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GUAM AGRICULTURAL EXPERIMENT STATION,

J. B. THOMPSON, Special Agent in [illegible]

ANNUAL REPORT OF THE GUAM AGRICULTURAL EXPERIMENT STATION FOR 1913.

UNDER THE SUPERVISION OF

OFFICE OF EXPERIMENT STATIONS

U S DEPARTMENT OF AGRICULTURE.

WASHINGTON

GOVERNMENT PRINTING OFFICE

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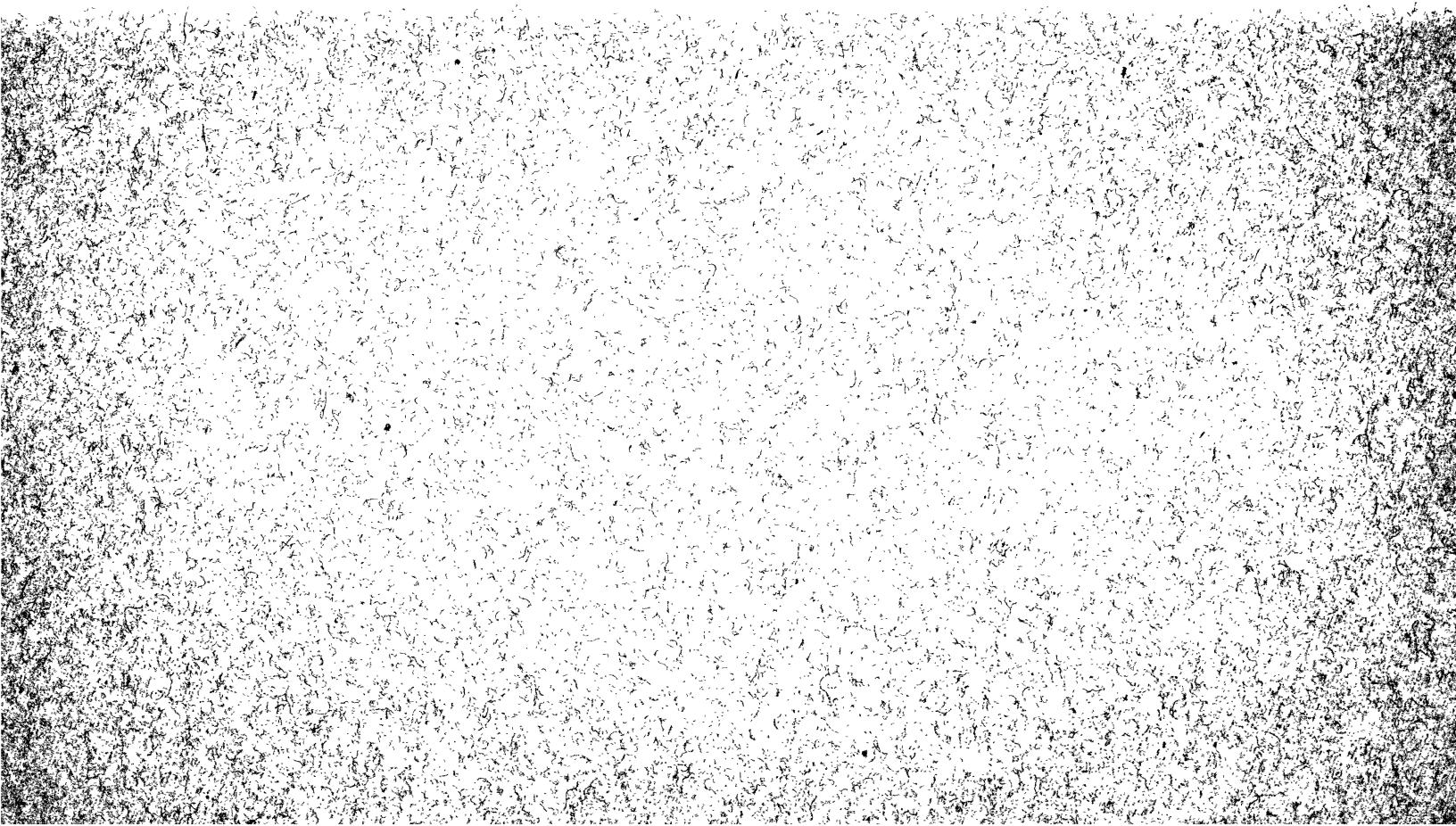

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GUAM AGRICULTURAL EXPERIMENT STATION, ISLAND OF GUAM.

[Under the supervision of A. C. TRUE, Director of the Office of Experiment Stations, United States Department of Agriculture.]

WALTER H. EVANS, *Chief of Division of Insular Stations, Office of Experiment Stations.*

STATION STAFF.

JOHN B. THOMPSON, *Special Agent in Charge.*
L. B. BARBER, *Veterinarian and Animal Husbandman.*
PETER NELSON, *Assistant.*

LETTER OF TRANSMITTAL.

GUAM AGRICULTURAL EXPERIMENT STATION,
Island of Guam, December 8, 1913.

SIR: I have the honor to transmit herewith the report of the Guam Agricultural Experiment Station for the fiscal year ended June 30, 1913.

Very respectfully,

J. B. THOMPSON,
Special Agent in Charge.

Dr. A. C. TRUE,
Director Office of Experiment Stations,
U. S. Department of Agriculture, Washington, D. C.

Publication recommended.
A. C. TRUE, *Director.*

Publication authorized.
D. F. HOUSTON, *Secretary of Agriculture.*

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ANNUAL REPORT OF THE GUAM AGRICULTURAL EXPERIMENT STATION FOR 1913.

By J. B. THOMPSON, *Special Agent in Charge*

INTRODUCTION.

The work of the past year was, in a large measure, a continuation of operations previously begun. The usual routine work connected with farm, field, and office now demands considerable attention, the extent of these duties having constantly increased since the station was established. Some improvements by way of grading and filling around station buildings, and through alterations and extensions to the lawns and walks have been effected during the course of the past annual period. A very convenient hog shed measuring 24 by 40 feet has been erected for the shelter and convenience of handling the station breeding hogs. (Pl. I, fig. 1.) This building is provided with a corrugated galvanized iron roof and a concrete floor and is intended to furnish a retreat from the heavy chilling rains of the wet season and a protection from the intense heat of the hot, dry period. In its construction four farrowing pens, of which the station has been in constant need, are provided. The new building facilitates the maintenance of cleanliness and renders sanitary conditions more easily controlled. Five double colony poultry houses (Pl. I, fig. 2) have also been erected within the past year to provide for the increased number of poultry and the work that is projected for the coming year. Each of these houses is 12 feet in width and 24 feet in length and is provided with suitable runs inclosed with galvanized wire poultry netting. These houses and runs may be utilized for housing 400 or 500 hens during the breeding season. The work in animal breeding, which will be considered in more detail under another heading (p. 7), has been continued throughout the year and the general results have been quite satisfactory. Experimental operations with field crops have been conducted on a less extensive scale than ever during the past year. The reduction in this line of the station work has been made necessary by the increased area of the station land being devoted to the production of forage for stock feeding, leaving less acreage available for experimental purposes. The area of cultivated land has been increased, however, through the

clearing and breaking of about 3 acres from the tract of land transferred to the station by Gov. G. R. Salisbury in 1912 and mentioned in the last annual report of the station. Practically all the forage required for feeding the stock has been grown on the station grounds. To produce this feed necessitates the use of a very large proportion of the arable land in the possession of the station, and as the herds increase in numbers a still greater acreage will be required. The acquisition of an additional tract of land capable of being brought under the plow is most desirable.

WEATHER CONDITIONS AFFECTING CROP YIELDS.

In 1912 a season of extreme drought prevailed in which there was practically no precipitation at the station during the period between the first week in December and the 10th day of June, and this drought was followed by an equally dry season during the past summer. In addition to the unusually dry seasons of two successive summers several severe windstorms visited the island within the same period, and these combined forces have seriously affected the copra crop of the past fiscal year. The extent of the damage caused by these unfavorable agencies may be partially appreciated from the fact that the copra exports for the fiscal year 1912 amounted to 1,047 tons, valued at $59,924.10, United States currency, while the exports for the past year only reached 565 tons and brought a return of $37,057.89 to the growers. These figures are not intended to indicate the full extent of damage resulting from unfavorable weather conditions, as there are young plantations coming into bearing which should have increased the production of the past year considerably over that of the preceding fiscal year had ideal weather conditions prevailed. On the other hand, it might be said that probably a somewhat larger amount of copra was stored and ready for shipment at the close of the fiscal year 1913 than at the end of the preceding year.

HORSE BREEDING.

The progress made in the work of horse breeding has been fairly satisfactory. On December 13, 1912, the registered Morgan filly Evangeline met with an accident in which the right fore leg was badly fractured. Blood poisoning set in soon following the accident and on December 20, 1912, one week after the injury was sustained, the animal, then in a hopeless condition, was killed to prevent useless suffering. Aside from this misfortune the horses have continued to thrive and were in better condition at the close of the past fiscal year than at the end of the preceding annual period.

The increase for the year consisted of the filly foal Mariana Bell out of the Morgan mare Princess Angeline and sired by the black

Morgan stallion Cassius 5869. This filly, foaled February 25, 1913, is of good conformation and has a natural pacing gait. In both conformation and style this filly shows greater resemblance to the dam than to the sire. Another foal, a colt sired by Cassius and out of a native mare privately owned by Mr. P. Nelson, of this station, shows a distinct improvement in type over the ordinary native colt.

The three mares belonging to the station have all been bred to Cassius, and several other mares, some of American blood and others of purely native stock, belonging to outside parties have also been bred to the same stallion. Four mares belonging to private owners have also been bred to the young stallion Donald 6483 during the past season. Both stallions have shown a tendency toward impotency, but it is hoped that this tendency may be rectified through a modification in the methods of feeding and handling them.

CATTLE BREEDING.

The work inaugurated during the preceding fiscal year to secure a better class of cattle through the use of introduced American Ayrshire cattle has gone on without reverses of any nature during the year just ended. The imported cattle have, without exception, continued to thrive, and aside from a few cases of an apparently temporary diseased condition manifested by the presence of an abnormally high temperature, the causes of which are not fully understood, each has maintained a good condition of health. The interest shown by the native cattle owner in this line of work during the first year has been continued and a number of calves of the native-Ayrshire cross are now to be found scattered over the island. Twenty-seven cows have been bred to the bull Willowmoor John Gray during the fiscal year ended June 30, 1913, giving this bull a total service record of 50 cows for the 20 months since his importation. In addition to this number eight cows have been bred to the young bull Netherhall King B 14987 during the same period. This bull was an unweened calf at the time the animals arrived in Guam in October, 1911, and was just 2 years old at the close of the year herein reported. On October 16, 1912, the registered Ayrshire cow, Willowmoor Red Rose, gave birth to a heifer calf (Pl. II, fig. 1) by Willowmoor John Gray. This heifer has been raised on the pail and has made steady and consistent gains. Another calf (Pl. II, fig. 2), a bull by the same sire and out of Willowmoor Queen Bess, was calved on January 23, 1913. At the time of birth this calf was small and lean, weighing only 50 pounds, but he has made fair gains and at the close of the year, when 5 months old, his weight was recorded at 318 pounds. It should be understood that in the management of this calf, as with the other young stock, no effort was made toward forced growth

with the object of placing the animal in temporary show condition or with the desire to make a record. His management has been directed toward the maintenance of steady growth and the promotion of permanent hardiness. As these two calves are the first, and so

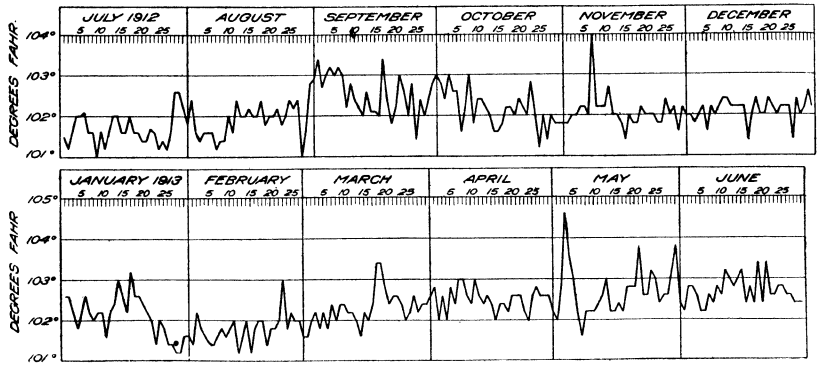

FIG. 1.—Temperature chart of Netherhall King B.

far the only, pure-bred Ayrshires calved on the island, their growth and development under Guam conditions is considered of much significance, and their initial progress, at least, seems to presage successful results from the introduction of this new breed of cattle

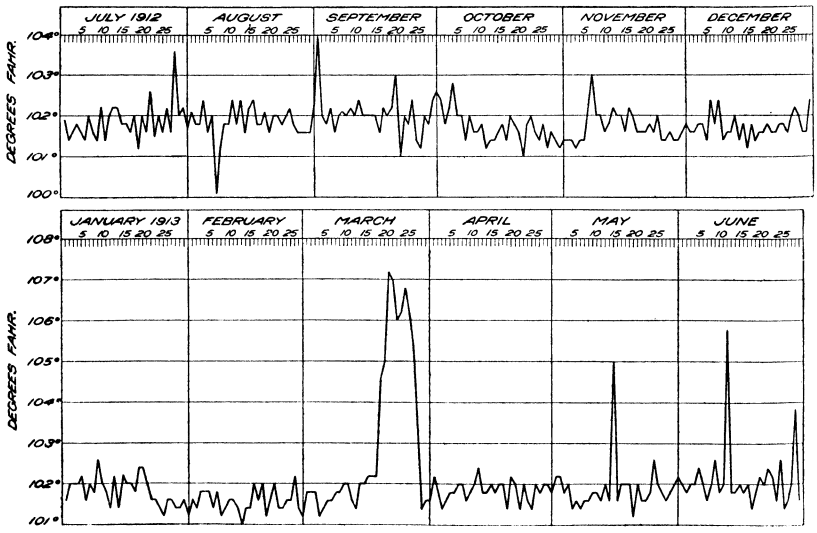

FIG. 2.—Temperature chart of John Gray.

into Guam. As a whole, the year's work with the pure-bred stock has been entirely satisfactory. The bulls have had all the services permissible, indicating the extent of interest manifest by the native cattle owners in the work; there has been no loss among the cattle

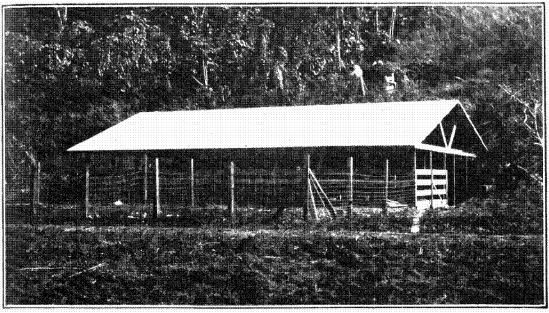

FIG. 1.—HOG HOUSE.

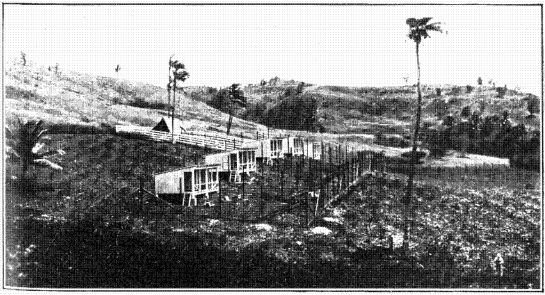

FIG. 2.—POULTRY PLANT.

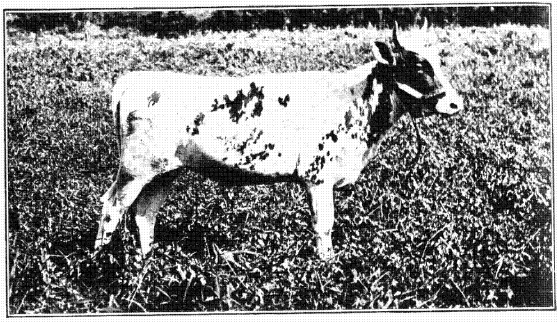

FIG. 1.—AYRSHIRE HEIFER CALF.

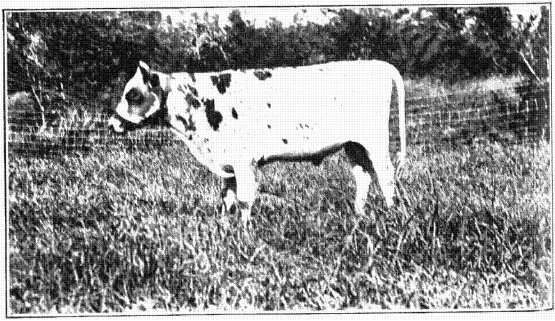

FIG. 2.—AYRSHIRE BULL CALF.

during the year, and both cows have brought forth good healthy calves. The grade calves resulting from the breeding of native cows to the Ayrshire bulls have generally proved greatly superior to the ordinary native scrub animal. Two very good individuals of this breeding are now owned by the station. One of these is a heifer sired by the bull Willowmoor John Gray and recently acquired as a promising addition to the station herd, and the other, a bull calf which has been raised by the station. Both of these animals show marked improvement over the native type in both size and general conformation.

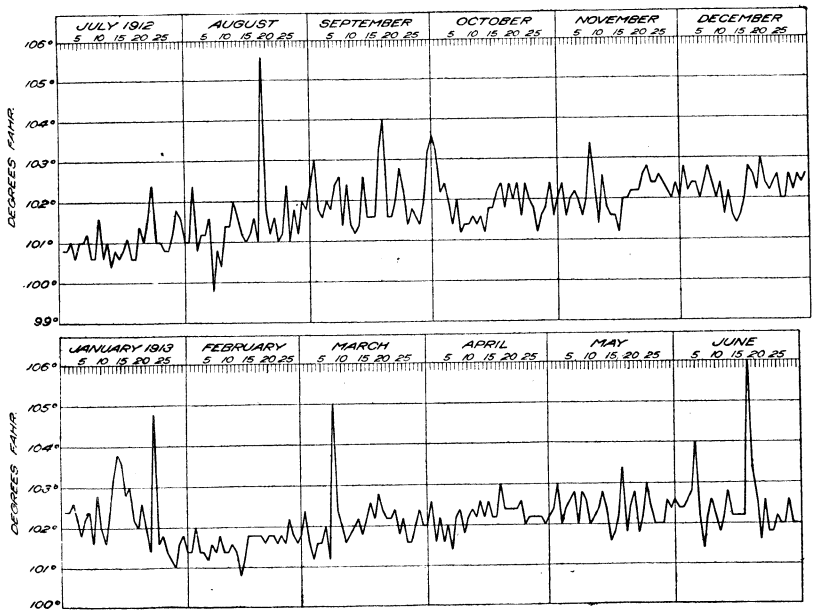

FIG. 3.—Temperature chart of Queen Bess.

Observations in the daily body temperature of the imported cattle, which were begun soon after the introduction of these animals in October, 1911, have been recorded during the past year. Periods of high temperatures similar to those observed during the preceding year and discussed in the report for 1912 have been noted, and each of the four animals have shown at least one such period during the year covered by this report (figs. 1–4). In some instances these fever periods have not been marked by excessively high temperatures and have been of comparatively short duration. In such cases the detection of disease would have been difficult without the use of the clinical thermometer. On the other hand, however, cases have been dealt with in which the temperatures have risen above 107° F.

and the period prolonged for more than a week. The most severe attack during the year was that of Willowmoor John Gray, occurring between March 19 and 28, inclusive. The daily temperatures of this

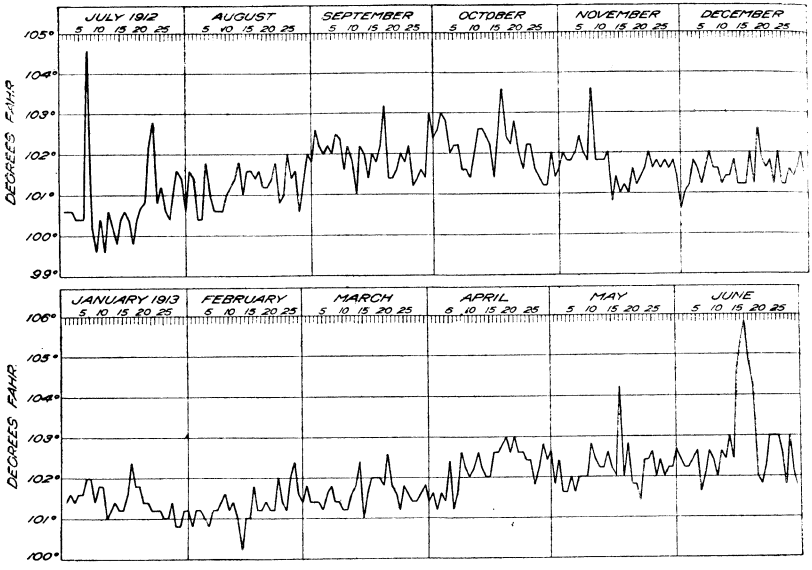

FIG. 4.—Temperature chart of Red Rose.

animal for the period mentioned are recorded in temperature (fig. 2), but in order to reduce the results to a form that will be more easily seen, these data are tabulated, as follows:

Temperature record of Willowmoor John Gray, covering a period of fever from March 18 to 29, inclusive

Date.	Atmospheric temperature, 3 p. m.	Animal-body temperature, 3 p. m.	Date.	Atmospheric temperature, 3 p. m.	Animal-body temperature, 3 p. m.
	°F.	°F.		°F.	°F.
Mar. 18	86	102.2	Mar. 24	86	106.2
19	83	104.6	25	82	106.8
20	85	105.0	26	86	106.2
21	88	107.2	27	85	105.4
22	87	107.0	28	84	103.4
23	88	106.0	29	84	101.4

During the course of this fever the first indication of disease, other than an abnormally high temperature, was observed about 4 o'clock p. m. on March 22, when weakness was indicated by the animal constantly shifting the weight of the hind quarters from one foot to the other. At the same time a trembling of the muscles of the hind legs and flank was noted, and the animal flinched with pain under the least pressure of the kidneys. During the latter stages of the attack the

bull showed but little desire for food or water, stood but little, and fell away rapidly in flesh. As the temperature dropped to normal the animal gradually recovered his usual appetite and soon regained his former condition of flesh. In each of the series of high temperatures observed in the various imported animals, since their introduction 20 months ago, symptoms similar to those just described have been noted.

At the close of the fiscal year ending June 30, 1913, the cattle in the station herd numbered 21, which are divided into pure-bred Ayrshires, Ayrshire-native cross-bred animals, and native stock, as follows:

Pure-bred stock:	
Ayrshire cows	2
Ayrshire bulls	2
Ayrshire calves	2
Total number of Ayrshires	6
Grade stock:	
Ayrshire × native bull	1
Ayrshire × native heifer	1
Total number of grades	2
Native stock:	
Cows	6
Heifers, weaned and under two years	4
Young bull, weaned calf	1
Unweaned calves (bulls)	2
Total number of native scrubs	13

HOG BREEDING.

The progress shown in this line of the breeding work during the first half of the fiscal year was specially gratifying, no other line of the work having attracted as much attention. In April disease broke out among the breeding stock, resulting in the loss of both pure-bred Berkshire boars and one of the pure-bred sows of the same breed. The two sows from the original importation having failed to breed prior to the loss of the boars, our pure-bred stock was thus reduced to a single sow, and the perpetuation of the pure strain without further importations was rendered impossible. The death of the two boars was specially regretted, as the cross by them upon the native sows had proved a remarkable improvement in size, quick development, and general conformation over the inferior native scrub hog. The advantages derived from the use of a superior sire being more quickly demonstrated in hog breeding than in the breeding of animals of larger size, this work has met with greater manifestations of interest than has been shown in any of the other lines of animal breeding. Between the dates of their introduction and death, covering a period

of about 18 months, 61 sows were bred to the two boars, and the pigs farrowed as a result of these breedings seem to possess the hardiness of the ordinary island type, while their distinct superiority may be recognized at sight. Prior to the time of death of the boars the station was fortunate in having bred and raised a number of half-blood pigs by one of these boars and out of a native sow and in having selected five of the sows, two of which were bred to the unrelated Berkshire boar before his death, for breeding purposes. As a result of this latter cross we now have one very good young boar pig and two good young sow pigs, all carrying three-quarters of the Berkshire blood. The illustrations herewith show the almost phenomenal improvement of the type by the use of the Berkshire boar. Plate III, figure 1 shows native sow No. 1, the native parent of all the half-blood Berkshire hogs now owned by the station; Plate III, figure 2, illustrates the half Berkshire sow No. 22, a daughter of sow No. 1; and Plate III, figure 3, represents a three-quarter Berkshire boar, No. 37, a second generation descendant of native sow No. 1.

POULTRY RAISING.

The work of the past year in poultry raising has been specially interesting. Chicken pox has been less prevalent than it was during the preceding year. Artificial incubation has been practiced, with increased success. In handling the incubator it has been found that better hatches and stronger chicks are obtained by maintaining a temperature of from 100° to 101° F. in the egg chamber during the hatch than by running at a higher temperature. Two incubators, both of which are provided with hanging thermometers, have been employed in the work. Chicks hatched from the incubator in which the usual incubating temperature of 103° F. has been maintained begin to hatch on the nineteenth day, indicating the subjection of the eggs to undue heat during the hatch. The chicks, too, hatched under an incubating temperature of 103° F. often show less vitality than is the case with chicks hatched under a temperature of from 100° to 101° F. The results of two years' experimentation also indicate that chicks hatched during the cool dry season from November to March have much greater vitality than those hatched at a later date in the dry season. The conclusion indicated in previous work that eggs intended for hatching should not be held under the usual conditions for more than a week prior to their being placed in the incubator have been further substantiated in experiments conducted during the past season. The station has raised during the season just ended more than 550 chickens of the Brown Leghorn and Barred Plymouth Rock breeds, more than four-fifths of that number being of the former breed.

Whether or not the introduced breeds are to prove well adapted to island conditions has not yet been determined. In the work conducted at the station the pure-blood fowls have given full promise of hardiness and have required no unusual amount of care, but in the hands of the native they have not given the same good account of themselves. Since the arrival of the first dozen hens and four cockerels in October, 1911, over 100 dozen eggs have been distributed to private poultry owners free of charge, in order to test the breeds out thoroughly under prevailing conditions in competition with the native fowl, and it is doubtful if more than 75 chickens were grown to maturity from the entire distribution. Assuming that no unforeseen misfortune overtakes us in the work prior to another favorable breeding season, the station should have a comparatively large number of young cockerels available, which it is hoped we will be able to sell or dispose of in such a manner as will best place them with fowls intended for breeding purposes and where they will not be associated with the native fighting cock, which would soon subdue them. A dissemination of male breeding birds, such as it is hoped will be possible, should prove of much value in improving the present strain. The cross between the Brown Leghorn and the native fowl should prove hardy, and at the same time it should possess egg-laying qualities superior to those of the native hen, and the cross between the Plymouth Rock and the native strain should show the same advantage, in addition to increased size.

A native strain of fowls, for which the native poultrymen claim immunity to chicken pox, exists on the island; and so much faith is shown by Chamorro farmers in the resistance of the strain to this disease that many are even fixed in the superstition that the presence of a chicken of this type in a flock aids materially in preventing the loss of associated fowls. Very little credence is placed in these claims of an immune type, however, since so many of the beliefs of the average native planter are based wholly upon common superstition. Nevertheless, it is believed that the crossing of our improved breeds upon the various hardy strains of native fowls is a particularly promising line of work, as such a cross should result in a hardy type, better able to thrive under local environments than the pure-bred fowls now appear to be, and their egg-laying tendencies should be more highly developed than are those of the ordinary native hen. The cross between the native chicken and the Plymouth Rock should show the same improvement with the additional advantage of greater size. Upon the arrival of the coming breeding season it is planned to inaugurate, in addition to the work with the pure breeds, a series of cross-breeding experiments using individuals of

the strain of native hens for which immunity is claimed as the native foundation to secure hardiness and a Plymouth Rock cock to give size and improved egg-laying qualities. A pen of hens of this native strain will also be kept with a cock of the same strain with the object of obtaining a larger stock of this type for further cross-breeding work, and this test should disclose some facts relative to the disease-resistant powers of the strain. Individuals of this type have dark, slate-colored legs, a very dark skin, and are particularly distinguished by an unusually black flesh. There is a wide range of variation in the plumage of different birds, some having a solid white, others a solid black color, and still others being black with either silver or golden colored lacings on the neck feathers. The comb is poorly developed and of a very dark or a distinctly black color. As a whole the strain is mixed with few fixed characteristics, but some characters are generally present which point to the Black Polish as its probable origin. Hens of an apparently related type but having a distinctly blue plumage resembling to some extent the Blue Andalusians are also common among native fowls.

FORAGE CROPS.

The need of nitrogenous feeding stuffs which can be successfully produced on the island is keenly felt. *Paspalum dilatatum* furnishes splendid pasturage and Para grass (*Panicum molle*) yields an abundance of green feed for soiling purposes. Both of these grasses are signally adapted to conditions in Guam, being remarkably vigorous growers during the wet season, and, on the other hand, possessing special drought-resistant qualities, rendering them valuable during periods of extremely dry weather. The first acre planted to Para grass after its introduction into Guam by this station has now been cropped constantly for two years and is still yielding good crops. The Paspalum has also been cropped for almost two years. This grass was originally transplanted from the seed bed to the field in rows 24 inches apart at intervals of 15 inches, and for two years it has been overstocked during all seasons of the year. Trampling when the soil is wet and muddy appears to have a tendency to spread it, and a good growth now occupies the entire field, the original rows being but indistinctly recognized among an almost solid growth of this grass. Grass is not, however, wholly satisfactory as an entire forage ration, and especially is this true in the management of milch cows and young growing stock. Much more successful results than are possible under the present system would be possible could the ration of grass be supplemented with some nitrogenous forage. To fill this want the peanut is the most promising crop that has been under trial at this station. This legume not only produces good

yields of top growth which would supply the required forage high in protein but also yields good returns of nuts which could be advantageously utilized as a hog feed. Field pumpkins have been grown successfully at the station during the past fiscal year and the crop produced was turned to good account as a stock feed.

STUDIES OF GUAM RANGE PLANTS.

GRASSES.

The island of Guam with relation to its pasture conditions is naturally separated into two divisions—the northern section, which is covered with forests, and the southern section, consisting of an undulating plain covered with uncultivated grasses. Many of the clearings of the northern section are overgrown with grasses and other species constituting excellent pasturage, while in the forests are found various shrubs and trees which also supply good, nutritious feed. This section is, however, poorly watered during the dry season, and consequently all the largest cattle ranches are established on the savannas of the south, where an abundant supply of water is always available. One of the principal grasses of the savannas is *Miscanthus floridulus*, a coarse woody swordgrass known by the native name of "neti," which while young and tender furnishes good pasturage, especially for carabao, but becomes coarse and fibrous in the later stages of its growth. Along the river valleys and on the lowlands fringing the coast *Andropogon aciculatus* is the most important species on the uncultivated range. This grass is called "inifooc," or "inifuk," and is a splendid pasture grass, but has the disadvantage of being provided with adherent awns, which collect on the clothing of those coming in contact with them. These awns also pierce the legs of horses, causing, in the case of animals constantly on pasture, sores which quickly mend when the animals are removed to land free from this species. Bermuda grass (*Cynodon dactylon*) is also a good pasture grass where it grows on lowlands in more or less close proximity to river courses and other sources of abundant moisture. As a lawn grass, Bermuda has no equal in Guam, but it is sometimes crowded out by *Centella asiatica*, a creeping weed of the parsley family. Among the species which grow in the forests and other locations rendered unsuitable for many grasses by a partial shading of the soil are *Centotheca latifolia*, *Oplismenus compositus*, and *Pollinia glabrata*. The following alphabetically arranged list includes all the species of the grass family included in the collection made by this station in cooperation with the Philippine bureau of science. (See also p. 20.) The list is known to be incomplete, and it is probable that a comparatively large number of grasses of the Guam flora are unrepresented in our collection.

Andropogon aciculatus.
A. contortus.
A. halepensis (not widely distributed).
A. sorghum.
Bambusa blumeana.
B. nana.
B. vulgaris.
Cenchrus echinatus.
Centotheca latifolia.
Coix lachryma-jobi.
Cynodon dactylon.
Dactyloctenium ægyptiacum.
Digitaria ciliaris.
D. mariannensis n. sp., Merrill.
D. sanguinalis.
Dimeria chloridiformis.
D. ornithopoda.
Eleusine indica.
Eragrostis tenella.
Isachæmum longisetum n. sp., Merrill.
I. rugosum.
Isachne miliacea.
Miscanthus floridulus.
Monerma repens.
Oryza sativa.
Oplismenus compositus.
Panicum ambiguum.
P. colonum.
P. distachyum.
P. isachne.
P. luzoniense.
P. maximum.
P. molle.
Paspalum conjugatum.
P. dilatatum.
P. scrobiculatum.
Phragmites karka.
Pollinia glabrata.
Saccharum officinarum.
Setaria flava.
Sporobolus indicus.
S. virginicus.
Zea mays.

SEDGES.

On the lowlands, and especially on wet, boggy soil, sedges of ma
species are found, sometimes in mixture with grasses and occasiona
on excessively wet land, constituting a large percentage of the vege
tion. As a class the sedges are of much less importance than are
grasses, yet some species of this family are worthy of note as use
pasture plants, while others should be mentioned as weeds wh
crowd out and suppress more useful species. In the wet season, wh
the sedges are specially abundant, they furnish a very considera
amount of the lowland pasturage. They are of greater importance
ranges where carabao are pastured than on land where cattle
grazed, since animals of the former class naturally feed upon
coarser types of vegetation. The following is a list of the species
the sedge family now in the station collection:

Carex fuirenoides.
Cladium aromaticum n. sp., Merrill.
C. gaudichaudii.
Cyperus compressus.
C. difformis.
C. flabelliformis.
C. rotundus.
Diplacrum caricinum.
Eleocharis capitata.
E. plantaginoides.
Fimbristylis complanata.
F. diphylla.
F. maxima.
F. miliacea.
F. spathacea.
Fuirena umbellata.
Kyllinga brevifolia.
K. monocephala.
Mariscus cyperinus.
M. stuppeus.
Rynchospora corymbosa.
R. wallichii.
Scirpus erectus.
Scleria laxa.
S. margaritifera.
Torulinium ferax.

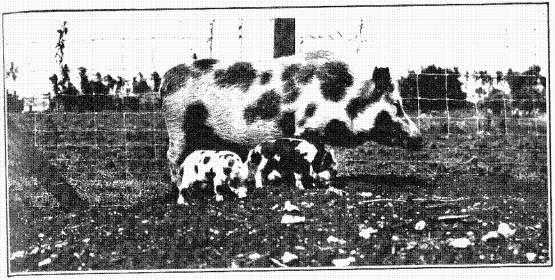

FIG. 1.—NATIVE SOW NO. 1.

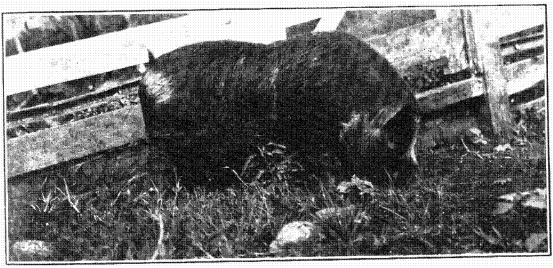

FIG. 2.—GRADE SOW NO. 22, DAUGHTER OF NATIVE SOW NO. 1.

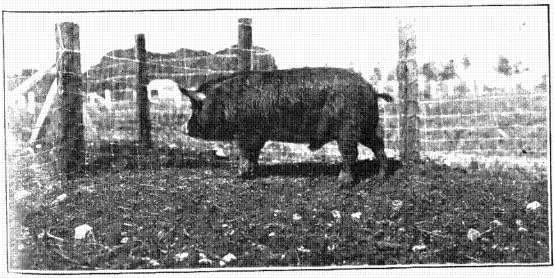

FIG. 3.—BOAR PIG NO. 37, NATIVE ANCESTOR TWO GENERATIONS REMOVED.

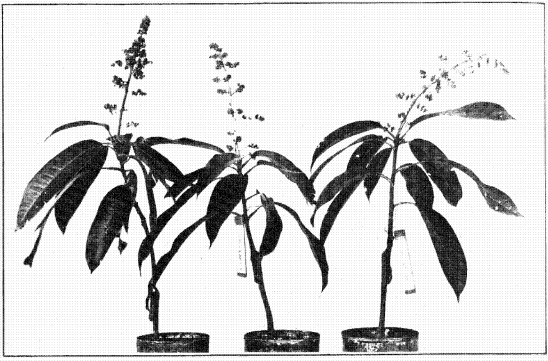

FIG. 1.—INARCHED MANGO IN FLOWER.

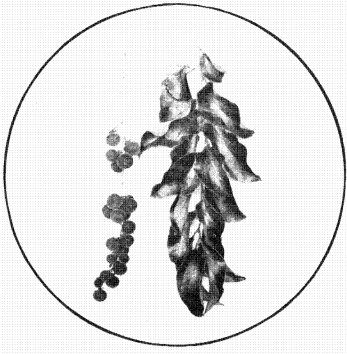

FIG. 2.—FRUIT OF ABERIA GARDNERII.

MISCELLANEOUS PLANTS.

There is a large number of widely different plants in Guam which furnish feed for animals. Among these the breadfruit tree (*Artocarpus communis*) is probably the most important. The succulent young growth bearing an abundance of leaves is cut and given to cattle, which eat the leaves with great relish. The practice of feeding the leaves of this tree is most commonly followed during the dry season when other forage is scarce. The false stems of bananas and plantains and the vines of the sweet potato are also utilized for feed. On lowland sod *Desmodium triflora* and *D. heterophyllum* are found associated with mixed grasses and often add much to the value of the pasture. In similar locations, though less common, *Alysicarpus nummularifolium* is found. A twining plant of the morning-glory family (*Merremia hederacea*) for which cattle, hogs, and chickens show remarkable relish, makes luxuriant growth on newly cleared areas, as well as on cultivated lands. A somewhat similar vine (*Ipomœa congesta*) is also relished by stock. Cattle and carabao also feed upon the succulent stems and leaves of *Commelina nudiflora*, a weed that springs up in cultivated fields during the wet season. This plant is called "siempre viva" by the natives, and when it once becomes established on a tract of land it is very difficult to eradicate.

ORCHARD NOTES.

THE MANGO.

The propagation of the ordinary Guam mango (*Mangifera indica*) on the stock of the "Saipan" mango (*M. odorata*), as outlined in our last report, has been continued. The method practiced in this propagation work was that of inarching by the system described by Oliver,[1] and this method has proved both simple and practical. The system has special advantages over the usual cumbersome method of constructing supports for heavy potted plants not only in Guam but elsewhere within territory subject to severe windstorms. Seedling plants prepared by the Oliver system and firmly bound to the parent tree have been found to withstand the force of a severe typhoon during the process of uniting without injury when plants supported on a platform would have been destroyed.

As has been mentioned in a previous report of this station, the time intervening between the planting of a seedling of the local variety of *Mangifera indica* and the fruiting of the tree varies from 12 to 20 years. In the work at the station inarched plants have flowered within four months from the time of inarching (Pl. IV, fig. 1). Trees of that age are too young and lack sufficient development to support or ma-

[1] Oliver, G. W. U. S. Dept. Agr., Bur. Plant Indus. Bul. 202.

ture fruit without causing permanent injury to the tree, but the results indicate a tendency of this variety when inarched to early bearing, and it is believed that trees thus propagated will fruit as soon as they have size and strength sufficient to support a crop. A number of native laborers have been instructed in the methods of inarching and their training has enabled them to perform the operation successfully.

Several new varieties have been introduced within the past year. These consist of the varieties Piri and Alphonse from Hawaii, and Bennett Best, Red Number Eleven, Singapur, and Totafari from Florida.

ABERIA GARDNERII.

Six plants of this jelly plant were introduced from Florida and planted at the station in 1911, and all but one plant, which was lost through transplanting to a new location on the station grounds some months later, have made rapid growth. During the past year all these plants have flowered profusely, but only one has set fruit (Pl. IV, fig. 2). This one shrub has been remarkably prolific, however, and two good crops, with another nearing maturity at the close of the period covered by this report, have been gathered from it during the year. The first crop was harvested during the first week in January and the second crop of 417 fruits was gathered about the middle of April. It is believed that had not the fruit been tampered with by visitors the number would have exceeded 500 at picking time. A limited supply of seedlings of this new fruit have been started and will soon be available for distribution, though it is probable that plants propagated from the fruiting specimen at the station by some asexual method would return the best results. The above plants and those of *A. caffra* were planted at the same time. Plants of the latter species have not yet shown indications of fruiting.

CITRUS FRUITS.

The imported trees of the Mediterranean Sweet orange, Triumph pomelo, and Eureka lemon have not given entire satisfaction, due, it is believed, to unfavorable soil conditions of the tract upon which they were grown. These trees were introduced from California during the fiscal year 1910, and since that time many of the trees have been lost from a disease, probably "gum disease," which is prevalent among citrus trees throughout the island. The soil of the station is a very heavy clay and has not adequate drainage for carrying off the excessive waters of the wet season. This condition is thought to have rendered the disease more fatal than it would have been under more favorable environments. The disease has attacked all species, being

most pronounced in the case of the lemon and least injurious in case of the orange. Such orange trees as have not been seriously affected by this disease have made satisfactory growth and were carrying their first fruits at the close of the fiscal year. A further introduction consisting of a few trees each of Valencia Late, Ruby Blood, and Navel oranges, Marsh Seedless pomelo, and Villa Franca lemon, have been obtained during the past fiscal year, and these were planted on a different location, which it is hoped will prove better suited to their growth.

ANNONAS.

A few seedlings of the cherimoya (*Annona cherimola*) were obtained through the Office of Seed and Plant Introduction of this department near the close of the previous fiscal year. The growth of these plants during the first few months led to the belief that the possibilities of success could be increased by working these seedlings upon the stocks of some of the various species of Annona that are common on the island, and experiments leading to that end were begun. Seedlings of *A. cherimola* were found to unite readily with those of both the bullock's heart (*A. reticulata*) and the sour-sop (*A. muricata*), and several inarched plants of the new species on these two stocks are now available for planting.

It has been observed at this station that there is a general tendency for nursery plants to grow tall and leggy with insufficient strength to support their weight, especially in the event of strong winds, and in order to grow good, stocky plants severe top pruning or heading in should be practiced regularly.

MISCELLANEOUS INTRODUCTIONS.

Among a number of new fruit introductions that have been successfully made during the past year, passing notice should be given the star apple (*Chrysophyllum cainito*), the akee tree (*Cupania sapida*), the Surinam cherry (*Eugenia uniflora*), the Barbados cherry (*Malpighia glabra*), the Spanish lime (*Melicocca bijuga*), the ceriman (*Monstera deliciosa*), the strawberry guava (*Psidium cattleyanum*), and the Otaheite apple (*Spondias dulcis*). Various other economic plants, of which the algaroba tree (*Prosopis juliflora*), the Panama-hat plant (*Carludovica palmata*), the cocaine plant (*Erythroxylon coca*), *Eucalyptus alba*, vanilla (*Vanilla planifolia*), and *Xanthosoma sagittifolium* are a portion, have been introduced successfully within the year. A white flowered variety of "cadena de amor" (*Antigonon leptopus*), a yellow flowered variety of *Cæsalpinia pulcherrima* new to the island, Honolulu holly (*Schinus* sp.), and the oak-leaved papaya (*Carica quercifolia*) have also been received.

BOTANICAL COLLECTION.

After considerable correspondence during the preceding fiscal year between Mr. E. D. Merrill, botanist of the Bureau of Science of the Philippine government, and the special agent in charge of this station in an effort to secure a native collector from the Philippines, it was found impossible to obtain the services of a satisfactory man from that place, consequently Mr. R. C. McGregor, of the above-mentioned bureau, came to Guam and with a native laborer from this station as helper collected specimens of the flora of Guam during a month of his vacation period. The material collected during that period amounted to 283 numbers. At the end of this time the native laborer had received sufficient training to enable him to continue the work, and material amounting to 480 numbers was subsequently collected and this was forwarded to Mr. Merrill for identification. In this work each number taken included sufficient material for several sheets, and Mr. Merrill very liberally agreed to return to this station one identified specimen of each number mounted on a standard herbarium sheet. This arrangement has given the station possession of an incomplete but valuable herbarium collection of the plants of Guam at a very nominal expense. The work has been very interesting in that not only has a large number of species not previously known to exist in Guam been found, but that one new genus of the myrtle family and some forty odd species of different families previously unknown to science have been described from the collection.

WORK WITH THE HONEYBEE.

During the fiscal year to which this report applies considerable prominence has been given the work of encouraging the adoption of modern and improved methods of handling the honeybee. As was mentioned in the report for the fiscal year ended June 30, 1912, all the honeybees on the island of Guam have descended from a single queen bee introduced by the naval government from Honolulu in the year 1907. In order to infuse new blood into the stock the station has introduced several queens during the course of the past fiscal year. An equipment of modern supplies suitable for the management of a small apiary has been obtained by the station and the use of these supplies is being demonstrated for the benefit of those interested in the work.

A simple method of transferring bees from the crude box hive in common use to the modern movable frame hive has been devised by the modification and adaptation of a method [1] in use by some apiarists for hiving colonies from hollow trees. The preparation for trans-

[1] Root, A. I. and E. R. A B C and X Y Z of Bee Culture. Medina, Ohio.

ferring by this method requires the construction of a bee-tight box provided with a door, or removable end, sufficiently large to permit the introduction of the box hive from which the colony is to be transferred. In one end of this box a Porter bee escape is arranged, and after the box hive has been introduced, a Langstroth hive with a nucleus and a fertile laying queen is placed with its entrance not farther distant than a few inches from the bee escape. The bees from the box hive pass out through the bee escape, but being unable to return through it they find their way into the decoy hive near by.

The box hives in use in Guam are of widely different sizes and styles, as almost any available empty box that may be conveniently obtained when needed is used as a hive. Many of these boxes are so loosely constructed that cracks large enough to serve as beeways are found between the boards on all sides, and the cover is generally nailed fast to the box. The transfer of a colony of bees from a box hive of this class is very unsatisfactory unless some method of inducing or forcing the bees to abandon the old hive and take possession of the new one is practiced. The method employed at this station is necessarily slow, requiring a month or more in which to transfer a colony, but there are conditions under which the loss of a little time is no great disadvantage, and under such conditions the above method renders possible the transfer and utilization of specially strong and valuable colonies which would be of little value in their original box hive.

The colonies in the station apiary have shown unusually rapid increase. On December 1, 1912, the station had but 2 good, strong colonies, and at the close of the fiscal year, just 7 months later, this number had increased to 15 good colonies.

SOME HONEY PLANTS OF GUAM.

Since the first colony of honeybees was obtained by this station in October, 1911, observations were made of some of the flowers from which honey was being collected. The coconut palm is one of the principal honey-producing plants of the island. Under favorable conditions this palm flowers almost continuously, and during the dry season when few other honey-producing plants are in bloom it furnishes practically all the honey gathered by the bees. Bees also frequent open bamboo joints in which tuba, the sap of the coconut palm, is being collected, and are able to extract a certain amount of saccharin matter from this liquid which is used in comparatively large quantities as a beverage and in the preparation of various products such as sirup, sugar, vinegar, and alcohol. The "cadena de amor" or chain of love vine (*Antigonon leptopus*), a beautiful flowering vine, is a splendid honey plant, but in Guam its occurrence is not sufficiently

extensive to render it of any great importance to the beekeeper. Corn is sometimes visited by bees in large numbers, but it is probable that they are attracted largely for the pollen which this plant provides. The Ceara rubber tree (*Manihot glaziovii*) would seem to be a heavy yielder of honey from observations taken on a single specimen tree at this station. The tree flowers for a period covering several months in the year and during clear weather while the flowers are open great numbers of bees swarm about the tree collecting honey. This tree has flowered at the station in 15 months from the time the seeds were planted. The "camachili" (*Pithecolobium dulce*) is also visited by bees under certain conditions. This tree is common on the island and flowers during the dry season when the honey flow is light. During the past year trees at the station have borne a mass of flowers throughout a long season. These trees have been constantly under observation with relation to their attraction for the honeybee, and the latter has been found working on them only a few times during the entire season and only in the early morning hours. The kapok tree (*Ceiba pentandra*) is also a good honey-yielding plant. It flowers during the early part of the dry season. This tree does not bear a profusion of bloom. "Siempre viva" is the native name for a small decumbent plant (*Commelina nudiflora*) bearing a light-blue flower which is visited by bees in large numbers during the early morning hours. In Guam this plant springs up during the wet season and blooms during the months of September, October, and November.

TEMPERATURE RECORDS.

Records of maximum and minimum temperatures at the Guam station throughout the year ending June 30, 1913, are shown in the following charts (figs. 5 and 6):

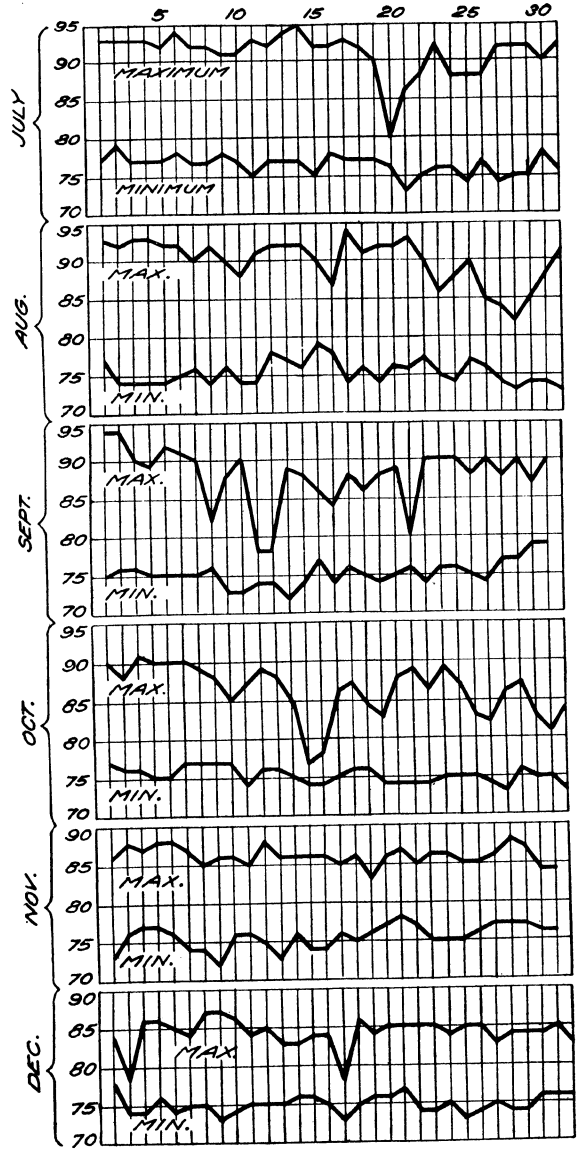

FIG. 5.—Temperatures at Guam Station, July to December, 1912.

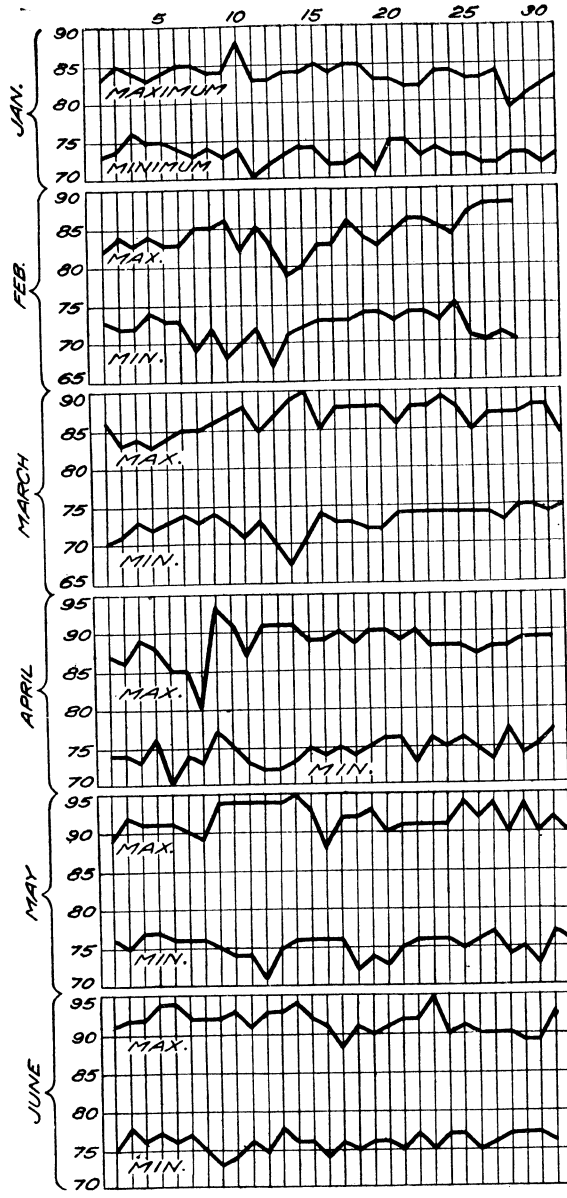

FIG. 6.—Temperatures at Guam Station, January to June, 1913.