# ON THE WATER RELATIONS OF THE COCONUT PALM (COCOS NUCIFERA)—ON THE OIL PRODUCED FROM THE NUTS—THE FACTORS ENTERING INTO THE RANCIDITY OF THE OIL, AND THE INSECTS ATTACKING THE TREES.

Introduction by PAUL C. FREER.

Investigations on the subject of the coconut palm (*Cocos nucifera*) have been carried on in the Bureau of Government Laboratories for the past eighteen months. The work has been divided into three parts and brought to its present state by coöperation between several divisions of the institution. It will be published in serial form in the JOURNAL. The first portion covers the water relations of the tree from the standpoint of its physiology, by Dr. Edwin Bingham Copeland, who spent several months on a plantation studying this question from an experimental standpoint. The second paper covers the coconut in its relation to the cultivation of the tree and the production of coconut oil, and includes a study of the deterioration both of the copra and the oil by reason of rancidity caused by molds and bacterial growth, by Herbert S. Walker; and in conclusion there is added a study of the insects which attack the plant, together with suggestions as to the best means of combating their depredations, by Charles S. Banks and William Schultze.

By this union of the laboratory work, the study of this most important tropical tree has been carried to an extent which not only will enable the conclusions to be of great value to planters but which will also have a scientific interest for those who are not immediately interested in coconut production. One topic which is of especial importance is still under investigation and not ready for publication. This is the study of the germinating nut together with the transformation which the oil undergoes during the growth of the embryo. This topic offers an opportunity for the study of the enzymes in a germinating plant which is unsurpassed, as the size of the seed of the coconut and the ease with which it is separated into its various constituent parts brings a certainty of results not to be encountered in other instances. This portion of the investigation is now being followed in the chemical laboratory. When the serial on the subjects mentioned above has been completed it will be published as a separate reprint.

San Ramon Government Farm, where most of these investigations were carried on, lies on the west coast of Mindanao 10 miles north of the town of Zamboanga. It extends for about 2 miles along the seacoast and toward the interior for 3 or 4 miles, to the base of a small range of densely wooded mountains, which forms an admirable watershed.

Four small streams run through San Ramon from the mountains to the sea. It is very probable that there is considerable underground drainage as well, for fresh water may be obtained at a depth of 5 or 6 feet almost anywhere along the shore, even at the edge of the beach. At present copra and hemp are the principal products of the farm, together with a little cacao.

At the time of writing all the coconut trees used for making copra at San Ramon were planted by the Spanish, but large numbers of new ones are being set every year from selected seed, for which only the largest and best nuts are taken. They are laid out on the ground in a sheltered place and a small section of husk is cut from the top of each to afford a more easy egress for the sprout. At the end of about six months' time, when the sprout is from 2 to 3 feet high and the nut has just begun to take root in the ground, it is ready for planting. For this purpose a hole about 2 feet deep is prepared and the young plant is firmly packed with the soil, so that the sprout stands erect and the top of the nut is 6 to 10 inches below the surface. As a protection against wild hogs it has of late been the custom to dig a pit 4 or 5 feet deep and to plant the nuts at the bottom of this. The seedlings are set out in straight rows, allowing a space of about 10 meters between each plant.

After planting, the young coconut requires very little care, except to keep it free from weeds and the attacks of animals and insects, until it reaches maturity. The average time before a tree begins to give a good yield of fruit may be set at ten years. Instances have been known when bearing commenced as early as the fifth year, but these are of rare occurrences and under exceptionally favorable circumstances.

The process in use for preparing copra is very simple. The nuts are gathered by natives, who climb the trees, cut off the ripe or nearly ripe fruit, and let it fall to the ground. No especial care is taken to prevent damage by falling. The nuts are then piled in a heap and allowed to stand for a few weeks before being opened. To remove the outer, fibrous husk the natives make use of a heavy spearhead firmly sunk in the ground. They force the nut down on the sharp point until it penetrates to the shell, then, by a peculiar twist, strip off the husk, a portion at a time. One man can husk, on an average, 1,000 nuts per day.

After being thus prepared the coconuts are split in halves by a couple of sharp blows from the back of a bolo. The milk is allowed to go to waste on the ground.

*Drying.*—The simplest method of drying the meat is to spread out the halves of the coconut on large wooden trays, face up, in the sun. At

night and in case of rain the trays are piled under a shed. After standing in the sun for two or three days the meat becomes partially dry and has shrunken sufficiently to permit its removal from the shell. It is then put back on the trays and again exposed for a few days until it is thoroughly desiccated.

The other method of preparing copra in use at San Ramon is to pile the coconut halves, face downward, on a bamboo grating over a slow fire of husks which is burning in a thick-walled brick kiln about 6 feet high, the whole being inclosed in a large shed. By this arrangement it is sufficient to dry the nuts over night before removing the shells.

After heating the meat in the same manner during four or five hours on the next day, it is ready to store for the market. "Grill-dried" copra prepared in this way is not quite so liable to be attacked by insects and molds, but on account of its dark color and slightly smoky flavor it is considered inferior in quality to the sun-dried article.