase of latex from outside estates. These are matters for local consideration. The likely advantages are improved efficiency in processing, and general upgrading in quality and uniformity of the rubber produced, economy in operation and better technical control of factory operation. The plantation managers, relieved of the responsibility for manufacture of their crop, would be free to spend more time on supervision of field work, tapping and cultivation would improve, the urgent job of replanting could be seriously tackled and the estates would gain in the steady rise in yield per acre, or unit of labour, resulting from improved field supervision. An incidental point of importance, the central factory could conveniently install creping machinery to process all scrap and off-quality rubber into good class grades of crepe, adding some ten to twelve per cent. to profitable commercial output. On balance there is much to be said for the central factory principle, and it might be worthwhile to consider it seriously for Sogeri and Kanosia.

(ix) *Desirability of Concentrating on Latex Production, and the Problems Involved.—*

It has been mentioned earlier in this report that for a brief period during and immediately after the war, some plantations in Papua obtained a good market for unconcentrated latex, that is field latex of thirty-eight to forty per cent. d.r.c. preserved with ammonia and packed in drums. At that time, liquid latex was in demand by manufacturers, because the principal producers of latex concentrates in Malaya and Indonesia were not in production. With the resumption of production of well prepared concentrates of sixty-five to seventy per cent. d.r.c., there is no longer any appreciable demand for preserved field latex. Latex concentration could well be undertaken at a central factory of the size indicated in Section (viii) preceding. But it is a highly specialized process requiring the greatest care in harvesting and transporting clean latex to the factory, as well as very close technical control in all stages of treatment and final packing in drums for export. In Papua, drum packing would be essential. In larger producing countries concentrated latex is shipped in rail tanker wagons to port installations, transferred to cargo tanks on specially equipped ships, and delivered to shore storage installations in the consuming countries. Shipping costs by such a procedure are of course much lower than those for drum shipment in small units of forty to fifty-six gallons.

Concentrated latex must meet rigorous market and manufacturers' requirements. It is not intended as a reflection on the Papuan industry when the writer advises that the time is not yet ripe for its introduction. The conditions would have to be very carefully examined before any sound advice on such an important venture could be given, and the advice of a specialist technologist, skilled in the operation of the process, would be essential. As a first step to the large-scale production of latex concentrates, the central factory project outlined in the foregoing section must be developed successfully. The introduction of a new process, once the organization of the central factory was well and truly working, would then be for consideration. There is no apparent reason why the manufacture of good concentrated latex should not take place in Papua, but on balance the writer would advise the course here outlined.

Regarding the capital cost of a latex concentration installation to meet modern requirements, the following figures are quoted. To set up a concentrate factory, with a battery of six centrifuges capable of dealing with a daily crop of about seven thousand acres, would be about £(A)55,000. In addition there would be the cost of transport tanker lorries, collecting points, and supplementary installation to deal with lower grade latex, skim and scrap.

Part XI.

Item B of the terms of reference requests comment on the setting up of a rubber research scheme. It is clear from a consideration of rubber research schemes in other producing territories that the relatively small rubber-growing industry in Papua and New Guinea cannot support a full research and advisory service on its own account. The only obvious alternative is that Government, through the Department of Agriculture, should endeavour to provide the rubber industry in the Territory with up-to-date information and advice, much of which is available in the publications and information freely published by rubber research organizations in other countries. It is suggested that a minimum of two specialist officers would be required; one to be concerned with problems of production; that is, provision of improved planting material, planting and cultivation problems, tapping and disease control; the other, with chemical and engineering experience, to be concerned with processing and improvement in the quality of the product. The function of these two advisers would be to keep in close touch with developments in other countries, and apply them with necessary modifications to local conditions.

Regarding the provision of improved planting material and general work on production problems, it is recommended that a small experiment station for rubber be established on the Department of Agriculture Station at Bisianumu in the Sogeri District. Suggestions for its establishment are briefly outlined.

On Bisianumu there are adequate facilities for work in this field. Already the station has some one hundred and twenty acres of young mature rubber, planted between 1937 and 1941, and there is good reserve land for expansion. Proximity to the major producing area of the Sogeri plateau is an advantage. The station would also be well placed to supply material, through Port Moresby, to all other established areas. It would be for further consideration, if rubber should attract planters in New Britain, to establish a subsidiary rubber experimental area at Keravat on the Gazelle Peninsula.

Reserve land on Bisianumu, lying to the east of the present mature area, consists partly of normal rain forest and partly of once-cleared land now under a good cover of regenerating scrub. Soil conditions appear satisfactory. The following procedure is suggested : An area of about fifty acres should be cleared and prepared for planting with seedling stumps, preferably on an avenue system, at twenty-two feet by eleven feet, equal to one hundred and eighty trees per acre, At the same time nurseries should be established, planted at two feet by two feet, to be budgrafted with a collection of proved high-yielding clones, locally available or imported. Budwood from the nurseries should be used first to budgraft the fifty acre field planting. Budding with a " systematic mixture " of a small number of proved clones known to be good parents of clonal seeds should be undertaken. Of the proved clones suggested for initial use, the following is a preliminary selection; Clones Tjirandji 1, Tjirandji 16, RRIM 501, RRIM 527, R.P. 107 (equal L.C.B. 510). These are high-yielding clones also known to give high-yielding seedling progeny. Included in a seed producing area, on the lines proposed, it would be advisable to use AVROS. 157, Pil. B 84 and T.K. 14. These are not among the highest yielders for commercial planting, but they are first-class parents. (All of these clones are available by purchase or agreement from Malaya. See Appendix D.) Additional clones, not necessarily good for seed production, but known to be excellent producers, for example Clone P.B. 86 and Glenshiel 1, could be established in compact separate blocks for demonstration purposes, and to provide material for distribution. Additionally small demonstration areas illustrating contour planting, avenue planting, different methods of cultivation and the like, could be profitably established. The principal objectives would be—

(*a*) to establish an authentic collection of the best available proved clones for general commercial planting, and for the establishment of seed gardens;

(*b*) to provide a simple museum collection to demonstrate the characteristics of different clones and their probable suitability for large scale planting in Papua;

(*c*) to provide nurseries for teaching and training local operators;

(*d*) to provide ultimately a reliable source of high grade planting material for distribution to the industry.

Additionally, it would be possible to set up a model factory on Bisianumu with modern equipment, in charge of the factory and processing officer, to demonstrate new procedures suitable for application on Papuan plantations. It is suggested that Officers of the Department of Agriculture, who may be chosen for such a development, might spend a preliminary period in one of the major producing countries, after having made a close study of rubber growing practices in the Territories. It may be felt that these suggestions make little reference to new research. This is true, but before new problems are tackled there is an urgent need to lay the foundation for any further development by application of experience gained and proved in practice elsewhere.

In concluding this brief outline of proposals for immediate adoption, the writer feels that some reference should be made to views generally expressed by rubber planters in Papua regarding the technical advice and assistance they receive from Government organizations. There appeared to be a general feeling that the rubber planting industry was treated as a stepchild by the Administration in that great interest was being displayed in the development of new agricultural ventures and little in helping the planter, whose contribution to agricultural revenue was considerable, to keep abreast of the times. The writer was privileged to see the outstanding work that has been carried out by Officers of the Department of Agriculture in the breeding and selection of cacao. By contrast the provision made for the rubber plantation industry suggested that there might be a real foundation for the rubber planters' complaint.

Part XII.

Expansion of the Industry in Papua and New Guinea.

The last term of reference reads, " On the assumption that some expansion of the industry is desirable, to advise upon best methods of achieving expansion ".

Now that natural rubber will have to face steadily increasing competition from the synthetic rubber and plastic industries, the major considerations for the natural rubber producer will be cost of production and quality of the product.

From the statistical evidence and from first-hand observation, Papua could be a low-cost producer. But to take full advantage of a potentially favourable position, it would be desirable to introduce a more rational system of employment of plantation labour; particularly the more skilled elements of the plantation labour force, and to provide high quality planting material. These are the two most important elements in cost of production.

Enough has been said in earlier sections of this report on the quality of the product. With some additional effort there is no doubt that a good quality product could be ensured.

Expansion of the producing area, at least in so far as suitable land is available, would present no difficulty. The difficulties would be in provision of adequate labour, and lack of faith in the future of natural rubber, discouraging further capital investment. It was estimated that the capital cost of developing a new plantation would be from £(A)80 to £(A)100 per acre. In some districts, in the writer's opinion, development could be quite considerably below this figure, depending upon availability of local labour and the methods of opening and planting employed. It was observed that some of the best and most efficiently operated plantations were not the largest. Being small, they had no large reserves in cash, but given some assurance of a reasonable market for their crop, several of the smaller plantation owners stated that they would willingly plant more rubber. In a world that gives much thought to security and stockpiles, it would not seem inappropriate for an expanding rubber industry in Australia to provide itself with a living stockpile of natural rubber within its own boundaries, even to the extent of affording some guarantee of security to the grower.

Expansion of production could be stepped up either by new planting or by replanting. New planting of considerable areas of land already leased for rubber cultivation would be possible. Many plantations have large areas of virgin land still undeveloped because the terms of alienation, providing for development within a specified period, have not been strictly enforced. Clearly, planting of additional areas of such land adjacent to established and fully equipped plantations would usually prove cheaper than opening new plantations. With regard to new districts for development with rubber, the most promising large areas seen were in the Popondetta-Sangara-Awala area of the Northern District; the Warangoi Valley in the Gazelle Peninsula, and possibly large areas on the northern coast of New Britain between the Gazelle and Willaumez Peninsula. Although no survey was possible, it is likely that good land for development, though possibly in small blocks, lies between Sogeri and Kanosia. Other promising areas have been mentioned in the detailed notes on the surveys made in all districts visited.

It is estimated that well over half of the total planted area in the Territory is on the way out, and replanting should be undertaken. This would probably prove the most economical and the most effective means to adopt generally to expand production. The figures cited for Malayan production in the section on statistics speak for themselves. Replanted fields are yielding up to one thousand pounds per acre and more. The trees the new material has replaced were yielding about three hundred and fifty pounds per acre. For the larger old established plantations, there is no doubt that replanting is the only rational policy, moreover replacement within an organized estate in full operation can be achieved at a much lower cost than development of new land.

Acknowledgments.

To His Honour, Mr. D. M. Cleland, Administrator of the Territory of Papua and New Guinea, and Officers in the Administrative Service, the writer expresses thanks for the excellent facilities provided throughout his tour.

To Mr. R. E. P. Dwyer, Director of Agriculture, Stock and Fisheries, who, with members of his staff, made all detailed arrangements for this visit, and whose intimate knowledge of the rubber industry in the Territory was always at his disposal, the writer is much indebted.

Rubber planters in all countries where rubber is grown have a tradition for generous hospitality. Papuan planters are very high on the list. The writer tenders sincere thanks to the many planters who discussed with him their views and problems, and gave information without reserve. To Mr. B. Fairfax-Ross, Chairman, and Mr. Colin Sefton, Vice-Chairman of the Papua Planters' Association, for their constant help and assistance in the many details of a most interesting and satisfying visit, the writer is especially grateful.

To Mr. Frank C. Henderson, Chief of the Division of Plant Industry, D.A.S.F., who accompanied him throughout the tour and provided from his sound and extensive experience much of the information recounted in this report, the writer wishes to record his most sincere thanks.

C. E. T. MANN.

Kuala Lumpur,
April, 1953.

GOOD HEALTH PAYS DIVIDENDS

(Contributed by the Director, Department of Public Health, Port Moresby.)

THERE is a Price to be paid to attain Health, but there is a Cost to be met to treat Sickness. Public Health has long realized that it is much cheaper to pay the price than to meet the cost.

In primary industry, the producer often finds himself faced with but small profit for his hard physical exertions. Many factors influence this return for his labours—world market prices, supply and demand, world politics, the availability or otherwise of substitutes, the vagaries of seasons, of pests and disease, and an infinite number of other reasons.

The producers of some crops are more prone to suffer fluctuations in price than others. One year there may be wealth—the next, a battle against poverty.

A review of the costs of production and the market prices for copra over the last thirty years shows considerable fluctuations. It is human nature to spend, even unwisely, in the good years and to decry the bad. When profits are good, then within the cost of production there may be preventible wastages. When the cost of production allows no profit, there is a powerful urge to correct these wastages.

Methods of production have improved but little in the copra industry over these many years. Replacement of the labourer by machines has been slow and the efficiency of the labourer has not been improved. The whole future efficiency of the copra industry would appear, to-day, to depend on the increasing efficiency of the unit of labour, and this includes, of course, an improvement in the efficiency of management to lead labour into better methods.

Amongst others, there is one important way to improve efficiency, and that is to improve health. Management, if capable, should have the knowledge to do this. If the price to pay in bringing about this improvement is cheaper than the cost to be met in the treatment of the sick, and this includes the cost of lost time, the cost of providing the larger numbers needed when ill health refuses to allow the labourer to give a normal production, then it is sound economics.

Over the years, the health of our Native workers has not improved sufficiently to give them enough increased efficiency to compensate for their increased cost as production units.

A number of diseases still infect the usual labourer; most important is malaria, then hookworm and its attendant anaemia, yaws and eruptions of the skin, skin diseases like scabies and ringworm, intestinal parasites in addition to hookworm, and finally in some few, venereal disease which is mainly gonorrhoea. All of these conditions can be cured or greatly alleviated by modern drugs. All of them, separately or together, cause a morbidity and certainly an inefficiency at work. Malaria and hookworm cause an anaemia and therefore lethargy; yaws causes bony pains; skin diseases will cause an irritability and a loss of necessary sleep; gonorrhoea can cause an arthritis and general ill health.

There are other diseases which seriously curtail labour efficiency: tropical ulcer and filaria. The former of these can be cured but not, perhaps, so easily as it can be prevented. The latter can be alleviated.

Add to these diseases that greatly disturb the human body, the condition of malnutrition. The body already lacks sufficient fuel for its own needs, and yet must provide some to maintain the active diseases present. This malnutrition and these diseases leave the body most ill equipped to meet the challenges of tuberculosis, pneumonia, the dysenteries and other infections.

Statistics have been produced in other parts of the tropical world, that clearly show a labour force may be reduced by twenty-five per cent. if, when malaria infected, they are made malaria free. It has been shown that when malaria was eradicated from a community, they naturally increased their crop output by fifteen per cent., with no increase in their hours of work.

It is easy to determine for any one industry the price to be paid for this improved health—it is the price of giving to the whole labour force *regularly* and *properly* each week, a malaria suppressive. Balance this price against the saving due to increased efficiency, both physical and mental. It is submitted there will still be a major reduction in the cost of production if the percentage of labour saved by the use of malaria suppressives is used to bring about mosquito control within at least half a mile of their barracks, to improve the sanitation of the barracks, provide a pleasant recreation area and especially to make a garden to relieve the monotony of the diet or supplement it with its produce. Mosquito control will definitely improve living conditions by removing pest mosquitoes.

Most Native people in this Territory dwelling below 3,500 feet are infected with malaria in their infancy and if they survive, develop an immunity. Whether these people should be made malaria free is still controversial. The Department of Public Health now believes that much more eventual good than harm will be done to the community by the use of suppressives whilst they are in employment. Their health will be improved to resist infectious disease, they will readily appreciate the effectiveness of the drug, properly used, and will seek early treatment from their nearest aid post, for themselves and their dependants. Mosquito control will induce them to take this practice home. If this can be done generally, a more efficient labour force will eventually be available for engagement, if not during this decade, then certainly in the next.

It can be proven to be economically sound to give all labour, on arrival, 900,000 units of penicillin-in-oil intramuscularly. This will cure their yaws and their gonorrhoea. It is advisable to treat all with tetrachlorethylene for hookworm ; to treat all skin disease and especially to examine all labourers at the end of the day and treat their scratches and cuts. It would be entirely uneconomical if the labourer were not given the full balanced diet as prescribed ; the missing of any one item can lead to a deficiency disease.

In conclusion, the routine eradication of certain disease in any labour force, and especially the control of malaria, will produce a more efficient force, at a price less than the ultimate cost of treating recurrent sickness.

Rural Broadcasts: Two Talks on Cattle Production—

(The following talks are the third and fourth in the series prepared by the Department of Agriculture, Stock and Fisheries and currently being broadcast by Station 9PA, Port Moresby.)

I.—THE CATTLE INDUSTRY IN PAPUA AND NEW GUINEA

ANY animal industry takes raw materials and by means of livestock turns them into animal products or gets work done.

The raw material may be grass or other herbage, surpluses, or by-products of no direct use as human food.

Other environmental conditions affect the choice of animals—the climate, for instance, and the kind of pests and diseases that are endemic.

There are, therefore, three main considerations in discussing animal industries; firstly, what feeds are available; secondly, what products or work are required; thirdly, what animals can be used in the environment. Let us consider the scope for animal industries in Papua and New Guinea against this background.

To put the cart before the horse, what products do we want?

Meat is one. Annual imports of refrigerated meats are about five thousand tons valued at over One million pounds. In addition, there are large imports of processed milk and other dairy products, of edible fats, eggs and egg products. Foodstuffs of animal origin are one of the most expensive items in European cost of living budgets and in the cost of rationing Native labour.

The Commonwealth Nutrition Survey classed lack of foodstuffs of animal origin as an outstanding feature of the dietary of Native communities.

Without even thinking of exports to the hungry East, there is thus a substantial market for locally produced animal products.

Planters want stock also to keep plantations clean and to work as draught animals; horses are wanted by Mission and Administration Officers as packs and rides. Ultimately Natives will use animals for draught power in farming and for transport of produce like coffee to markets.

The next question is, "What feeding stuffs are available?"

For the grazing animal there are large areas of grasslands. Parts of these are already covered by palatable and moderately nutritious grasses and by legumes. A lot is covered by kunai or kurra-kurra. If burning is restricted with skilful management, this grass can be replaced with better swards of volunteer or introduced grasses. A system of rotating crops and pastures for stock is the most promising for permanent agriculture under local conditions.

"Rundown" copra plantations, particularly if planted with a leguminous cover crop, offer good prospects for running livestock.

In coastal areas there is a wide range of useful fodders not exploited largely because, due to our Australian background, we have not had much to do with them. Pueraria, or "tropical kudzu" as it is known in the Southern United States, and Centrosema are excellent leguminous fodders. *Leucaena glauca* is a valuable fodder for ruminants. Para grass, which is becoming a pest on some plantations in high rainfall areas, guinea grass, and even Johnson grass are useful species.

At higher altitudes a number of introduced grasses and legumes of temperate and sub-tropical regions do quite well—*Paspalum dilatatum*, *Phalaris tuberosa*, the Ryes, and white and red Clovers, for example.

One disadvantage in the Territory is the tendency of many grasses to be over-succulent when young, and over-fibrous when old; they are difficult to manage so that they are fed at the leafy protein-rich stage, not too much diluted with either water or fibre.

Crops such as sorghum and maize, peanuts, pigeon pea and cow pea, sweet potatoes—including the tops—and cassava can be grown for feeding stock.

Local crushing of copra will make available coconut meal, a valuable supplement containing twenty per cent. of protein of high value.

Local manufacture of salt, which is needed by lactating animals and animals that sweat, would be useful for stock feeding and for curing of products. It should be easy enough in the dry area of Papua during the South-East season. Ground limestone also could be made locally. It may prove necessary to add trace elements in some areas, but this will not be expensive.

Supplements of animal origin such as meat or blood meal are useful but are not indispensable. Eventually they will become available as by-products of slaughtering.

Having regard to available feed and other local conditions, what livestock are we going to use to produce our meat, dairy products, and draught power, and to fit our mixed farming systems?

British breeds of cattle, both dairy and beef breeds, have done well in all parts of the Territory to which they have been introduced providing management has been good; in particular, presence or absence of tick infestations seems to be critical.

Crosses with Indian or Zebu breeds will be discussed in another talk.

The nature of the grazing, the absence of roads, bridges and the like in much of the available country, the fact that cattle can travel long distances on the hoof, and that relatively little labour is required to care for them make one believe that beef production is the obvious pioneering use for a great deal of the grasslands of our Territory. Presence of the screw-worm fly, the fact that land and labour in the Territory are, relatively speaking, limited, and that carrying capacity is high all indicate that *intensive* rather than *extensive* management will in the long run be more suitable; that is to say that ranch and station management will be replaced as development proceeds by livestock farming, and that the main role of cattle ultimately will be in cropping—by rotations to supply butter fat and milk processing plants and to grow prime beef for packing plants.

Both cattle and goats are satisfactory dairy animals in the Territory. They both need supplementary feeding, however, and heifers or young does must not be mated too early.

Sheep and goats have a definite niche to fill as meat producers in many parts of the Territory. Sheep produce reasonably good fleeces for which there will be a local demand for blanket manufacture when production increases to the level of supporting a small spinning plant.

The Hallstrom Trust is conducting a valuable pioneer experiment in commercial sheep farming. Trouble has been experienced in working out a system of pasture management that on the one hand fully uses the exuberant pasture growth, and on the other hand does not give rise to trouble with internal parasites as a result of dense stocking. Strip grazing and a ley rotation with Native foods and cereals may well provide the solution. Several people have small flocks and in most cases these are doing well.

In general, ponies and cobby types of horses seem to do better than walers and remount types. When we have sufficient numbers of brood mares, we shall breed some mules. With artificial insemination this is not as much trouble as it used to be.

Pigs, of course, are useful and prolific animals. To be reared without trouble from internal parasites, they need to be run either on pasture with plenty of room, or on floored sties from which the manure can be removed each day before the worm eggs in it hatch. Healthy pigs cannot be reared in wallows contaminated with urine, as this promotes infestation with kidney worm. Keeping pigs on deep litter saves cost in building sties, is hygienic, gives the pigs biotic supplements, and provides useful composted material for gardens. Ideally the ration for pigs should be relatively free of fibre and contain some protein of animal origin. However, though they grow more slowly, pigs can be reared economically on rations comprising grass and a green legume, a root, a cereal, and an oil meal; kau kau tops seem very useful.

One must mention veterinary problems. Most of these are still before us and will develop as stock numbers increase.

Anthrax is endemic in the highlands of the mainland, but the Australian vaccine is an effective prophylactic.

The screw worm fly is a worse pest than the Australian blowfly, as it strikes anywhere there is a fleck of blood, including the navels of new born animals. We have a couple of effective dressings, but of course the animals have to be handled in applying a dressing.

Internal parasites require attention in all species, including cattle, once density of stocking reaches a certain level. Less trouble is experienced in localities having a definite dry season.

Deficiencies of soluble minerals will no doubt show up. The fact that in mobs of cattle lactating animals are sometimes unthrifty while dry cattle are in good store condition, may be due to this, to climatic conditions, or to inadequate protein.

There are many diseases we do not have, and must be careful to exclude. We do not even have pleuro-pneumonia, a cause of considerable economic loss in Australia. We have a chance to eradicate cattle tick, and to control tuberculosis and contagious abortion so that they will not become the trouble they formerly were in Australia.

In short, there is potential for substantial animal industries in Papua and New Guinea; the exploitation of this calls for close co-operation between pastoralists, farmers, and Administration, and for the careful development of Native animal husbandry.

II.—ASIATIC BREEDS IN BEEF AND DAIRY PRODUCTION

MUCH interest has recently been focused on the use of Asiatic breeds of cattle in tropical environments.

This state of affairs has, to a large degree, been brought about by the recent importations into Australia of the Santa Gertrudis cattle from United States of America and the introduction into Papua of Zebu cattle from Pakistan.

It would, therefore, seem that this is an appropriate time to discuss the origin of Asiatic cattle, and the use to which they may be put and the role they may be expected to play in cattle breeding in tropical environments.

Asiatic cattle, commonly known as Zebu, constitute the species *Bos indicus* as distinct from the European breeds of cattle, *Bos taurus.*

Zebu cattle are the humped cattle of India and are characterized by prominent withers and a pendulous dewlap and umbilical fold. In their native habitat various breeds have been evolved with the species to suit various purposes. As in the British breeds, Milch and beef types have been evolved, so in the Zebu have been evolved two types, one a milch animal and the other a draught breed. These two classifications are very broad, and further types have been evolved in each category but, by and large, we need consider only the milch type and the draught type.

The draught animal has been bred to provide motive power for draught purposes and, with this in mind, a large framed, powerful, quick-moving beast has been bred by a process of selection. It has happened that by virtue of breeding for a fast-moving beast of fiery temperament has developed coincidentally.

The milch type of Zebu has been evolved to produce milk and butterfat and, as might be expected, is of a much milder temperament than its draught counterpart.

A summary of the advantages which Zebus are claimed to have over European breeds is—

1. foraging ability and the ability to digest fodders with a high cellulose content ;
2. heat tolerance ; that is, the ability to withstand high temperatures and not be adversely affected by high humidity ;
3. resistance to insect pests.

The Zebu breed is stated to have the ability to digest foods which are high in fibre content. This confers a great advantage on the beast as a forager, because it enables it to live on poor quality pasture and still thrive, whereas the British breed which is unable to digest the highly fibrous fodders, is at a distinct disadvantage on such poor quality pastures. It is claimed that Zebu stock will thrive and gain weight on pastures which will enable European breeds of cattle only to subsist. It is also claimed that Zebu cattle have a high degree of tolerance to heat, which enables them to endure high temperatures, combined with high humidity, without discomfort. This means that whereas in a tropical environment British cattle almost invariably go to cover during the greater part of the day and do the majority of their grazing at night, the Zebu grazes through most of the day without discomfort. This advantage of heat tolerance is brought about by virtue of the fact that Zebu cattle can disperse body heat through the skin, whereas British breeds lose body heat only through the lungs and mouth. The pendulous dewlap and umbilical fold of the Zebu assist in the loss of body heat by increasing the skin surface, and thus the area from which heat may be lost.

The pure Zebu animal has a much shorter coat than the British breed, and the ability to move the skin at will. It may be that the short coat and ability to move the skin play some part in the resistance of the Zebu to insect pests, for the Zebu is not affected by cattle tick or Buffalo Fly to the same degree as are the British breeds. It would, therefore, seem that by virtue of the factors previously mentioned, the Zebu cattle can play a large part in the development of a cattle industry in tropical environments, particularly the low, humid areas.

By crossing the Zebu with British breeds of cattle, it is hoped that the advantages of the British breeds of cattle will be maintained, and superimposed upon these will be the advantages of foraging ability, heat tolerance and resistance to insect pests, passed on by the Zebu side of the cross.

The matter is not, however, as simple as it would appear on the surface, for other considerations, particularly temperament, must be kept in mind. It has been previously mentioned that the larger type of Zebu which is comparable to the beef type of British breeds, has a very fiery temperament and is a fast-moving animal. The beef type in British breeds has been evolved as a large framed beast with a comparatively mild temper and quiet nature, and temperament has always been a factor taken into consideration in the breeding of beef cattle in the British breeds. Thus, while it is most desirable to confer upon the British breeds the advantages of being heat tolerant and insect resistant, care must be taken that, at the same time, the fiery temperament of the Zebu is not passed on to the cross-bred animal. If this fiery temperament were to be transmitted to the cross breed, it would do much to nullify the advantages gained by crossing, for an animal of placid temperament will gain weight far more quickly than one which is flighty and easily upset.

However, by a process of careful selection in which temper is considered as a factor, it should be possible to gain many of the advantages which the Zebu has in a tropical environment without, at the same time, incurring to any great degree the disadvantages of a fiery temperament.

The dairy type of Zebu whilst not producing the same quantity of milk, produces a milk which has a high butterfat content. However, by careful breeding there have been breeds evolved in its native habitat which produce nearly as much milk as do the British breeds. This dairy type of Zebu can, therefore, confer upon the dairy type British breed a high butterfat content in addition to the advantages already discussed. This would mean a great deal for tropical dairying, for it would mean that milk production would not be higher at one time in the day than at another, as is the case when animals spend much of their time resting.

A dairy cow may be likened to a milk making machine. It consumes pasture and converts nutriments in such pasture to milk. This means that the ability of the Zebu to convert poor quality pastures into nutriments, would be reflected in an increased milk production from such pastures.

The advantages of heat tolerance and insect resistance have been discussed previously with reference to the beef type and need not be repeated. Temperament is not an important factor in this case, because the dairy type Zebus evolved have a placid nature and, therefore, would pass this placidity to their crosses.

The advantages that one might expect to obtain from crossing British breeds of dairy cattle with dairy type Zebu cattle are, therefore, ability to produce milk on poorer quality pastures than British breeds, a higher butterfat content in the milk, heat tolerance and insect resistance.

Whilst on the surface it would appear to be merely a case of crossing Zebu and British breeds to obtain an animal more suitable for a tropical environment than the British breeds, the matter, in principle, is not so simple, as many factors must be taken into consideration. It is most likely that an infusion of Zebu blood will produce a beast more suitable for a tropical environment than the British breeds, but it is a matter for many years experimentation to decide what proportion of Zebu blood is most desirable, and it is quite likely that the proportions which suit one particular part of the tropics will not be ideal for another portion. For instance, in Texas where the Santa Gertrudis breed was evolved, it was found that three-eighths Zebu, five-eighths Shorthorn was the most suitable animal, whereas in Africa, it is found that a higher proportion of Zebu blood is desirable.

The Zebu cattle which have been introduced into this Territory from Pakistan, are to be used in cross breeding experiments with various British breeds, to ascertain which cross and how much Zebu blood is the most desirable for the local conditions. These Zebus will be crossed with various British breeds of cattle, in various ratios of Zebu to British blood, and the progeny resulting from such cross breeding will be carefully observed and compared, so that the advantages or disadvantages of any particular strain can be noted and either bred for in the case of advantages, or corrected or discarded in the case of undesirable features.

Such a programme of experimentation must of necessity occupy a number of years, and it will be a long time before any definite conclusions can be reached. However, indications from other parts of the world are that there is a definite advantage to be obtained by infusing a proportion of Zebu blood into British breeds in tropical environments. One of the factors which has prevented more work being done with Zebu cattle in the past is that the Zebu, in its native habitat, is subject to many exotic diseases which do not occur in Australia.

These diseases are ones such as Foot and Mouth Disease, Rinderpest, Surra and so on, which are very virulent and capable of causing high mortality and great economic loss. For this reason Australia is loath to import cattle which might, if they were affected by any of these diseases, cause exceptionally high losses in the Australian pastoral industry.

The importation of Zebu cattle from Pakistan to this Territory is the first direct importation undertaken in the Australasian area. All previous stock have been obtained from America where direct importations were carried out many years ago. The most elaborate precautions have been taken to prevent the introduction of any of the diseases previously mentioned into this Territory and the stock, as well as having been most carefully screened for any possible disease before leaving Pakistan, are now undergoing very strict quarantine in this area.

These stock, as well as being utilized in the manner explained, will also be used to determine whether there is any advantage in using Zebus imported directly from Pakistan over using those obtainable from the U.S.A.

NEW AND INTERESTING IDENTIFICATIONS.

POISONING CASE.

Phaseolus lunatus.—

A REPORT has been received from Nondugl in the Western Highlands of a case of poisoning from a Native bean called Pintanga locally. A woman and her three children ate this wild bean. Some of the beans were first roasted, the shells discarded, and eaten. Later in the day some of the beans were boiled, the shells discarded and the beans eaten together with some sweet potato. During the night all vomited and the two youngest children, a boy and a girl, died.

The specimens of Pintanga bean were identified by the Queensland Government Botanist as *Phaseolus lunatus,* the Lima bean. Lima bean is extensively cultivated in many parts of the world, especially in the United States of America, Java, Ceylon, Madagascar, etc., both the seed and the tender pods being edible.

Mr. J. S. Womersley, Forest Botanist at Lae, commented as follows on a similar sample submitted to him from Chimbu in 1951, under the Native name Pingapinga.

"The bean is *Phaseolus lunatus,* a cultivated form of which provides the lima bean of commerce. There are many wild varieties of this plant, most of which have dark seeds, containing a poisonous substance called linamarin, which during the digestive process breaks down to prussic acid, the cause of the fatalities. Mottled beans contain less linamarin than the dark coloured ones and the white lima beans none at all."

Prolonged cooking with many changes of water is said to render most of the poisonous types harmless.

Printed and Published by William Samuel Nicholas, Government Printer, Port Moresby.—5748/6.54.