A PROJECT IN THE DEVELOPMENT OF CATTLE ADAPTED TO A TROPICAL ENVIRONMENT

By J. L. Anderson.*

INTRODUCTION.

THE Administration of the Territory of Papua and New Guinea is aiming at a Cattle Industry which will enable the Territory to be self-sufficient in beef. The following paper outlines one aspect of the Administration's functions in approaching this aim.

The cattle industry in the Territory of Papua and New Guinea commenced well before World War II and was, at that time, chiefly associated with coconut plantations around the coasts of the islands. The cattle were, in general, of a nondescript type and many of them had a smattering of Zebu blood. The majority of these animals were killed off during the war although pockets of them are still found in many parts of the Territory.

Postwar the cattle industry has developed along slightly different lines, although the use of cattle as grass cutters in coconut plantations is important in some areas. Large areas of land have been made available as grazing leases and have been taken up for the grazing of beef cattle. However, most of these areas are in the hot lowland environment of the Territory where European breeds of cattle show poor productivity. Although much can be done in the development of improved pastures to provide a better nutritional level, the immediate answer seems to lie in the development of types of cattle which are fitted to economic performance in the environment.

In other parts of the world strains of adapted cattle have been developed. The American Brahman (Jacobs 1949, Kelley 1959) and the Santa Gertrudis (Rhoad 1949) are types developed for the environment of southern United States. In South Africa, where the environment is marginal for European breeds of cattle, the Afrikaner type has been used both as the purebred and for cross-breeding with European breeds (Bonsma, van Marle and Hofmeyr 1953, Joubert, 1957). The recent development of the "Droughtmaster" type in Northern Australia is a step towards this adapted type.

The development of adapted types in the Territory of Papua and New Guinea is based upon the use of two of the breeds mentioned above, namely American Brahman and Afrikaner. Brahman cross-breeding is carried out at the Papuan Lowlands Livestock Station, Moitaka, Port Moresby, and the Afrikaner cross-breeding at the New Guinea Lowlands Livestock Station, Erap, via Lae. The Brahman cross-breeding project is described below.

Environment.

The Papuan Lowlands Livestock Station, Moitaka, is typical of the dry coastal belt of Papua but is not representative of the whole of the hot lowland environment of the Territory since humidity and rainfall registrations elsewhere are generally higher. The station occupies an area of 40,000 acres about eight miles north-east of Port Moresby but only 10,000 acres are used. Port Moresby is at a latitude of 9 degrees 30 minutes south and longitude 147 degrees 10 minutes east. The monthly means of rainfall, humidity and maximum and minimum dry-bulb temperatures are shown in Table I. Figure 1 gives the climographs of Messina (South Africa), Port of Spain (Trinidad), Rockhampton (Queensland) and Port Moresby. A discussion of the use of climographs is included later.

* Chief, Division of Animal Industry, Department of Agriculture, Stock and Fisheries, Port Moresby.

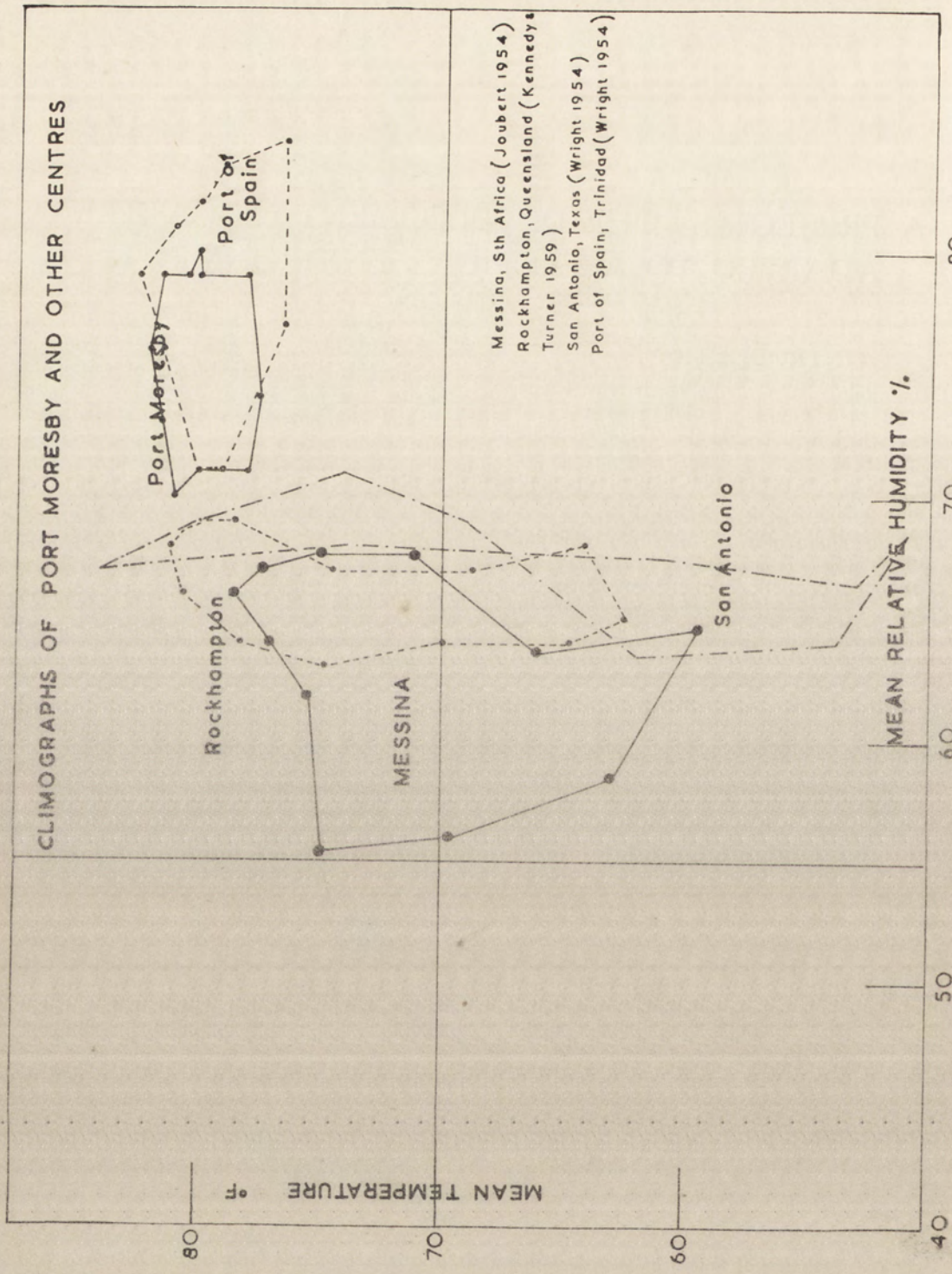

CLIMOGRAPHS OF PORT MORESBY AND OTHER CENTRES
Port Moresby
Port of Spain
Rockhampton
MESSINA
San Antonio
Messina, Sth Africa (Joubert 1954)
Rockhampton, Queensland (Kennedy & Turner 1959)
San Antonio, Texas (Wright 1954)
Port of Spain, Trinidad (Wright 1954)
MEAN RELATIVE HUMIDITY %
MEAN TEMPERATURE °F
80
70
60
50
40

Figure 1.

Table I.

Climatic Averages—Jackson's Airport, Port Moresby 1946-1960.

Month.	Average Daily Maximum Temperature.	Average Daily Minimum Temperature.	Average Daily Relative Humidity.	Average Monthly Rainfall.	Average Number of Rain Days.
January	90	74	76	529	15
February	89	74	79	839	19
March	88	73	79	674	18
April	87	73	80	801	16
May	87	73	79	201	8
June	86	72	79	175	7
July	86	71	74	71	5
August	86	72	71	132	7
September	87	73	71	159	6
October	89	73	70	147	7
November	89	73	70	321	9
December	89	74	73	637	14

Highest Maximum Temperature recorded—97.0—February, 1947.
Lowest Minimum Temperature recorded—57.3—July, 1946.

"Moitaka" is bounded on one side by the Laloki River and on the other by a range of hills up to 1,500 feet in height separating it from the sea. It extends from an altitude of about 200 feet to parts which are permanent swamps caused by the Laloki and Brown Rivers. The low country is susceptible to flooding during the "wet" season and much is covered by heavy rain forest. When the rain forest has been cleared improved pastures of Elephant grass (*Pennisetum purpureum*), Para grass (*Brachiaria mutica*) and Molasses grass (*Melinus minutiflora*) have been established. The higher country is covered mainly by Kangaroo grass (*Themeda* spp.) on the poorer soils, and Kunai (*Imperata* spp.) on the better soils. This country provides grazing during the wet season and for a short period following the rain. The Kan-

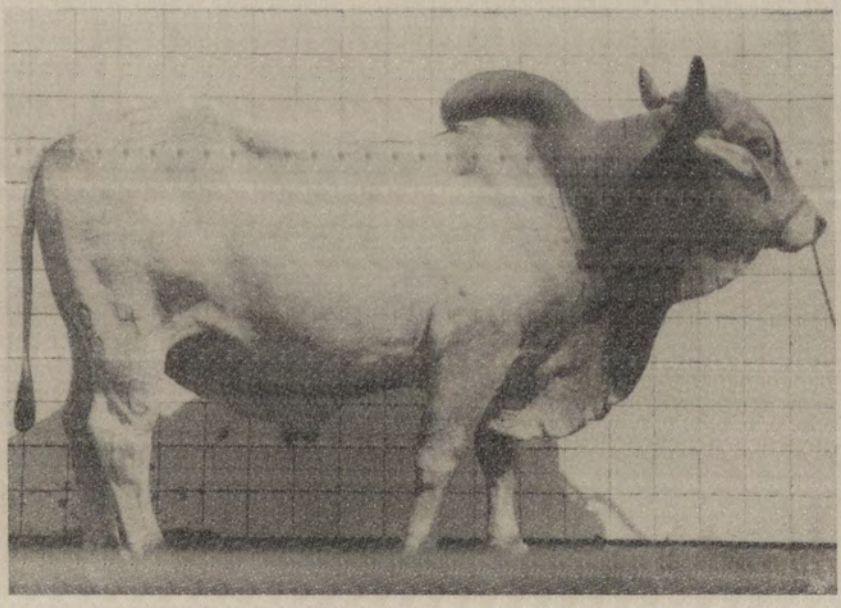


Plate I.—Imported Brahman Bull "Vela de Manso".
(The Pedigree of this Bull is shown at Figure 2.)

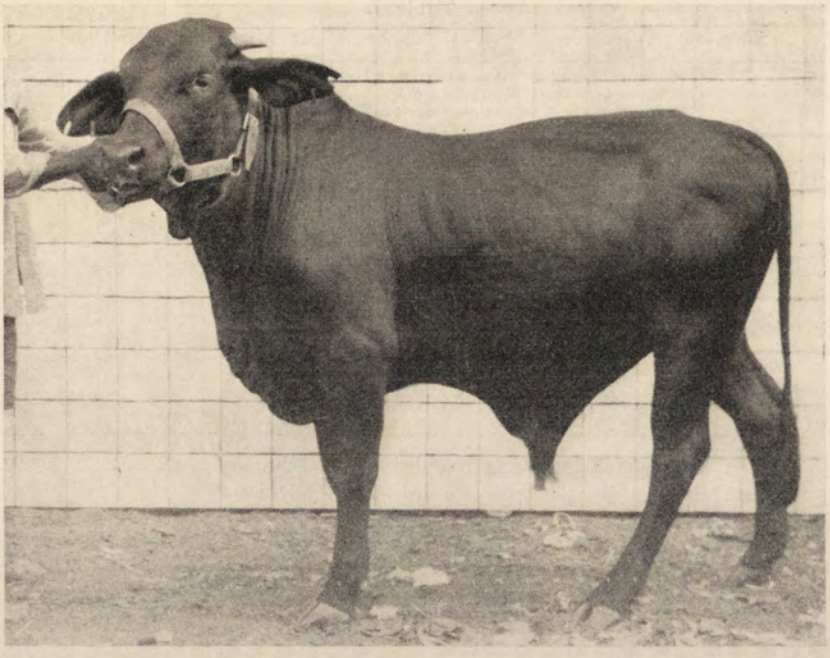


Plate II.—Three quarter Brahman one quarter Angus Bull. Twelve months of age.

garoo grass dries off extremely quickly in the high environmental temperatures and provides little more than poor quality roughage. Both areas have been liberally sown with the tropical vine type legumes Centro (*Centrosema pubescens*), Pueto (*Pueraria phaseoloides*), Calopo (*Calopogonium mucunoides*) and Clitoria (*Clitoria ternatea*), which have helped to provide a longer grazing period on the higher ground. Townsville lucerne (*Stylosanthes sundaica*) has also proved of considerable benefit.

Because of the uneven distribution of the rainfall during the year it has been found necessary to conserve fodder in the form of silage for use during the dry season. It has been made in the past from crops of maize and sorghum planted for this purpose. During 1960 part of the standing crop of Elephant grass was cut and ensiled. Approximately 900 tons of Elephant grass silage is available for feeding out should is be necessary.

Diseases.

Screw Worm Fly (Chrysomyia bezziana).

This fly is endemic to the area. It necessitates prophylactic insecticide treatments every four to six weeks and inspection of all animals at least every two days. Station procedures such as branding and castration must be carried out when the incidence of the fly is low or has been reduced by spraying. The treated animals must be kept under close supervision until the wounds have healed to the stage where they are no longer attractive to the fly. It is important also that each calf, as it is dropped, be treated to prevent navel strike. This procedure becomes part of the experimental management described later.

Cattle Tick (Boophilus microplus).

This parasite is also present. Eradication programmes have been attempted but re-infection has occurred due primarily to the presence of deer and wild horses which are proving difficult to eliminate and which act as hosts for the cattle tick. The tick is controlled by treatment of all stock in the area every three weeks.

Bovine Tuberculosis.

The herd is regularly tested and no reactors have been found.

Bovine Brucellosis.

The breeding herd is regularly tested and the beef herd has shown clean tests.

Internal Parasites.

Parasites are not a severe problem but all calves are treated with "Neguvon" at weaning.

Plant Poisonings.

Cycas circinalis, the common fern tree, causes a condition of incoordination in the hind quarters of cattle. This incoordination limits the grazing habits of the animals, but cows can calve normally provided they are maintained on reasonable pasture. The plant is being eradicated from all grazing areas.

Animals.

The breeds of cattle in this project are the European breeds, Angus and Polled Shorthorn and the Zebu breed, Brahman. The major breeding programme is based upon the Brahman/Angus cross while the small number of polled Shorthorn breeders have been used as a basis upon which to develop a line of grade Brahman animals by continual back crossing to Brahman bulls.

The Brahman animals available are animals imported from J. D. Hudgins, Texas, U.S.A., and their progeny. All carry a high proportion of "Manso" blood as is shown by the pedigree of one of the imported bulls "Vela de Manso" shown in Figure 2.

The Department imported three bulls and three heifers from U.S.A. in 1954. One of the imported bulls has since died and an unfortunate distribution of sexes among the progeny resulted in only two bulls out of ten calves up to the 1959 calving. This has severely limited the use of the Brahman bulls in the cross-breeding programme.

The Angus breeders have been imported from herds in Queensland and New South Wales. They number 460 but many are approaching the time when they are beyond economical breeding age. Previous experience in the breeding of the purebred Angus has shown the difficulty of producing European breeds in the environment. Locally bred animals have failed to thrive and have shown a considerable reduction in size compared with their imported mothers. Heifers in particular fail to approach the size and conformation of the imported cows. The greatest setback seems to be at weaning when the animal is thrust onto its own resources. Weaner unthrift is a considerable problem with the weaners' growth remaining static for up to 12 months. In the limited cross-breeding undertaken to date, this unthrift does not occur with the F_1 crossbred and in several cases these animals have weaned themselves when the mother's milk

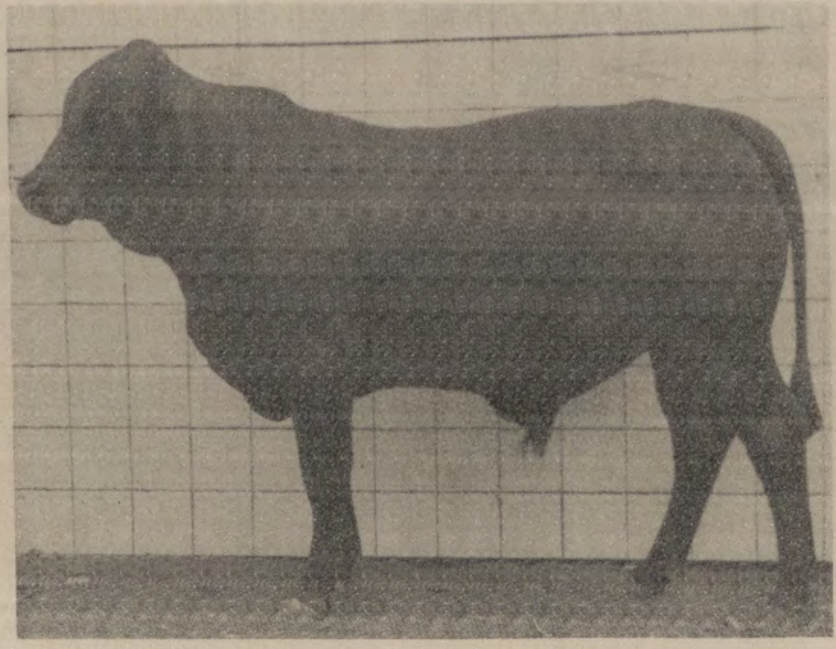
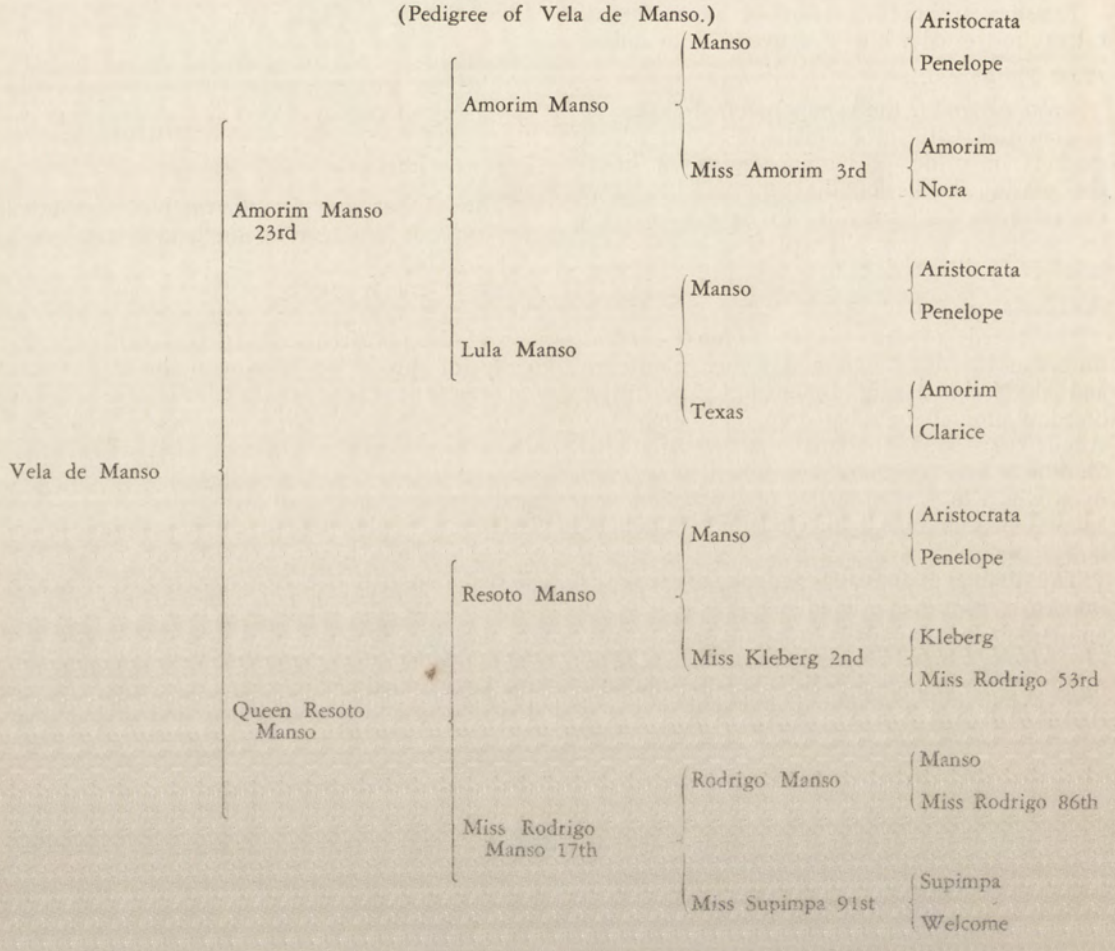


Plate III.—Half Brahman half Angus Bull. Twelve months of age.

Figure 2.

(Pedigree of Vela de Manso.)



production has decreased. Even under such early weaning they have shown no setback corresponding to that suffered by the purebreds.

As a result of these preliminary observations the present breeding programme was formulated to introduce Brahman blood into the whole herd as soon as possible. The programme is handicapped by the present shortage of Brahman and Brahman cross bulls. The present sires are three Brahman bulls and four F_1 Brahman/Angus bulls. The latter are only two years old.

In the first few years of the project the aim will not be to attempt breeding towards a type of animal with a fixed percentage of Brahman blood but rather to produce a herd of varying percentages which can be compared under existing environmental conditions. It will also be essential, at least in the early years, to continue to produce some purebred Angus animals. There will, therefore, be opportunities to compare critically the performance of these against the crossbreds.

Future policy in determining the final aim of the project will be based upon the observations made upon the performance of the animals within the various percentage groups. It will then be possible to select towards the type which shows optimum performance under the local environment.

In conjunction with this major programme a subsidiary breeding programme based upon the 30 head of polled Shorthorn cows is being carried out. These animals are mated to Brahman bulls and their progeny are continually

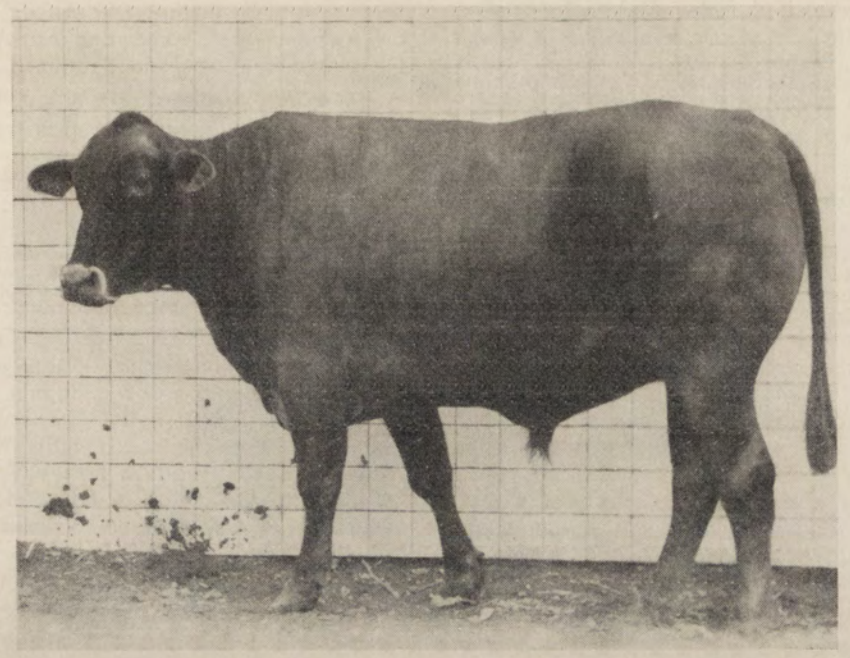


Plate IV.—Half Brahman half Shorthorn Bullock. Four and one half years of age, live weight 1,700 lb.

Plate V.—A mixed Guinea Grass—Centrosema Pasture.

back crossed to Brahmans. The grading up process is being carried out to produce a herd of high-grade Brahmans which will be available for distribution. Bulls from this herd will be sold as they become available and their percentage of Brahman blood will be indicated at the time of sale. All females born into the herd will be retained until the herd is of sufficient size to allow for some distribution.

Management.

Mating.

Prior to the establishment of the present breeding programme, cows had been mated throughout the year resulting in an extensively distributed calving. One of the reasons for this type of mating was the failure of the Angus bulls to cover the cows in a restricted mating period even when used at a density of five per cent. With the introduction of the more active Brahman and Brahman/Angus bulls an attempt is being made to close the mating period down. In 1960 the mating was carried out in two parts:—

1. The primary mating commenced on 1st April and was carried through for three months until 30th June. The bulls were then removed and rested for one month. During that month they were maintained on special pasture in an attempt to improve their condition.
2. The secondary mating commenced on 1st August following a pregnancy diagnosis on the herd. This mating was carried through until 30th September at which stage the bulls were removed and the cows which had not conceived at either of these matings will be carried through until the 1961 season or culled from the herd.

As a result of this programme the calving will extend over a period of six months in two definite groups. In 1961 the period will be closed down to five months and it is hoped that by 1964 the mating and calving will be further restricted.

In both the primary and secondary matings the cows were divided into two families:—

Family 1:—Those mated to Brahman bulls. In the primary mating 165 Angus breeders were included in this family as well as a small number of Brahman-Angus, Brahman-Shorthorn and Shorthorn cows. In the secondary mating 140 Angus were in this family with some Brahman-Angus, Brahman-Shorthorn and Shorthorn cows.

Family 2:—Those mated to F_1 Braham-Angus bulls. In the primary mating 97 Angus breeders were mated to four F_1 Brahman-Angus bulls. In the secondary mating there were 85 Angus breeders.

Both families were mated on an extensive system with the cows as one group. There was no attempt to arrange individual sire mating groups.

This system has some advantages under the existing circumstances of a shortage of Brahman and Brahman cross bulls. It has allowed the extended use of the present bulls over a greater number of cows and so brings closer the aim of the introduction of Brahman blood into the whole herd. By the time the mating has been closed down to four months there will be four more Brahman bulls and several more F_1 Brahman/Angus bulls available.

Calving.

A pregnancy diagnosis will be made on the secondary mating group at about six months gestation so that the pregnant cows can be given special treatment. As calving approaches the pregnant cows will be moved to calving paddocks which will enable the close supervision of calving. Stockmen will patrol the calving paddocks and each calf will be ear-tagged and recorded as soon after birth as possible. This duty merges well with the prophylactic treatment of the navel of each calf to prevent screw fly strike.

The cows will be broken up into the families mentioned above so that the parentage of the calves is known. This fact, as well as the sex of the calf, will be recorded at birth against the ear tag number. As cows calve they and their calves will be moved out of the calving paddocks into a "wet" cow paddock. The calving will begin in January and the bulls will be returned to this "wet" cow mob in separate families in April.

Branding and Marking.

Under the present mating programme this must necessarily be carried out in two stages. Calves are branded and marked at an average age of three months. Cross-bred calves, as well as being branded with a registered and age

Plate VI.—**Purebred European breeds and crossbred Brahman cattle on heavily grazed Elephant Grass pasture.**
(The crossbred cattle are grazing while others rest under shade.)

brand are given a distinctive brand on the near thigh of a numeral between 1 and 8 representing eighths of Brahman blood. This figure will provide a ready field identification of percentage of Brahman blood in the animal.

Pastures.

The basic pastures were mentioned above and the distinct wet and dry seasons dictate the pasture management of "Moitaka". During the wet season the herd is maintained on the natural pasture. This is the period of active growth of these pastures and they are utilized as fully as possible before the change in season dries them off. Although it is not the policy to burn these pastures, fires occur almost annually as a result of the hunting methods of the local people. This does provide a fresh growth following the first rains but the burning is, on the whole, badly timed and is a considerable problem. Every effort is made to graze heavily this pasture so that there is insufficient bulk to feed a severe fire.

During the dry season the cattle are shifted on to areas of cleared rain forest which are planted down to improve pasture. Management of these pastures to keep them in a condition suitable for the cattle is important. The excessive growth must be removed about six to eight weeks before grazing. In some instances this excessive growth is utilized in the preparation of silage and as a green feed supplement for dairy cows and horses. This management, therefore, must include the subdivision of these areas into small paddocks that can be intensively grazed for a short time and then rested. Under such conditions the Elephant grass-legume mixture will carry better than one beast to the acre.

Discussion.

In our attempt to produce cattle adapted to the hot lowland environment of the Territory of Papua and New Guinea we have been guided by experience in this field in other tropical and sub-tropical countries. In the United States of America most of the cross-breeding for adapted types was carried out by commercial breeders. The three most advanced groups of crossbreds in America are Santa Gertrudis (Rhoad 1949), Beefmaster (Joyce 1955) and Brangus. These types are stable crossbreds of Zebu and European breeds.

Controlled crossbreeding has been commenced in the Union of South Africa on experiment stations operated by the Government. The aim on these stations is to establish a type of cattle well adapted for production within the Union. The major breeding experiments consist of the breeding of Afrikaners, Shorthorns and Herefords as such, and the crossbreeding of Afrikaners on Shorthorns and Herefords with backcrossing to produce animals of varying percentage of Afrikaner blood. After 20 years, these experiments resulted in the development of the Bonsmara breed which is five-eighths Afrikaner and three-sixteenths Shorthorn and three-sixteenths Hereford and shows outstanding adaption to the local conditions (Joubert 1957).

Crossbreeding with dairy type cattle has been carried out with success in several different tropical countries. In Jamaica a new breed called the Jamaica Hope, a relatively fixed crossbred of Jersey and Sahiwal breeds with 75 per cent. Jersey, has been developed (Lecky 1949; Department of Agriculture, Jamaica, 1952). Extensive work has been carried out on military farms in India but much is not recorded. Littlewood (1933), provides details of Ayrshire-Sindhi cross-breeding in Madras State, and Stonaker, Agarwala and Sundaresan (1952) record the production characteristics of Sindhi crossbreds. Work is under way at Beltsville in the United States (Fohrman, McDowell, Sykes and Lee, 1951) with Sindhi cattle, and in Australia (Rendel, 1959) with Sindhi and Sahiwal cattle.

The first large consignment of Zebu cattle imported into Australia for crossbreeding with European breeds was brought in under the direction of the Council for Scientific and Industrial Research in 1933 (Kelley 1932). These animals were used in a co-operative experiment on Stations in North Queensland which were owned by private interests (Kelley 1943). The success of the crossbreeding from this importation prompted private importations of Brahmans after World War II as well as the importation for C.S.I.R.O. in which were included the animals at present in Papua and New Guinea. In this shipment were the Brahmans and Afrikaners in use on the National Cattle Breeding Station "Belmont", where the C.S.I.R.O. is carrying out research to investigate, from a genetic point of view, the physiology of adaption of cattle to a tropical environment (Kennedy and Turner 1959).

The environments of some of the areas in which these experiments have been carried out are compared with that of Port Moresby in the climographs in Figure 1.

Climographs were originally devised by Ball (1910) and have been applied to cattle breeding and development by Wright (1946). They are a convenient method of diagrammatically indicating the climate of an area to be studied and are constructed by plotting as a single graph the mean monthly temperature against the mean monthly relative humidity. The shape and position of the climograph gives a composite picture of the environment. Climographs can be used in predicting the adaptability of breeds of cattle to new environments. Where they show, by their close agreement, homoclimatic environments, the cattle from these environments are equivalent types. Similarly it may be assumed that the introduction of cattle into a new environment will show most success where the climograph of this new environment and of the original home of the cattle coincide.

The areas chosen for the climographs in Figure 1 are areas where crossbreeding for adapted cattle has been carried out.

The fairly close correlation of the climographs of Rockhampton (Queensland) and San Antonio (Texas) and of Port Moresby (Papua) and Port of Spain (Trinidad) indicate that the same type of cattle would be suitable to each corresponding environment. It is interesting to note that the climographs for Port Moresby (Papua) and Port of Spain (Trinidad) coincide closely with those of the home environments of the dwarf breeds of Indian and African Zebus. These "dwarfing" areas show the characteristics of high levels of temperature and humidity with a complete lack of any marked seasonal variation in climate. This type of climate provides a severe challenge to the production of high producing cattle.

The home environment of the Brahman animals used in this experiment shows a climograph that overlaps that of Port Moresby but for three months of the year the temperature is below the critical 70 degrees F. and for one month the relative humidity drops below 55 per cent.

The measurement of performance within the environment being used is body weight gain. Preliminary observations on purebred and F_1 crossbred types are under way. Critical

observations on the weight gain of various percentage groups will depend upon the establishment of significant numbers of these animals. Although critical observations are essential the present obvious advantage of the crossbred animal is appreciated by most of the cattle producers of the lowlands of the Territory. The demand for part Brahman animals at present exceeds the supply but the breeding programme that is now in operation should provide an adequate source of Brahman blood for the cattle herds of Papua and New Guinea.

ACKNOWLEDGEMENTS.

Thanks are due to Dr. J. M. Rendel, Chief, Division of Animal Genetics, C.S.I.R.O., Mr. H. G. Turner and Mr. J. F. Kennedy of this Division at the National Cattle Breeding Station, "Belmont", Rockhampton, for their advice and assistance in the establishment of the breeding programme, and to Mr. F. C. Henderson, Director, Department of Agriculture, Stock and Fisheries, for his encouragement and permission to publish this paper.

REFERENCES.

BALL, J. (1910). *Cairo sci. J.* 4 : 280 cited by Wright (1954).

BONSMA, J. C., VAN MARLE, J., and HOFMEYR, J. H. (1953). Climatological research on Animal Husbandry and its significance in the development of beef cattle production in Colonial Territories. *Emp. J. exp. Agric.* 21 : 154 - 175.

Department of Agriculture, Jamaica (1952). *The Jamaica Hope—a new breed of Dairy Cattle.* Kingston : Government Printer. 22 pp.

FOHRMAN, M. H., MCDOWELL, R. E., SYKES, J. F., and LEE, D. H. K. (1951). Progress report of the Red Sindhi cross-breeding experiment at Beltsville, Md. *U.S. Bureau Dairy Ind. Bull. No.* 128. 6 pp.

JACOBS, W. S. (1949). The American Brahman. *Amer. Brahman J.* 3 (11): 15, 17, 38.

JOUBERT, D. M. (1954). Breeding for Beef in Tropical and Sub-Tropical Climates—with special reference to the continent of Africa. *Colon. Pl. Anim. Prod.* 4 : 1 - 13.

JOUBERT, D. M. (1957). The Bonsmara breed of Cattle in South Africa. *Agric. Rev. (Lond.)* 2 (12): 15 - 17.

JOYCE, E. B. (1955). Tom Lasseter and has Beefmasters. *Pastoral Rev.* 65 : 720 - 722.

KELLEY, R. B. (1932). Zebu (Brahman) cross cattle and their possibilities in North Australia *C.S.I.R.* Pamp. 27.

KELLEY, R. B. (1943). Zebu cross cattle in Norhern Australia : an Ecological Experiment. *C.S.I.R.* Pamp. 172.

KELLEY, R. B. (1959). *Native and Adapted Cattle.* Sydney : Angus and Robertson. 275 pp.

KENNEDY, J. F., TURNER, H. G. (1959). A Project on Genetics of Adaptation in Cattle—Aims and Methods. *C.S.I.R.O. Div. Anim. Health & Prod.,* Rep. No. 8 (Series SW3): 26 pp.

LECKY, T. P. (1949). The Hope Jerseys. A Study of the breeding of Jersey Cattle at Hope Agricultural Station, Jamaica. *Dep. Agric. Jamaica Bull.* No. 42: 66 pp.

LITTLEWOOD, R. W. (1933). Cross-breeding for milk. *Indian J. vet. Sci.* 3: 325 - 337.

RENDEL, J. M. (1959). Division of Animal Genetics. C. S. I. R. O. Sydney. *Personal communication.* December, 1959.

RHOAD, A. O. (1949). The Santa Gertrudis Breed. The genesis and genetics of a new breed of beef cattle. *J. Hered.* 40: 115 - 126.

STONAKER, H. H., AGARWALA, O. P. and SUNDARESAN, D. (1953). Production characteristics of crossbred, backcross and purebred Red Sindhi cattle in the Gangetic plains region. *J. dairy Sci.* 36 : 678 - 687.

WRIGHT, N. C. (1946). Report on the development of cattle breeding and milk production in Ceylon. *Ceylon State Council, Sessional Paper* XX. 76 pp.

WRIGHT, N. C. (1954). *Progress in Physiology of Farm Animals.* ed. J. Hammond. London: Butterworth. Vol. 1, pp. 191 - 249.