RACES OF MAIZE IN ECUADOR

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NATIONAL ACADEMY OF SCIENCES—
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Publication 975

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Funds were provided for this publication by a contract between the National Academy of Sciences—National Research Council and The Institute of Inter-American Affairs of the International Cooperation Administration. The grant was made for the work of the Committee on Preservation of Indigenous Strains of Maize, under the Agricultural Board.

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NATIONAL ACADEMY OF SCIENCES—
NATIONAL RESEARCH COUNCIL
Washington, D. C.
1963

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Library of Congress Catalog Card Number: 62-60020
Price $2.00

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ACKNOWLEDGMENTS

Many individuals and institutions have shared in the preparation of this monograph. The collection and storage of the Ecuadorian collections were carried out through the collaboration of the Colombian and Ecuadorian governments and The Rockefeller Foundation, aided by financial grants from the International Co-Operation Administration to the National Academy of Sciences—National Research Council. We are grateful for the concern and interest of the Committee on Preservation of Indigenous Strains of Maize, and particularly to Mr. J. Allen Clark, its Executive Secretary, for supervising the editing and publication of the English edition. For the Spanish edition we wish to thank Dr. Milcíades Martínez G. and the other members of the Publications Office of the Department of Agricultural Investigations of the Colombian Ministry of Agriculture.

We are especially indebted to Ingenieros Agrónomos Efraín Alvarado C., Fernando Arboleda R., Clímaco Cassalett D., Libardo Escobar R., Efraín Díaz B., Bertulfo Peña V., and Ricardo Ramírez E. They were primarily responsible for caring for the plants, collecting data and sporocytes for this report, and for the maintenance of the collections. Ing. Ramírez also contributed a great deal to the classification and descriptions of the races. A large number of students from the Facultades de Agronomía at Medellín and Palmira assisted the Ingenieros Agrónomos in note taking, summarizing data, and maintenance of the collections.

We are indebted to Dr. Barbara McClintock of the Carnegie Institution of Washington for her kind permission to use the chromosome knob data which were obtained by her. Laboratory facilities for Dr. McClintock were provided by the Universidad Nacional, Facultad de Agronomía at Medellín.

The responsibility for receiving, cataloging, and storing the collections properly was borne in large part by Dr. L. M. Roberts, to whom we are extremely grateful for his encouragement, assistance, and contributions throughout the course of the study.

The methodology we have employed obviously reflects the influence of Drs. Edgar Anderson and William L. Brown, for whose advice, encouragement, and criticism we are indebted. We also wish to express our gratitude to Dr. Canuto Cardona A., Director of the Department of Agricultural Investigations, and to the other members of the Colombian Ministry of Agriculture, for their continued interest and support, without which this study would have been impossible.

Sr. Víctor Manuel Patiño R. served as principal field collector; he was ably assisted by Messrs. Manuel Giler, Honorio Moreno, Victor H. Andrade, Ricardo Gallegos, and others. Sr. Pablo E. Daza B. received, cataloged, and stored the collections, and was of great assistance in organizing materials for study. He also took the data for the internal characteristics of the ears. Sta. Eloisa Rivera E. assisted in locating records and photographs.

The bulk of the plant data was sumarized by Ing. Pedro R. Oñoro C., Sr. Luis Mahecha T., Stas. Nora Rivera U., and Marina Duque B. Distribution maps were drawn by Victor M. Pinzón R., Héctor H. Escobar L., and Sta. Berta Escobedo G. Photographs were taken by Sr. Terencio Rengifo H.

Thanks are due to Sta. Cecilia Cancelado S., Merilyn D. Hatheway (Mrs. William H.), and Alice Faye Ellenberg for typing various sections and stages of the manuscript.

RACES OF MAIZE IN ECUADOR

David H. Timothy, William H. Hatheway, Ulysses J. Grant,
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INTRODUCTION

The completion of monographs of the races of maize in Colombia, Bolivia, and Chile (15, 16, 23) has made it clear that the diversity of Andean maize is considerable. In effect, a catalogue of many types of maize has been made available to the plant breeders of the world. The authors of these monographs, of course, provided much more than simple compendia. Attempts were made to determine the origins and relationships of certain races, especially in Colombia. The essentially artificial nature of political boundaries, however, often made such studies difficult. For example, the cultural ties between Ecuador and Nariño, the southernmost department of Andean Colombia, are very strong. Therefore, it is to be expected that the relationships of certain races found in Nariño might be southern. The completion of the present report makes it possible to begin study of some of these relationships. More generally, as the Peruvian and Venezuelan gaps are filled in, we may hope to see Andean maize as a whole, and to understand something of its origin and history under domestication.

The collections of Ecuadorian maize studied in this monograph are stored at the Andean Center, Estación Tulio Ospina, Medellín, Colombia. The seed center is maintained cooperatively by the Colombian Ministry of Agriculture and the Rockefeller Foundation. Living material was studied at Bogotá, Medellín, Palmira,

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and Montería, experiment stations of the Colombian Ministry of Agriculture. Like the Bolivian and Chilean monographs, this report was prepared outside the country in which the subject material was collected. Ecuador and Colombia, however, are contiguous countries which possess similar ranges of climate and elevation. Since both countries are essentially equatorial, day lengths—variation in which can produce marked effects on many vegetative characters in maize—are virtually the same. In almost all cases, growth of Ecuadorian varieties in Colombia seemed normal.

VALUE OF THE MAIZE COLLECTIONS

The authors of earlier monographs in this series have eloquently stated the case for preservation of indigenous strains of maize. From the point of view of the plant breeder, the collections represent a bank from which "exotic" material can be drawn to introduce variability into increasingly uniform local stocks of maize. To the geneticist they are a source of untapped and untested genes. They provide opportunities for study in the newer fields of complexes of characters and their interrelations with cytological behavior. Moreover, it is to be expected that use of the material in the collections may shed some light on the perennial problem of heterosis.

More modestly, perhaps, we may hope that these collections will be of some value to the plant geographer and the economic botanist interested in studying certain aspects of the history of a fascinating plant under domestication. Dr. Barbara McClintock's cytological studies, reported in the Bolivian and Chilean monographs as well as in here, give us grounds for some optimism on this topic. She has shown that all high Andean races so far examined, with a single interesting exception, have the same chromosome knob pattern. These data are suggestive of a possible common history and perhaps even of a common origin of highland Andean maize. Furthermore, two curious "jungle corns" of Bolivia, *Coroico* and *Enano*, are essentially "Andean" in their knob compositions, obviously suggesting some former cultural connection or contact between the highlands around Cuzco and

Lake Titicaca and the Amazonian forests of northwestern Bolivia.

In Ecuador, the area between Baños, on the Río Pastaza, and Tenjo, on the Río Napo, a region of intermediate elevation on the eastern slopes of the Andes, is a center of distribution for several unusual types of maize. The races *Clavito, Tusilla,* and *Enano Gigante* probably will be of no practical value to corn breeders of the near future. Their importance as sources of untested genes is equally dubious. To the plant geographer, however, they raise fascinating questions; e.g.: How can we account for the presence of three distinctive, small-eared races of maize in this small area? How did they reach the Baños region, and why have they been preserved there? Another center of diversity is the Loja region of South Andean Ecuador. Here, mixing of several types of upland and lowland maize has occurred, apparently of considerable magnitude. The Loja area might thus be useful for case studies on the mechanics of race formation in maize.

From the taxonomic procedures followed in these studies—classification, description, and plotting of geographical distributions—have arisen newer, broader problems worthy of study in their own right. In terms of human welfare, these problems may not be of primary importance for the immediate future. The economic value of the maize collections and the monographs describing them, however, has already been amply demonstrated. Their justification is not difficult in a world which must give high priority to the solution of vexing social and economic difficulties. Furthermore, in terms of scientific and cultural values, studies of the origin and distribution of cultivated plants are of interest. It is cheering, therefore, to note that these monographs have begun to produce, as by-products, answers to certain fascinating problems, many of which have no relation to primary human needs.

GEOGRAPHY AND CLIMATE

Extensive use of the information published by Svenson (22), has been used in this section. Material was also freely used from Diels (6), Molestina (12), Sauer (17), and Sodiro (18).

Ecuador is a small country. Its area of 106,000 square miles is about that of the State of Colorado in the United States. Its

population probably does not exceed 4,000,000. To account for such great diversity in maize in such a small area may at first appear a hopeless task. The complex physical geography and history of Ecuador, however, combine to simplify the task.

Ecuador is bordered by the Pacific Ocean on the west, Colombia on the north, and Peru on the south and east. The country, straddling the equator, is bisected by the Andean Cordillera, which has for centuries served as a formidable isolating barrier between the Pacific coastal lowlands and the tropical Amazonian Basin. The cordillera is from 70 to 180 miles wide and elevations range from 20,500 feet at Chimborazo to about 6,900 feet near Peru.

The Pacific Coastal Lowland is a transitional zone between the Peruvian desert and the tropical rainforest of the Colombian coast. The rainforest extends southward to just below the equator and joins with the dense forests of the Andean slopes. Northwest of Quito, these forests reach upwards to about 10,000 feet. Trees are heavily festooned with orchids and bromeliads, and ferns are common in the wetter areas. Dominant tree species include *Cecropia, Ochrama* (balsa), and large bamboos.

The arid zone, in some places 25 miles wide, extends northward from Peru. Annual rainfall is less than 10 inches, although 30-40 inches have been recorded. The sandy areas give way to savannas of *Pennisetum* sp., four to five feet tall, and *Jacquinia macrocarpa* (whose fruits are used for fish poison). Further inland, small, densely jungle-covered mountain ranges rise out of the western tableland. The large valley between the coastal hills and the Andes is cut by numerous rivers and subjected to heavy flooding during the rainy season. The vast savannas in this area extend eastward to the sugar cane and fruit plantations in the Andean foothills.

Volcanic peaks are characteristic of the Ecuadorian Andes from the Colombian border to about 2° S. The Andean mass consists of two chief ranges separated by a broad valley running generally from north to south. Nine large intermontane basins lie in this valley, separated from one another by small cross ranges which link the Eastern and Western Cordillera. The basins are drained by torrential streams in a seemingly capricious manner to either the Pacific Ocean or the Amazon Basin. The natural vegetation in

this area has been destroyed by intensive cultivation. From Cuenca northward, the inter-Andean rainfall tends to occur in two seasons, permitting two cultivations a year of a number of crops. Maize will not mature rapidly enough at these altitudes for two harvests a year. High on the surrounding crests above timberline, the "Paramos", the area is often completely enshrouded by clouds and is characterized by bleak foggy mists, interrupted only briefly by periods of intense sunlight. The higher slopes have much in common with the Peruvian Puna, usually dry but subjected to occasional rains. Changes from a luxuriant vegetative season to arid, desert-like characteristics are common.

In the long valleys of the Western Cordillera, at elevations from 1,500 to 3,700 feet, vegetation changes rapidly from rainforest to scrub, because the western slope of the range acts as a rainshadow. Large trees are occasional at 4,000 to 6,000 feet in the area of cloud condensation. The Eastern Cordillera is penetrated only by a few roads into the wilderness of the eastern slope and lowlands. High rainfall supports dense vegitation and the growth of orchids, bromeliads, and mosses is luxuriant.

The eastern lowland area of the Amazon basin is a vast, largely unexplored tropical rainforest. However, small-scale commercial agricultural pursuits have been initiated in recent years along the larger rivers.

With such environmental extremes, crops of tropical, semitropical, temperate, and alpine nature are grown. Barley and potatoes are cultivated as high as 11,000 feet. The principal crops of the altiplane and Andean hillsides, corn and wheat, are somewhat lower. Below 6,000 feet, sugar cane and coffee are cultivated, while lower yet there are bananas, yuca, rice, and peanuts.

MAIZE AND THE INDIGENOUS PEOPLES OF ECUADOR

Ecuador is made up of three principal regions: The Amazonian forests, the Pacific Coastal lowlands, and the Andean highlands. Historically, the greatest population density in Ecuador has been in the highlands. Although this same situation prevails today,

there is an increasing shift to the eastern and western lowlands, a shift made possible by improved health measures, an increasing number of roads, and more intensive agricultural practices capable of supporting a denser population. An introduction to the location and habits of some of the indigenous cultural groups of Ecuador is a great help in grasping the significance of certain specific types of maize, as well as a number of apparent racial crosses.

The coastal Indians navigated the rivers by canoe and balsa raft in prehistoric times (5), and contact with the highlands is thought to have been made through the river valleys. Some of these rivers are semi-tropical in their lower reaches, and there are a number of old overland trails from the valleys to the higher elevations, as well as from river to river. Two of the tribes, the *Colorado* and the *Cayapa*, whose numbers are rapidly decreasing, subsist on a staple of plantain. In the areas immediately surrounding the household, yams, yucca, and cacao are grown. Maize fields are usually reserved for larger areas a short distance from the house (14). There are a number of ways to reach Santo Domingo de los Colorados from the coastal lowlands, and from there to Quito by trail and roads. The *Colorados* are said to have made trips across the Andes to obtain fish poisons (14), and it is possible that on these expeditions they could also have carried maize. With this in mind, it becomes easier to analyze the varied types of maize collected in Santo Domingo de los Colorados and the surrounding areas.

A vast amount of territory of the northern Coastal Lowlands may be reached by water travel along the coast, along the Gulf of Guayaquil, and also through the Guayas and Daule River systems. The curious race *Chococeño* extends southward from its center of distribution in Colombia into the humid forests of the northern province of Esmeraldas. The Indians of this region are related ethnologically to the Chocó, although they are less advanced. Most of the coastal groups were related culturally, and had regular contact through coastwise trade (13). The endemic races *Candela* and *Gallina* occur farther south, but are being displaced by more recent arrivals, the commercial types of *Tuxpeño* and *Caribbean Yellow Flint*.

The absence of Central Andean influence in the Pre-Inca archeological periods of the Ecuadorian highlands is noteworthy (1), and the affiliations of the region with the Colombian highland pattern are much better established. This affiliation is readily observable today, particularly in northern Ecuador. The highland Indians were sedentary agriculturists; their sustenance was based on the cultivation of maize, beans, squash, quinoa, and potatoes (1, 13). Condiments and various tropical fruits were obtained from the deeper valleys, which drained either to the Pacific or the Amazon (1). Before the *Inca* conquest, nine intermontane basins were occupied by seven tribes who spoke different, mutually unintelligible languages (Table 1).

In the second half of the fifteenth century, Ecuador fell under the dominion of the *Inca* Empire, and a post road was constructed to run from the present town of Quito to Cuzco, the *Inca* capital (1,13). Revolts against the foreign appressors broke out from time to time. On such occasions the *Incas* resorted to a strikingly modern imperial device. Great parts of the dissident population were uprooted, sent to Peru or Bolivia, and replaced by carefully indoctrinated colonists from other areas. Thus a great many *Paltas* (intelligible to the *Jivaros*) from the Loja region were taken to Collao in Bolivia, and colonies of Peruvian Indians from Huamachuco and Cajamarca were settled in the Riobamba region of Ecuador. The Ecuadorian tribes were never thoroughly integrated into the social structure of the *Incas*. However, the impact was tremendous. Many Indians today consider Quechuan as their native tongue. Some of the present groups have similar farming and subsistence methods, while they maintain different dress and customs (Julio Cabrerra, personal communication). One can more easily understand the complex and astonishingly varied collections of highland Ecuadorian maize, when the *Inca* conquest, the interbasin travel throughout the intermontane depression, the east and west travel of the tribes, and the Spanish conquest with subsequent exploration and development are considered.

Consequently, it is not surprising that the maize of highland southern Ecuador is similar to that of neighboring Peru and Bolivia. We cannot be sure that the Ecuadorian forms, *Cuzco* and *Kcello*, which also occur in Bolivia, are introductions made by

Incan colonists. It would be remarkable, however, if such imports were not made. Similarly, the maize of northern Ecuador resembles that of neighboring Colombia. The Ecuadorian races of *Sabanero* and *Montaña*, found in the basins of Tulcán and Ibarra, were grown by Indians who spoke the same Chibchan-type languages as the Indians around the present Colombian town of Pasto. In central highland Ecuador, the races *Chillo* and *Mishca* seem to be endemics. The long isolation of the Panzaleo, Puruhá, and Cañari tribes is probably not unrelated to the emergence of these distinctive types of Andean maize.

The eastern slopes of the Andes, the Montaña, are geographically selva or tropical rainforests, but differ from the Amazon basin in having very rugged topography, deeply cut by many rapid streams and rivers. The environment has isolated tribes from one another very effectively. Additionally, the jungle culture had spread westward, rarely occurring at altitudes over 3,000 or 4,000 feet, and stopping at the steep sides of the Andes, penetrating, however, ". . . the deep, canyonlike valleys which thrust long prongs into the mountains,. . .". "It was halted only where the mountains rise precipitously above 5,000 to 6,000 feet . . . into zones of thick clouds and heavy rains. The Highland cultures clung to the tops of the drier, cooler mountain masses and spread eastward around the deep valleys, sometimes nearly engulfing the lowland peoples . . . but never descending into the low valleys (19)."

The inhabitants of the Montaña, the *Chunco*, were related culturally to the tropical forest people of the Amazon Basin, although they were extremely diverse culturally and linguistically, some having more traits characteristic of the Andean cultures than others (19). The native staple of these tribes was sweet manioc (*Manihot utilissima aypi*), and followed by maize, sweet potatoes, peanuts, and presently plaintain and banana. Fishing and hunting are important, of course, with the fish and game population. The *Jivaro* tribes occupy the largest area of the Ecuadorian Montaña, and their economy is based on slash-and-burn farming and river resources (20, 21). Their food is prepared mostly with mortars (20).

The submarginal *Zaparoans*, including the probably related

Canelos, occupied the vast area between the Marañon, Napo, and Pastaza Rivers. The considerable variation in their cultures was due, perhaps, to their native lack of canoes, extreme isolation of their communities, and the surrounding terrain (21). Fields were cleared with stone axes, burned, and tilled with dibble sticks. This submarginal culture relied more on hunting, fishing, and gathering than did those of the Montaña, and food was prepared with grinding troughs or slabs instead of mortars.

The corn of the Amazonian basin of Ecuador is essentially that grown by the forest peoples of Bolivia and probably Peru as well, but the number of races is much reduced. The interesting interlocked types so abundant in Bolivia (*Coroico, Enano,* and related races) are represented in Ecuador only by *Pojoso Chico Ecuatoriano* and *Enano Gigante.* The tropical forest cultures are widespread, due principally to navigation on the vast rivers of the Amazon and Orinoco basins. Their distinctive achievement is the domestication and cultivation of tropical root crops: bitter and sweet manioc, sweet potatoes (*Ipomoca batatas*), yams (*Dioscorea* sp.), and arrowroot (*Maranta arundinacea*) (10).

In spite of the isolation and difficulty encountered in travelling, tribes of the Highlands, Montaña, and Tropical Forests of the Amazon, had contact, direct or indirect, with one another. From Loja (7,000 feet) to Sabanilla (5,700 ft.) by Andean trail into the Montaña, and then to Zamora (3,280 feet) at the fall line of the Zamora River, requires about a two-days journey (9). The river continues southward and joins the River Marañon at Pongo de Manseriche, thus permitting some access to the tropical forest cultures. When viewed in this vein, the highly variable collections from the Loja-Malacatus-Zamora region are more easily interpreted.

We have not studied the detailed relationships of Ecuadorian maize with the Indian tribes of the regions in which they grow. We have no doubt, however, that such studies, in collaboration with knowledgable anthropologists, would be rewarding. The maize of highland Ecuador is still remarkably free from excessive mixing and has not been displaced by modern commercial varieties. The population is still largely Indian, and old customs are maintained.

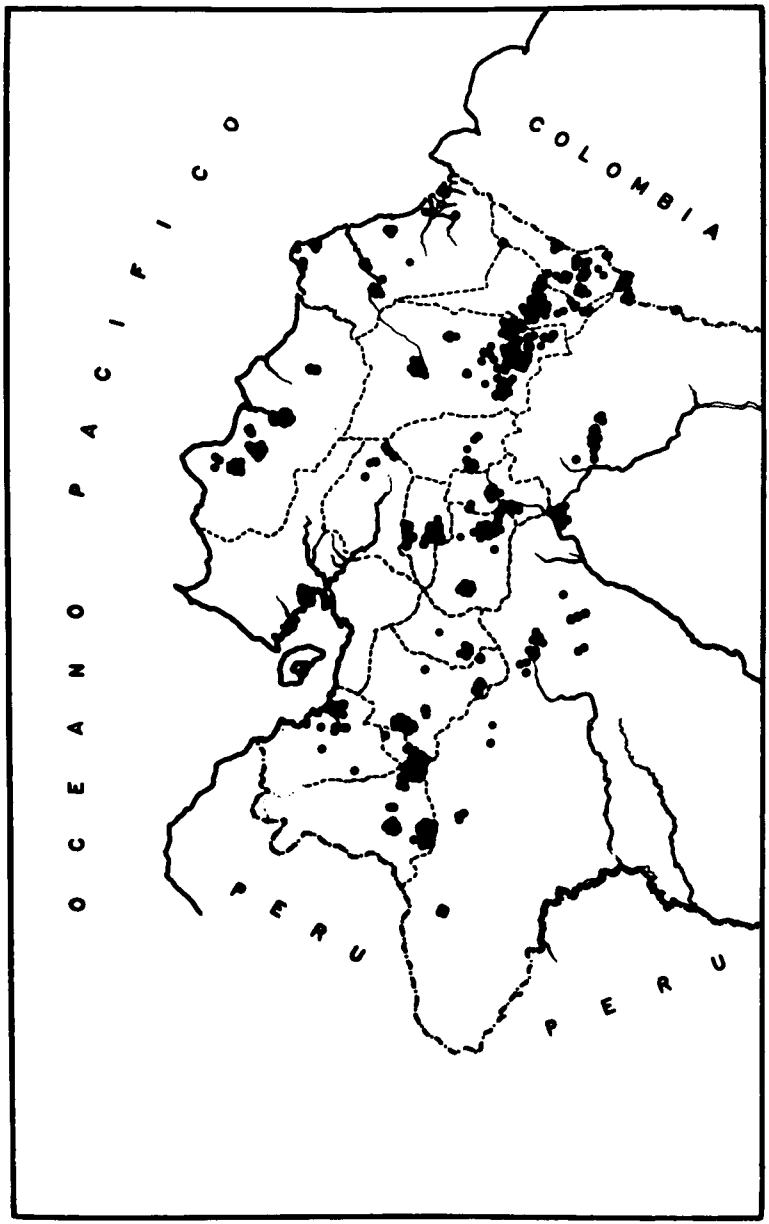

FIG. 1. Map of Ecuador showing the localities from which the maize collections in Table 9 were made.

COLLECTING PROCEDURES

Most collections were made directly from farmers' fields during the harvest season. Other collections were made from farmers' "granaries" and from markets. An effort was made to obtain a sample of at least ten ears and to include a good representation of the variation in ear and plant type from each collection site. Such data as locality, altitude, local name of the variety, and mean temperature and rainfall were noted at the time of collection. The localities at which the collections were made are shown in Figure 1.

Each collection received at Medellín was catalogued, dried and photographed, and data on ear and kernel characteristics of ten ears were recorded. Two rows of grain were shelled from each of three or four ears selected for museum specimens. This seed was mixed with that from the remaining ears of the collection, which were completely shelled. These large samples of seed were put into cold storage and are periodically renewed by open pollination in isolated blocks or by controlled sib pollination. As a precaution against accidental loss, duplicate samples of four ounces each were put in cold storage at Medellín, and at the seed storage center at Glen Dale, Maryland, maintained by the Division of Foreign Plant Introduction of the United States Department of Agriculture.

Lists, sources of origin, and brief descriptions of the Ecuadorian collections, together with those from other countries, have been issued by the National Academy of Sciences in "Collection of Original Strains of Maize," Volumes I and II, as reports of the Committee on Preservation of Indigenous Strains of Maize.

Seed of the races described in this report will be stored at the Colombian Seed Center at Medellín, Colombia, and in the United States at the National Seed Storage Laboratory at Fort Collins, Colorado. Requests for seed should be directed to the Colombian Seed Center.

METHODS OF CLASSIFICATION

The methods used in the present study were, with very slight modifications, those followed in classifying the maize of Colom-

bia, Bolivia, and Chile. Three representative ears saved from each of the original 675 Ecuadorian collections and properly identified by accession number were laid out on large tables in a well-lighted room. Certain distinctive types, easily classified because of their similarity to races already described elsewhere, were separated and placed in groups. Thus collections of *Cuzco Ecuatoriano, Montaña Ecuatoriana, Canguil, Chococeño, Tuxpeño,* and *Maíz Cubano* were removed, making the classification of the collections that remained considerably easier. Distinctive, previously undescribed races like *Huandango, Chillo,* and their intermediates were next recognized and removed to other tables.

After repeated separations of known and provisional races, about 200 undetermined collections remained. These were separated into smaller geographical groups, within which distinctive types could sometimes be recognized. In the collections that remained from Amazonian southeast Ecuador, for example, a few ears with obvious affinities to the Bolivian race *Cholito* were noted. When these collections were separated, it became apparent that much of what remained could be assigned to the race *Yungueño,* also of Bolivia. In the group of unclassified collections from northeast Ecuador, several collections stood out which vaguely resembled *Cónico Dentado,* but which possessed rounder, harder, more densely packed grains. This type of maize, which has the common name "Yunga," is also found in the contiguous Colombian department of Nariño. We have classified many of these types as "poorly defined races," either because the collections are extremely variable or because only one or two collections were available from which descriptions could be prepared.

Seed was planted from collections classified provisionally as typical specimens of well-defined races for study of characters of tassel, leaves, and habit of growth. In some cases, collections with similar ears produced very different sorts of plants, requiring a revision of the classification. For the most part, however, plant types within a provisional race were homogeneous and in many cases actually distinctive as a group. For example, the short, awkward, many-tillered plants of *Canguil,* with their nearly unbranched, "bottle-brush" tassels, were unmistakable. Collections of *Canguil* with admixtures of Sabanero Ecuatoriano produced

taller plants with several tassel branches. With practice it became easy to recognize these and other plants of mixed parentage. Such judgments, of course, are always somewhat subjective, since all races of maize are mixed to some extent. Data were generally taken, however, only from well-formed typical plants after elimination of obviously mixed specimens.

CHARACTERS USED IN CLASSIFICATION

The characters used in classifying the Ecuadorian races are essentially the same as those used in the description of the races of maize in Bolivia (15). Since the systems of measurement and scoring are more or less standardized, and the methods employed are identical to those of the Bolivian report, we are repeating almost verbatim the procedures reported in that monograph. This repetition is desirable, because some workers interested in Ecuadorian maize may not have access to the earlier reports.

Since all measurements made on ear characters were made on the original ears—usually ten per collection—these characters are from plants grown in their native environment. All other measurements or scores were made on five to twenty plants, grown in Colombia either at "Tibaitata" near Bogotá (2,650 meters elevation), Medellín (1,500 meters), Palmira (1,000 meters), or Montería (50 meters).

Using the collector's data as a guide, the collections were grown at the elevation to which they were apparently best adapted. Data used for the descriptions are those recorded at Tibaitata and Palmira.

VEGETATIVE CHARACTERS OF THE PLANT

Adaptation to Altitude—One of the principal factors influencing the distribution of the Ecuadorian races of maize is altitude. In mountainous equatorial countries, temperature is directly related to elevation; consequently a race can be moved up and down only within a narrow range of elevations and still remain relatively well adapted to the environment.

Altitudes for most of the collections were accurately determined with an aneroid altimeter. In the small percentage of the collections where this was not possible, the altitude was taken from the best maps available.

Height of Plant—Plant height was obtained from an average plant of a typical collection grown at or near the elevation of its original habitat. The measurement was made from ground level to the base of the tassel.

Height to Ear—Ear height, for the uppermost ear, was not recorded directly in the field but was calculated from the internode measurements of all measured plants of typical collections. Ear height for plants with the modal number of internodes may be determined from the internode patterns.

Stem Diameter: Maximum and Minimum—The means for this character by races are averages of all plants measured at the mid-point of the first internode above ground level on the main stalk. Comparison of maximum and minimum diameters of the main stalk at the mid-point of the first internode gives an indication of its cross-sectional shape. Some races have slightly elliptical stems; others have stems that are almost round; the majority have stems which fit between these two extremes in shape.

Length of Leaf—The mean for each typical collection is based on the measurement of a leaf from all normal plants in a plot. The measurements were made from the ligule to the tip of the leaf arising immediately above the ear-bearing node. The means of the representative collections were averaged to obtain the racial means for this character.

Width of Leaf—The same procedure was followed as for length of leaf, the measurement being made at the longitudinal mid-point of each leaf.

Venation Index—The procedure described in the study of the races of Mexico (24) was used to derive this index. It consists of the quotient of the average number of veins, counted at the longitudinal mid-point of the leaf arising immediately below the upper ear-bearing node, and the average width at the same point. The counts and measurements were made on all plants scored in each collection.

Number of Tillers—Actual counts were made on all plants scored. The means of the typical collections were averaged

to derive the racial means. Tillers were also given a height score of tall, medium, or short. Those scored tall were equal or sub-equal to the main culm. Medium tillers were approximately one-half the height of the main culm, and those scored short were less than one-half the height of the main culm. Class percentages for height were calculated from the total number of tillers.

Internode Patterns—After the modal number of internodes for each race had been chosen as characteristic, the pattern was determined by using the length of successive internodes on all plants having that number of internodes. The results were then averaged and expressed in a diagram showing the pattern of relative internode lengths. The diagram also indicates the position of the uppermost ear, length of the base of the tassel (peduncle), and the position of the tassel. Numbers on the vertical scale in the diagrams represent lengths of each internode in centimeters. Numbers at the base of the diagram represent the number of internodes from the base upwards.

CHARACTERS OF THE TASSEL

Length of Peduncle—The distance was measured in centimeters from the upper node of the stalk to the lowermost branch of the tassel.

Length of Branching Space of Tassel—The distance was measured in centimeters along the central axis of the tassel between the basal and uppermost primary branches.

Length of Central Spike—This length was measured in centimeters between the uppermost primary branch and the apex of the tassel.

Other Tassel Characteristics—Also measured were the lengths of the uppermost primary branch and the best-developed primary branch; the number of secondary and tertiary branches on the best-developed primary; the number of primary branches with secondaries; the number of primary branches with tertiaries; and the total number of primary branches. From these measurements several useful indices, such as percent branching space (24), can be derived.

EXTERNAL CHARACTERS OF THE EAR

Ear length—The measurements were made on normally developed ears in the collection.

Ear Diameter—The diameters of the same ears used to determine ear length were measured with calipers at the base, mid-point, and tip of the ear.

Row Number—Actual counts were made of the number of rows of grain on the same ears used for length and diameter determinations.

Number of Husks—The husks (modified leaf sheaths) surrounding the ear were counted on the principal ear of all plants scored. The data are expressed as an average per plant. The number of condensed husk nodes of the shank was also determined by counting the number of apparent nodes and comparing this number with the total number of husks produced.

Kernel Width—The width of ten kernels taken from near the middle of the ear and laid side by side was measured in millimeters.

Kernel Length—The same ten kernels were measured in millimeters when laid end to end.

Kernel Thickness—The thickness of ten consecutive kernels in a row near the mid-point of an ear was measured in millimeters with metal calipers. The measurements were made while the kernels were on the ear.

Kernel Denting—This is a visual estimate on an individual-ear basis recorded on an arbitrary scale; from 0 (maximum) to 5 (none). Observations were made on the same ears as for the above characters.

Kernel Hardness—Visual estimates were made on individual ears and these were recorded on an arbitrary scale from 1 (hard) to 5 (soft). This is presented as an average for the same ears used for the other characters.

INTERNAL CHARACTERS OF THE EAR

The cross-sectional diagrams of the ears of each race, based on these measurements and observations, are included with the descriptions.

Cob Diameter—This was measured with calipers from the center of the upper surface of the glume on one side of the cob to the corresponding point on the upper surface of a glume directly opposite.

Rachis Diameter—This was measured with calipers on the lower half of the broken ear. The measurement was made from the base of an upper glume on one side of the cob to the base of an upper glume directly opposite. Since the base of the glume is usually somewhat below the rim of the cupule, this measurement does not represent the maximum diameter of the rachis but rather its diameter to the points at which the upper glume arises.

Cob/Rachis Index—This is computed by dividing the diameter of the cob by the diameter of the rachis.

Glume/Kernel Index—This index gives a measure of the length of the glume in relation to the length of the kernel. It is computed by subtracting the diameter of the rachis from the diameter of the cob and dividing the figure obtained by twice the average length of the kernel.

Cupule Hairs—The cupule, a term to designate the depression in the rachis from which the spikelets arise, is almost invariably hairy. The hairs vary both in number and length from a few short prickles to many long, sometimes appressed hairs. They also vary greatly from race to race in their distribution within and about the cupule. The variation is so extensive that the characteristic alone is of little value. It may, however, be useful when considered with other characteristics and employed as part of the total description. Hairiness is scored by numbers from 0 (none) to 2 (profuse).

Lower Glume: Texture—The texture of the lower glume is estimated by probing or puncturing with a dissecting needle. In some races the glumes are chaffy, often with considerable areas toward the margins of thin transparent material resembling tissue paper. In other races the glumes are fleshy and thickened, but soft, and yield easily to the needle point. In still other races glumes are distinctly indurated and are difficult to puncture. Induration is scored by numbers, from 0 (none) to 3 (strong).

Lower Glume: Hairiness—The hairs of the lower glume vary in

number, length, and position. Hairs are found almost universally on the upper margins of the glume. These vary from a few short hairs to many long, soft hairs. The surface of the glume proper may be completely glabrous. More commonly, a few hairs are found at the base or toward the lateral margins of the glumes. In general, the hairiness of the lower glume is not in itself a satisfactory diagnostic character, since there is often considerable variation within a race. Considered with other characteristics, however, it has some usefulness. Hairiness of the glumes is scored by numbers, from 0 (none) to 2 (profuse).

Lower Glume: Shape of the Glume Margin—The upper margin of the glume varies in shape from race to race. The margin is rarely truncate and is usually more or less indented. The indentation may be luniform (crescent-shaped), more or less broadly angulate (wedge-shaped), sinuate (undulate or wavy), or cordate (heart-shaped). The shape of the margins is fairly uniform among different ears of the same race.

Upper Glume: Hairiness—Hairs on the upper glume, like those on the lower, vary in number, length, and position, and are scored in the same way.

PHYSIOLOGICAL AND GENETIC CHARACTERS

Maturity—The number of days from planting to silking was used as a measure of maturity. The date of silking for each collection was recorded when one-half of the plants in a plot containing 50 to 60 plants had put forth silks.

Corn Rust—Three species of corn rust, *Puccinia sorghi, P. polysora,* and *Angiospora zeae,* have been identified on maize grown in Colombia. Since *P. sorghi* is of major importance and the other two species are relatively unimportant, only one rust note was taken with respect to the degree of resistance or susceptibility on the scale of 1 to 5, 1 being highly resistant and 5 highly susceptible. The various races of maize exhibited considerable difference in reaction to *P. sorghi.*

Helminthosporium—This disease, like rust, is very common and damaging in parts of Colombia. To date the species of *Helminthosporium* prevalent in Colombia have not been identi-

fied with any degree of certainty, although it is now fairly apparent that *H. turcicum* largely predominates, with *H. carbonum* present but unimportant. All of the collections have been scored for resistance or susceptibility to this disease although no distinction is made in the report between the two species of leaf blight. The scale used for recording the visual estimates was from 1 (resistant) to 5 (susceptible).

Pilosity—Pubescence is arbitrarily scored from 1 to 5 for both frequency and intensity, the higher number indicating the stronger pubescence. Texture of pubescence was scored as hard, medium, and soft.

Plant Color—Many high-altitude races of Central and South America have strongly colored leaf sheaths. This color is sometimes due to the B factor on chromosome 2, sometimes to one of the R alleles on chromosome 10, and sometimes results from both. The empirical scores, ranging from 1 to 5, do not distinguish between these two genes for color. Color, like pubescence, reaches its maximum intensity in the high altitude corns. A visual estimate was made on each measured plant for both frequency and intensity. Purple and brown plant color were also scored separately using the scale of 1 to 5, with 5 representing the most intensive plant color.

Lemma Color—The color of red-cobbed corn is in the lemma, but there are other colors in the lemma as well. No attempt was made to distinguish between colors due to the different genes involved, and only the presence or absence of color was noted on 10 to 15 ears of each original collection. This is expressed as per cent of ears with lemma color among the ears scored for this character.

Glume Color—Lacking anthocyanin, the glumes are white, buff, or brownish. Anthocyanin coloration may be red, cherry, or purple. The frequency of glume color is recorded as a percentage of the ears of the original collections studied.

Midcob Color—Midcob color affects the tissues between the pith and epidermis of the rachis. The data recorded represent an average percentage of the ears that had midcob color. Approximately ten ears in each collection were studied for this character.

Pith Color—Expressed in percentage of the ears of the original

collections that showed color in the pith, regardless of its nature. The genetic basis for pith color is not known.

Aleurone Color—Expressed in percentage of the ears of the original collections that had aleurone color, irrespective of its nature.

Pericarp Color—Scored on ten ears of the original collections and expressed as a percentage.

CHROMOSOME KNOB NUMBERS AND POSITIONS

The authors of "Races of Maize in Bolivia" (15) showed that patterns of chromosome knob positions and types were strikingly consistent with their taxonomic judgments based on external morphology of ears and plants. For example, with one exception (the very distinctive popcorn *Pisankalla*), all highland races studied were cytologically homogeneous. Each of the 56 plants examined in these ten races possessed a small to medium-sized knob on the long arm of chromosome 7. A very small knob at the lower position on the long arm of chromosome 6 was found in 44 preparations. No other knob was present in any of the 56 plants studied. Following Dr. Barbara McClintock, this pattern of knob types and positions is called "Andean."

Dr. McClintock's studies of South American maize included Ecuadorian collections. It is with her kind permission that we present the knob counts and positions contained in this report. As in the case of Bolivia, her data are preliminary, since she was able to study only 14 of the 29 Ecuadorian races in the limited time available. Nevertheless, her results are strikingly consistent with those she obtained for Bolivia and Chile, and with our independent classification based on external morphology of ears, tassels, and plants. Thus the Andean pattern is evident in six of the seven highland races studied (the single exception is the popcorn *Canguil,* closely related to, or basically the same race as, the Bolivian *Pisankalla*). The knob patterns in maize found at lower elevations are again more complex, but within races there is considerable consistency. As in Bolivia, knob number is highest in the lowlands. For example, the race *Chococeño,* which occurs at sea level, had knobs at 11 distinct positions in both collections studied.

Reference to Table 2 shows that the "Andean" knob pattern occurs in the races *Sabanero Ecuatoriano, Mishca, Chillo,* and *Huandango,* which have no counterparts in Bolivia. *Kcello Ecuatoriano* and *Chulpi Ecuatoriano,* also included in Table 2, may be related to the Bolivian races *Kcello* and *Chuspillu. Sabanero Ecuatoriano* is very similar in external morphology to the race *Sabanero,* originally described from Colombia (6). The latter averaged only 1.5 chromosome knobs per plant, although positions of the knobs were not determined. Thus the "Andean" knob pattern is extended from Chile, at least to Ecuador, and very possibly to central Colombia, a distance of over 2,000 miles. The degree of genetic relationship among the Andean races implied by this identical knob pattern is at present a matter for conjecture. Certainly, considerable diversity in types of ear, tassel, and plant occurs among the Andean races. In fact, the only obvious unifying characters provided by external morphology are the large, round, mostly floury grains, generally low ear row number, intense plant color and strongly pilose leaf sheaths.

Cónico Dentado and *Clavito,* which occur at somewhat lower elevations, also possess essentially "Andean" knob patterns. An occasional heterozygous knob at either of two positions on chromosome 8 separates them from the pure "Andean" type. Several lowland races, as shown in Table 3, possess similar configurations on chromosome 8. Consequently, the data do not rule out the conjecture that *Cónico Dentado* and *Clavito* are essentially highland Andean types slightly modified by introgression from lower-elevation maize.

The cytological relationship of Ecuadorian *Canguil* to Bolivian *Pisankalla* is far from obvious, although similarities in certain collections are striking (c.f., for example, Bolivia 965-2 and Ecuador 447-1, or Bolivia 1106-2 and Ecuador 447-2). In *Canguil,* knobs occur on all chromosomes except 1, 2, and 10; two positions are occupied on chromosome 9. *Pisankalla* possesses knobs on every chromosome except 3. The discrepancies can be accounted for to some extent by noting that many collections of these popcorns exhibit obvious contaminations by Andean types, especially *Sabanero Ecuatoriano* in Ecuador. Crossing with "Andean" maize, recombination, and selection for grain type might account for loss of certain knobs in Bolivia and others in Ecuador. Partial

confirmation of this hypothesis is found in the high proportion of heterozygous knobs—53 per cent in *Canguil* and 42 per cent in *Pisankalla.* Cytological examination of morphologically "pure" types might throw more light on this problem. However, McClintock's more recent work (11) suggested that *Pisankalla* is related to maize from central Mexico and *Canguil* is related to the corns from the southern Mexican state, Chiapas. In any case, the morphological and cytological conclusions do not seriously conflict, and illustrate the need for additional work.

Interpretations are even more difficult in lowland Ecuadorian maize. The race *Uchima,* for example, is in many respects intermediate between *Gallina* and *Kcello Ecuatoriano.* The cytological data do not preclude (nor do they strongly support) the hypothesis of a hybrid origin of *Uchima.* Similarly, the knob data suggest a vague relationship between *Candela* and *Tusilla.* Perhaps the chief conclusion to be drawn is that the high observed frequency of heterozygous knobs suggests that many lowland races are not stable, either because race formation is not yet complete or because recent mixing has introduced new knob configurations into formerly homogeneous types. Study of the external morphology of most Ecuadorian lowland maize strongly supports these interpretations of the cytological data.

An outstanding exception is the race *Chococeño,* which is uniform in external morphology and strikingly homogeneous in its knob pattern. As the authors of "Races of Maize in Colombia" (16) noted, *Chococeño* occurs in the humid tropical lowlands of the Pacific Coast of Colombia. Cultural methods there are exceedingly primitive. Apparently conditions are essentially the same in Esmeraldas, the Ecuadorian department in which *Chococeño* occurs. *Chococeño* thus is isolated geographically and ecologically from other races of maize. Consequently, its morphological and cytological uniformity comes as no surprise.

B-TYPE CHROMOSOMES

Only five plants of the forty-four examined cytologically had B-type chromosomes. B-type chromosomes were found in four of the six highland races. Although a representative sampling of all the races was not cytologically obtained, the situation appears to parallel that in Bolivia, where only two lowland plants

were found to contain B types, and a preponderance of them was noted in the highland races (15).

DESCRIPTION OF RACES

In the following pages, twenty-nine races of maize are described. To be sure, six of these are designated as "poorly defined." This epithet, however, merely indicates that the race was represented by only a few collections or was badly mixed. The races are arranged roughly according to altitude, from highest to lowest. It should be made clear that this monograph is not intended as a definitive statement on the origins of the races of maize in Ecuador. We did not employ inbreeding or cross-breeding techniques, which are extremely useful in determining the relationships of different types of maize. Such studies could well alter some of our concepts. We have mentioned, however, obvious relationships or striking similarities of certain of the Ecuadorian races to others already described elsewhere. In many collections it is apparent that introgression of one race into another has occurred. In these cases the collections are listed as a complex of the races concerned.

The races were named, whenever possible, in accordance with the designation used at the collection site. Local names were often useless since they meant yellow, white, flint, hard, flour, soft, etc. The term *morocho*, for example, of very wide usage, was used to describe local types of white flints, yellow flints, and even flour corns. In general, the Ecuadorian collections did not have the highly descriptive local names which are found so often in the other Andean countries. It was therefore necessary to originate names for many of the races. In such cases, we have tried to use terms which are descriptive of the corn. With races similar to those already described, the published name has been retained and supplemented with *Ecuatoriano* to distinguish the race from its counterpart in another country.

The method of presentation used is obviously modeled after the Bolivian and Chilean Monographs (15, 23). For each race only those features that are essentially distinctive are described. The descriptions are supplemented by photographs of typical ears, diagrams of internode patterns, cross-sectional ear diagrams, and distribution maps.

CANGUIL

Ear Photograph ..... Figure 2
Ear Diagram ..... Figures 3,4
Internode Diagram ..... Figure 5
Distribution Map ..... Figure 6

Mean altitude of type specimens 2,260 meters. Strongly imbricated white popcorn; grains pointed, rasp-like, on short, thin cylindrical ears. Plants very short, slender, and ungainly. Two to three tillers about as tall as main stalk. The arching central spike of tassel bristles with densely packed spikelets; lateral branches are few or entirely absent. Tassel ears and seeds common. Leaves narrow at base, with small auricles. The predominant local name for the race is *Canguil.*

This race is similar to *Pisankalla* of Bolivia, from which it differs in its longer, excessively beaked, and more strongly imbricated grains. At higher elevations in Ecuador a larger-eared conical form predominates, which we have designated as subrace "Grueso." (Fig. 2, left ear). Plants of this form are larger and coarser with many tillers, most of which have tassel ears. The stalks are very heavy, and the nodes are inserted.

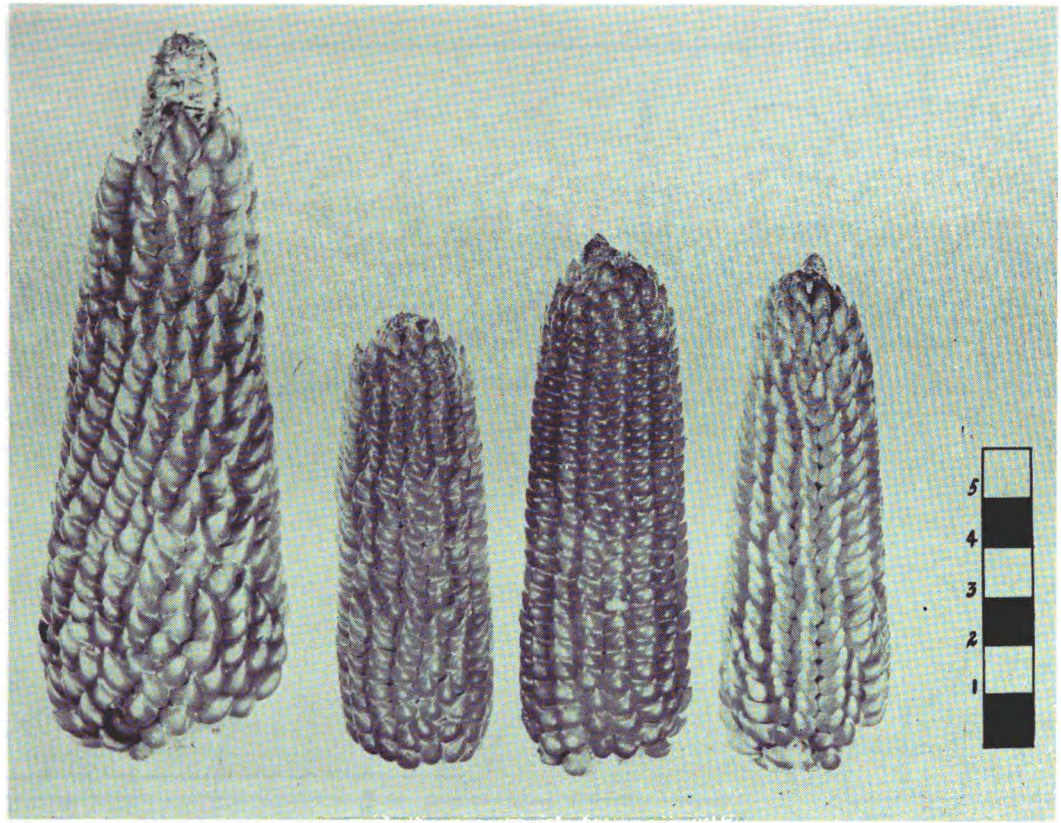

FIG. 2. Representative ears of Canguil.

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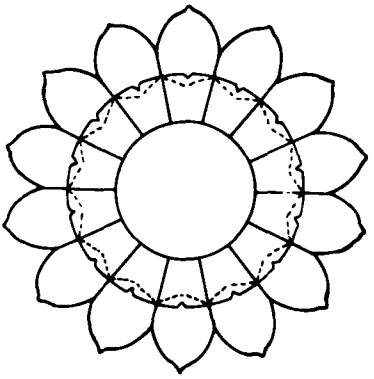

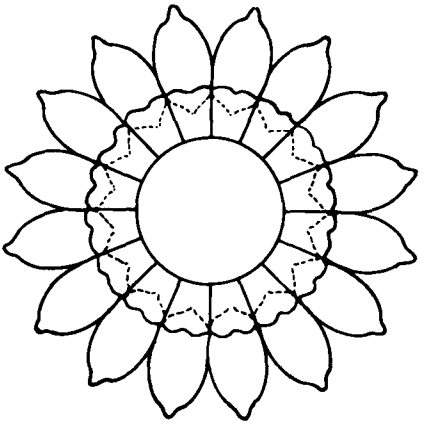

FIG. 3. Ear cross-section diagram of Canguil.
FIG. 4. Ear cross-section diagram of Canguil, subrace "Grueso."

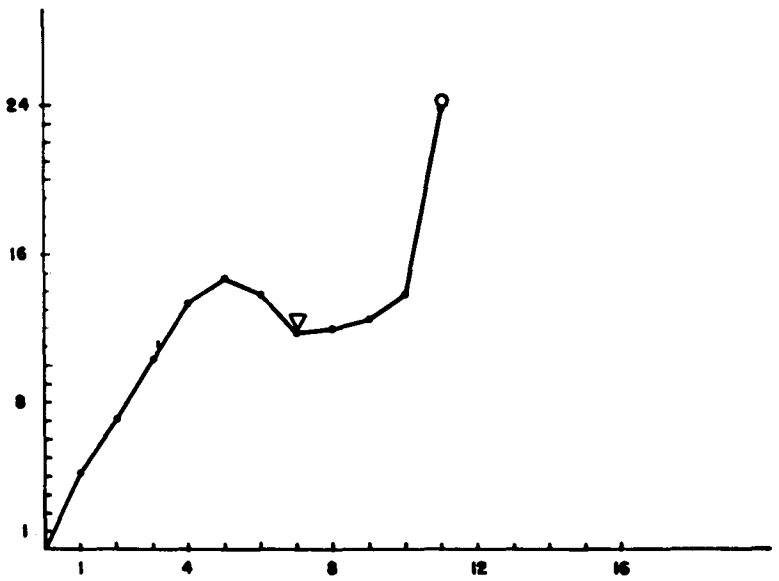

FIG. 5. Internode pattern of Canguil.

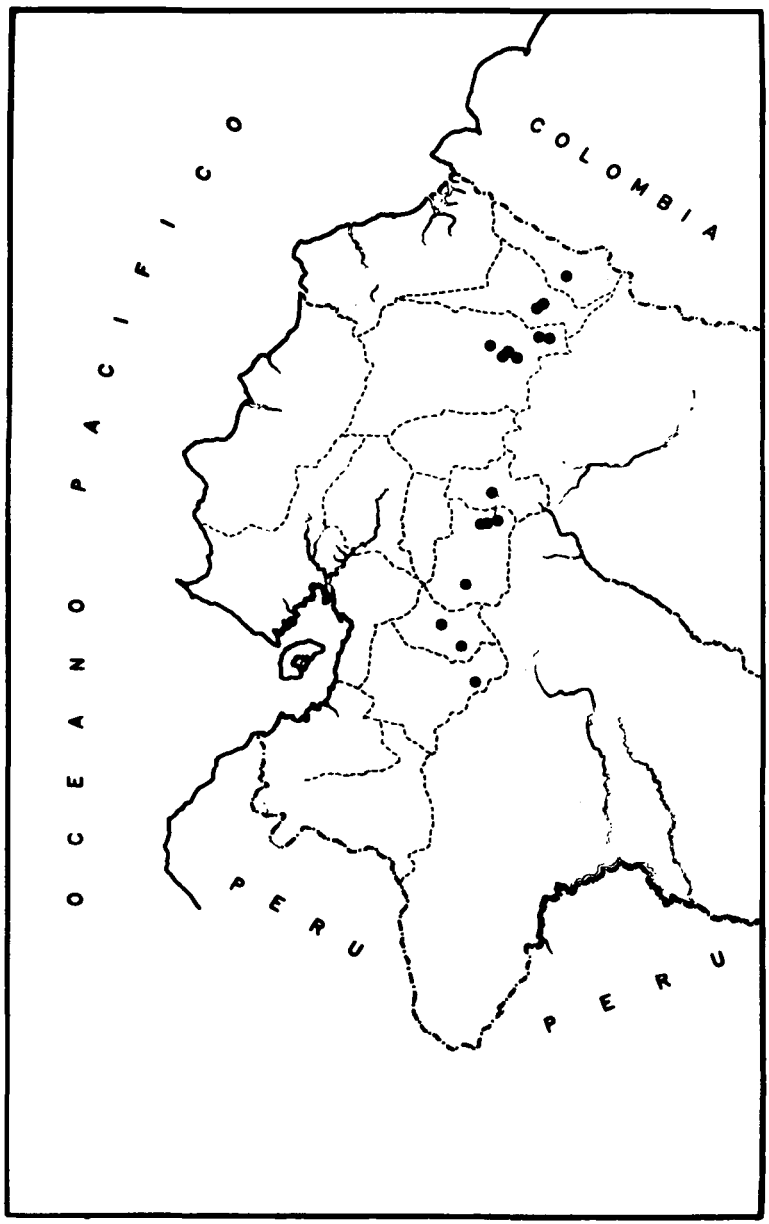

FIG. 6. The distribution of Canguil.

SABANERO ECUATORIANO

Ear Photograph ..... Figure 7
Ear Diagram ..... Figure 8
Internode Diagram ..... Figure 9
Distribution Map ..... Figure 10

Mean altitude of type specimens, 2,660 meters; range, 2,300 to 3,000 meters. Short conical ears with 10 to 16 rows of white flint grains; irregular and spiral rows common. Cobs white. Plants sturdy with dense soft pubescence and intense sun-red leaf sheaths; nodes included. Most plants have two ears placed medium low on the stalk. Leaves short, wide, dark green. The well exserted tassels are ovoid in outline with many short densely arranged branches which arch upward around a short central spike. We are unable to distinguish this race from collections of *Sabanero* made in southern Colombia.

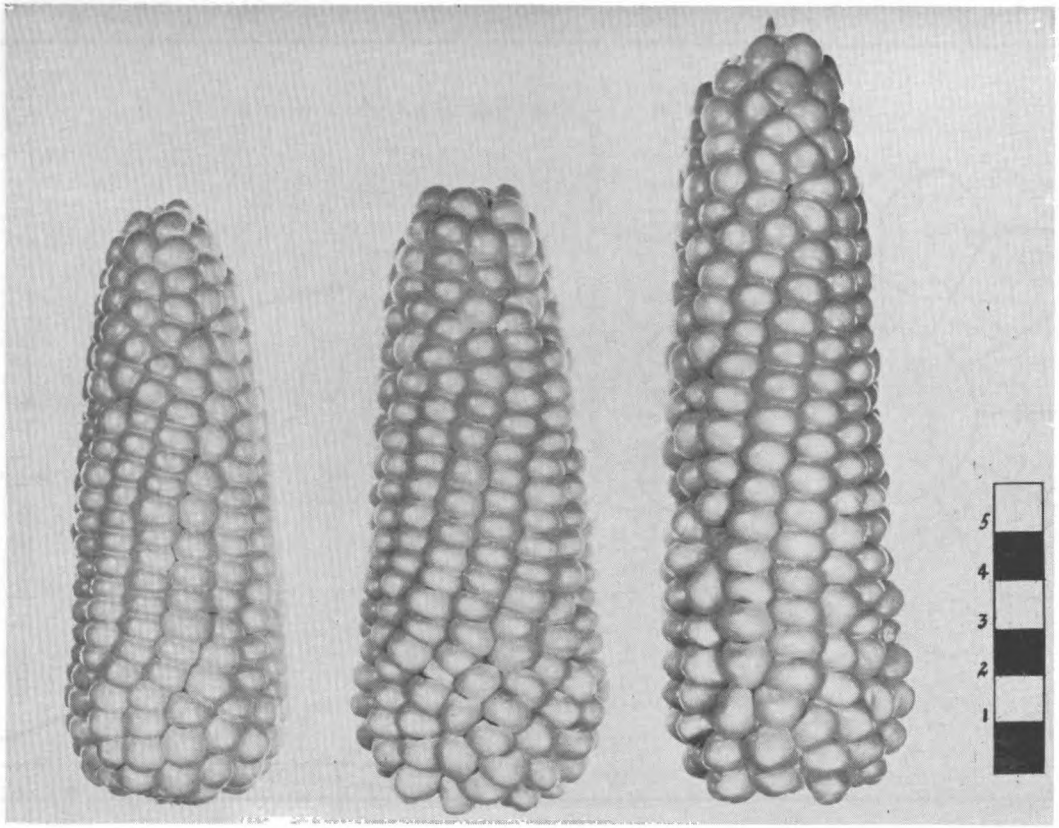

FIG. 7. Representative ears of Sabanero Ecuatoriano.

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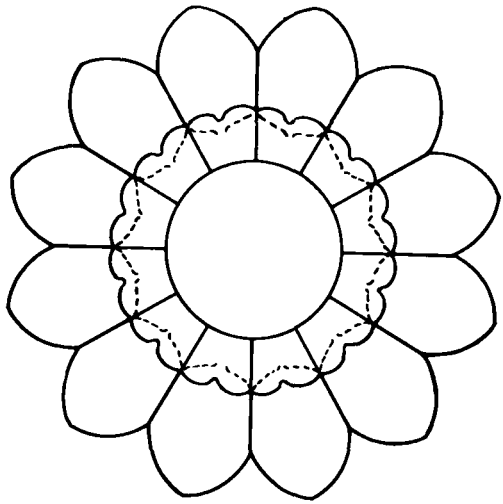

FIG. 8. Ear cross-section diagram of Sabanero Ecuatoriano.

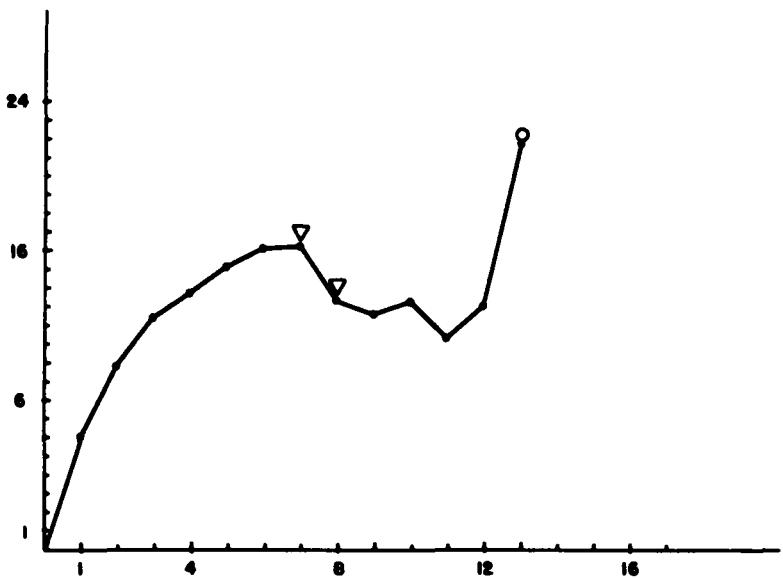

FIG. 9. Internode pattern of Sabanero Ecuatoriano.

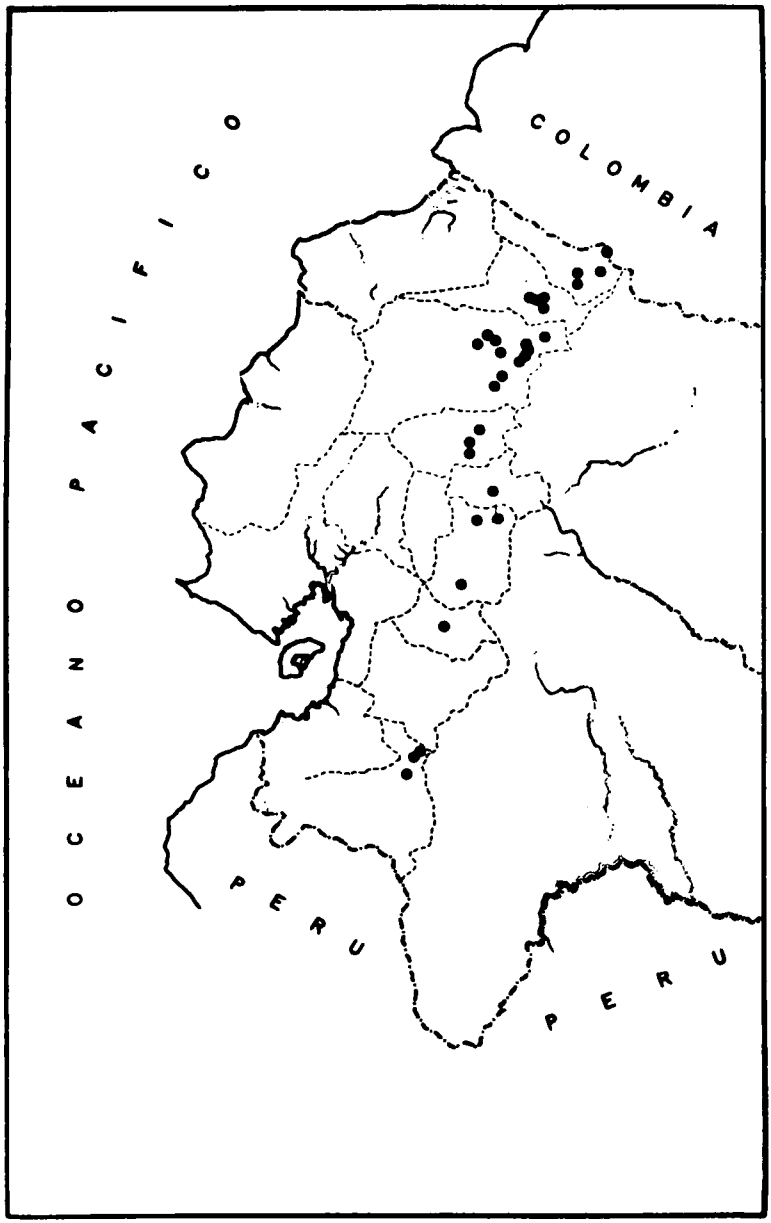

FIG. 10. The distribution of Sabanero Ecuatoriano.

CUZCO ECUATORIANO

Ear Photograph ..... Figure 11
Ear Diagram ..... Figure 12
Internode Diagram ..... Figure 13
Ditribution Map ..... Figure 14

Mean altitude of type specimens, 2,720 meters; range, 2,300 to 2,800 meters. Ears cylindrical, tapering at both ends, producing a cigar or ovoid shape, with 8 or 10 rows of large, flat, mostly white flour grains. Cobs very thin, the grains shattering readily. Stalk thick with fairly dense pubescence. Sun-red plants common; more brown plant color than in any other Ecuadorian race. Central spike of tassel slender and stiff on well exserted tassels. The tassel branches, widely spaced on central rachis, are also slender, stiff, and usually horizontal. Although the ears of this race differ only slightly from the classical *Cuzco* of Peru and Bolivia, the Ecuadorian form seems somewhat contaminated with other types of maize. This is noticeable in the plants; also the grains of the Ecuadorian race are smaller than those of Peru and Bolivia. Occasional white flint grains are additional evidence of contamination.

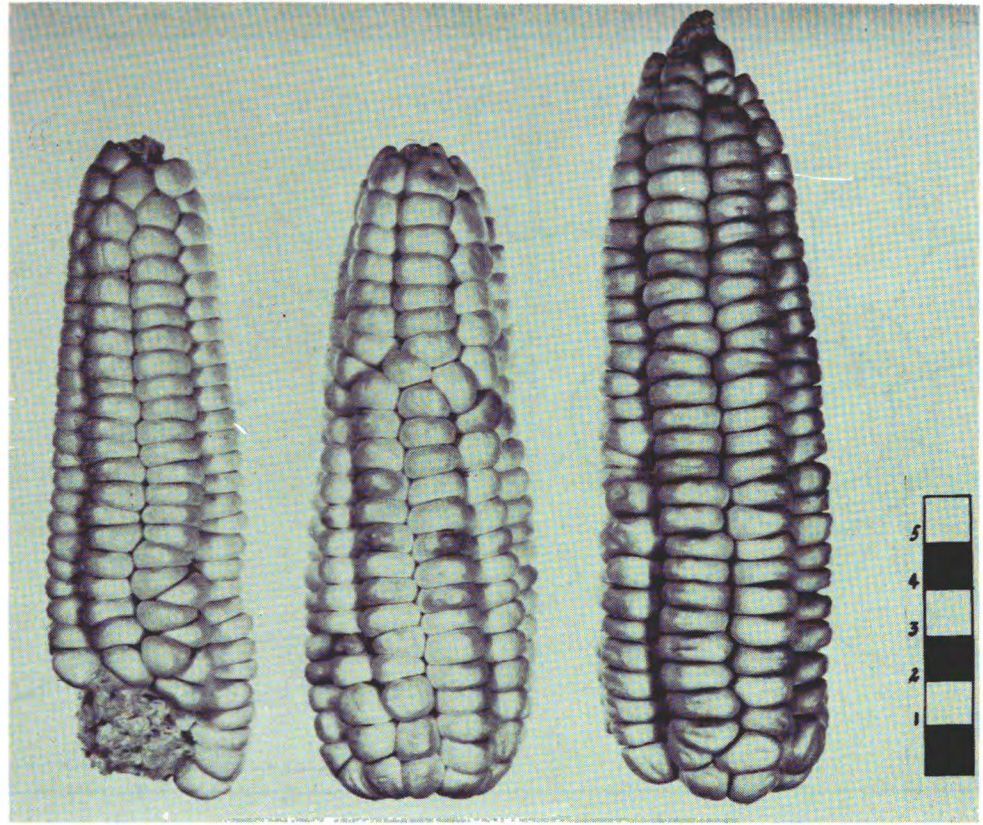

FIG. 11. Representative ears of Cuzco Ecuatoriano.

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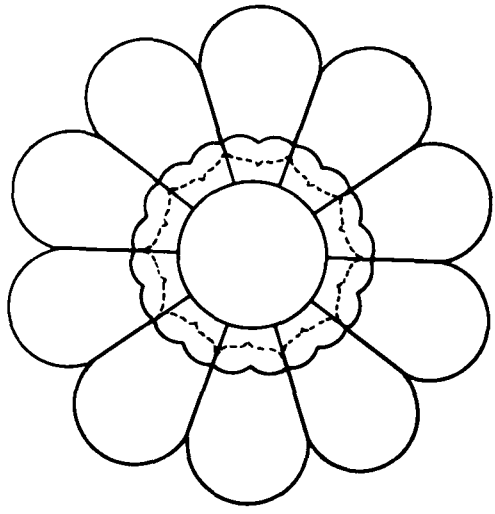

FIG. 12. Ear cross-section diagram of Cuzco Ecuatoriano.

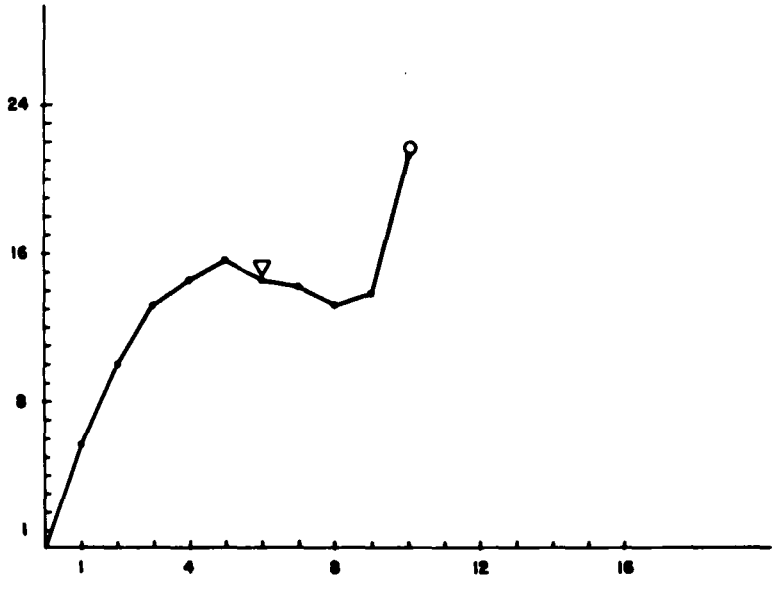

FIG. 13. Internode pattern of Cuzco Ecuatoriano.

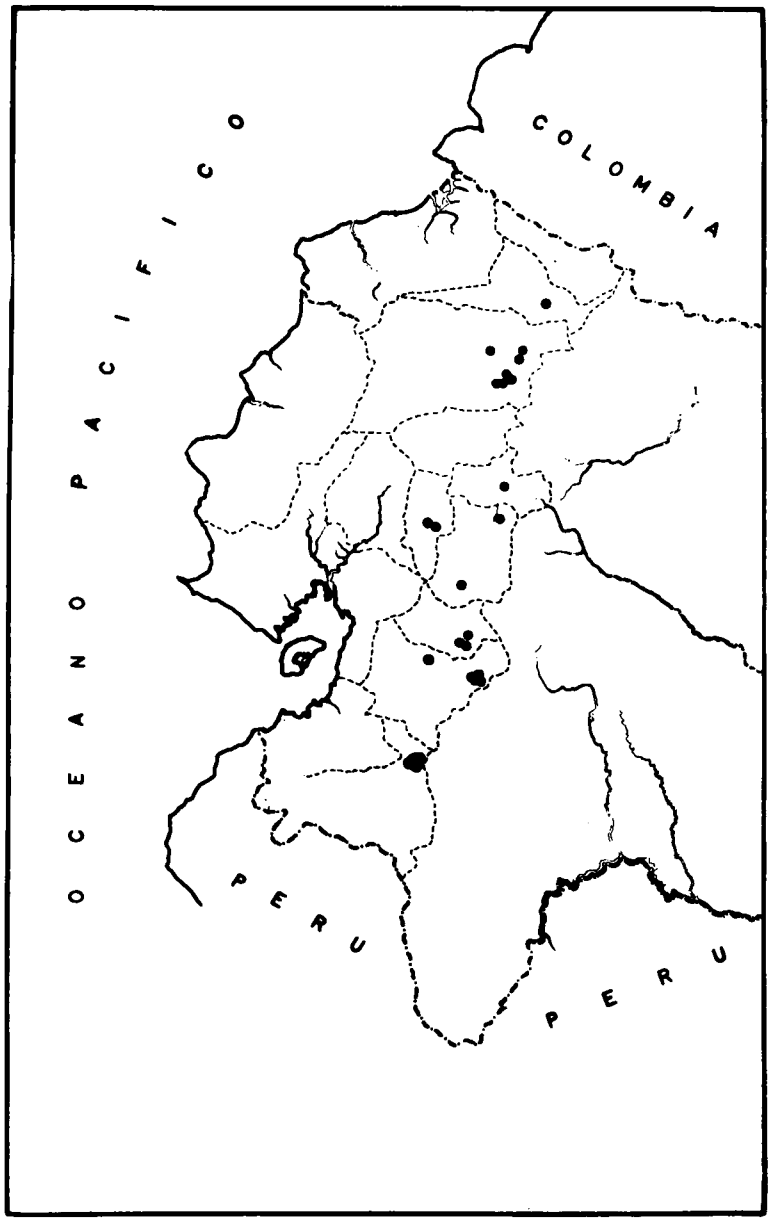

FIG. 14. The distribution of Cuzco Ecuatoriano.

MISHCA

Ear Photograph ..... Figure 15
Ear Diagram ..... Figure 16
Internode Diagram ..... Figure 17
Distribution Map ..... Figure 18

Mean altitude of type specimens, 2,620 meters; others, 2,100 to 2,800 meters. Short conical ears with 8 to 12 rows of yellow flour grains. Irregular rowing at base of most ears, with some tendency toward spiral rows. Kernels with slightly rounded points. Cobs red and white. Plants short with many small tillers, sun-red and moderately pilose. Tassels open; large relative to plant size. The local name varied, but Mishca was a common term. Other names were "amarillo" and "harinoso."

This race is one of the most difficult to define in Ecuador. There is little uniformity among the collections and the number of collections is small. *Mishca,* however, is involved in complex interrelationships with other highland corns in Ecuador. Apparently it has crossed and back-crossed repeatedly with *Huandango* and *Chillo* and, to a lesser extent, with *Kcello Ecuatoriano.* The ears and plants are reported as complexes in the Appendix (Table 9). Supporting data are not reported in this bulletin. Complexes such as these should probably be studied in Ecuador, taking into consideration the regions where they are cultivated, methods of agriculture, and migratory history of the people.

MISHCA-CHILLO COMPLEX

This group is characterized principally by its relatively short, conical ears with somewhat irregular rowing and large bases. The kernels are large and usually pointed or semi-pointed, giving the ear the appearance of a hand grenade.

MISHCA-HUANDANGO COMPLEX

Ears are tapering to almost cylindrical, with a tendency toward well defined, straight rows. Irregular rows at the base of the ear, however, are common. The kernels are semi-pointed to round and are fairly large. The cobs thin and of medium length.

MISHCA-KCELLO ECUATORIANO COMPLEX

Ears short, with a gentle taper to cylindrical shape. Cobs thin, with wide, almost rounded, grains. Rows mostly straight or helical except at the base of the ear where they are irregular.

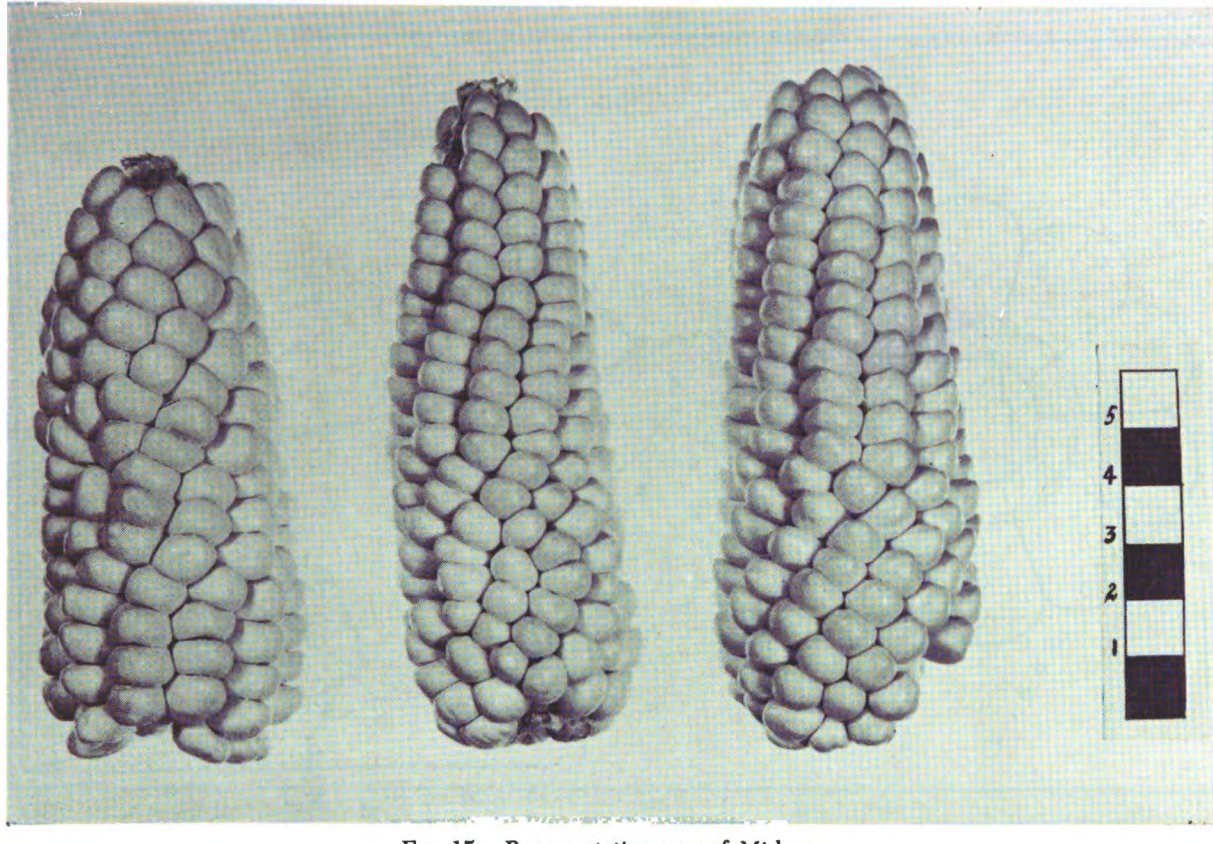

FIG. 15. Representative ears of Mishca.

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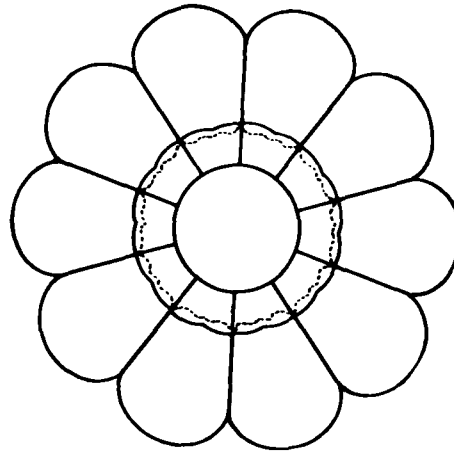

FIG. 16. Ear cross-section diagram of Mishca.

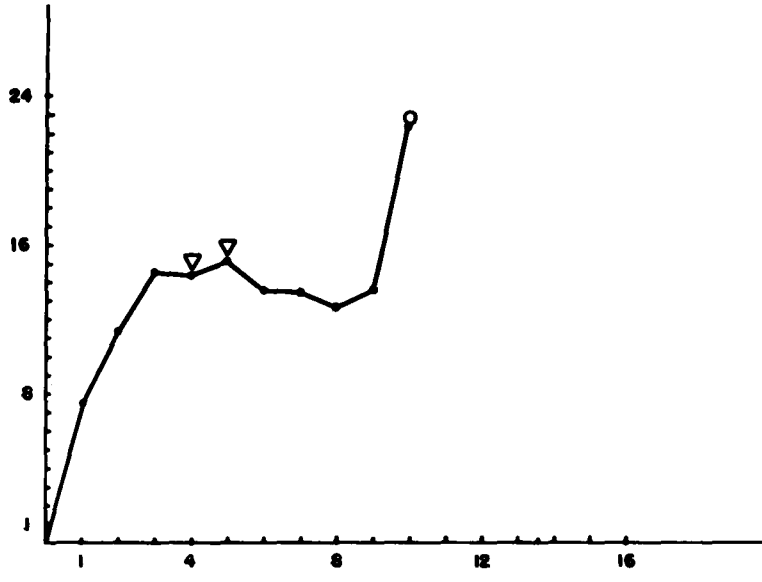

FIG. 17. Internode pattern of Mishca.

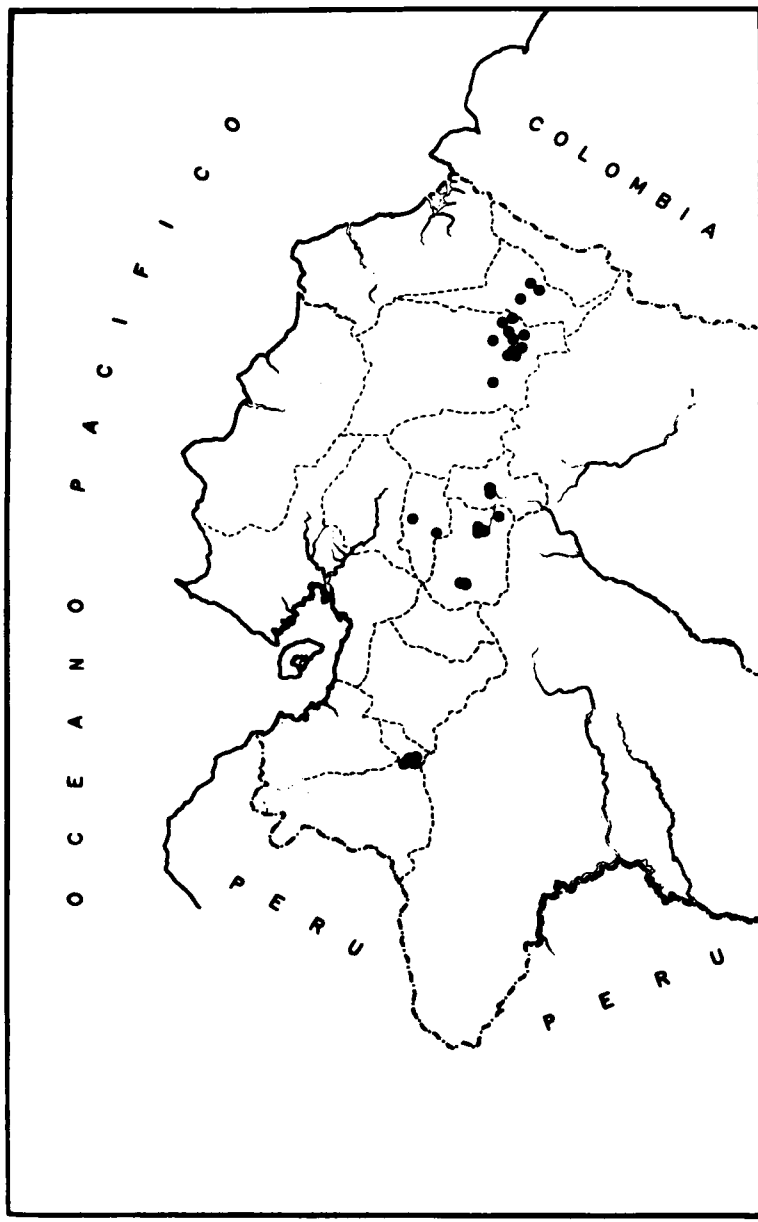

FIG. 18. The distribution of Mishca.

PATILLO ECUATORIANO

Ear Photograph ..... Figure 19
Ear Diagram ..... Figure 20
Internode Diagram ..... Figure 21
Distribution Map ..... Figure 22

Mean altitude of type specimens, 2,600 meters; others 2,400 to 3,200 meters. Ears very short, conical to oval, with 8 to 12 irregularly spiralling rows. Cobs frequently red. Kernels nearly round; red pericarp common. Plants very early with very low ears on sturdy stems. Much purple and sun-red plant color. Severely attacked by leaf rust and leaf blight at Tibaitata. Tassels all exserted with prominent arching central spike, short, with small, stiff, arching branches; branching space short. Spikelets not appressed. Leaves short, narrow, and stiff. The ears and kernels are similar to those of *Patillo* of Bolivia, but longer. The plants are also similar, but larger. In characters of ears and plants this race seems to be at the small extreme of a series intergrading to the *Sabanero*-type corns of both Ecuador and Colombia.

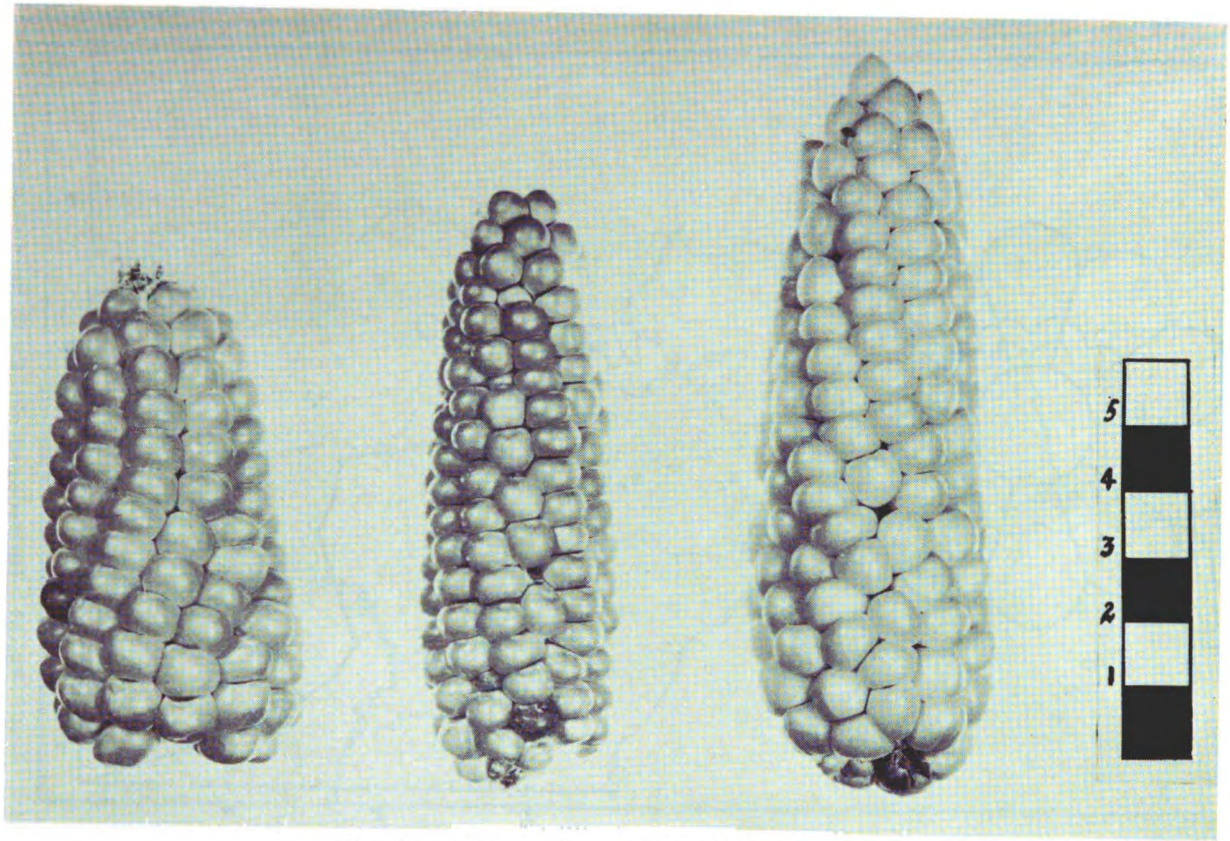

FIG. 19. Representative ears of Patillo Ecuatoriano.

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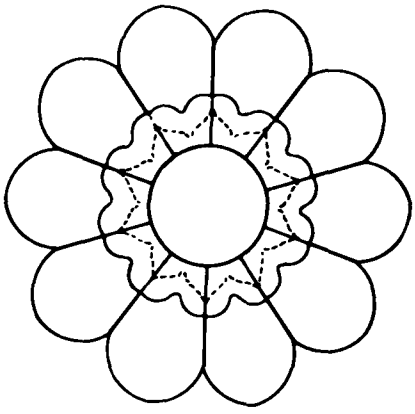

FIG. 20. Ear cross-section diagram of Patillo Ecuatoriano.

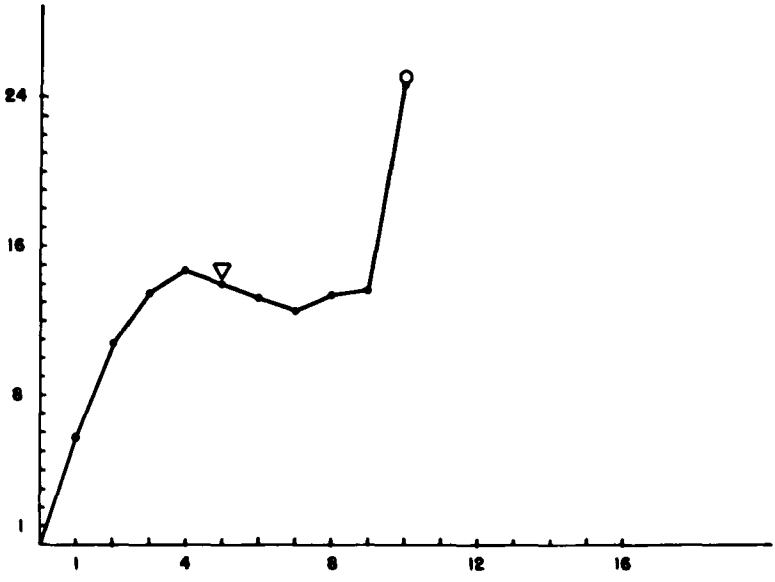

FIG. 21. Internode pattern of Patillo Ecuatoriano.

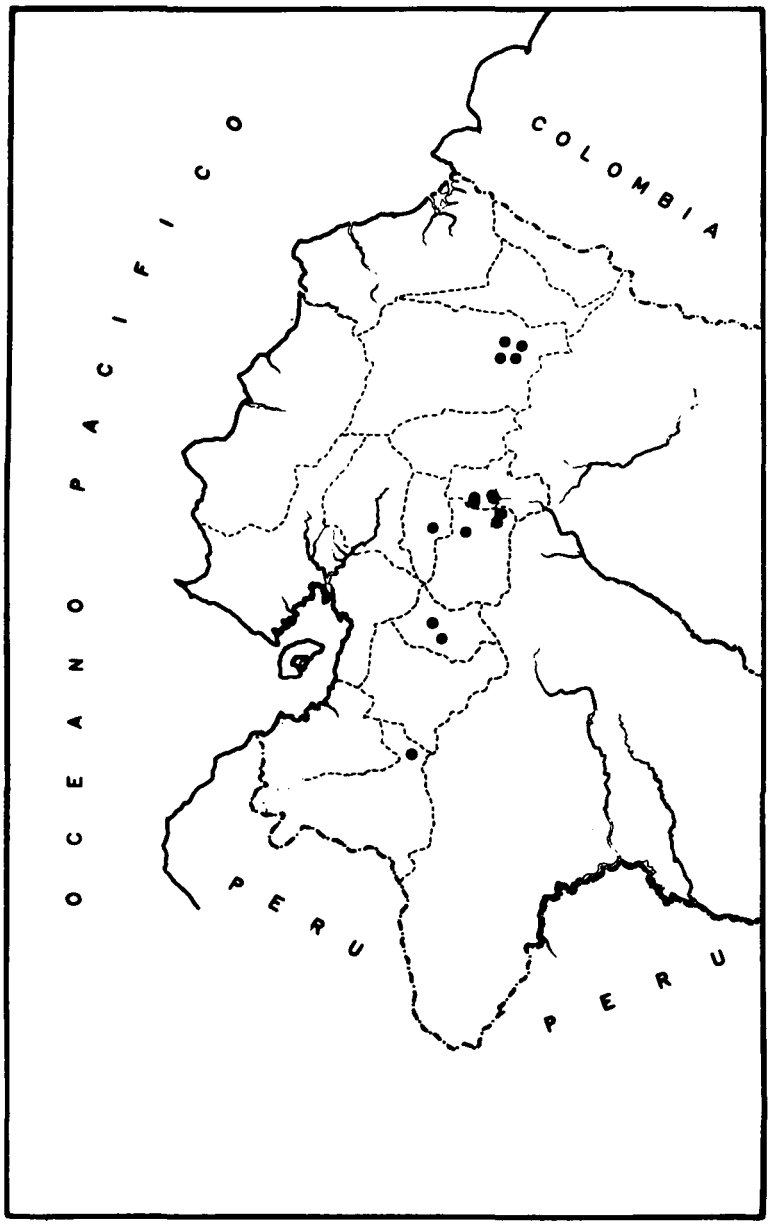

FIG. 22. The distribution of Patillo Ecuatoriano.

RACIMO DE UVA

Ear Photograph ..... Figure 23
Ear Diagram ..... Figure 24
Internode Diagram ..... Figure 25
Distribution Map ..... Figure 26

Mean altitude of type specimens, 2,580 meters; others, 2,400 to 2,900 meters. A dye corn with medium-size conical to oval ears. Grains with red or cherry pericarp over blue aleurone, rounded and tightly packed to give a grape-bunch effect (hence the name). Rows 8 to 14, spiral; irregular rows are common. Entire cob is colored, including lemmas, glumes, and pith. Plants very short, thin-stemmed with low ears; many plants bear two ears. Nodes included. Leaves short, very narrow at the auricle, gently arching and leathery to the touch. Moderate sun-red and purple plant color. Tassels well exserted with a few branches which vary from gently arching to stiff whiskbroom-like affairs. Central spike heavy; spikelets not appressed. The ears of this race are about twice as large as those of the apparently related *Kulli* of Bolivia; the grains are rounder and less pointed.

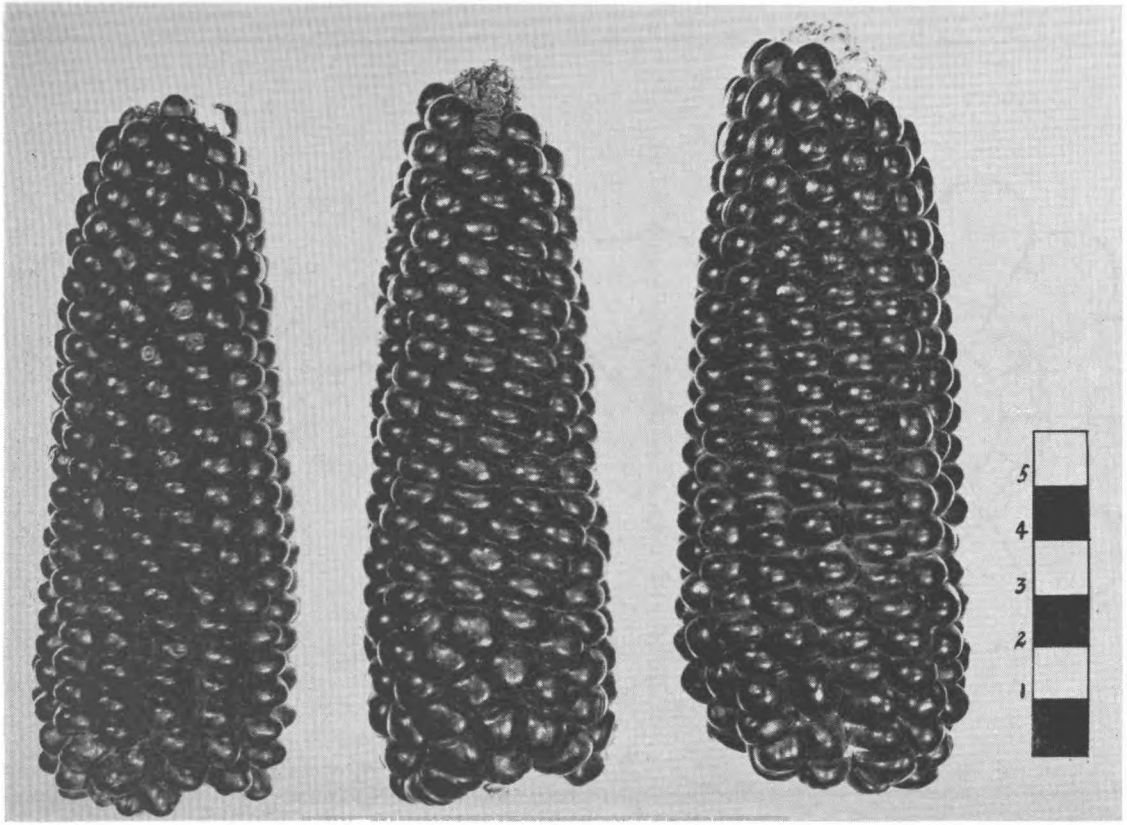

FIG. 23. Representative ears of Racimo De Uva.

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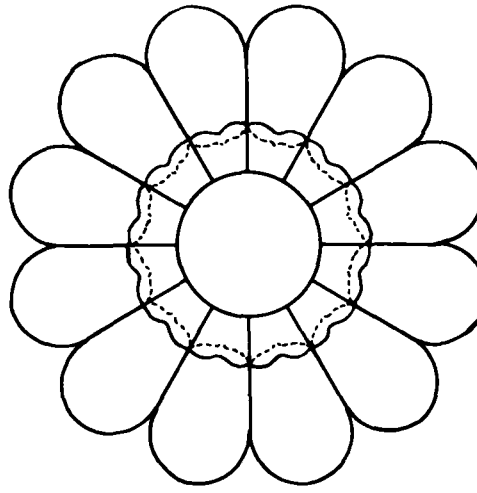

FIG. 24. Ear cross-section diagram of Racimo De Uva.

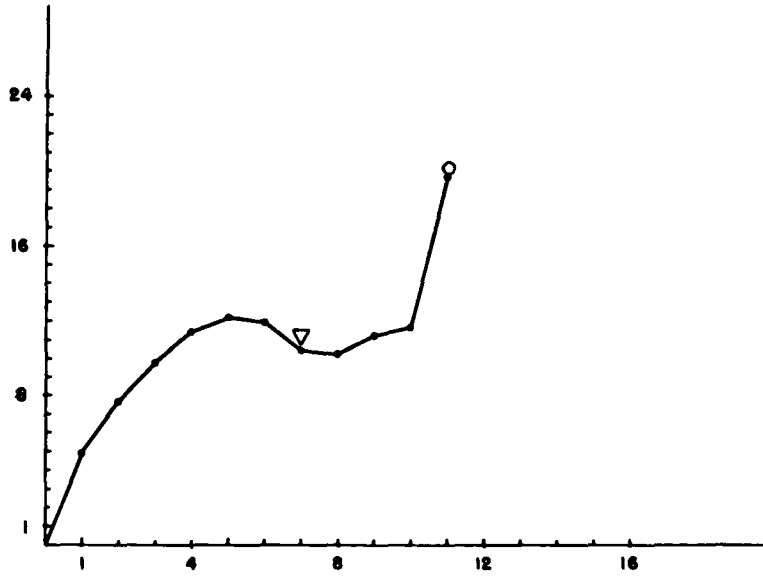

FIG. 25. Internode pattern of Racimo De Uva.

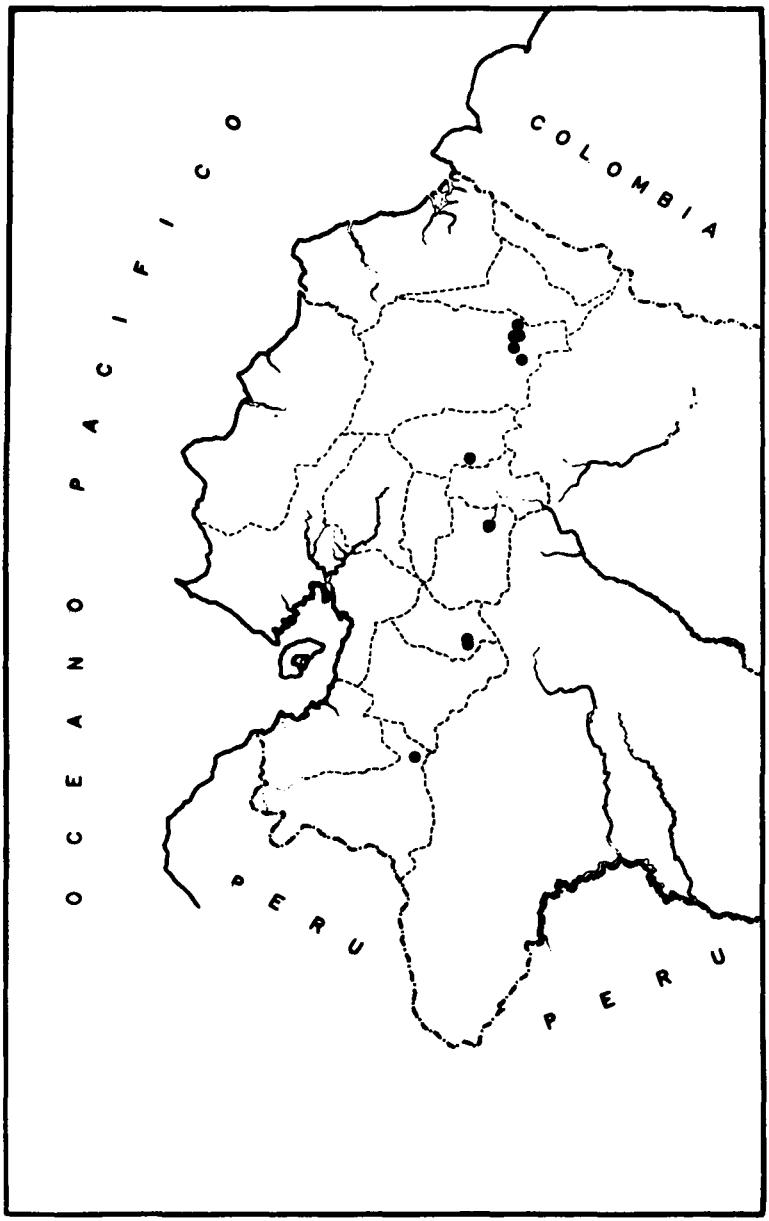

FIG. 26. The distribution of Racimo De Uva.

KCELLO ECUATORIANO

Ear Photograph ..... Figure 27
Ear Diagram ..... Figure 28
Internode Diagram ..... Figure 29
Distribution Map ..... Figure 30

Mean altitude of type specimens, 2,550 meters; others, 2,000 to 2,600 meters. Row number mostly 8; a few ears with up to 14 rows. Kernels large, round, yellow, flint-type; occasional blue aleurone. Cobs mostly red. Ears short, cylindrical with a slight taper; rows straight. Plants slender, with prominent zig-zag tendency. Many plants have more than two ears, the uppermost often below the mid-point of the plant. Tassels well exserted and large. Tassel branches long, widely separated, and horizontal with drooping tips. Large sterile zones on branches and central spike. Spikelets not appressed. This race has a restricted distribution and has strong affinities in ear type to the Bolivian race, *Kcello*. Many collections are apparently crossed with *Patillo* or *Patillo-Sabanero*.

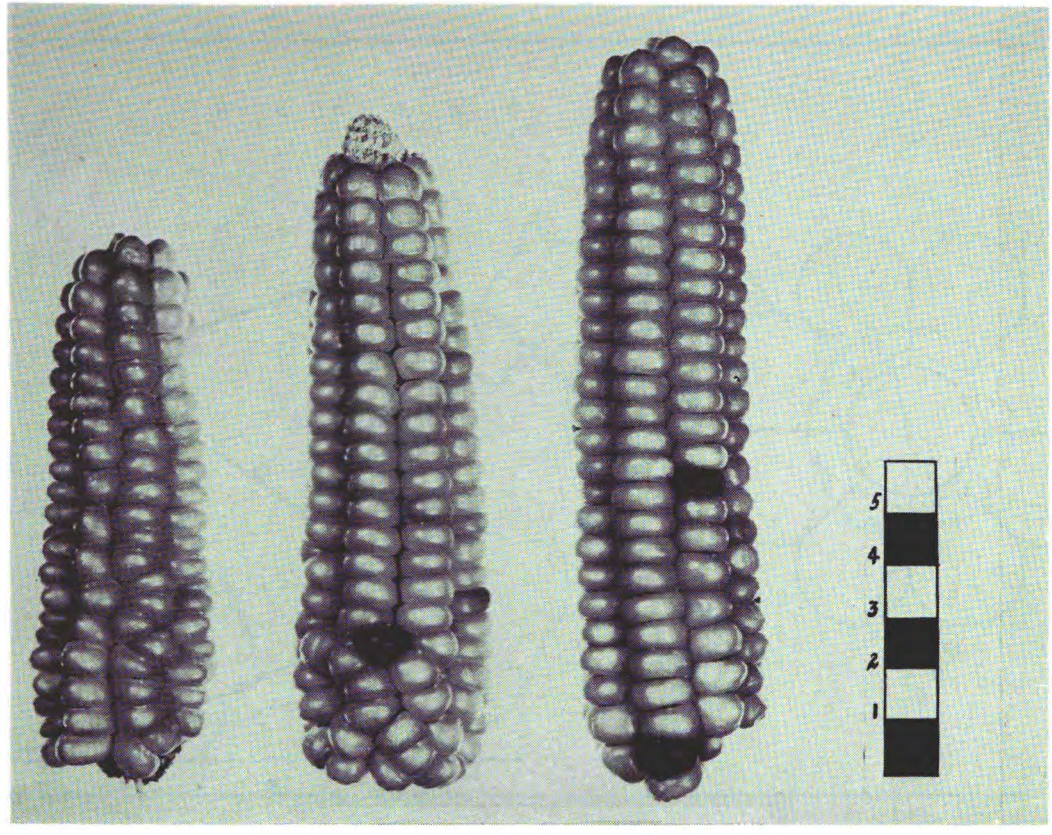

FIG. 27. Representative ears of Kcello Ecuatoriano.

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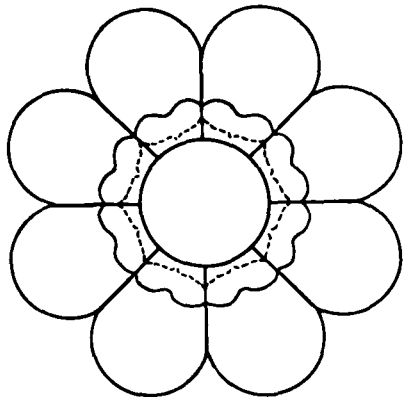

FIG. 28. Ear cross-section diagram of Kcello Ecuatoriano.

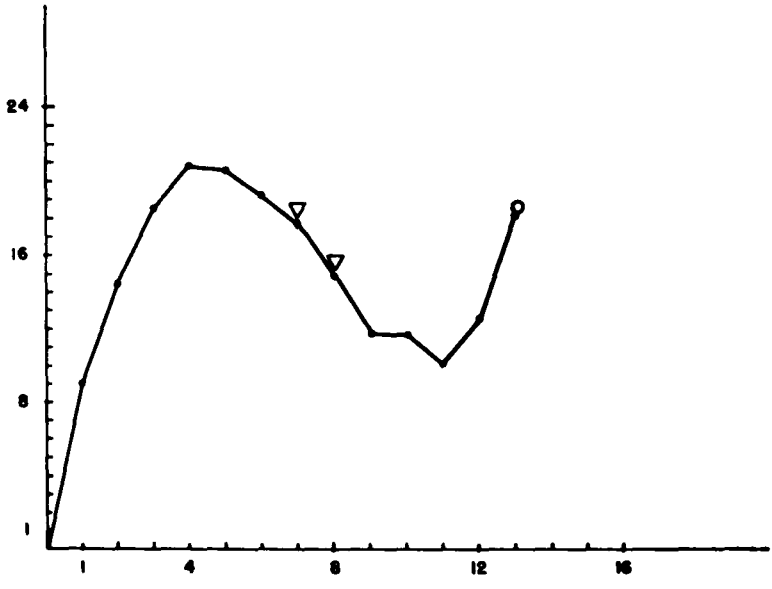

FIG. 29. Internode pattern of Kcello Ecuatoriano.

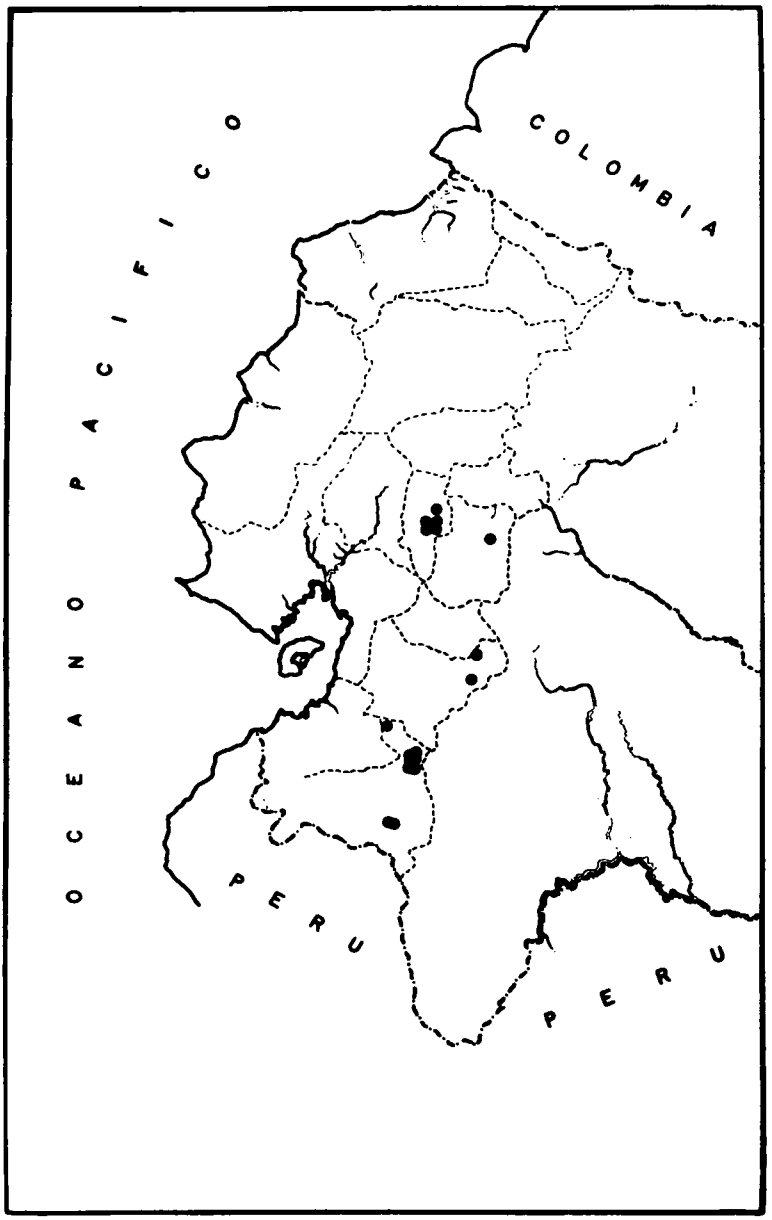

FIG. 30. The distribution of Kcello Ecuatoriano.

CHILLO

Ear Photograph ..... Figure 31
Ear Diagram ..... Figure 32
Internode Diagram ..... Figure 33
Distribution Map ..... Figure 34

Mean altitude of type specimens, 2,520 meters; others, 2,400 to 3,000 meters. Very large, pointed, yellow, floury kernels. Ears mostly conical; some husk compression at the very thick base of the ear, where irregular rowing is common. The 10 to 14 rows are otherwise fairly straight. Cobs thin, mostly white. Leaves broad and short relative to their width. Sheaths with intense sun-red plant color and sparse soft pubescence. A robust appearance is imparted to the plant by thick culms and two heavy ears, the uppermost a little above the mid-point of the stem. Tassels with long central spikes and open; horizontal to slightly arching branches. This race has local fame in the valley of the *Chillos* and surrounding areas and is locally referred to as *Chillo* or *Maiz Chillo.*

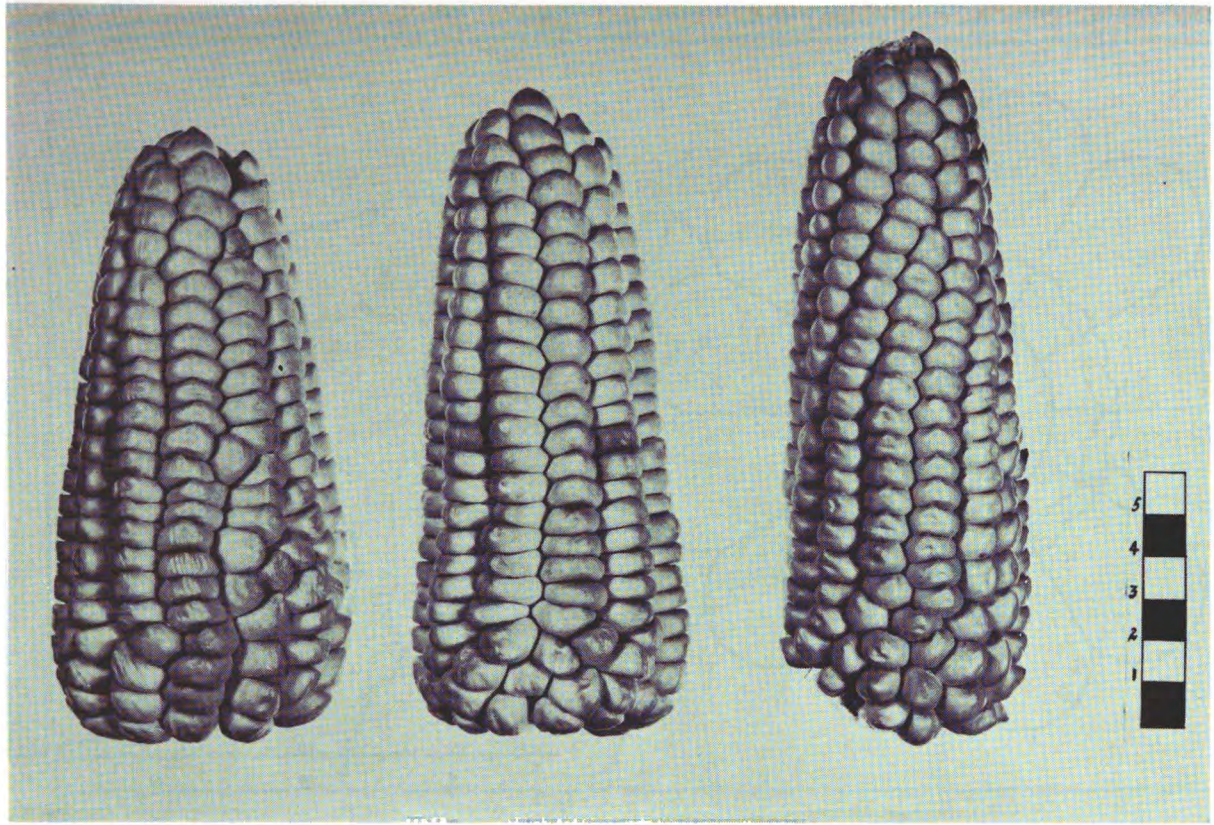

FIG. 31. Representative ears of Chillo.

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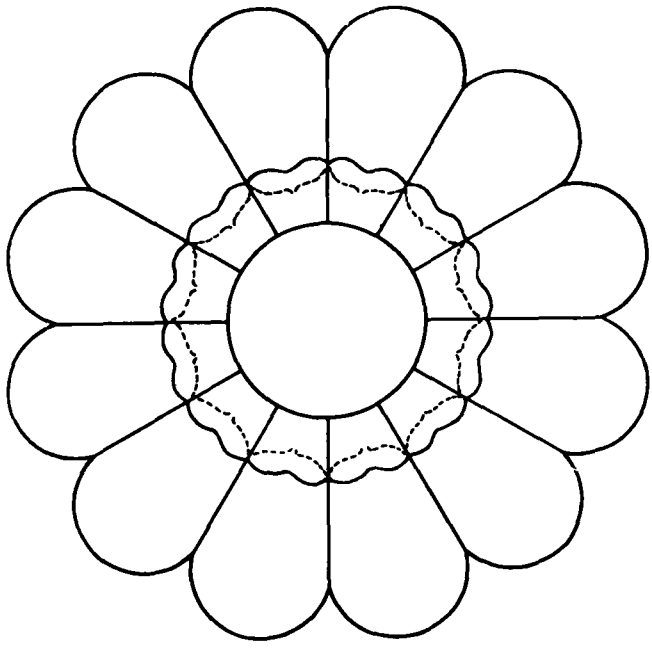

FIG. 32. Ear cross-section diagram of Chillo.

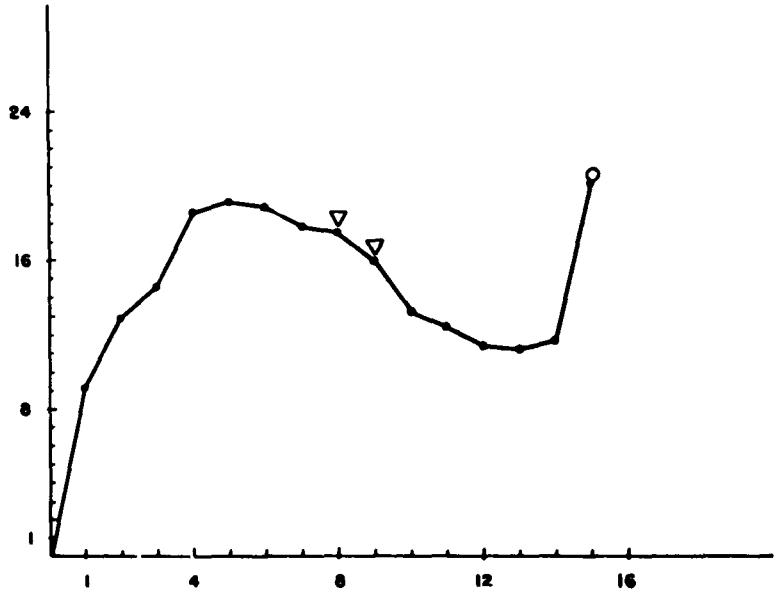

FIG. 33. Internode pattern of Chillo.

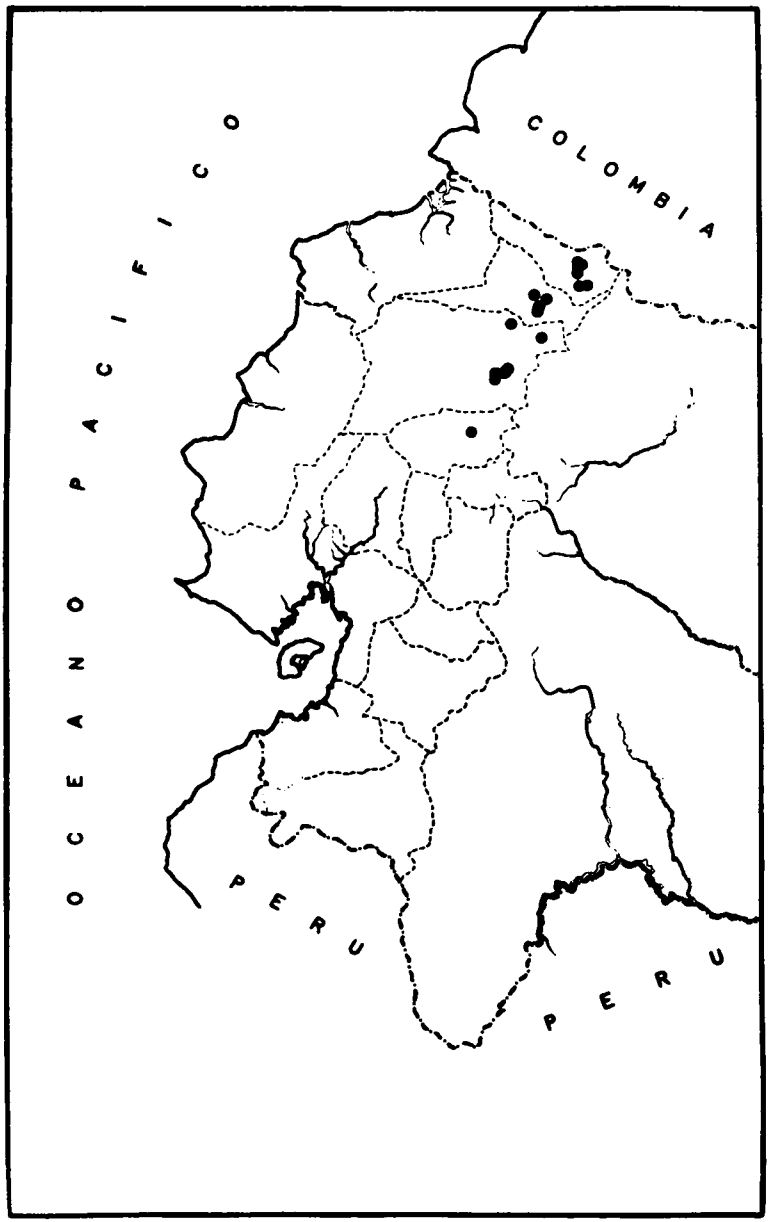

FIG. 34. The distribution of Chillo.

CHULPI ECUATORIANO

Ear Photograph ..... Figure 35
Ear Diagram ..... Figure 36
Internode Diagram ..... Figure 37
Distribution Map ..... Figure 38

Mean altitude of type specimens, 2,570 meters; other, 2,200 to 2,600 meters. Ears conical to short cylindrical with large mostly white cobs, and 14 to 22 irregular, spiraled or straight rows. Endosperm sugary except for contaminating polinations; pericarp white or red. Many ears strongly fasciated. Plants robust, thick-stemmed with wide leaves. Tassels moderately well exserted and ovate in outline. Tassel branches short; spikelets densely arranged along the rachis. Many secondaries and tertiaries. Central spike heavy and erect. Glumes of the spikelets extremely long and intensely colored. Leaves wide relative to length. Moderate sun-red and light purple plant color.

Two collections of a small-eared variant of this race are noteworthy. Ecu. 387 (Figure 35, left) contains a nearly sperical ear about 7 cm. long with spiralling rows. Ears of Ecu. 424 are conical and have low row numbers (10 to 14). The plants of the short-eared types are also smaller in most respects than those of the larger-eared types.

Chulpi is the only Ecuadorian highland race with stiff wire-like pubescence. Very late maturing at Tibaitata. The race is probably related to the Peruvian and Bolivian forms of *Chuspillu*.

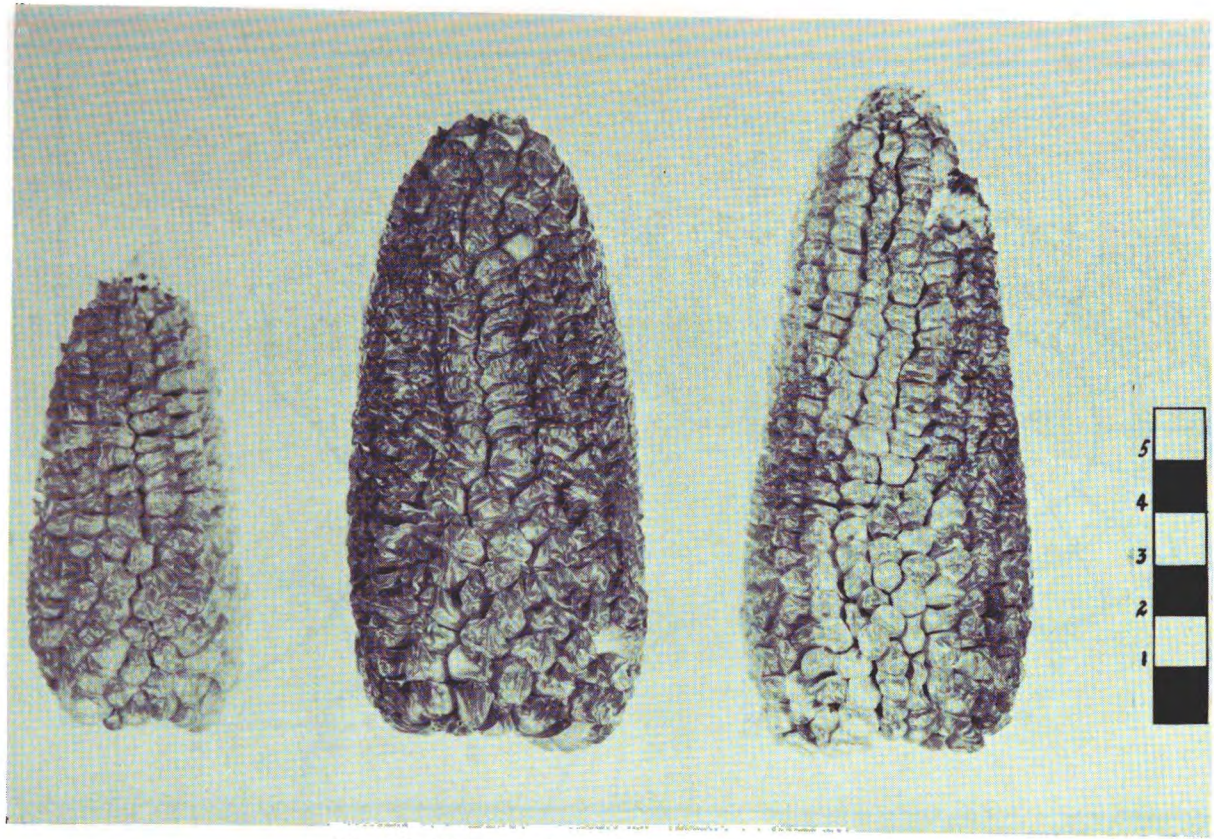

FIG. 35. Representative ears of Chulpi Ecuatoriano.

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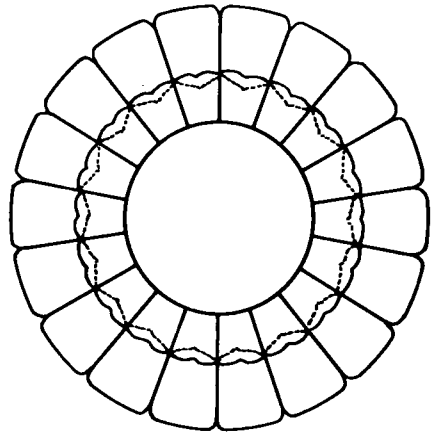

FIG. 36. Ear cross-section diagram of Chulpi Ecuatoriano.

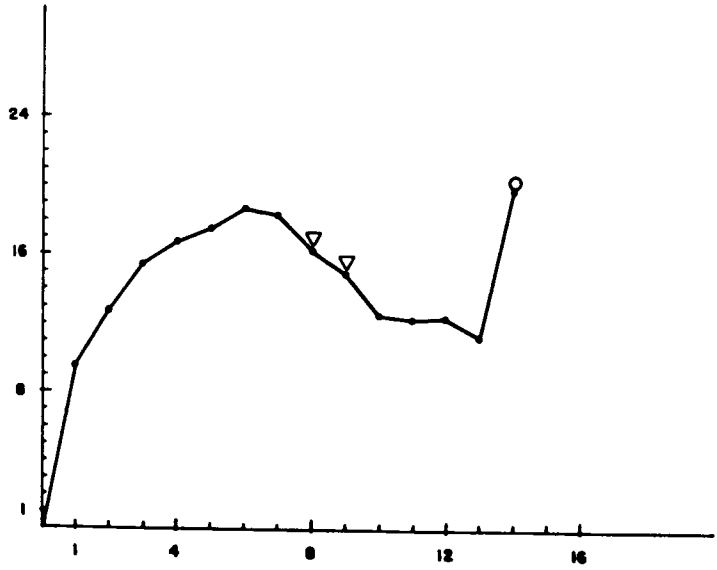

FIG. 37. Internode pattern of Chulpi Ecuatoriano.

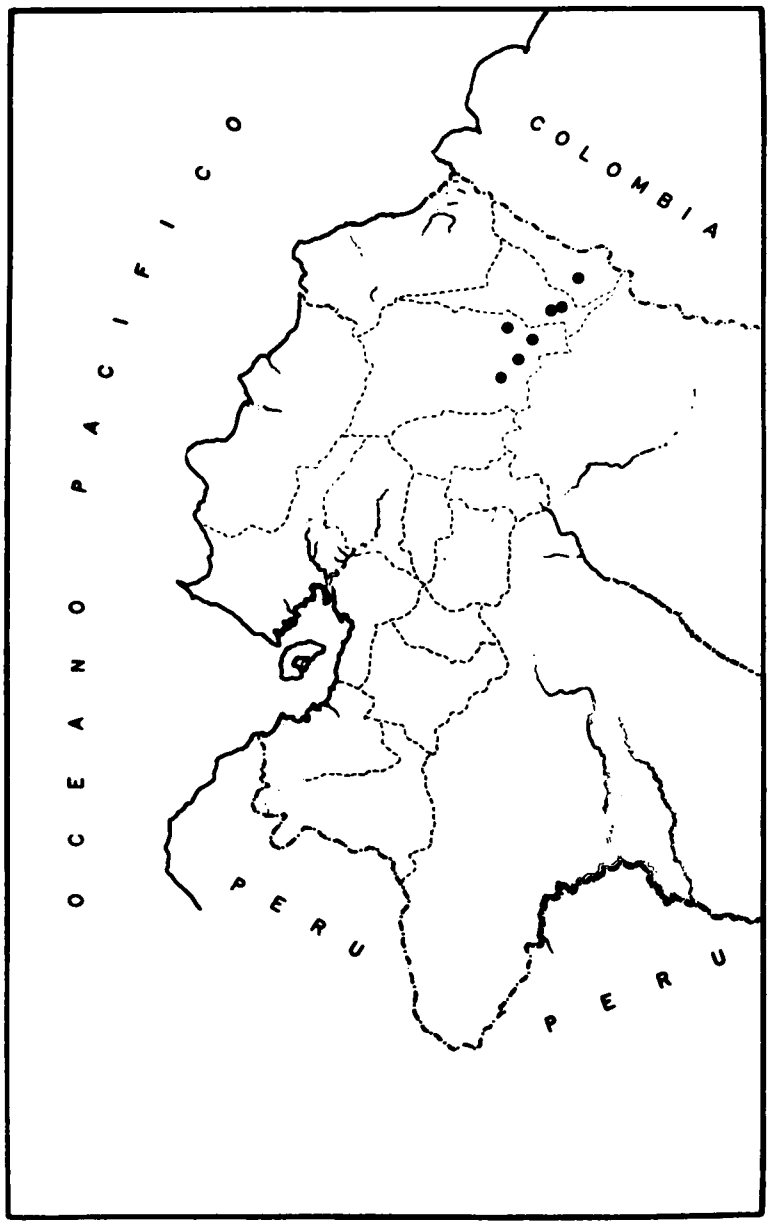

FIG. 38. The distribution of Chulpi Ecuatoriano.

MOROCHÓN

Ear Photograph ..... Figure 39
Ear Diagram ..... Figure 40
Internode Diagram ..... Figure 41
Distribution Map ..... Figure 42

Mean altitude of type specimens, 2,410 meters; others 1,700 to 3,000 meters. Medium-size ears, slightly conical to long cylindrical, commonly with barren tips; 8 to 12 rows, usually well-defined except at the butt. Kernels white, flint-type, fairly wide and long. Cobs white. The sturdy plants are medium tall with two ears, the uppermost well above the mid-point of the plant; about 15 per cent of the plants have tillers. Strong sun-red plant color and some soft pubescence. Tassels well exserted, with many branches, including several secondaries and tertiaries. Spikelets appressed to the rachis. Central spike long. *Morochón* has strong affinities to *Sabanero Ecuatoriano* in plant and ear characters, but is larger in both respects. The ear rows are straighter. This race is an intermediate member of an intergrading series running from *Montaña Ecuatoriana* at one extreme to *Patillo Ecuatoriano* at the other. Because of the easily recognizable characteristics of the two intermediate groups—*Morochón* and *Sabanero Ecuatoriano* —and the large number of collections involved, we have described them separately. *Morochón* means a large form of *morocho*. A great number of the collections bore the name *morocho*.

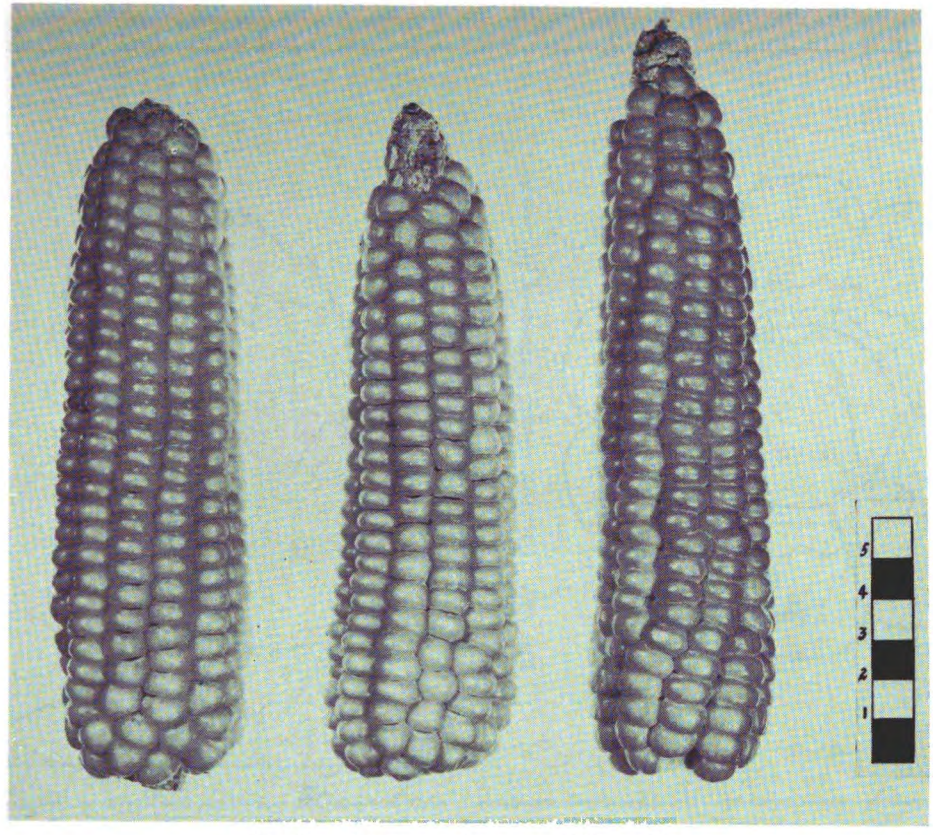

FIG. 39. Representative ears of Morochón.

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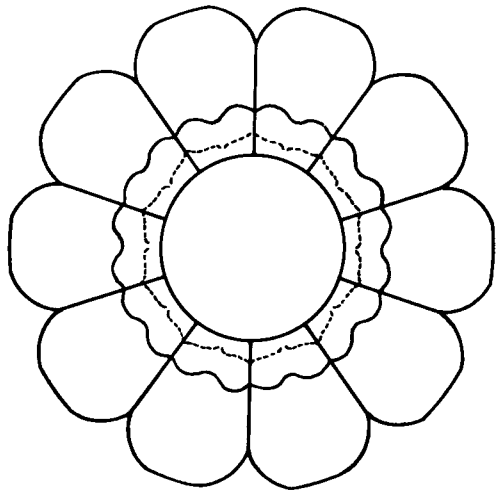

FIG. 40. Ear cross-section diagram of Morochón.

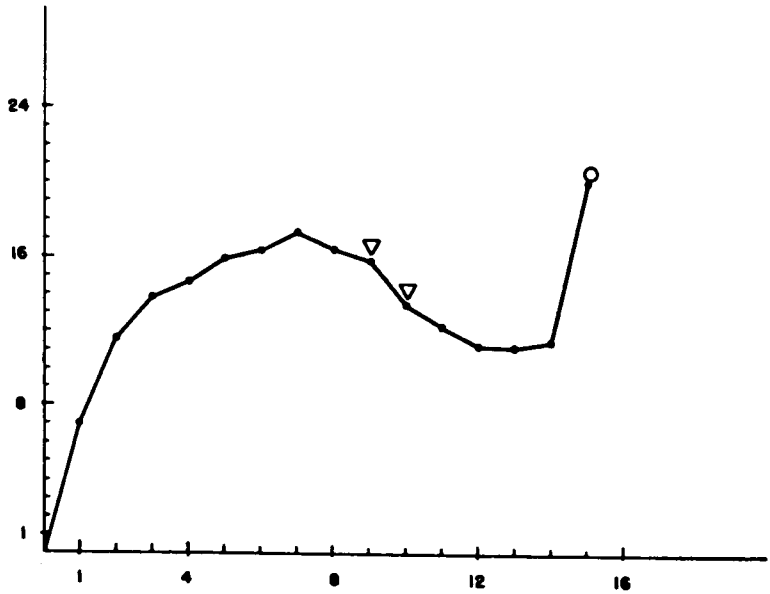

FIG. 41. Internode pattern of Morochón.

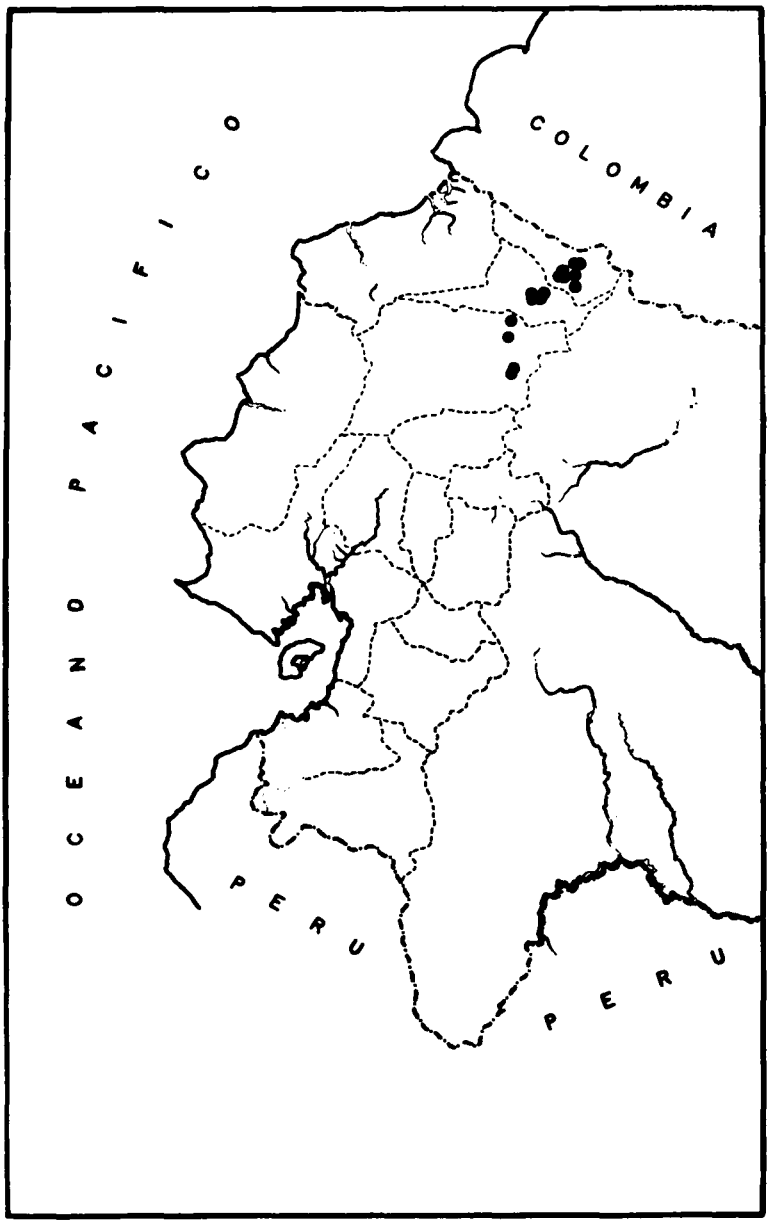

FIG. 42. The distribution of Morochón.

HUANDANGO

Ear Photograph ..... Figure 43
Ear Diagram ..... Figure 44
Internode Diagram ..... Figure 45
Distribution Map ..... Figure 46

Mean altitude of type specimens, 2,350 meters; others, 1,700 to 2,800 meters. Ears long, thin, and cylindrical; practically untapered. Most cobs red with predominately straight rows of wide, round, lemon-yellow flour-type grains. Some irregular rowing at the base of the ear. Plants slender with a slight zig-zag tendency. Internodes mostly inserted. Sun-red color, light to medium intensity, some purple. Leaves wide and rippled. Commonly more than two ears per plant; ear placement mostly near the middle of the plant. Tassels well exserted and open, with slender, long, arching branches. The central spike also slender and slightly arching. Galinat's ring (7) prominent on the central rachis. A few tillers half as large as the plant. This race is apparently the same as *Cabuya* of Colombia, but seems to be purer or more highly selected in Ecuador. Although the race is not widely grown, crosses of *Huandango* with *Chillo* and *Mishca* are common in the collections. The race was received under the names of *Huandango, Fandango, Guandango.*

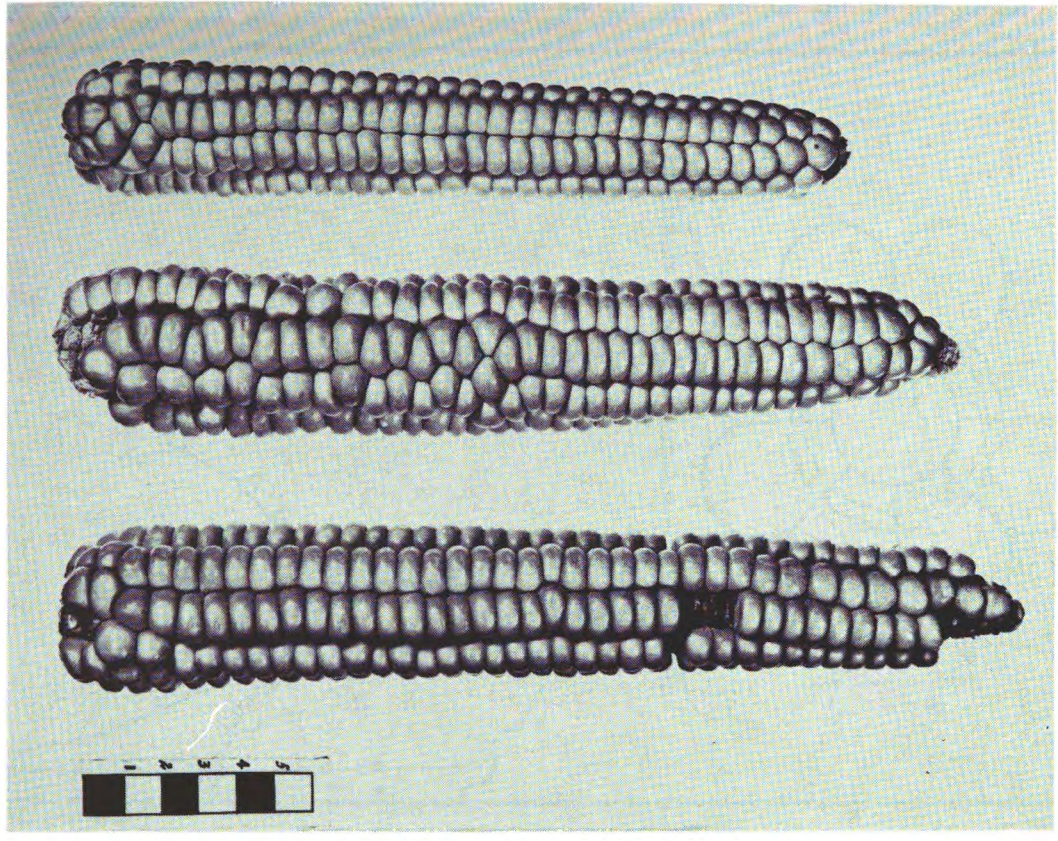

FIG. 43. Representative ears of Huandango.

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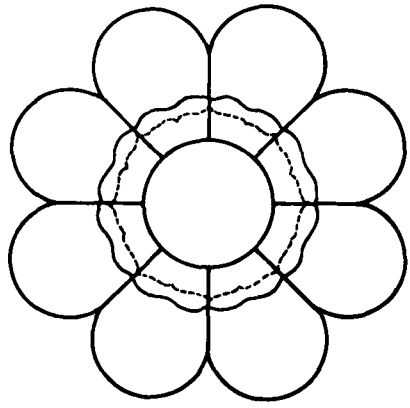

FIG. 44. Ear cross-section diagram of Huandango.

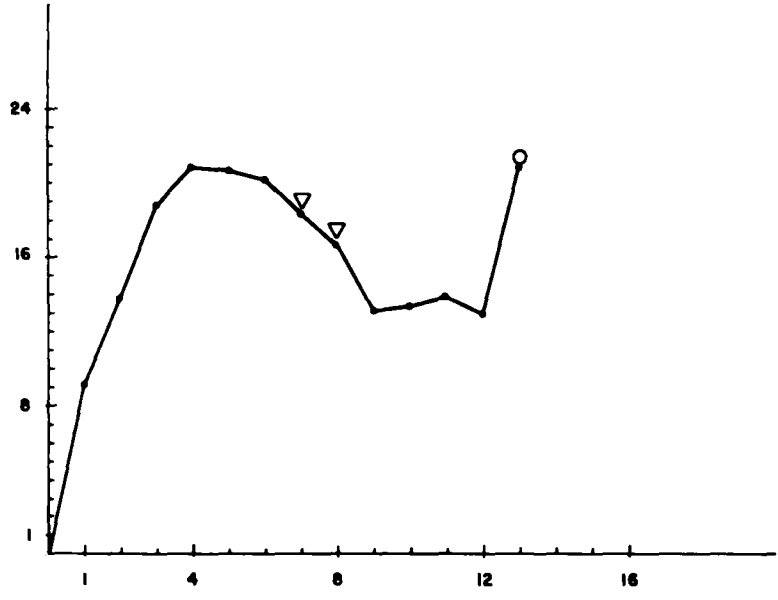

FIG. 45. Internode pattern of Huandango.

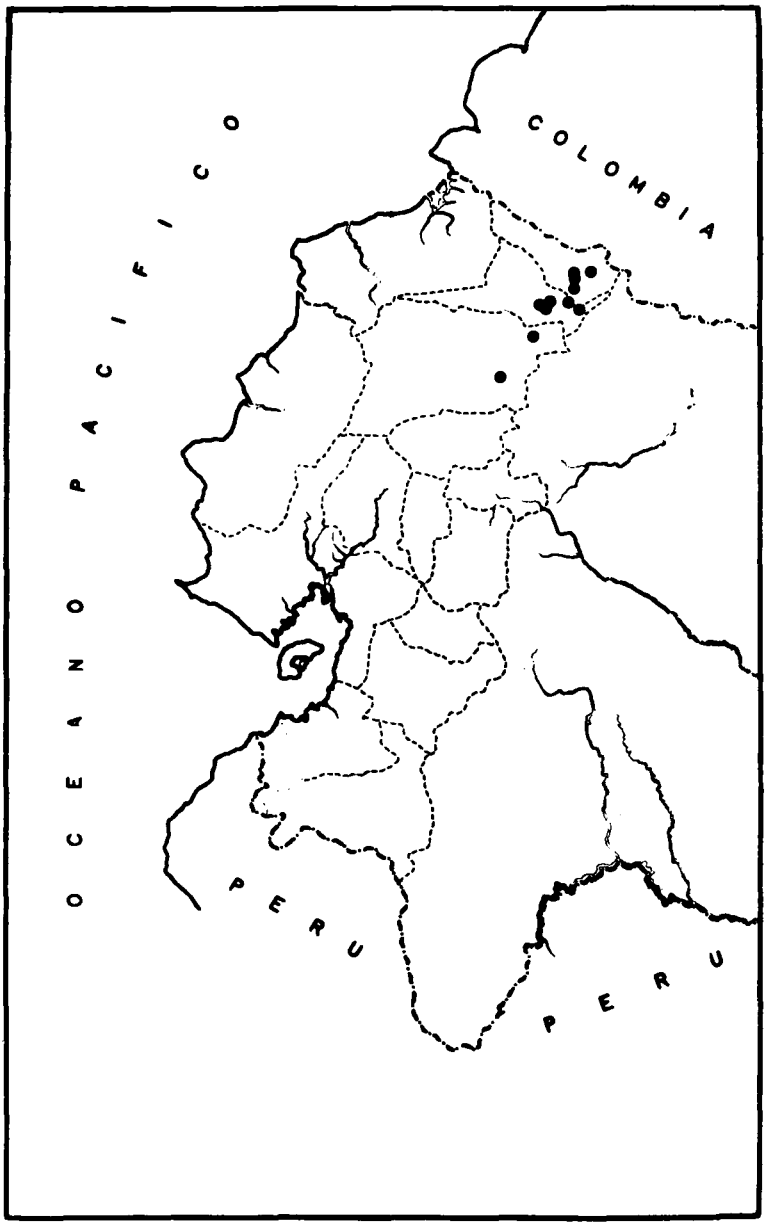

FIG. 46. The distribution of Huandango.

MONTAÑA ECUATORIANA

Ear Photograph ..... Figure 47
Ear Diagram ..... Figure 48
Internode Diagram ..... Figure 49
Distribution Map ..... Figure 50

Mean altitude of type specimens, 2,310 meters; others, 800 to 2,200 meters. Ears very long (the longest in Ecuador), slender, and gradually tapering. Grains white, flint-type, some pearly in appearance, tightly packed in 10 to 12 straight rows. Butts somewhat irregular and swollen. Cobs white. Plants tall, bamboo-like, with heavy stalks. Nodes included in strongly pubescent sheaths with light to medium sun-red color. Leaves long and wide. Severely attacked by rust at Bogota. Internodes at base of the culm short; adventitious roots to the third node common. Tassels poorly exserted; branches approximately equal in length, with appressed spikelets. Branching space long, the branches widely separated. The long, heavy tassels are usually arched so that all the branches hang down loosely giving the appearance of one-sided branching. Although this race closely resembles *Montaña* of Columbia in many characters, the Ecuadorian form has much straighter rows and lacks yellow endosperm: it may be an improved or highly selected *Montaña*.

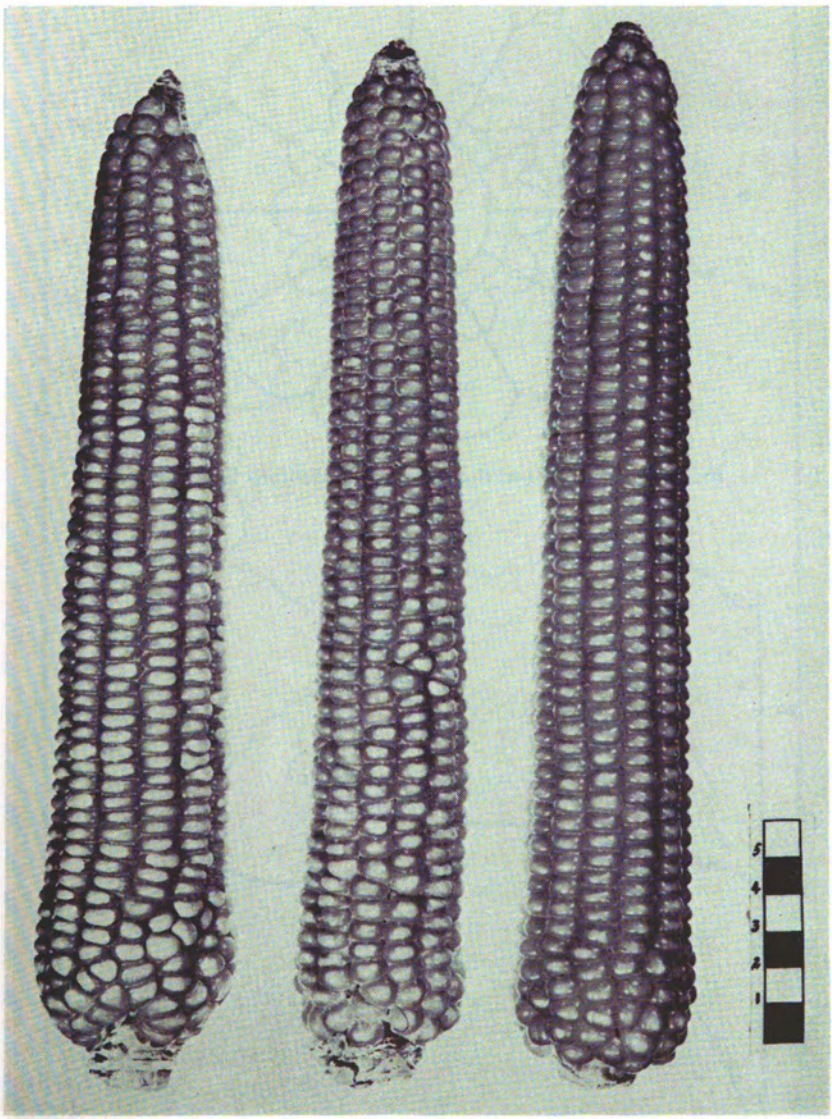

FIG. 47. Representative ears of Montaña Ecuatoriana.

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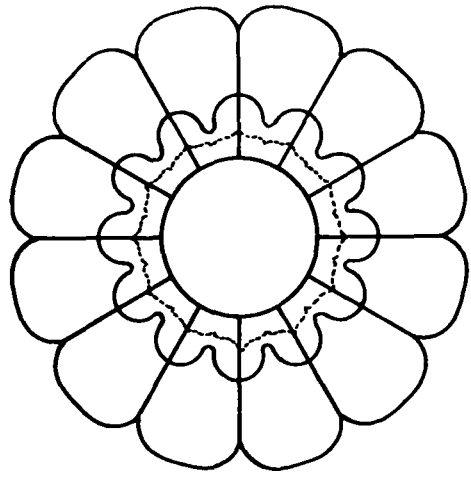

FIG. 48. Ear cross-section diagram of Montaña Ecuatoriana.

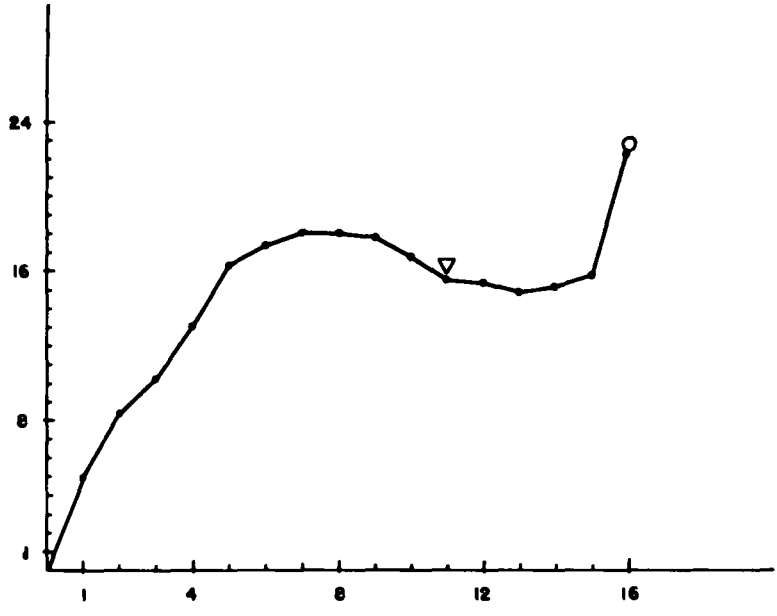

FIG. 49. Internode pattern of Montaña Ecuatoriana.

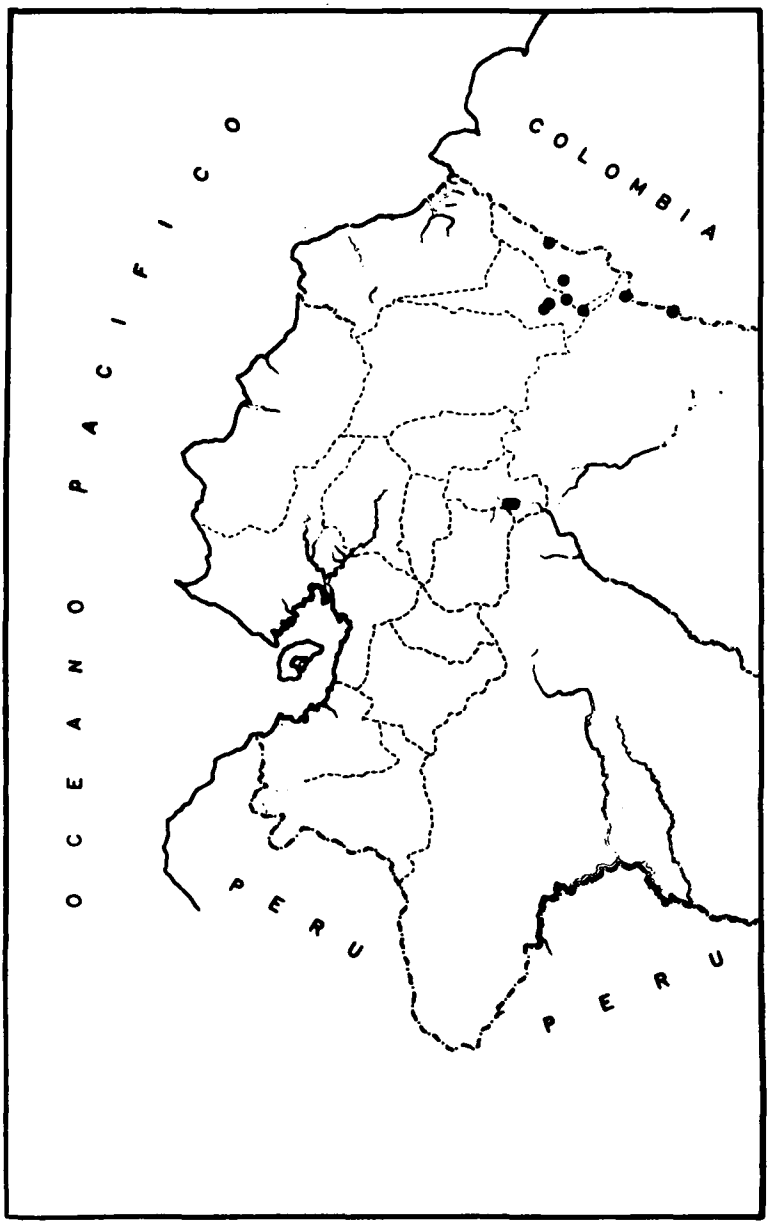

FIG. 50. The distribution of Montaña Ecuatoriana.

BLANCO HARINOSO DENTADO

Ear Photograph ..... Figure 51
Ear Diagram ..... Figure 52
Internode Diagram ..... Figure 53
Distribution Map ..... Figure 54

Mean altitude of type specimens, 2,300 meters; others, 2,100 to 2,600 meters. Kernels large, white, floury dents in 10 to 16 distinct rows on very thick ears. Pericarp color in about 15 per cent of the ears studied, aleurone color less common. About half the cobs are red. Plants very tall, extremely thick-stemmed and moderately pilose with light sun-red plant color. Leaves long and wide. Ear placement high. One plant in each of the two collections studied had six or more silking ears. Tassels very large, heavy, and well exserted. Many tassel branches with secondary and tertiary branches. The name selected means white flour dent. Plants of this race resemble those of *Sabanero Ecuatoriano.*

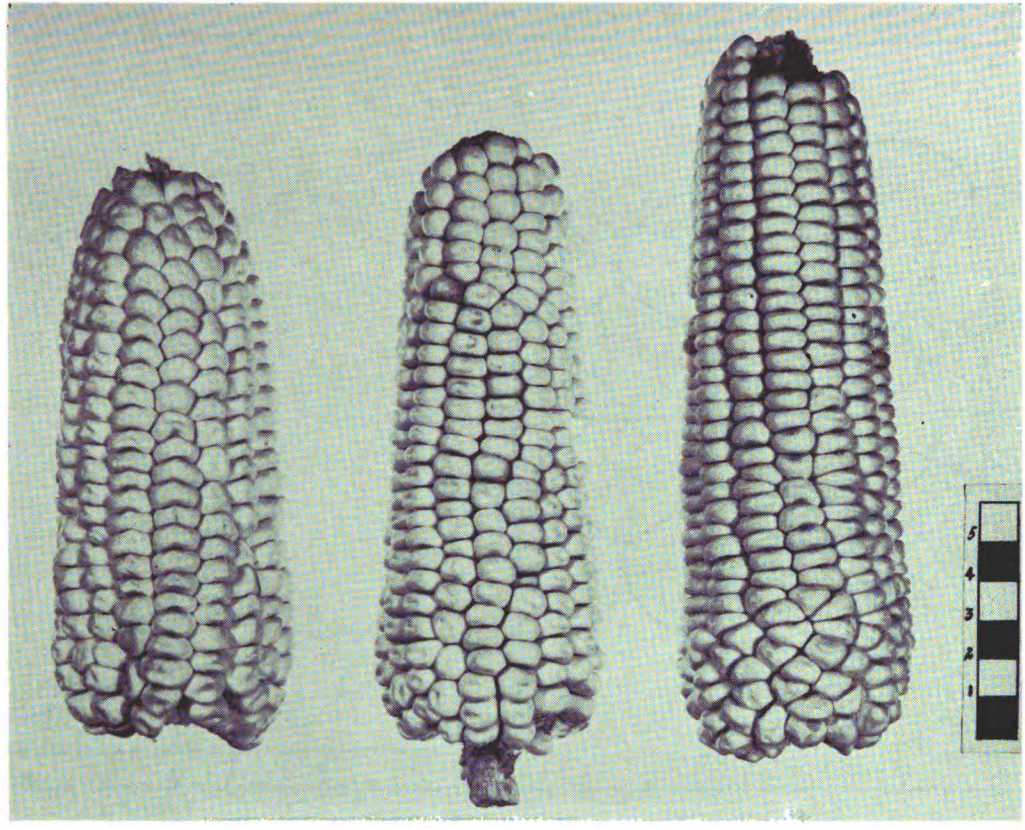

FIG. 51. Representative ears of Blanco Harinoso Dentado.

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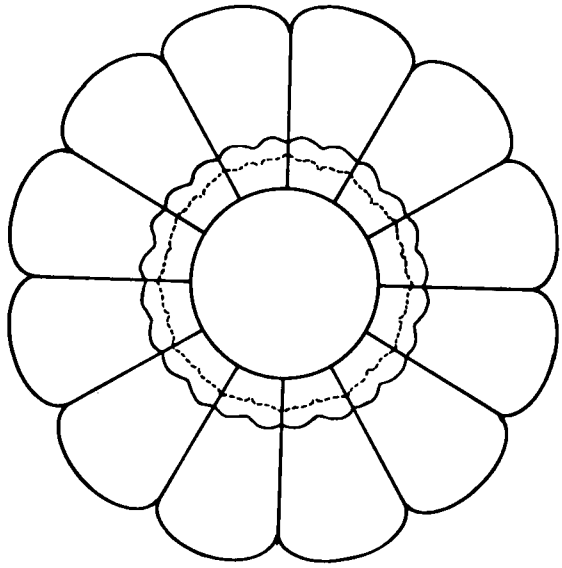

FIG. 52. Ear cross-section diagram of Blanco Harinoso Dentado.

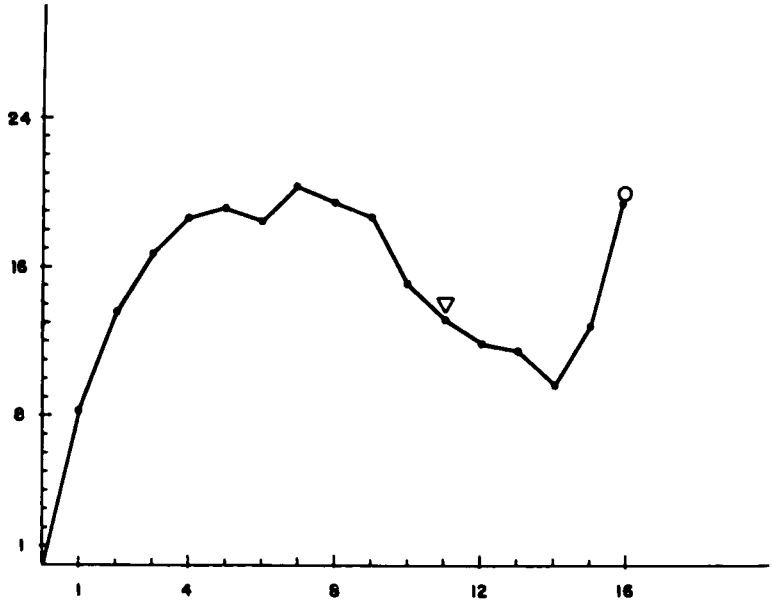

FIG. 53. Internode pattern of Blanco Harinoso Dentado.

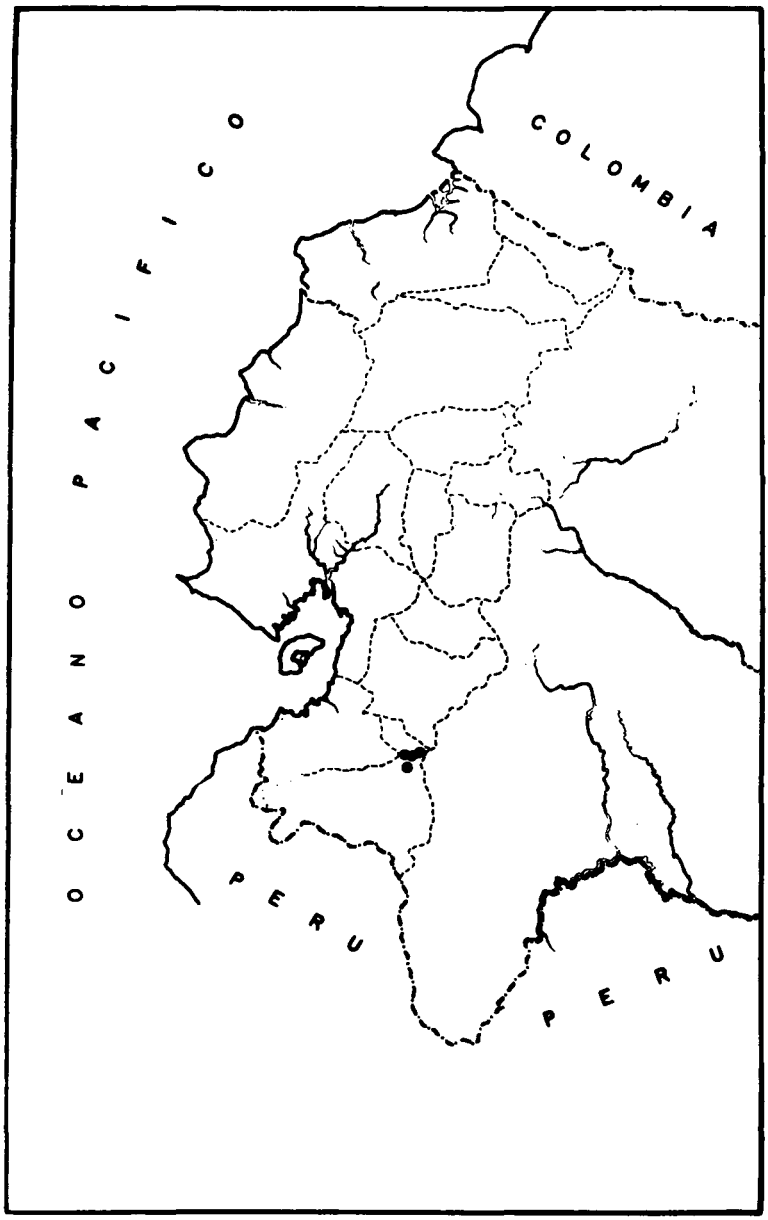

FIG. 54. The distribution of Blanco Harinoso Dentado.

CÓNICO DENTADO

Ear Photograph ..... Figure 55
Ear Diagram ..... Figure 56
Internode Diagram ..... Figure 57
Distribution Map ..... Figure 58

Mean altitude of type specimens, 2,000 meters; others, 550 to 2,400 meters. Ears long and conical, with barren tips and 10 to 16 straight or spiralling rows, with some irregularity at butt. Kernels mostly white soft dents; a few dented flints. Cobs mostly white with some pith coloring. Plants short, strongly tillered, slender-stemmed; nodes completely included. Plant color weakly sun-red or purple. When grown near Bogotá, the plants were pale green and weak as if outside their area of adaptation. The internodes of the tillers were telescoped. The leaves were stiffly ascending, and the plants were grass-like. The tassels were long, conical in outline, and with many drooping branches. There were large sterile areas on the central spike and tassel branches. In general, the droopiness of the tassel causes the central spike to be practically indistinguishable from the tassel branches when seen from a distance. Data are reported for plants grown at Bogota. When this race was planted at Medellín, the above characteristics were noted with a few exceptions; for example, a few leaves were very broad and much less tillering occurred. The selected name translates to "conical dent."

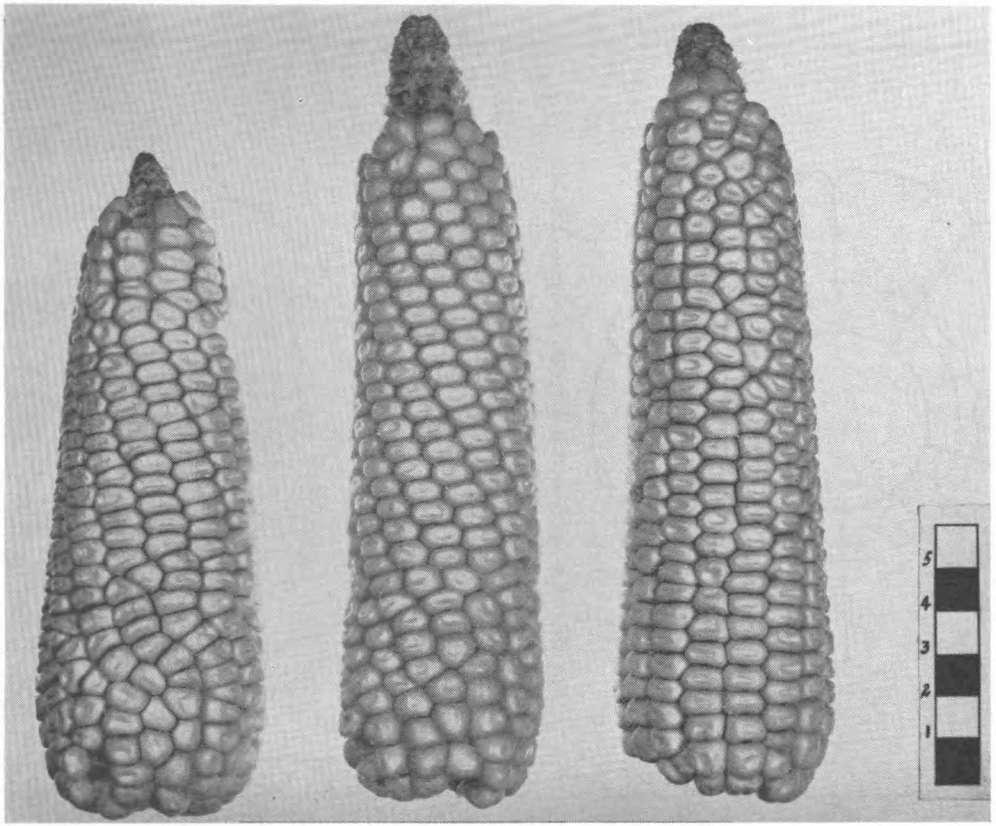

FIG. 55. Representative ears of Cónico Dentado.

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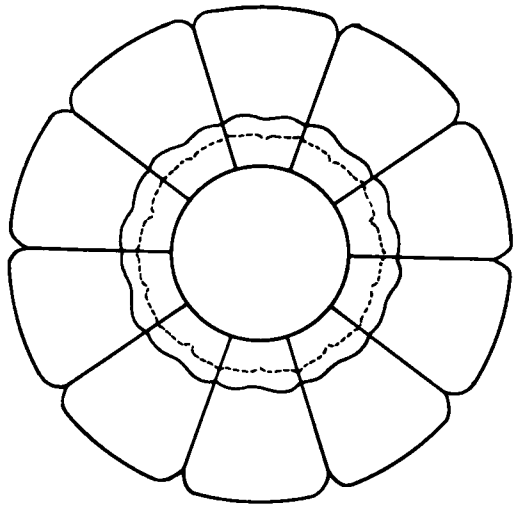

FIG. 56. Ear cross-section diagram of Cónico Dentado.

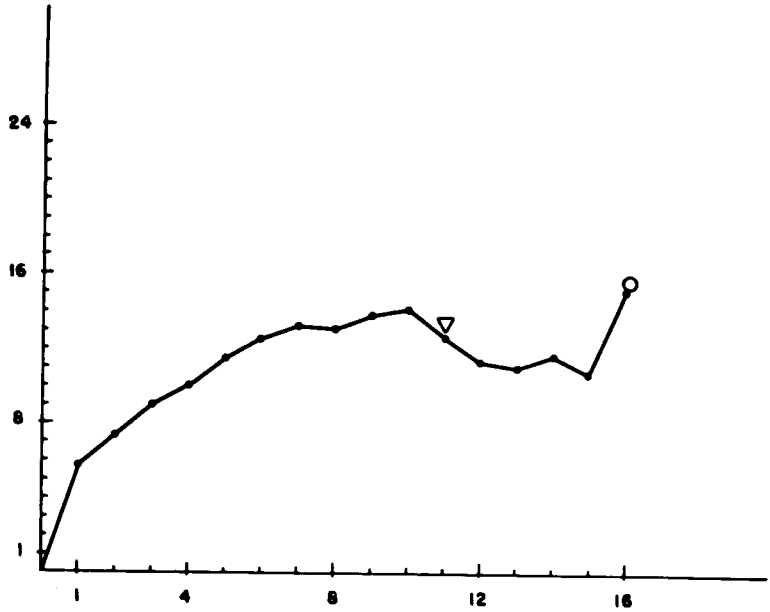

FIG. 57. Internode pattern of Cónico Dentado.

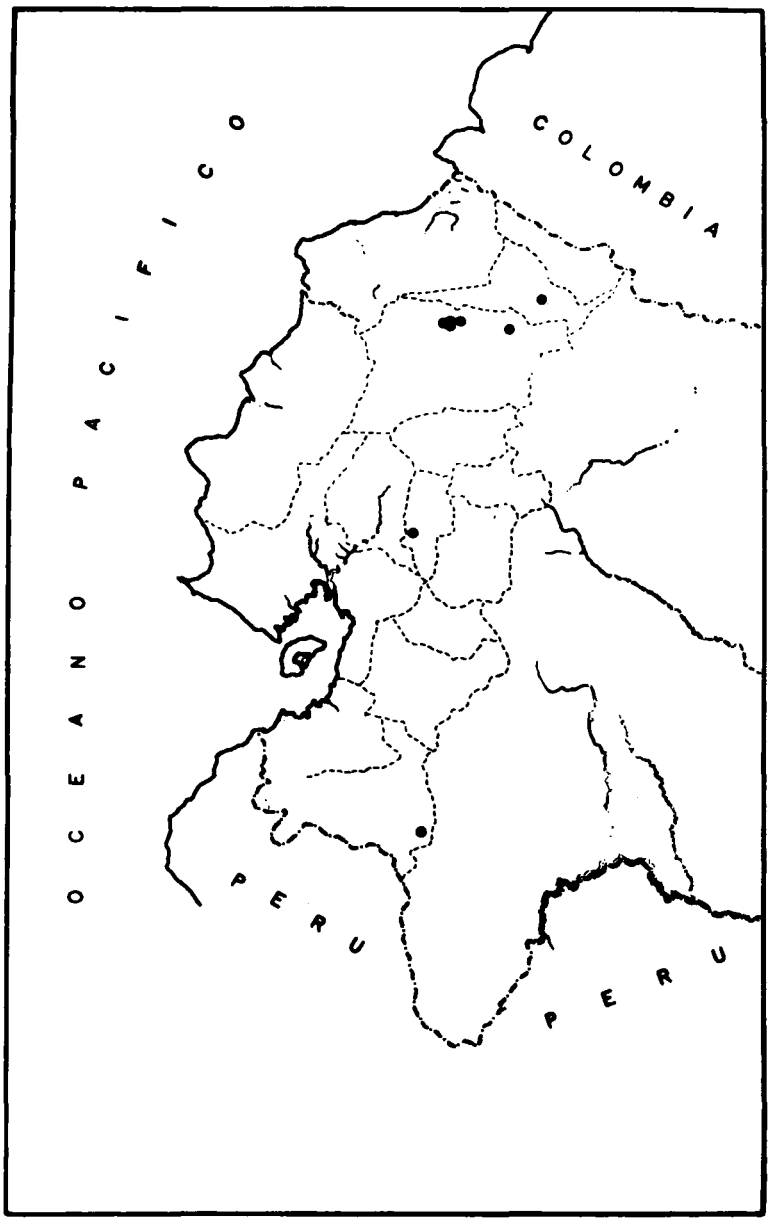

FIG. 58. The distribution of Cónico Dentado.

UCHIMA

Ear Photograph ..... Figure 59
Ear Diagram ..... Figure 60
Internode Diagram ..... Figure 61
Distribution Map ..... Figure 62

Mean altitude of type specimens, 1,770 meters; others, 1,400 to 2,000 meters. Ears slightly tapering, medium size with 10 to 14 rows of orange-yellow flinty grains; butts irregular and swollen. Kernels smoothly rounded and protruding, giving the ear a rough and bumpy appearance. Red cob color due to both lemmas and glumes; most midcobs colored. Pericarp colored in some ears. Very tall plants with relatively slender culms at Medellin. Occasional intensely sun-red plants; purple plant color common. Adventitious roots to the second and third node; nodes well exserted in most plants. Leaves very long and narrow. Tassel very large and dense with extremely long central spike. Tassel branches long; many secondaries and tertiaries. When dry the tassel doubles over, forming a semi-circle. Ears very high on plant. Although the name Uchima was not widely used, it was selected because the other local names (*amarillo*) were descriptively too broad.

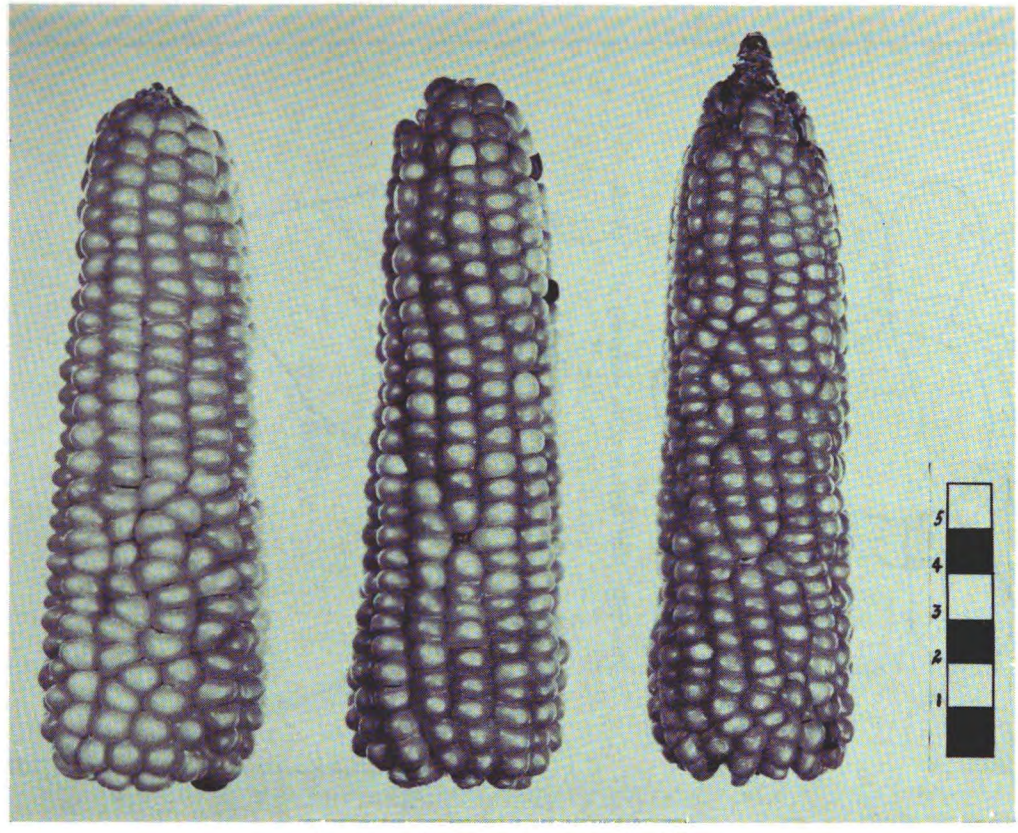

FIG. 59. Representative ears of Uchima.

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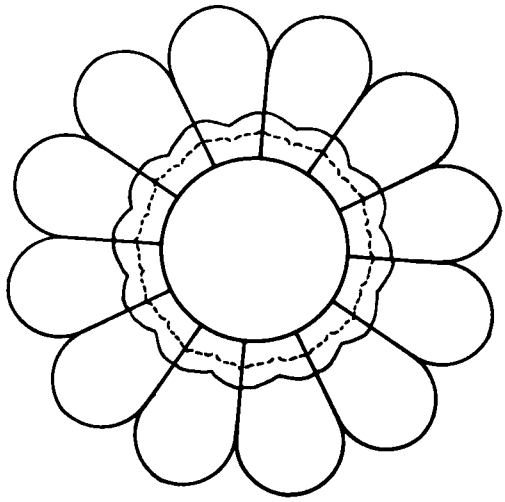

FIG. 60. Ear cross-section diagram of Uchima.

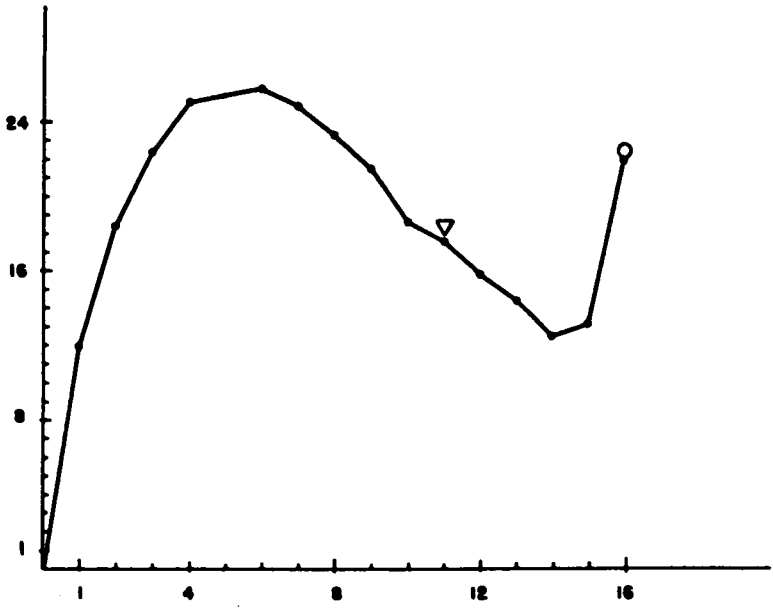

FIG. 61. Internode pattern of Uchima.

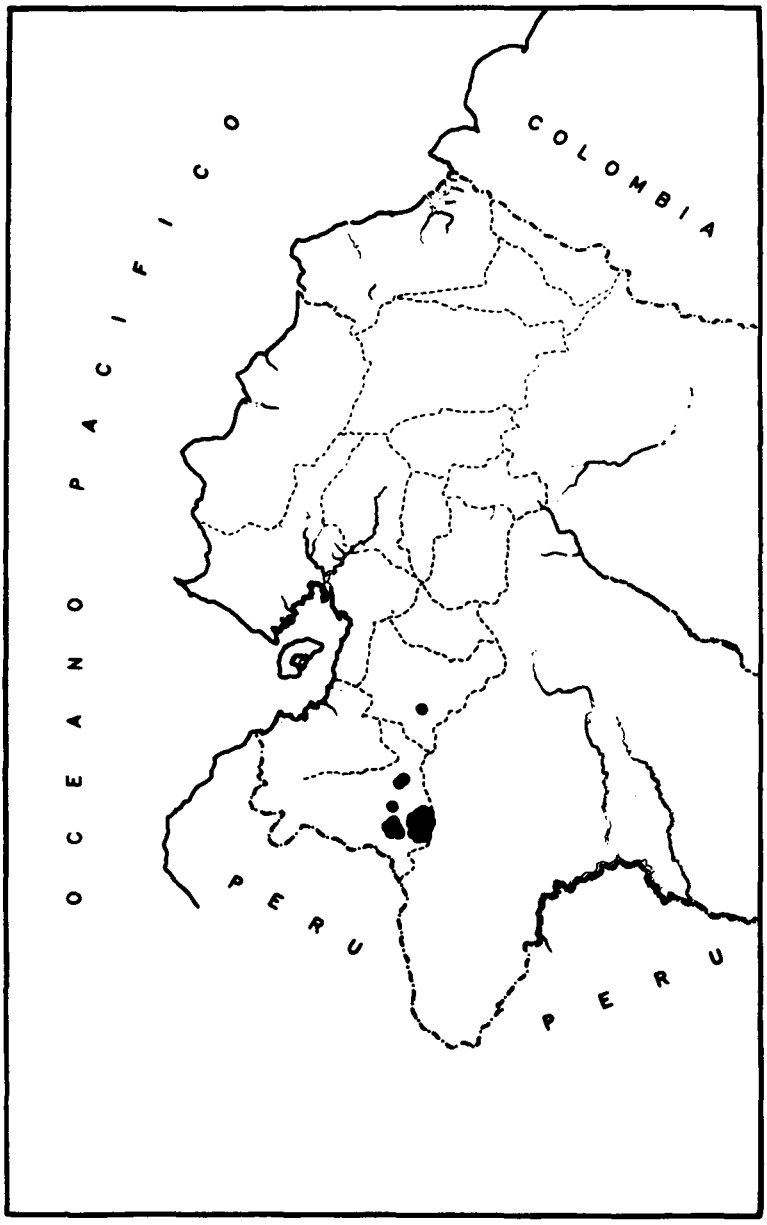

FIG. 62. The distribution of Uchima.

CLAVITO

Ear Photograph ..... Figure 63
Ear Diagram ..... Figure 64
Internode Diagram ..... Figure 65
Distribution Map ..... Figure 66

Mean altitude of type specimens, 1,530 meters. Small thin flexible ears with a very slender cob. Cobs mostly white, occasional color in the midcob and pith creamy white. Kernels small, round, flint-type. Ears of two types: cylindrical with straight rows, and conical with irregular and spiral rows. Row number 8 to 12. When grown at Bogotá, plants of this race produced slender and tapering ears with staminate flowers at the tip; the rows were more or less irregular, with round, hard, pearly grains. Plants short, prolific, with many tillers; culms telescoped, stem diameter decreasing toward apex. Nodes and tassels mostly included. Tassels with many thin branches or short branching space; these curl when dry. Variable. The race is similar to *Clavo* of Colombia in many respects but has smaller ear and plans. It was therefore given the diminutive name *Clavito*. Plant data were taken at Medellín.

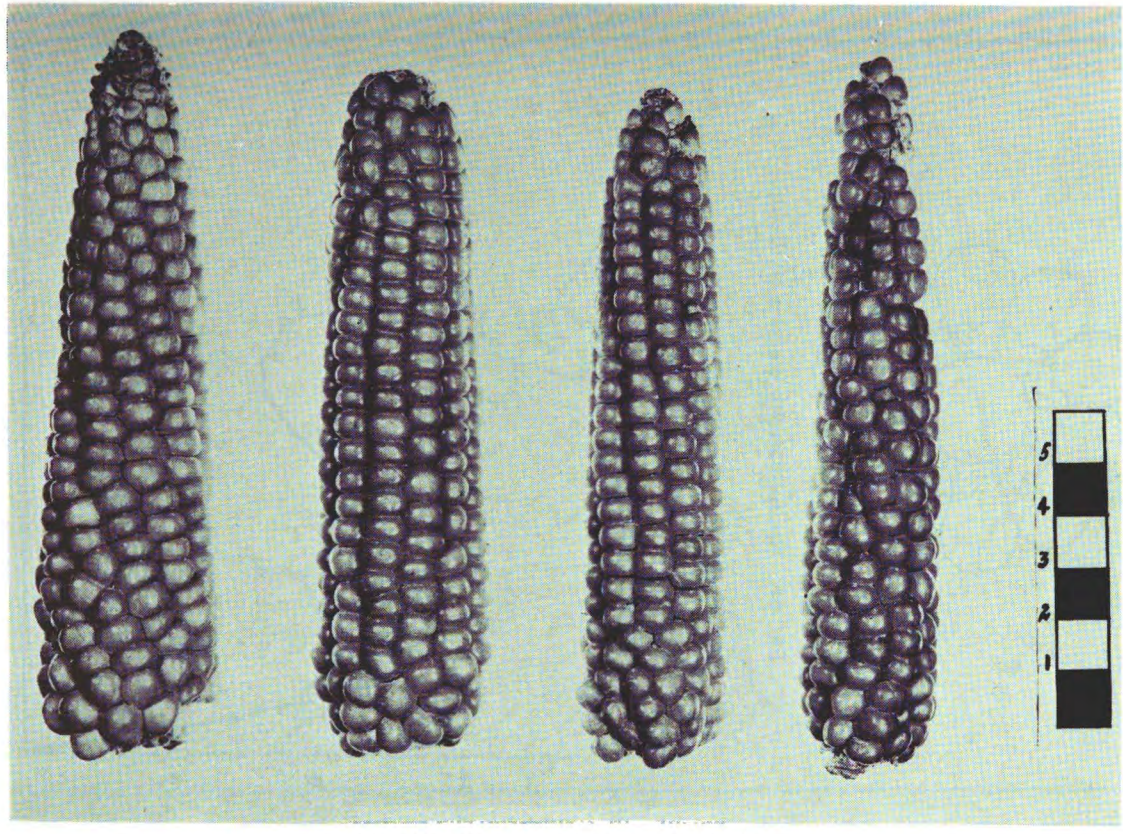

FIG. 63. Representative ears of Clavito.

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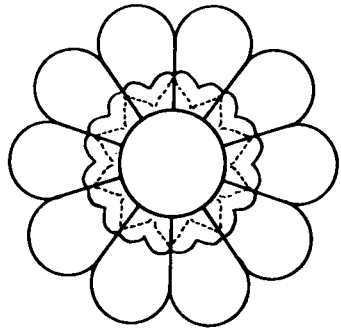

FIG. 64. Ear cross-section diagram of Clavito.

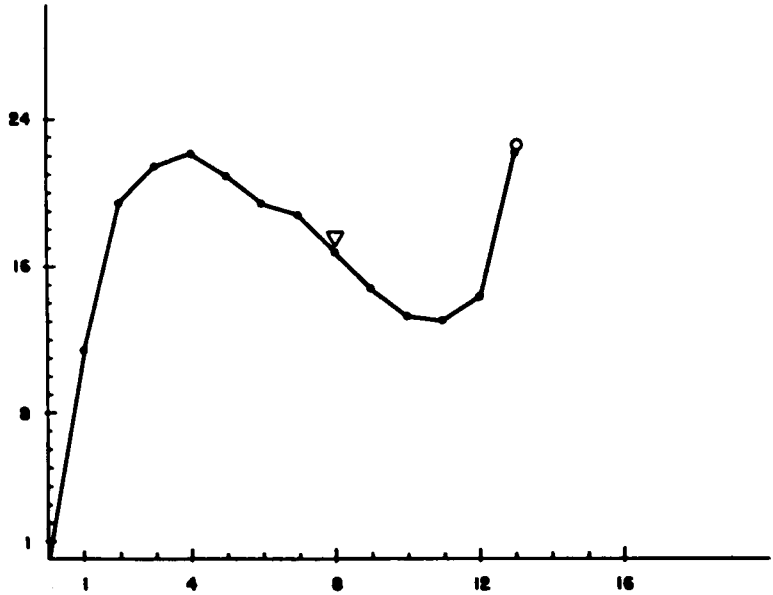

FIG. 65. Internode pattern of Clavito.

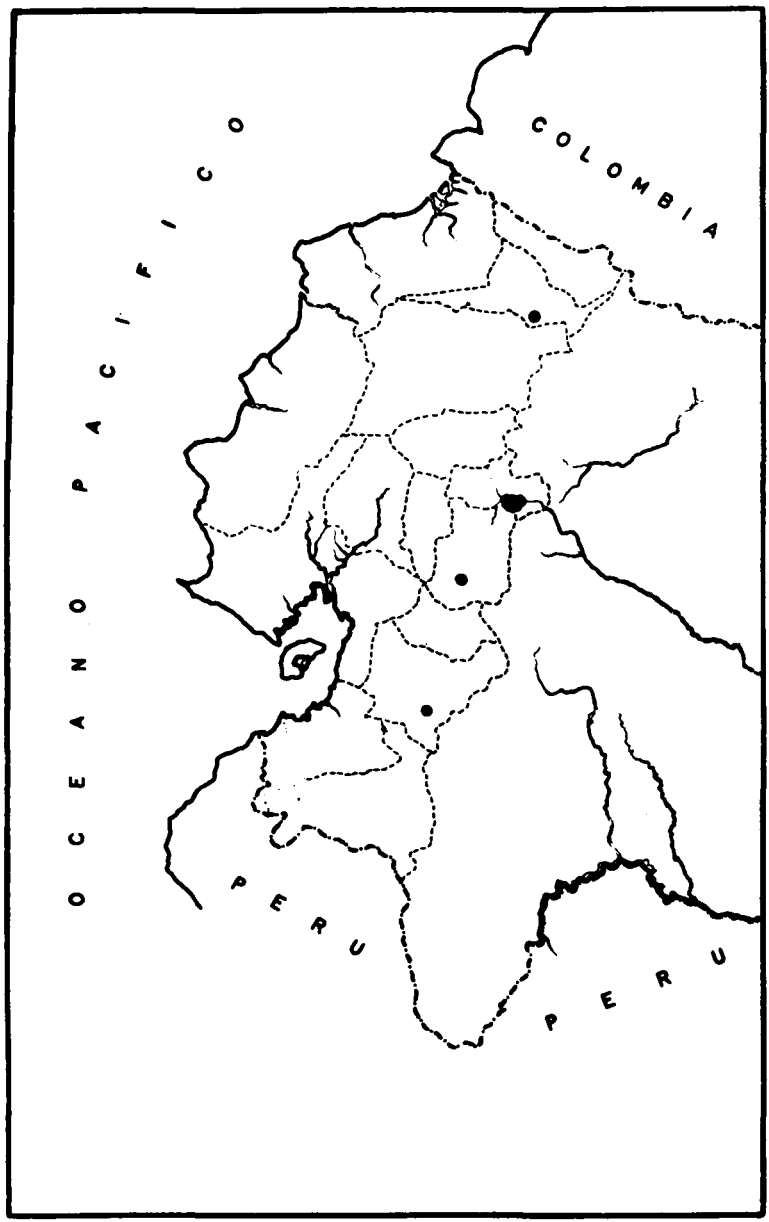

FIG. 66. The distribution of Clavito.

POJOSO CHICO ECUATORIANO

Ear Photograph ..... Figure 67
Ear Diagram ..... Figure 68
Internode Diagram ..... Figure 69
Distribution Map ..... Figure 70

Mean altitude of type specimens, 540 meters; others 550 to 1,200 meters. Ears short, very strongly tapered, barren-tipped, with 14 to 20 irregular rows. Grains round, small, flour or flint types, pale yellow through creamy to white. Shanks adhere to base of ear. Kernel arrangement, tessellate. Cobs mostly white with some glume and lemma coloring. Pith and midcob also colored. Plants tall, with stiff, long, and relatively narrow leaves on sturdy culms. Many nodes included; sheaths covered with wiry pubescence. Weak sun-red plant color. Tassels large, poorly exserted, with long gently arching branches on long branching space. Many secondaries and tertiaries.

Some collections now assigned to this race were originally classified as a yellow flour component of the race *Chococeño* (described below). Study of the plants showed that the two races are distinct. *P. Chico Ecuatoriano* has fewer tillers, thicker stalks, more included nodes, wider leaves, and larger, more exserted tassels than *Chococeño*. The ears resemble superficially *Chococeño, Gallina,* and *Candela,* all of which occur on the Pacific lowland side of the Andean Cordillera. *P. Chico,* on the other hand, occurs in the eastern lowlands, and probably has affinities with the *Pojoso* and *Coroico* types of Amazonian Peru and Bolivia.

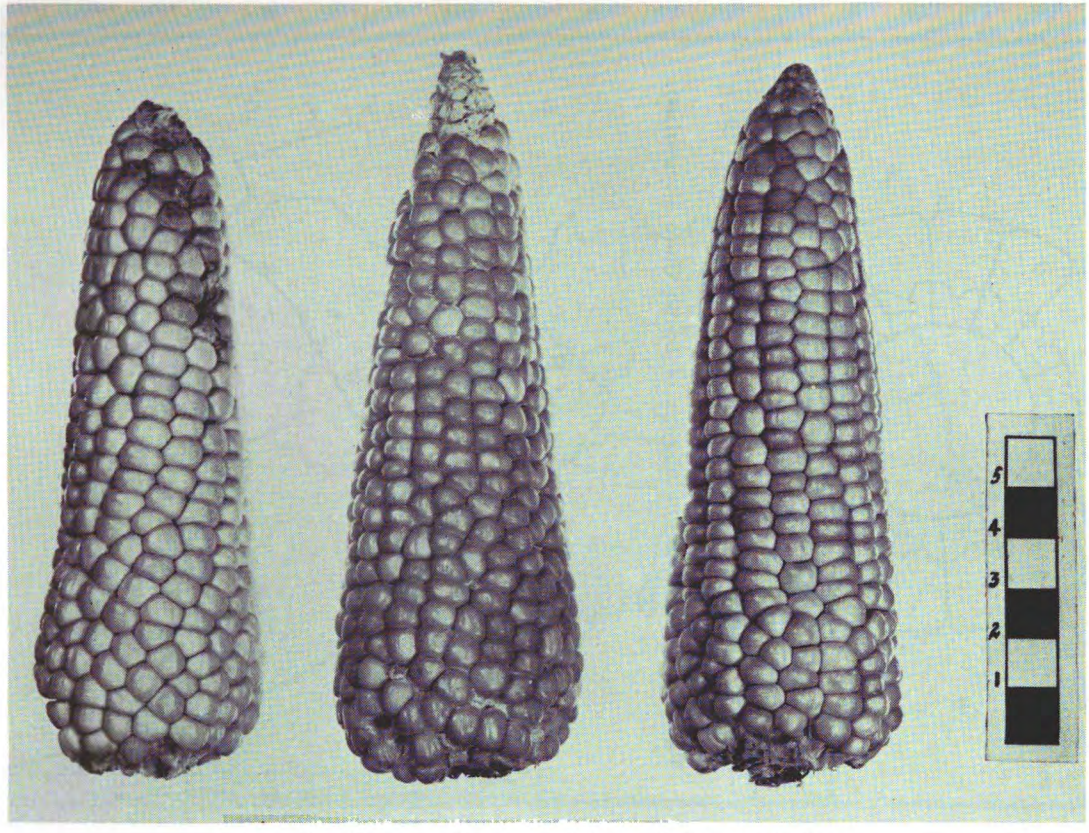

FIG. 67. Representative ears of Pojoso Chico Ecuatoriano.

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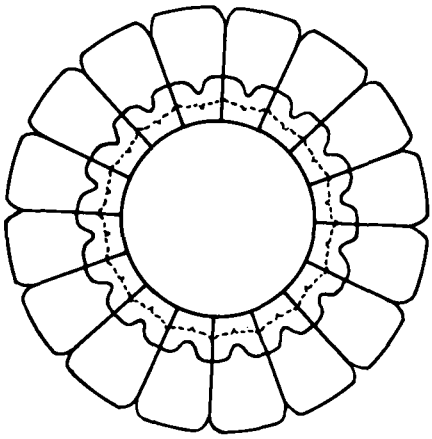

FIG. 68. Ear cross-section diagram of Pojoso Chico Ecuatoriano.

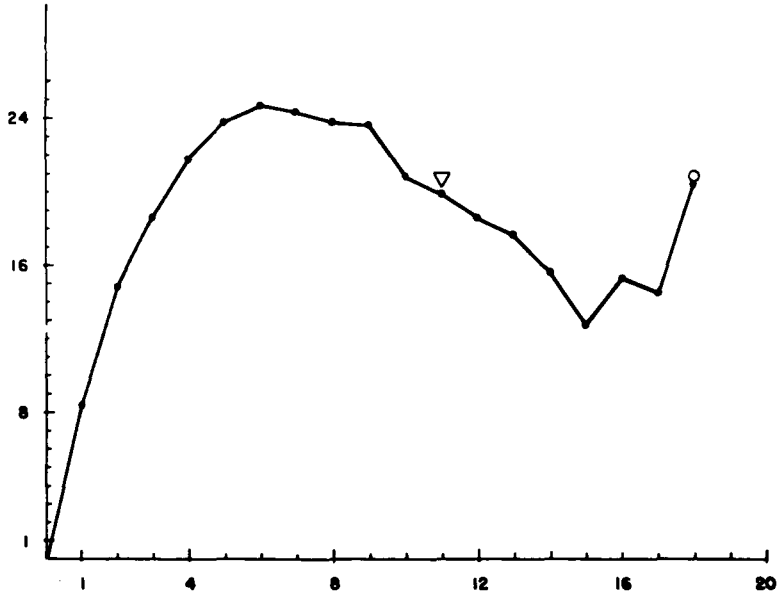

FIG. 69. Internode pattern of Pojoso Chico Ecuatoriano.

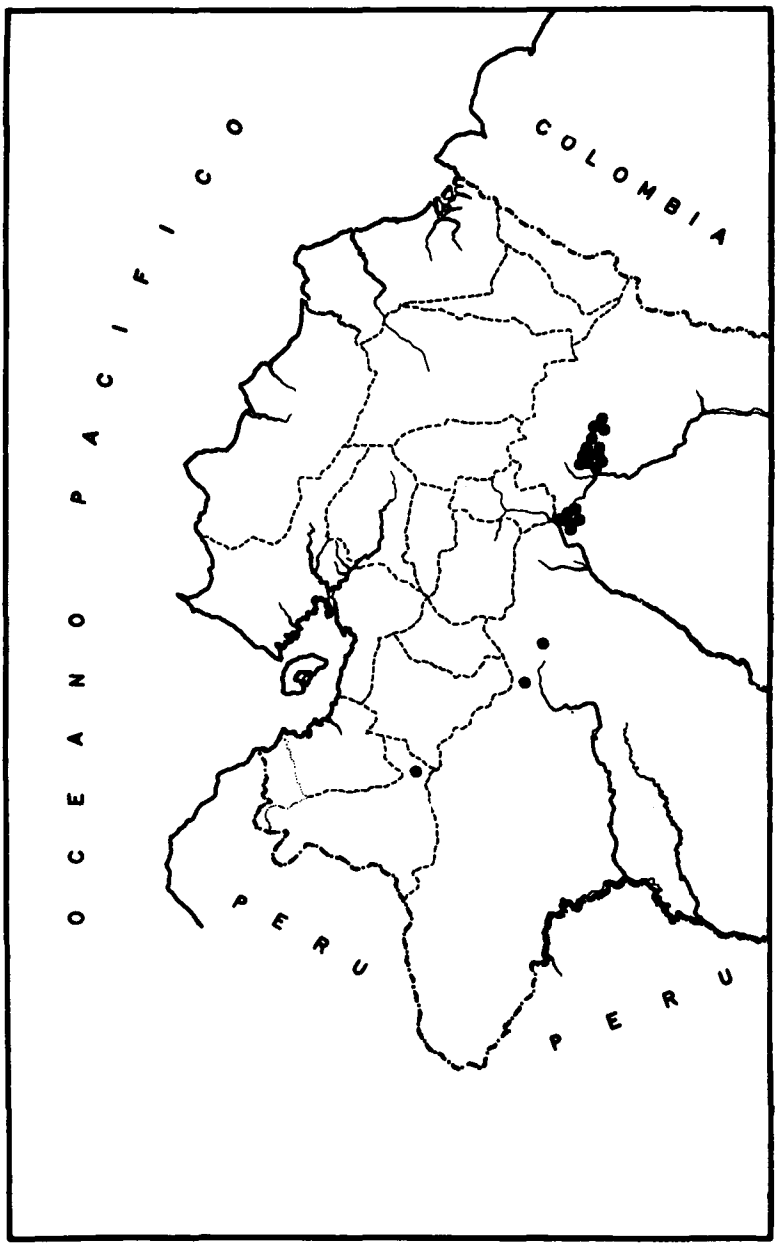

FIG. 70. The distribution of Pojoso Chico Ecuatoriano.

TUSILLA

Ear Photograph ..... Figure 71
Ear Diagram ..... Figure 72
Internode Diagram ..... Figure 73
Distribution Map ..... Figure 74

Mean altitude of type specimens, 520 meters; others, 90 to 1,500 meters. Ears short to medium, flexible, thin cylindrical or slightly tapering, with adherent shanks. Kernels round, flint type, mostly orange-yellow, with some red pericarp. Many ears have strong husk compression. Some straight-rowed samples with protruding grains, resemble *Karapampa* of Bolivia. Rows, 10 to 12, frequently tessellated, on thin, predominately white, slender cobs. Plants strongly tillered, tall, and ragged looking because of the broken midribs on the long, thin, stiff, upper leaves. The lower leaves usually arch. Culms thin, with nodes well exserted. Sheaths beset with stiff hairs. Tassels well exserted with large sterile areas on the branching portion of the central rachis and on the primaries. Although there are many secondaries, the tassels are open, with branches stiffly ascending, and then arching downwards at tips. The strong resemblance of the ears of *Tusilla* to those of the Colombian *Pira Naranja* seems superficial. The races do not appear closely related. The race is locally referred to as *Tusilla,* meaning little cob.

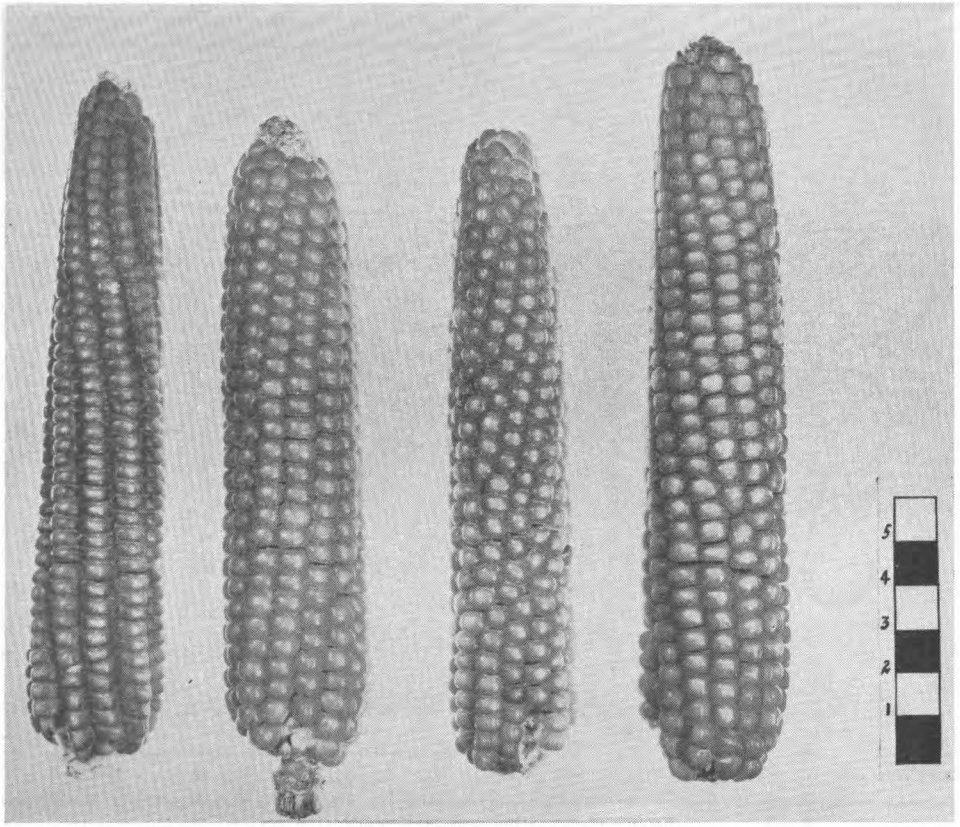

FIG. 71. Representative ears of Tusilla.

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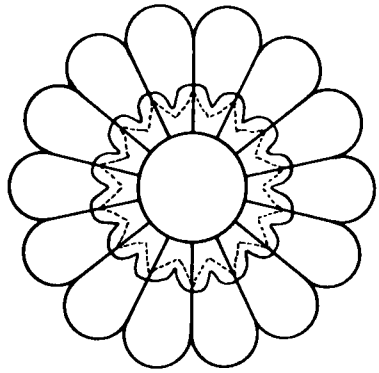

FIG. 72. Ear cross-section diagram of Tusilla.

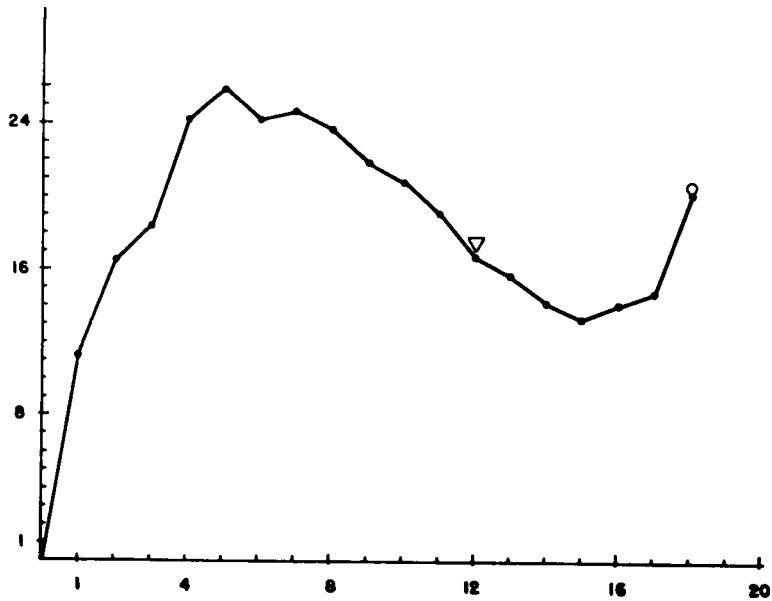

FIG. 73. Internode pattern of Tusilla.

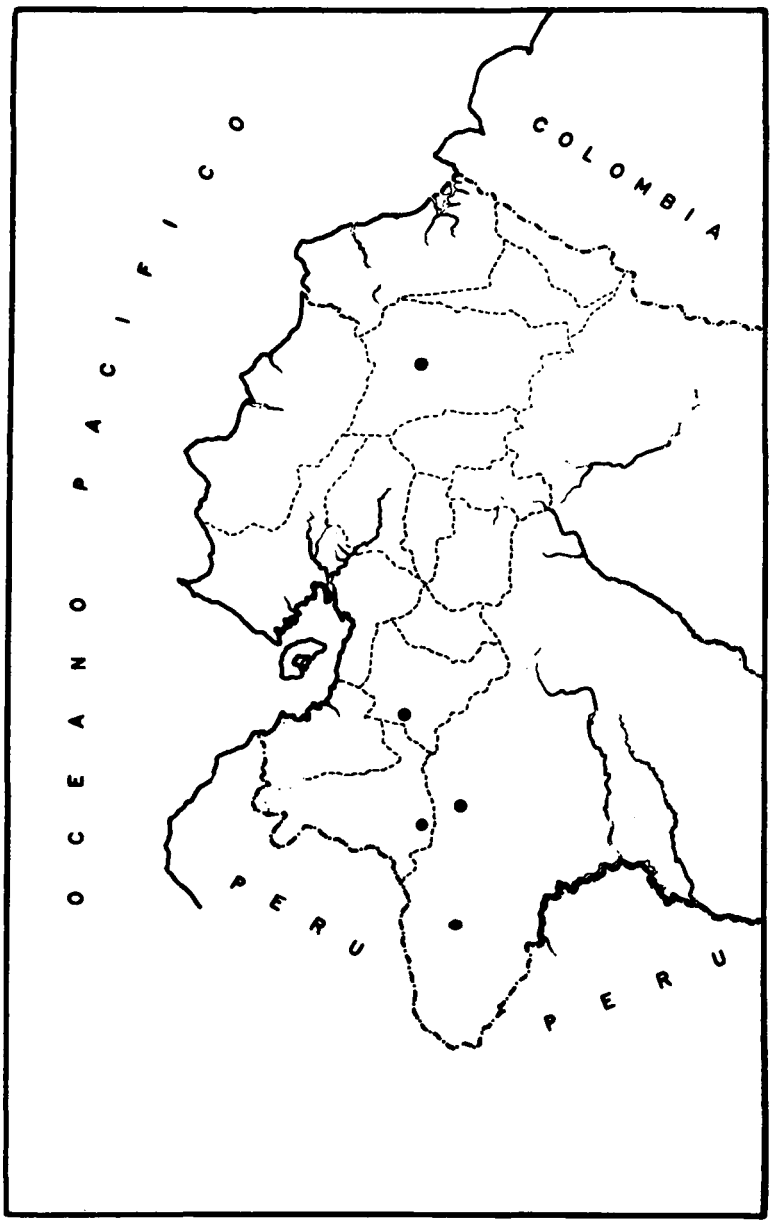

FIG. 74. The distribution of Tusilla.

GALLINA

Ear Photograph ..... Figure 75
Ear Diagram ..... Figure 76
Internode Diagram ..... Figure 77
Distribution Map ..... Figure 78

Mean altitude of type specimens, 340 meters; others, 4 to 1,400 meters. Ears of medium length, conical to cylindrical, always with a barren tip and commonly with adherent shanks. Rows 12 to 18, mostly straight. Kernels small, floury, slightly dented, pale yellow to orange; many colors on the same ear. Plants tall with thick culms and wide wavy leaves. Nodes included; sheaths sparsely beset with stiff hairs. Plants mostly two-eared; flag leaves common. Tassels mostly exserted, with large sterile areas on branches and central rachis. Some of the many branches were curled; others were stiff and straight. This race occurs on the southeastern coast of the Gulf of Guayaquil but extends eastwards into Loja, where mixing with *Uchima* has given rise to irregular-rowed ears with harder, darker, and more protruding grains.

This race is widely referred to as *maíz de gallina* or *de gallina,* denoting chicken feed, and also *maíz criollo,* meaning creole. We have chosen *Gallina,* "hen," because criollo is used for many types of corn in the Andean countries.

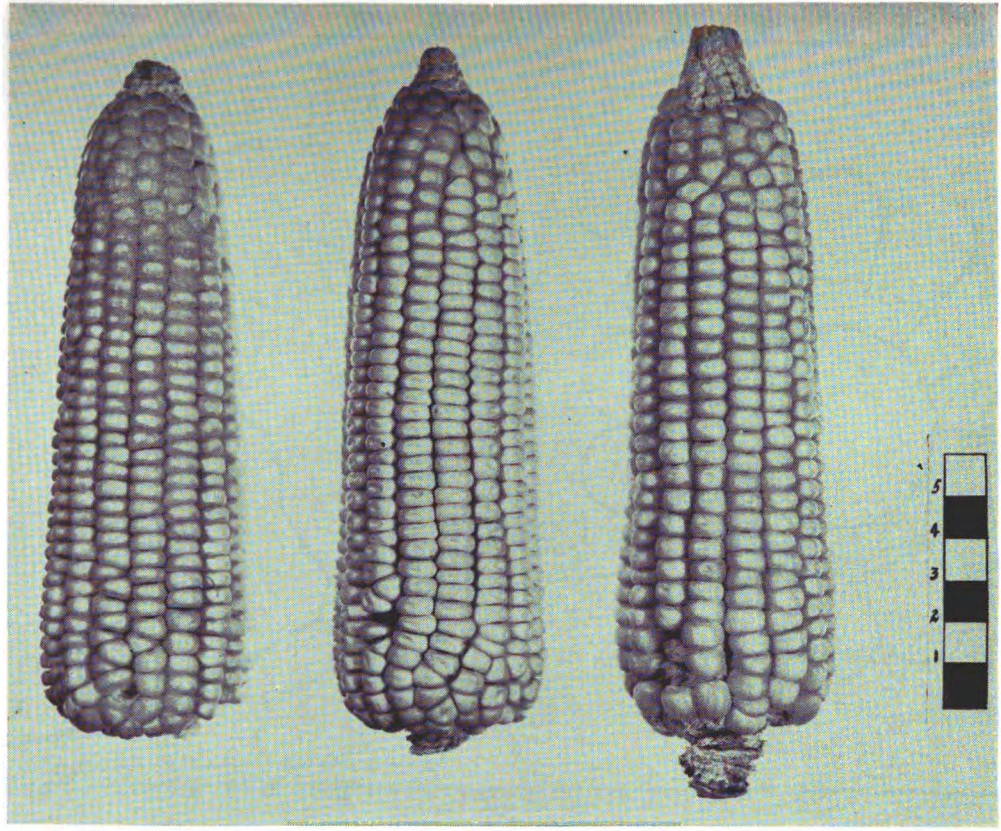

FIG. 75. Representative ears of Gallina.

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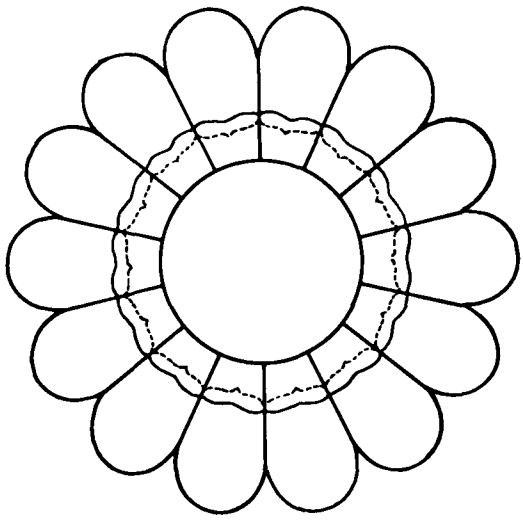

FIG. 76. Ear cross-section diagram of Gallina.

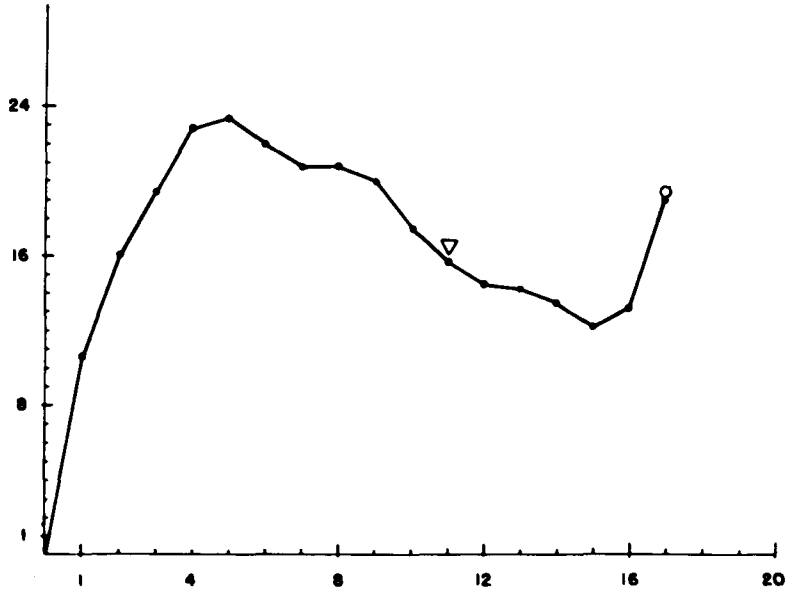

FIG. 77. Internode pattern of Gallina.

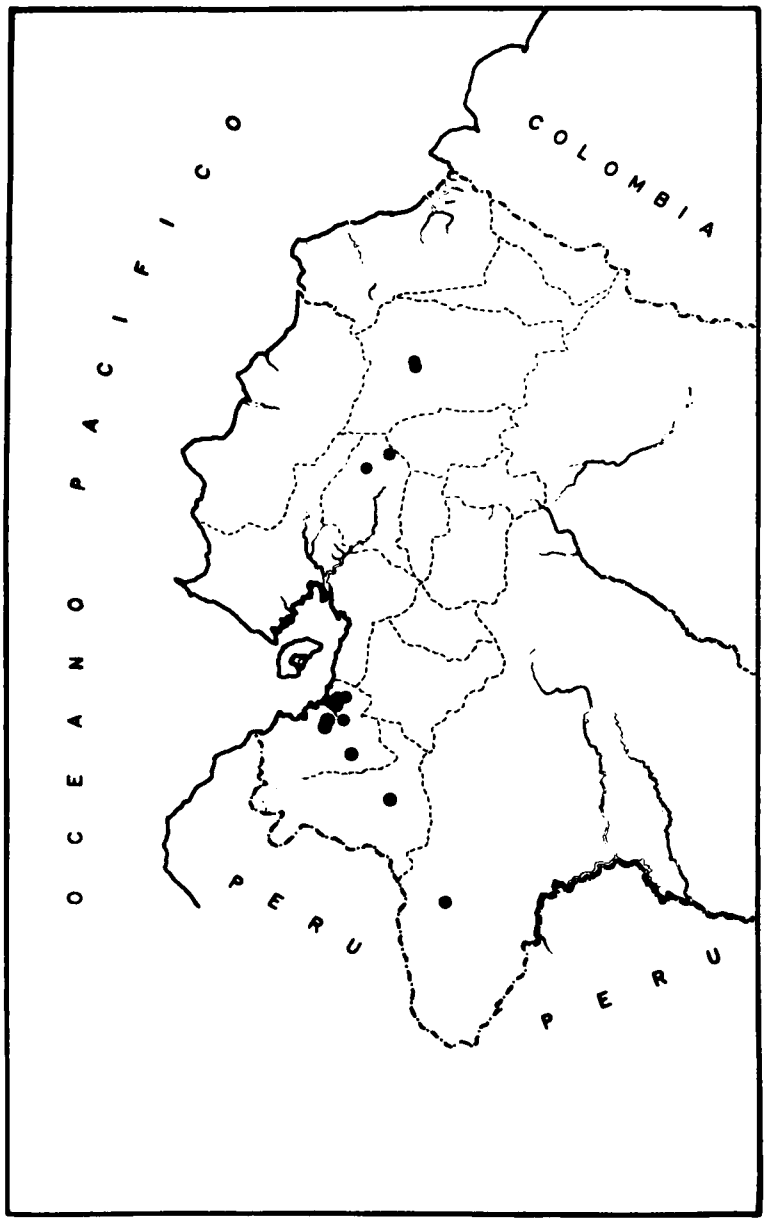

FIG. 78. The distribution of Gallina.

CANDELA

Ear Photograph ..... Figure 79
Ear Diagram ..... Figure 80
Internode Diagram ..... Figure 81
Distribution Map ..... Figure 82

Mean altitude of type specimens, 93 meters; others, 10 to 300 meters. Ears of two types: stubby and cylindrical with barren tips, or thin, cigar-shaped and flexible. Rows 12 to 16, tessellated. Kernels small, floury, pale lemon-yellow to bright orange or bronze. Strong husk compression at base of ear. Plants about three meters tall at Palmira, with slender stalks. Deep purple plant color and some sun-red on husks, midribs, and sheaths of leaves. Nodes mostly included. Leaves long and narrow. Two good ears placed above the middle of the plant. The internodes above the ear are short and appear telescoped. Tassels large, well exserted, with some condensation. Many secondaries and tertiaries. Central spike very prominent. Most tassel branches stiff to gently arching.

This corn resembles the interlocked flour corns of Amazonian Bolivia and Brazil. We are, therefore, surprised to find *Candela* along the northwest coast of Ecuador rather than in the interior lowlands. This unexpected distribution suggests that this race could be a recent introduction from Venezuela, or an isolated form from the Amazon Basin which traversed the Andes.

The local name, *Candela*, is very descriptive, and refers to the fiery or candle-like aspect of the ears.

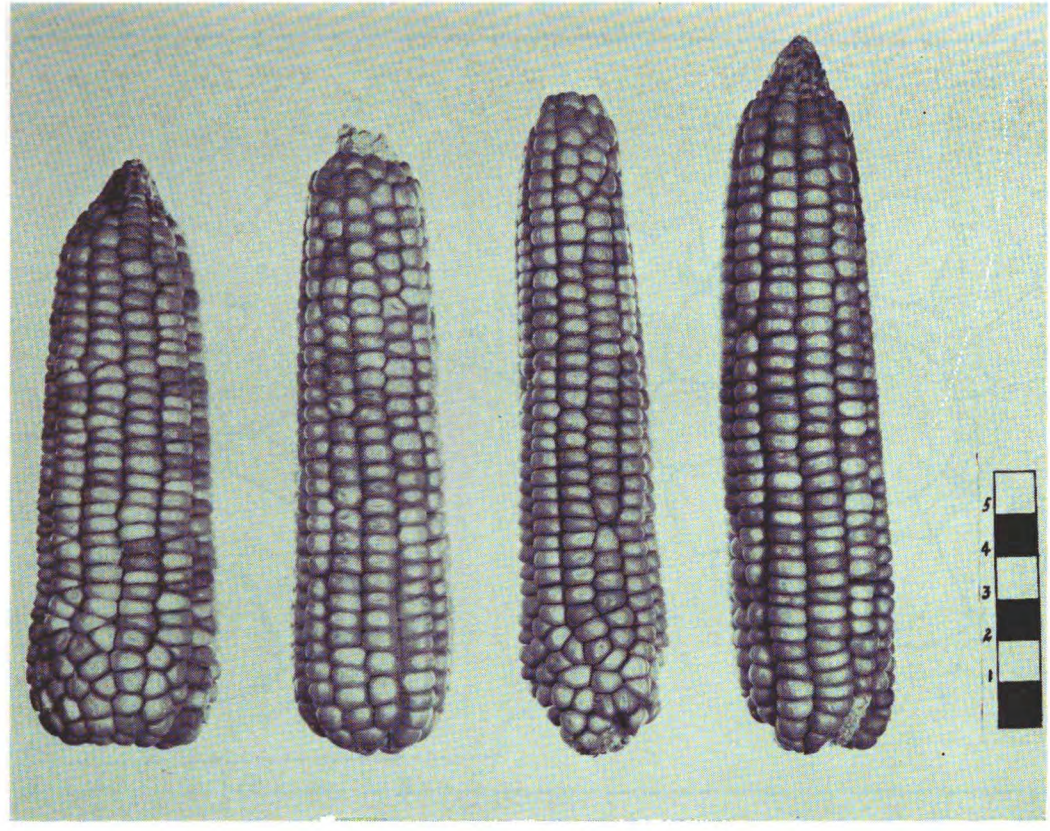

FIG. 79. Representative ears of Candela.

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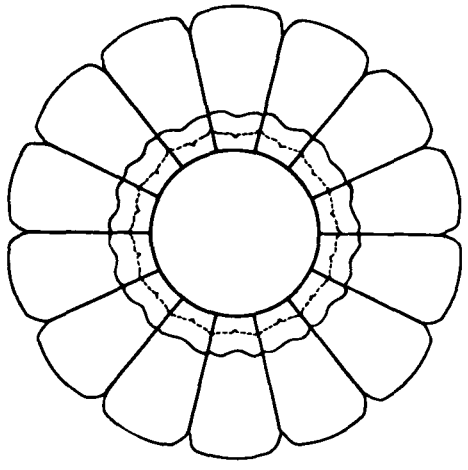

FIG. 80. Ear cross-section diagram of Candela.

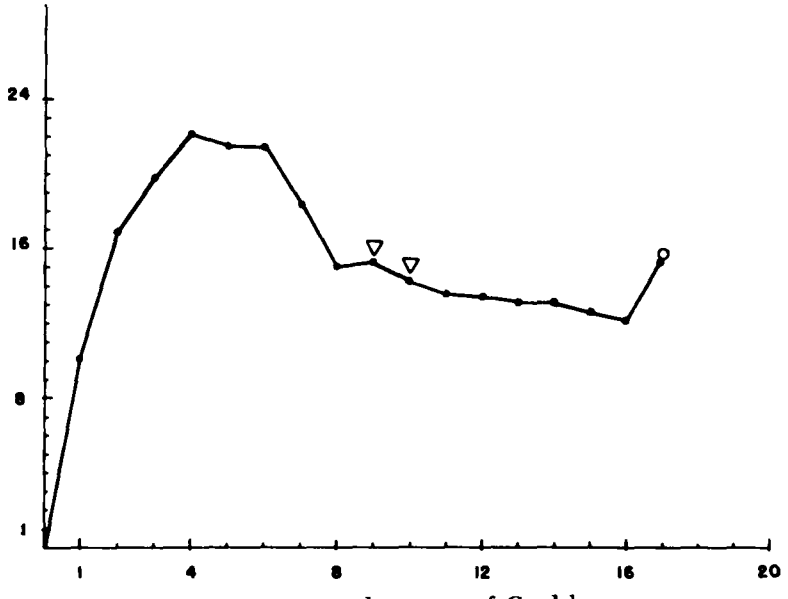

FIG. 81. Internode pattern of Candela.

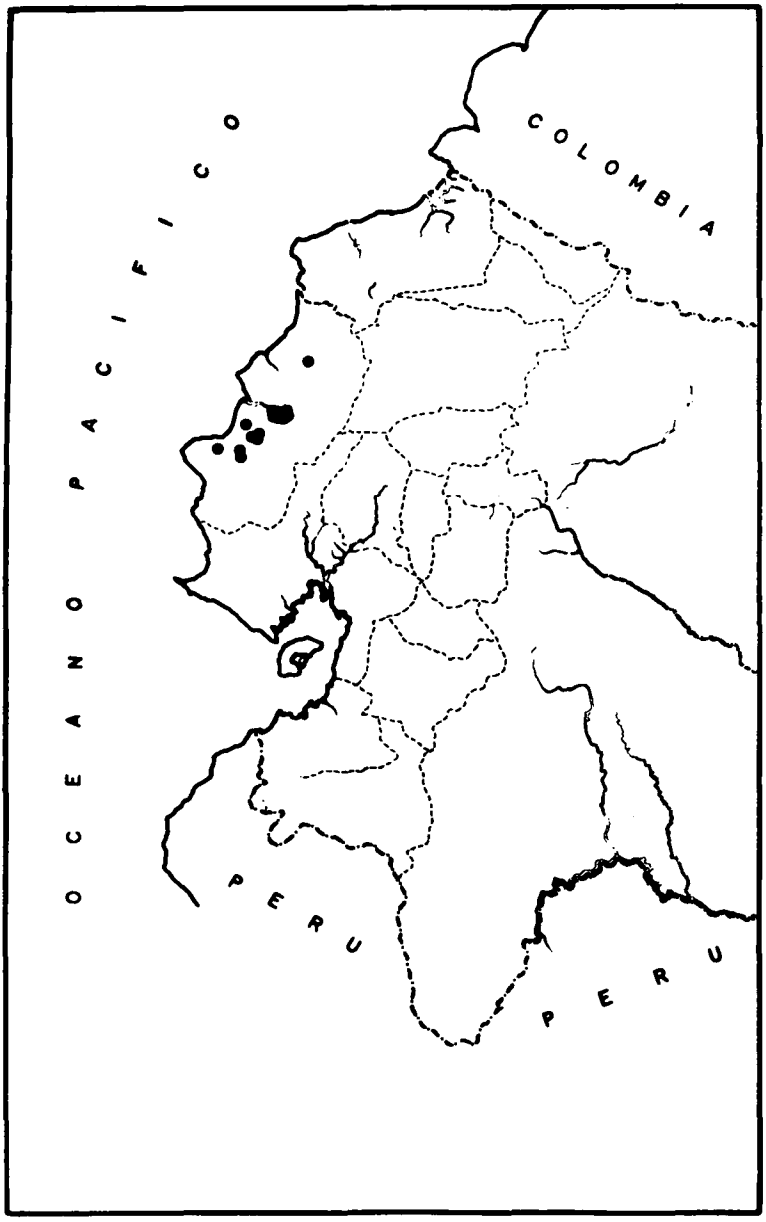

FIG. 82. The distribution of Candela.

MAÍZ CUBANO

Ear Photograph ..... Figure 83
Distribution Map ..... Figure 84

Altitude of specimens, 3 to 100 meters. The range of variation included in the Ecuadorian collections is similar to that observed in Cuba and parts of the West Indies (4, 8). At one extreme are short, deep-orange flint ears with low row number and barren tips, similar to the *Catetos* of eastern South America (3). At the other occur yellow cylindrical dents, resembling in most respects the race *Tusón* of Cuba. Intermediate specimens are of medium length with a slight taper, barren tips, and straight rows of orange flint kernels with soft flour caps.

Maíz Cubano is probably a recent commercial introduction from the Caribbean; it includes most of the variation found in the yellow semi-dents of that area.

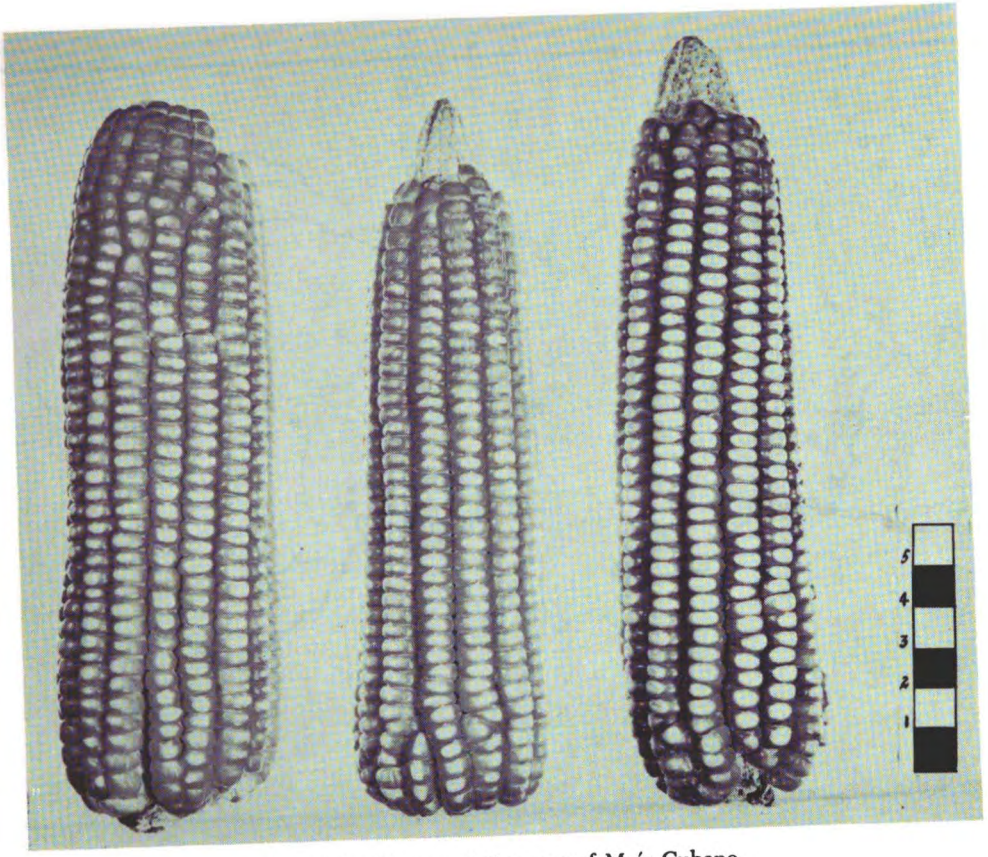

FIG. 83. Representative ears of Maíz Cubano.

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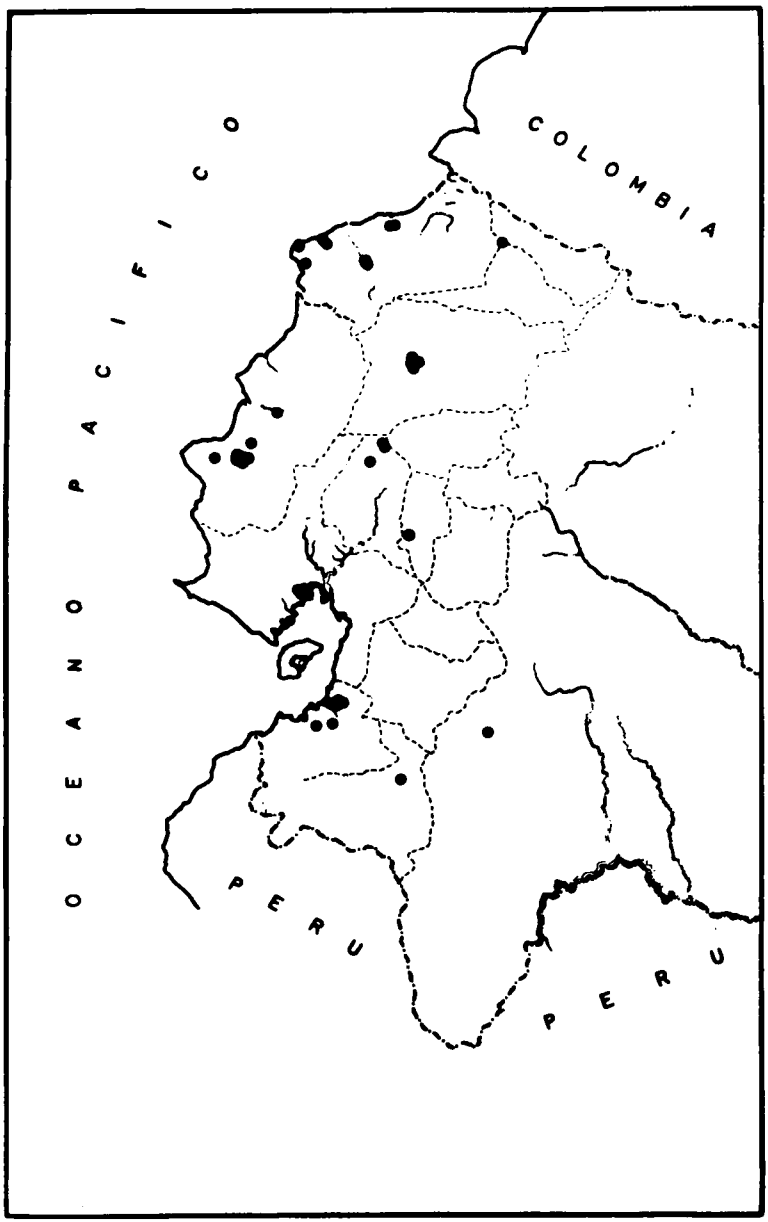

FIG. 84. The distribution of Maíz Cubano.

TUXPEÑO

Ear Photograph . . . . . Figure 85
Distribution Map . . . . . Figure 86

Altitude of specimens, 20 to 230 meters. This race is *Tuxpeño* from Mexico, slightly modified by admixture of local corns. The local names recorded by collectors are often those used in Mexico (e.g. "Rocamex"). The center of distribution of this race is an Ecuadorian experiment station (Manabi, near Puerto Viejo).

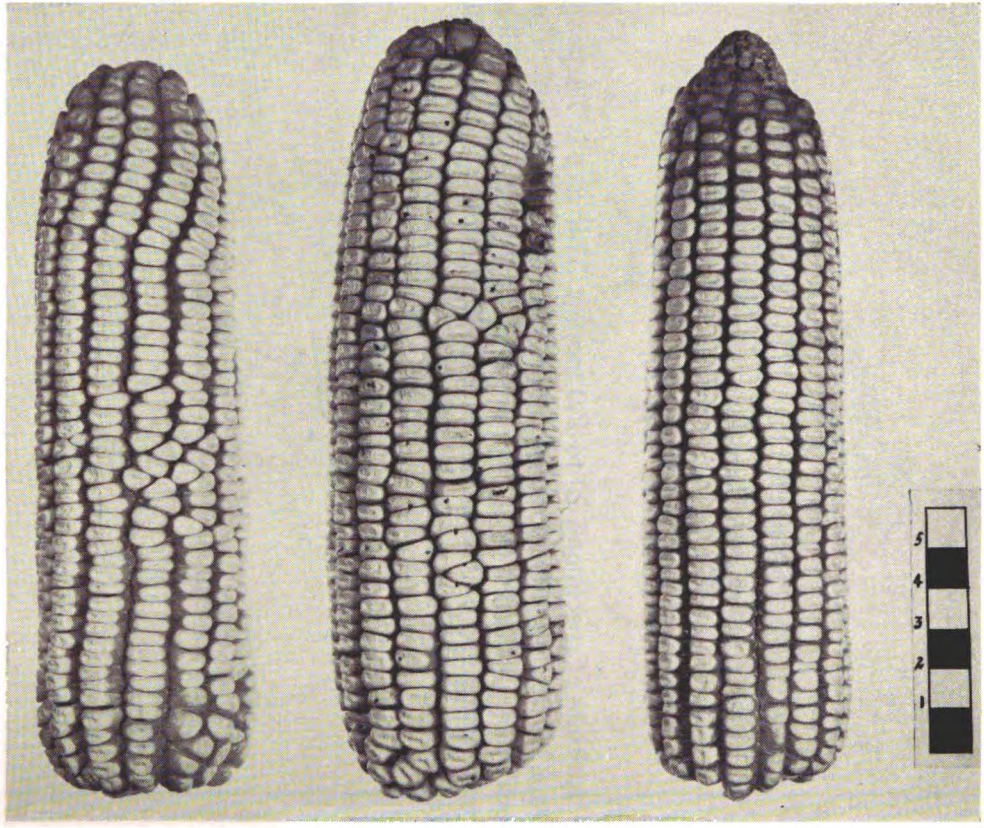

FIG. 85. Representative ears of Tuxpeño.

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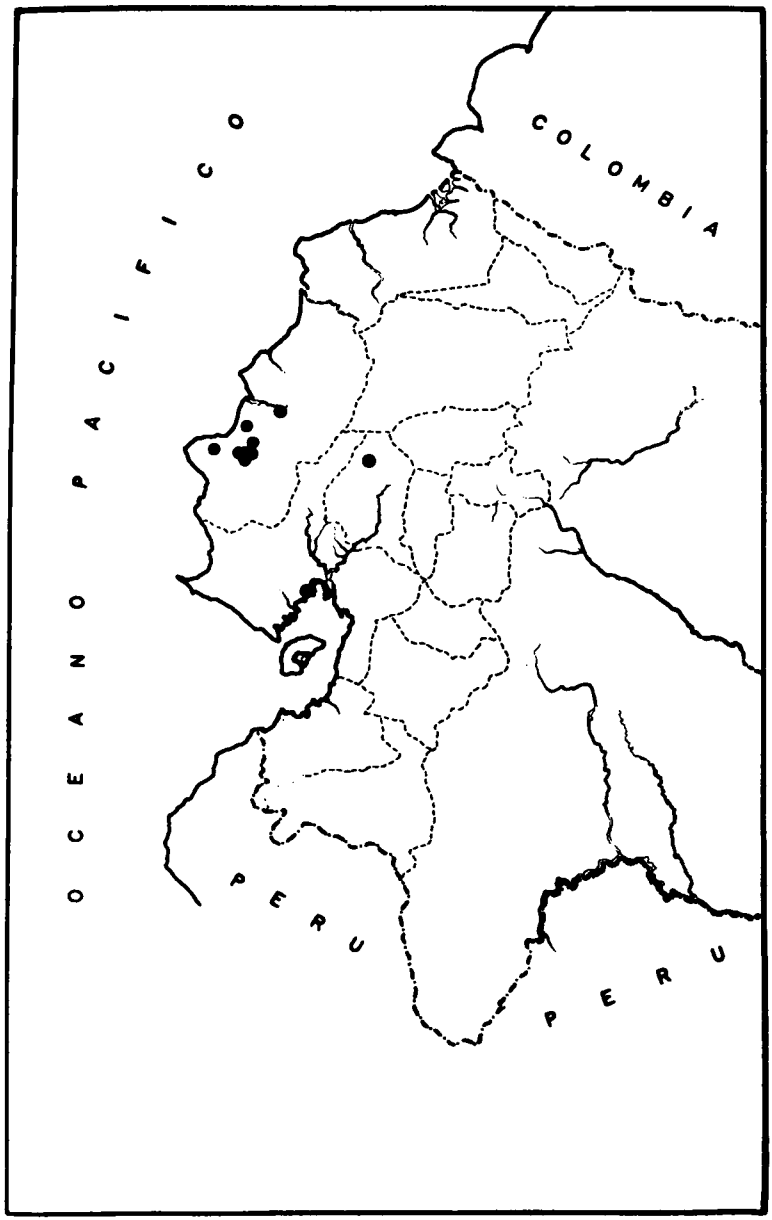

FIG. 86. The distribution of Tuxpeño.

CHOCOCEÑO

Ear Photograph ..... Figure 87
Ear Diagram ..... Figure 88
Internode Diagram ..... Figure 89
Distribution Map ..... Figure 90

Mean altitude of type specimens, 22 meters; others, 10 to 500 meters. Ears short, strongly conical, with 18 to 22 irregular rows. Husk compression evident in most ears; adherent shanks and barren tips common. Kernels small, round, yellow, with pop-type endosperm. Cobs white. Plants tall, thin-stemmed and strongly tillered, with nodes well exserted. Leaves very long and thin, particularly toward the base of the plant. Ear placement very high; upper internodes shortened. Tassels poorly exserted and mostly with the lower branches included. Central spike prominent but short. Tassels dense and small with short, stiff branches. In outline the tassel resembles an open broomcorn inflorescence.

This race is the same as *Chococeño* of Colombia. The white and yellow flour forms found in Colombia, however, are not represented in Ecuador. The ears of Ecuadorian *Chococeño* are somewhat larger than those of Colombia.

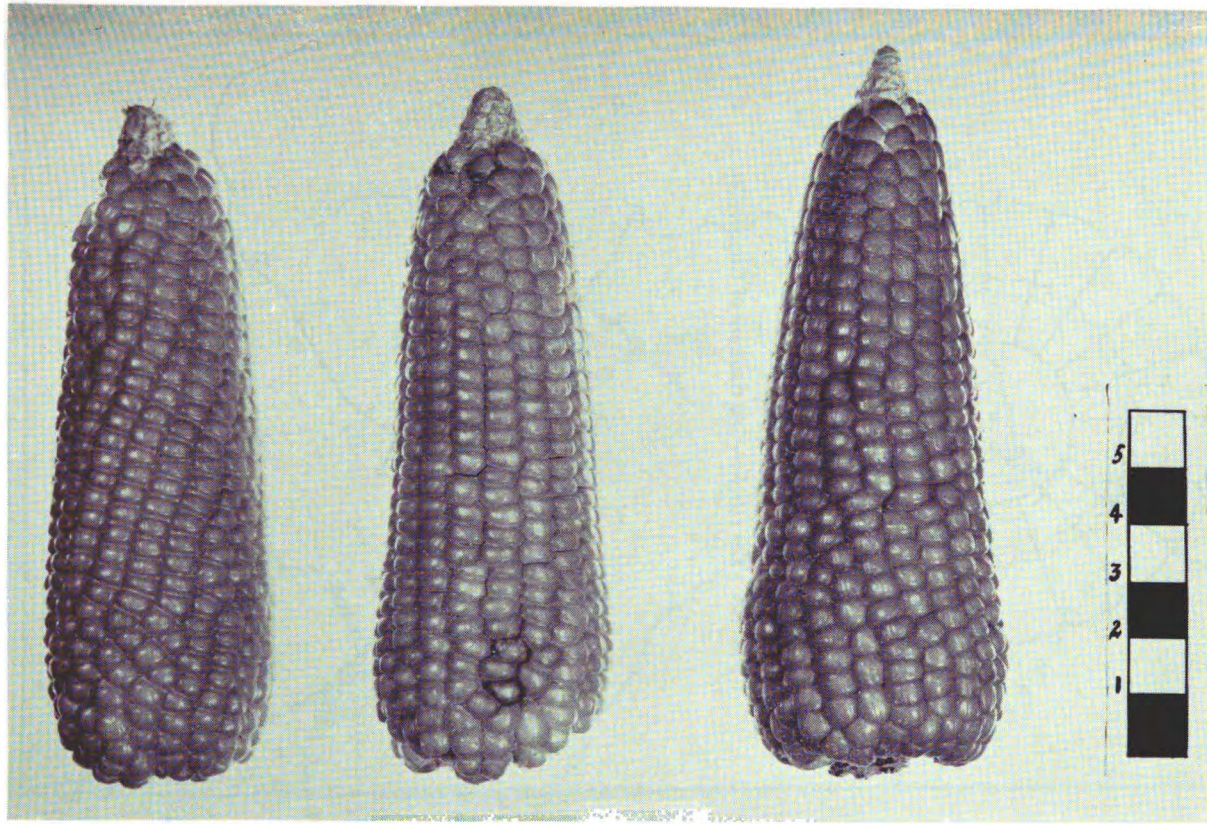

FIG. 87. Representative ears of Chococeño.

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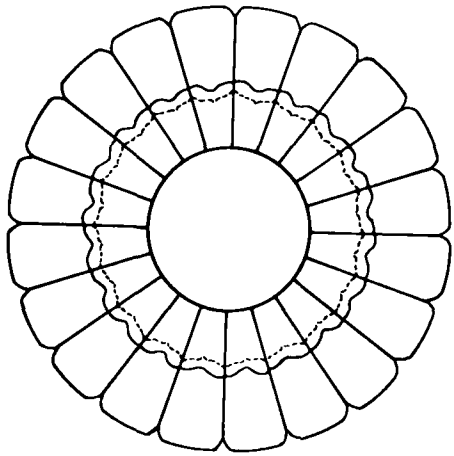

FIG. 88. Ear cross-section diagram of Chococeño.

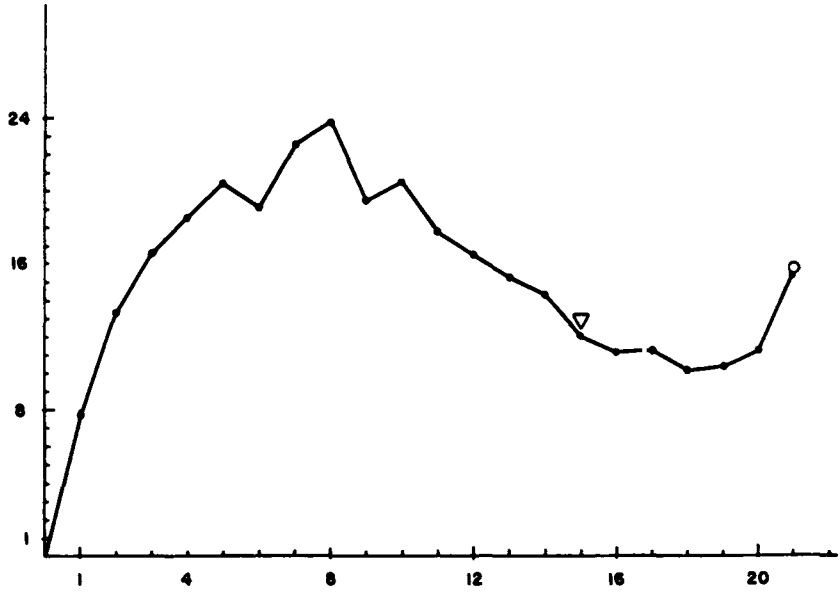

FIG. 89. Internode pattern of Chococeño.

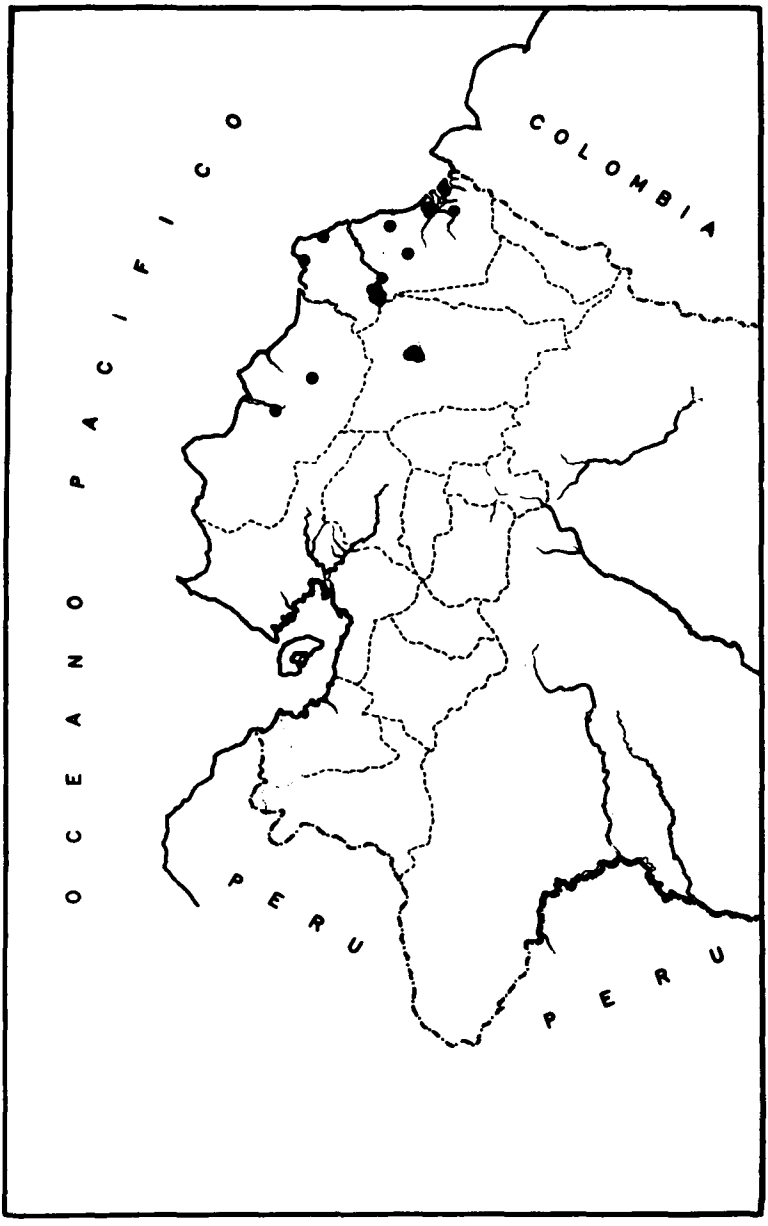

FIG. 90. The distribution of Chococeño.

POORLY DEFINED RACES

These groups or races are presented with a photograph and a short description of the ears, but without other supplemental data. In most cases we have very few collections of these races and the variation among the different collections of the same race is usually considerable. We feel that their inclusion in this monograph may be of value to students interested in the origins and relationships of maize in the Andean highlands, and in the lowland eastern drainage basins, from Bolivia northward into Venezuela.

BLANCO BLANDITO

Ear Photograph ..... Figure 91

Distribution Map ..... Figure 92

Mean altitude of type specimens, 2,660 meters; one other collection was made at 2,400 meters. Ears slightly tapering to stubby cylindrical; with 8 to 14 rows and barren tips. Kernels round, large, very white; endosperm soft floury. This race may be related to *Blanco Harinoso Dentado* although it has shorter ears, smaller grains, and white cobs. The kernels are also smoother, undented, and softer appearing. Butts show strong husk compression.

Ears of this type have been collected in the highlands from Colombia to Bolivia. It is not always easy to distinguish the ears of *Blanco Blandito* from the low-elevation flour dents and soft white flour corns, particularly some of the *Cariaco* types of Venezuela.

Although *Blanco Blandito* is not common, it has been important in the development of the white flour corns of the Ecuadorian highlands. Introgression of this race with *Blanco Harinoso Dentado, Mishca,* and *Chillo* has resulted in three complexes. The first is characterized by large-grained, dented, cylindrical ears; the second by small thin ears with pointed or semi-pointed kernels which give it a rough appearance; the third by thick ears and cobs with enlarged butts and irregular rowing at the base of the ear.

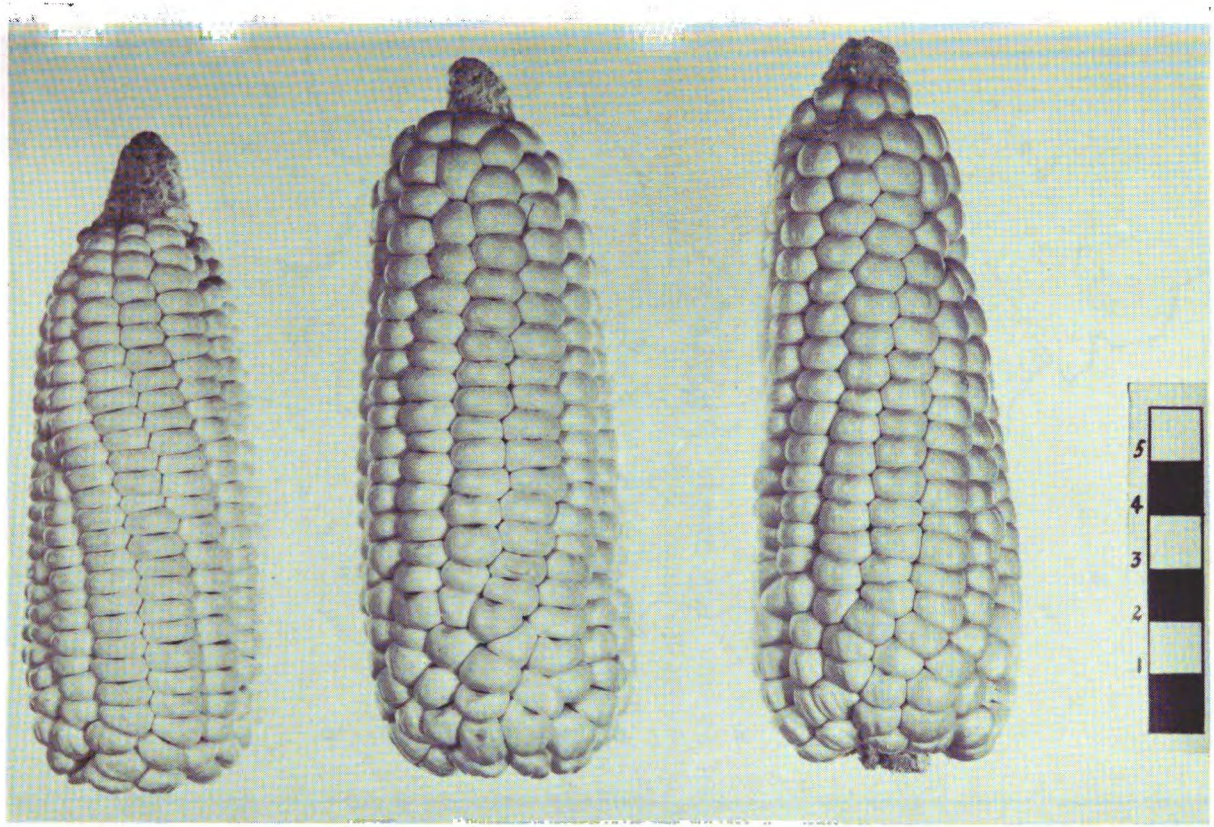

FIG. 91. Representative ears of Blanco Blandito.

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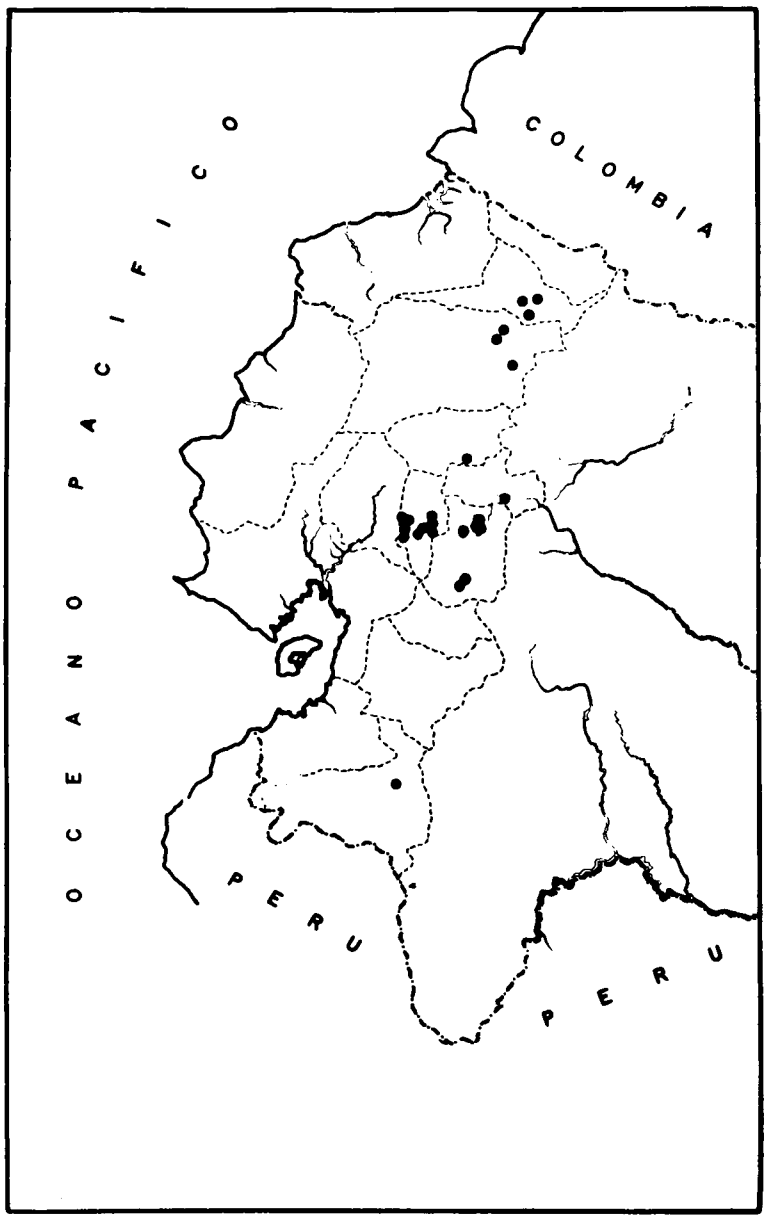

FIG. 92. The distribution of Blanco Blandito.

CHOLITO ECUATORIANO

Ear Photograph ..... Figure 93
Distribution Map ..... Figure 94

Altitudinal range, 1,500 to 2,000 meters. Ears medium long, tapering, with barren tips, and adherent shanks. Butts enlarged; row number from 14 to 18. Kernels mostly long, floury, white dents, occasional blue aleurone, sometimes tessellated. Rounded butts and strong husk compression in some ears. Similar in most respects to the Bolivian race, *Cholito.*

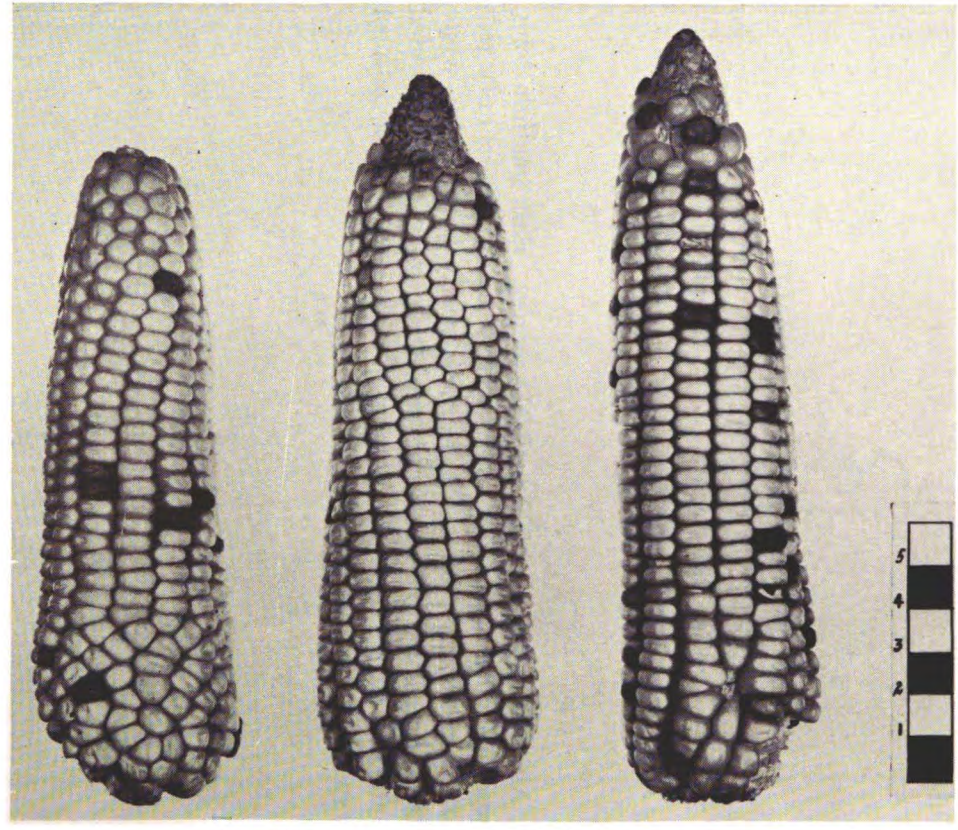

FIG. 93. Representative ears of Cholito Ecuatoriano.

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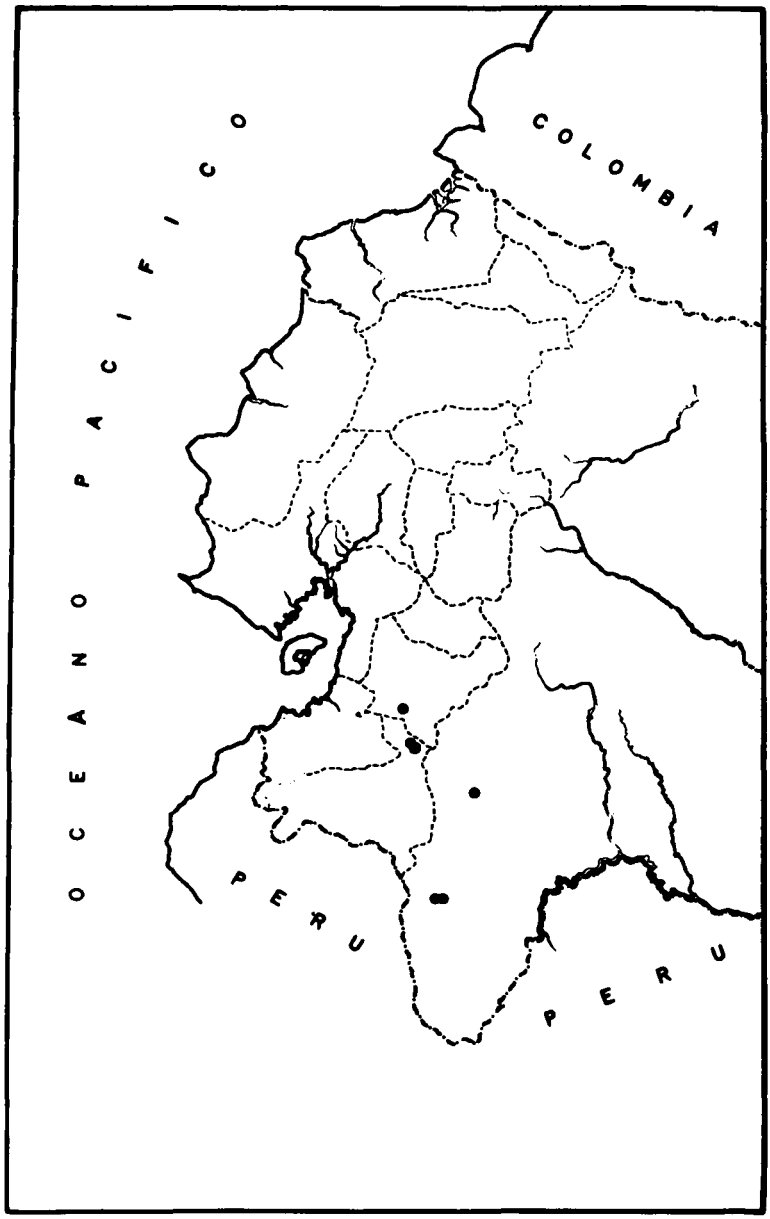

FIG. 94. The distribution of Cholito Ecuatoriano.

YUNGA

Ear Photograph ..... Figure 95
Distribution Map ..... Figure 96

Altitudinal range, 220 to 800 meters. Ears long, slender, tapering, with strongly adherent shanks. Grains protruding in 12 to 16 mostly irregular spiralling rows. Red pericarp or blue aleurone common. This race occurs in the same areas as *Montaña Ecuatoriana* but at lower elevations. Collections of similar material have been made in southern Colombia in the department of Nariño. "Yunga" is a Quechuan geographical term referring to the spurs of the cordillera which extend toward the Amazonian lowlands.

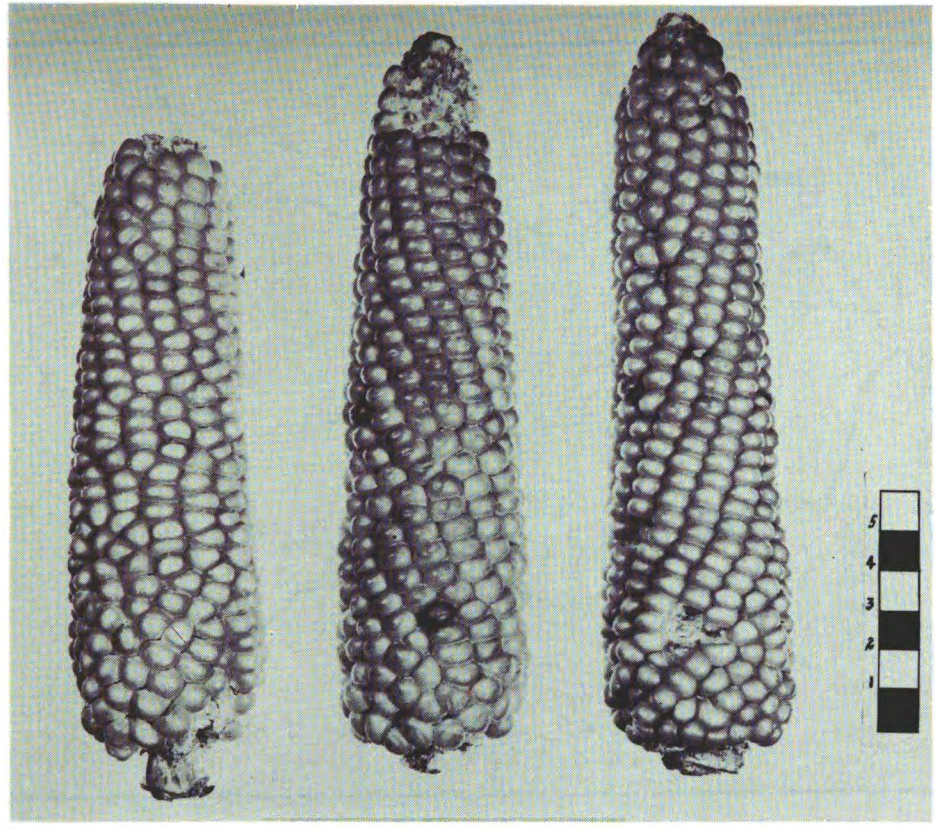

FIG. 95. Representative ears of Yunga.

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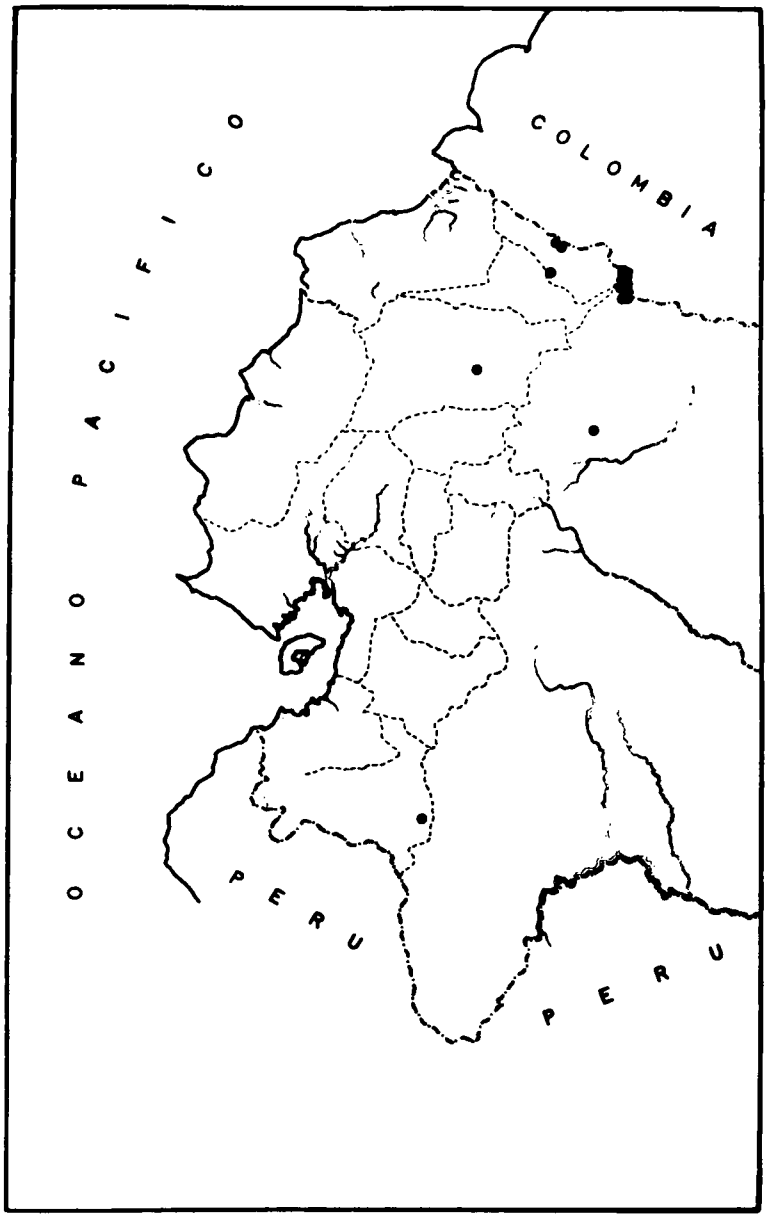

FIG. 96. The distribution of Yunga.

ENANO GIGANTE

Ear Photograph .....Figure 97
Distribution Map .....Figure 98

Only three collections were made, at 400, 1,000, and 1,200 meters. Ears short, conical with many irregular rows of small, round mostly hard grains. Red pericarp, probably due to the P^{cw} allele on chromosome 1. Shanks adherent in certain collections. This race is similar to *Enano* of Bolivia, from which it differs in its conical ears (*Enano* is oval-shaped) and somewhat larger, softer grains. The incongruous name was selected because the ears appear to be a large form of the Bolivian *Enano*, hence "giant dwarf".

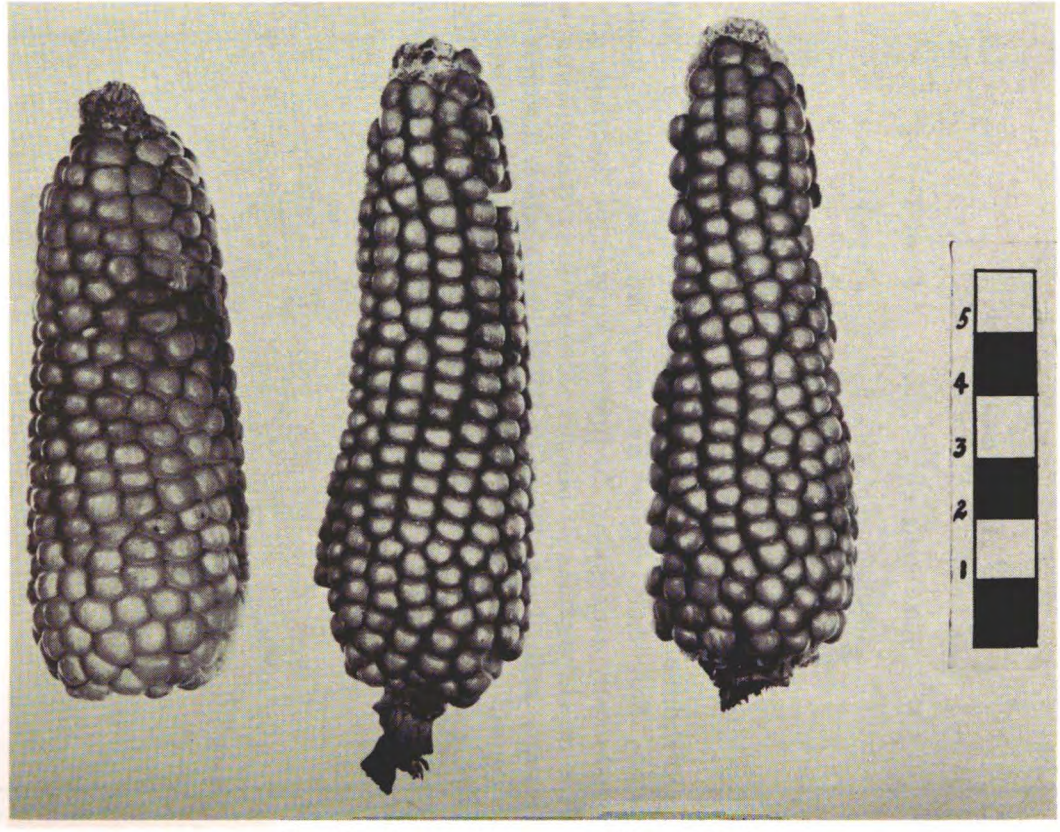

FIG. 97. Representative ears of Enano Gigante.

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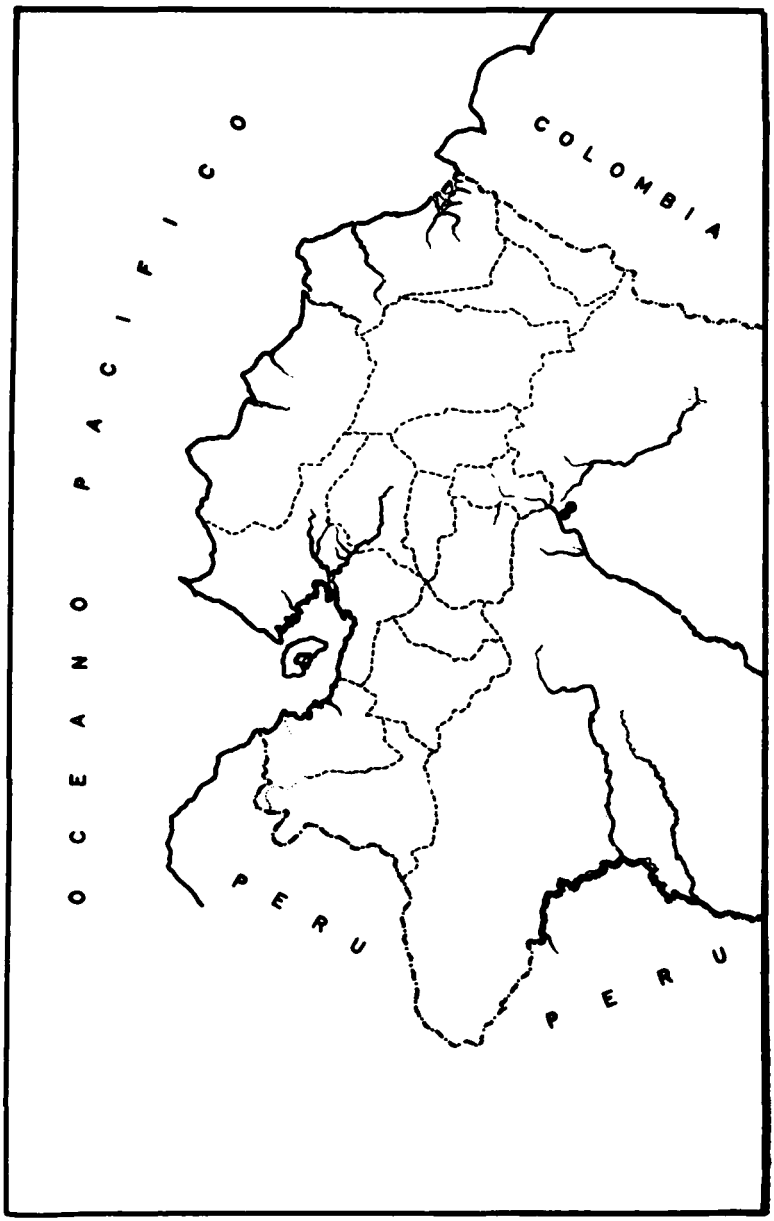

FIG. 98. The distribution of Enano Gigante.

YUNQUILLANO

Ear Photograph ..... Figure 99
Distribution Map ..... Figure 100

Altitudinal range: 1200 to 1500 meters. Ears short, tapering to barren tips, with 10 to 14 straight rows of small, white or yellow, flinty grains. Blue aleurone is common in the white grained collections with pop-type endosperm. This race is similar to *Andaquí* of Colombia and to some of the white-grained pop types of Venezuela, which also occur on the watersheds of the Amazon and Orinoco Rivers. The Ecuadorian collections are so mixed with other material of the eastern lowlands that identification is difficult.

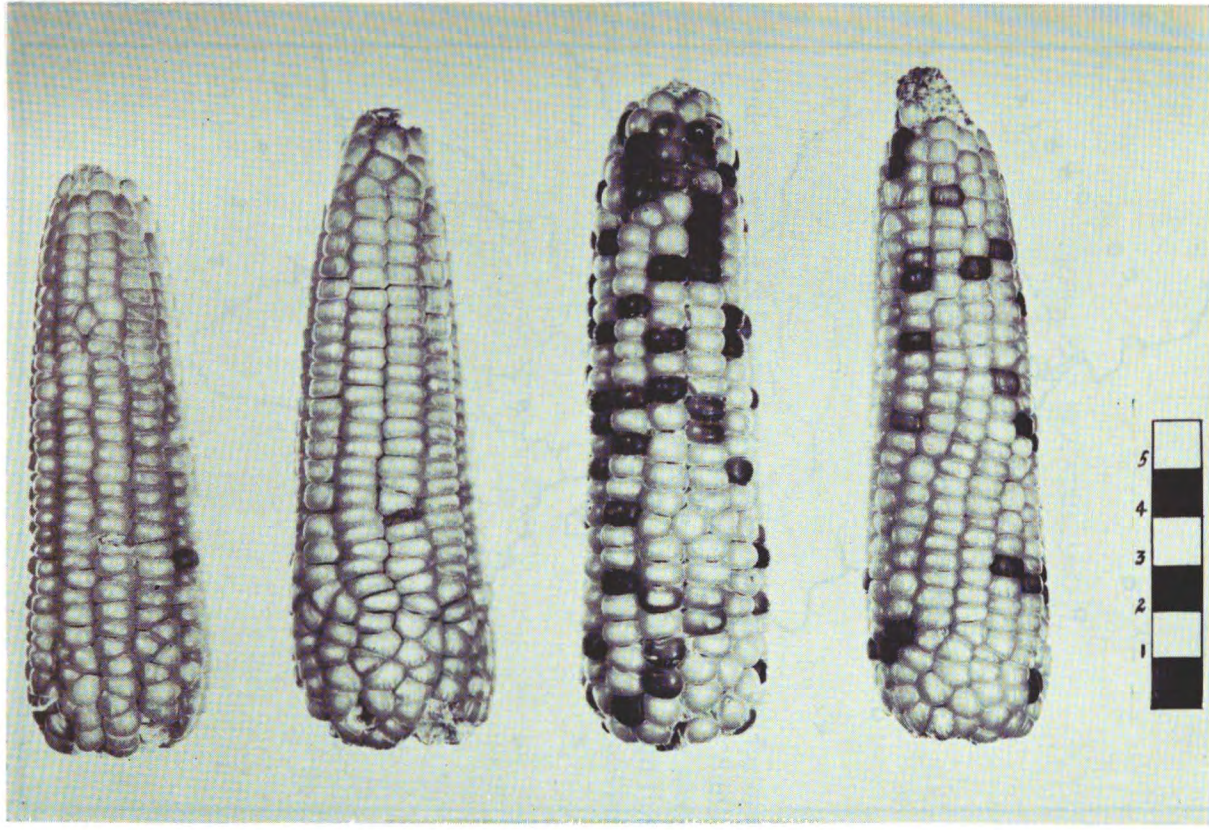

FIG. 99. Representative ears of Yunquillano.

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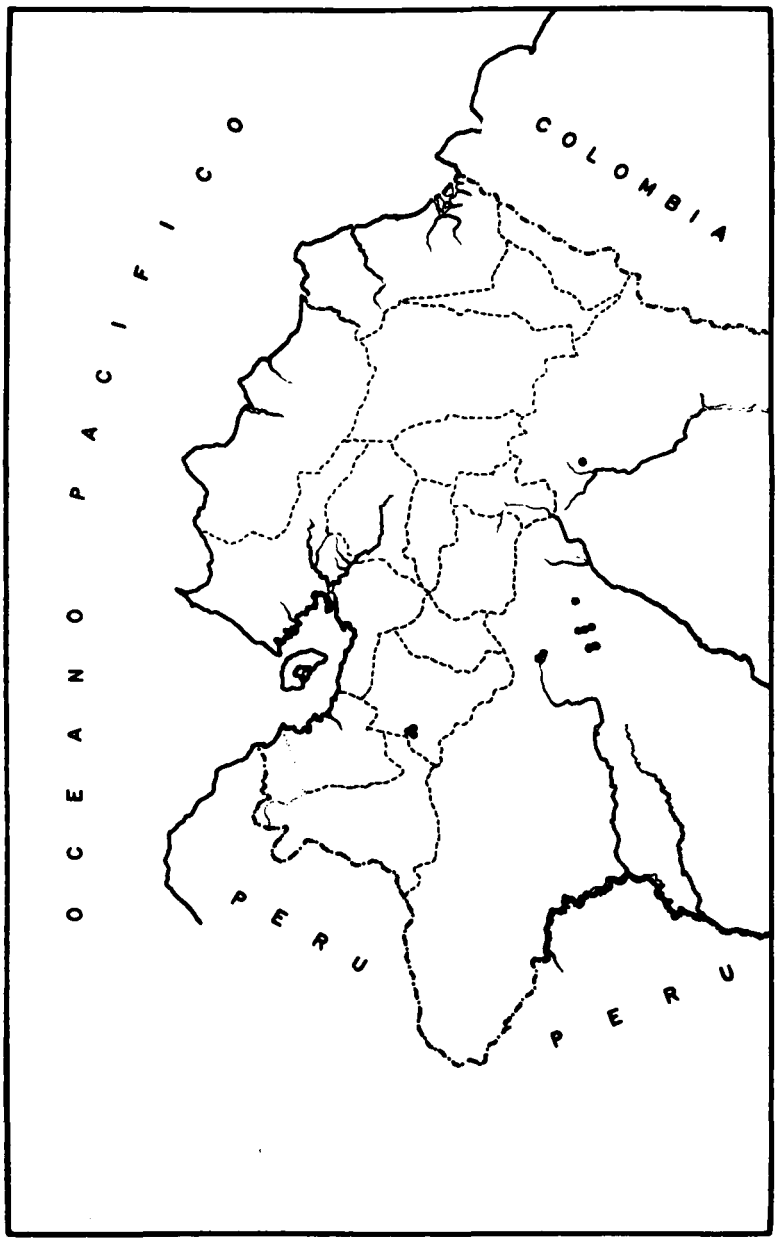

FIG. 100. The distribution of Yunquillano.

YUNGUEÑO ECUATORIANO

Ear Photograph .....Figure 101
Distribution Map .....Figure 102

Altitude known for only two collections: 100 and 1200 meters. Ears long, tapering, with 12 to 14 straight rows. Kernels flinty, sometimes with a small flour cap, mostly white, some blue aleurone and red pericarp. Shanks hard and adherent. Although this race is exceedingly variable it is obviously similar to the Bolivian *Yungueño.*

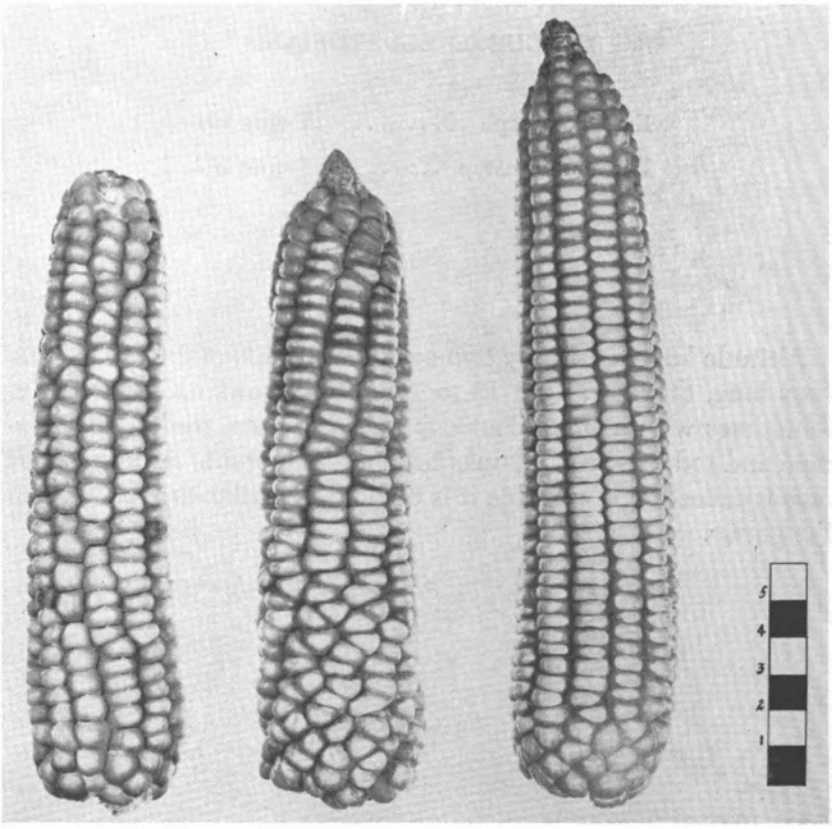

FIG. 101. Representative ears of Yungueño Ecuatoriano.

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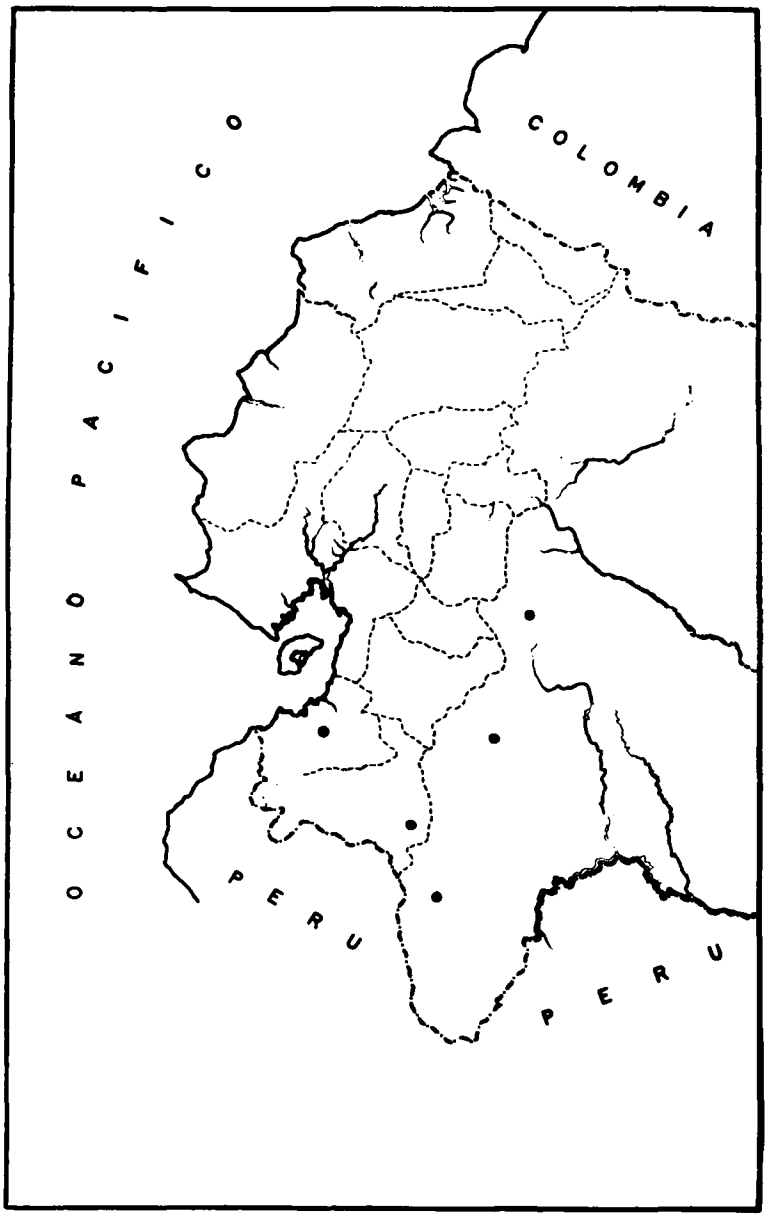

FIG. 102. The distribution of Yungueño Ecuatoriano.

SUMMARY

1. In this report we recognize 29 races of maize, of which six are "poorly defined." This classification is based on 675 collections, which were studied with respect to ear characteristics and geographical distribution. A provisional arrangement made on this basis was revised by study of plant, tassel, and other characteristics.

2. General descriptions, tabular data on ears, tassels and other characters, internode diagrams, ear cross-sectional diagrams, and ear photographs and distribution maps are presented for each race.

3. The great diversity of Ecuadorian maize is related to the complex geography and history of that country. Races have been introduced from the north and south; hybridization between races has occurred; and geographical isolation has permitted the development of new forms in central highland Ecuador.

4. Positions of chromosome knobs were determined for 14 of the 29 races described. The Andean knob pattern, first discovered in the races of highland Bolivia, is extended at least to northern Ecuador. Knob patterns are more variable in lowland races, and total knob number is generally higher.

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APPENDIX

TABLE 1. Ecuadorian Intermontane Basins, Indian Cultures, and Associated Types of Maize

Basin	*Elevation (meters)*	*Culture*	*Maize*
Tulcán	2,900	Pasto	Sabanero, Montaña
Ibarra	2,300	Cara	Sabanero, Huandango, Montaña
Quito	2,500	Panzaleo	Sabanero, Chillo, Morochón, Cuzco
Latacunga	2,800		Sabanero
Riobamba	2,700	Puruhá	Patillo, Mishca
Alausí	2,400		Mishca Complex
Cuenca	2,500	Cañari	Cuzco, Kcello
Oña	2,500		Harinoso Dentado, Cuzco, Kcello
Loja	2,300	Palta	Uchima

TABLE 2. Number and position of chromosome knobs of six "Andean" races of Ecuadorian maize

Race	*Collection Number*	*Chromosome 7*	*Chromosome 6*	*Other Knobs*	*Number B-type Chromosomes*
Sabanero	496	m-s[1]	small	0	0
Ecuatoriano	433	m-s	0	0	0
Mishca	321	m-s	small	0	3
Kcello	712	m-s	small	0	0
Ecuatoriano	589	m-s	0	0	0
	766	m-s	small	0	0
Chillo	481	m-s	0	0	0
	894	m-s	small	0	0
Chulpi	387 (chico)	m-s	0	0	0
Ecuatoriano	434-1	m-s	small	0	0
	434-2	m-s	small	0	1
	598	m-s	small	0	0
	697	m-s	0	0	0
Huandango	510	m-s	0	0	0
	623	m-s	0	0	1
	735-1	m-s	0	0	0
	735-2	m-s	0	0	2

[1] m-s = medium-small

TABLE 3. Numbers and Positions of Chromosome Knobs of "non-Andean" Races of Ecuadorian Maize

Race	Chromosome Number 1	2	3	4	5	6	7	8	9	10	B-type chromosomes
CANGUIL [1]											
413	0	0	Het. l.	0	s.	0	m-s	0	0	0	0
443–1	0	0	Het. l.	0	s.	0	0	0	Het. L.	0	0
443–2	0	0	l.	0	0	Het. s.	0	0	Het. L.	0	0
447–1	0	0	0	0	0	s.	M	Het. M-l.	Het. s. T.S.	0	1
447–2	0	0	0	0	s.	0	0	Het. M-l.	0	0	0
CÓNICO DENTADO											
397	0	0	0	0	0	s.	m-s	Het. L.	0	0	0
UCHIMA											
656	0	Het. m-s	Het. m-s	0	0	s.	0	0	Het. L. T.S.	0	0
746	0	0	Het. l.	Het. l.	0	s.	m-s	0	0	0	0
762	0	0	Het. l. T.S.	Het. L.	0	m-s	l.	0	Het. L.	Het. "Abnormal 10"	0
CLAVITO											
890	0	0	0	0	0	m-s	Het. m-s	Het. S. lower position Het. l. upper position			
366	0	0	0	0	0	S.	m-s	0	0	0	0
884–1	0	0	0	0	0	0	m-s	0	0	0	0
884–2	0	0	0	0	0	0	m-s	0	0	0	0
TUSILLA											
581–1	0	0	0	0	M-l.	0	m-s	0	0	0	0
581–2	0	0	0	0	0	S.	m-s	Het. S. lower position Het. l. upper position	0	0	0
569	Het. m	Het. l.	0	Het. l.	Het. M-l.	0	m-s	l. upper position	0	0	0
GALLINA											
329	0	l.	0	0	Het. M-l.	Het. m	M-l.	S. lower position l. upper position	0	0	0
369	0	Het. l.	Het. L.	0	Het. l.	0	L.	Het. S. lower position Het. m upper position	0	0	0
383	0	l.	0	0	Het. l.	Het. s.	l.	Het. m upper position	0	0	0

TABLE 3. Numbers and Positions of Chromosome Knobs of "non-Andean" Races of Ecuadorian Maize—continued

Race	Chromosome Number 1	2	3	4	5	6	7	8	9	10	B-type chromosomes
CANDELA											
531–1	Het. m-s	0	0	Het. l.	0	0	m-s	L. upper position	0	0	0
531–2	0	0	0	l.	0	0	m-s	L. upper position	0	0	0
630–1	0	0	0	0	0	m (slender)	Het. l.	0	Het. L. T.S.	0	0
630–2	0	Het. L.	0	0	Het. s.	m (slender)	m-s	Het. L.	L. T.S.	0	0
699–1	Het. l.	0	Het. L.	0	0	0	Het. m-s	L. upper position S. lower position	0	0	0
699–2	0	0	Het. L.	Het. l.	0	Het. s.	m-s	L. upper position	0	0	0
CHOCOCEÑO											
891	Het. m	L.	L.	l.	l.	M. upper position Het. m-s lower position	l.	L.	Het. l. L. T.S.	0	0
987	Het. m	L.	L.	Het. l.	l.	M. upper position Het. S. lower position	m-s	L.	l. L. T.S.	0	0

[1] Canguil occurs at high altitudes but does not possess the "Andean" knob pattern.

Explanation
All knobs homozygous and on long arms unless otherwise noted.
Het.—Heterozygous
s.—Very small
S.—Small
m-s—Medium-small
M—Medium
M-l.—Medium large
l.—Large
L.—Very large
T.S.—Terminal position, short arm

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TABLE 4. Races of Maize of Ecudaor Compared in Characters of the Plants

Races	Adaptation to Altitude (meters)	Height (cm.)		Stem Diameter (mm.)		Leaves			Ears per Plant	Tillers per Plant			
											Height %		
		Plants	Ears	Minimum	Maximum	Length (cm.)	Width (cm.)	Venation Index		Number	Tall	Med.	Short
Canguil	2260	94	67	17.9	19.2	64.0	6.6	2.77	1.6	0.55	82	9	9
Sub-raza Grueso	2750	109	64	19.3	20.6	68.5	7.7	2.17	1.6	1.33	43	29	28
Sabanero Ecuatoriano	2660	157	109	23.5	25.5	81.2	10.5	2.17	2.2	0.05	0.0	0.0	100
Cuzco Ecuatoriano	2720	192	94	23.6	26.5	69.3	8.7	2.34	1.6	0.03	0.0	100	0.0
Mishca	2620	132	72	21.3	22.7	66.0	7.5	2.40	2.0	0.07	0.0	0.0	100
Patillo Ecuatoriano	2600	98	62	19.4	21.1	58.7	6.6	2.47	1.3	0.00	—	—	—
Racimo de Uva	2580	122	56	15.6	17.1	54.0	6.6	2.85	1.7	0.03	—	—	100
Kcello Ecuatoriano	2550	190	133	24.2	26.0	85.4	10.5	2.17	2.2	0.03	0.0	100	0.0
Chillo	2520	218	151	28.4	31.0	90.4	11.6	2.23	2.0	0.10	16	17	67
Chulpi Ecuatoriano	2530	206	144	27.0	29.0	84.2	11.8	1.99	2.0	0.00	—	—	—
Morochón	2410	184	137	23.7	26.2	81.7	10.8	2.32	2.1	0.15	50	33	17
Huandango	2350	190	130	26.4	28.9	86.3	11.5	2.16	2.2	0.09	50	25	25
Montaña Ecuatoriana	2310	240	167	23.9	26.2	84.7	9.7	2.70	1.5	0.03	100	0.0	0.0
Blanco Harinoso Dentado	2300	252	180	31.9	33.9	89.2	11.6	2.27	1.5	0.30	67	33	0.0
Cónico Dentado	2000	151	121	23.5	25.4	68.5	8.7	2.70	1.5	0.70	92	5	3
Uchima	1770	283	234	25.6	27.9	100.8	10.8	2.63	1.6	0.02	100	0.0	0.0
Clavito	1530	228	157	21.7	23.6	86.3	10.0	2.32	1.7	0.00	—	—	—
Pojoso Chico Ecuatoriano	540	311	224	28.7	30.2	105.7	10.4	2.54	1.6	0.52	69	23	8
Tusilla	520	308	247	28.1	29.5	103.7	11.1	2.76	1.6	2.50	40	60	0.0
Gallina	340	290	209	28.8	31.0	104.7	11.6	2.48	1.9	0.10	67	33	0.0
Candela	90	282	174	27.4	29.6	105.1	10.9	2.58	2.0	0.20	0.0	62	38
Chococeño	20	304	259	23.2	23.6	92.1	9.1	2.92	1.8	2.10	97	0.0	3

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TABLE 5. Races of Maize of Ecuador Compared in Characters of the Tassels

Race	Length (cm.)				Best Developed Primary Branch			Number of Primary Branches		
	Peduncle	Branching Portion	Central Spike	Uppermost Primary Branch	Length (cm.)	Number of Secondaries	Number of Tertiaries	Total	With Secondaries	With Tertiaries
Canguil	23.2	8.9	23.2	13.3	21.2	1.00	0.00	10.5	1.40	0.15
Sub-raza Grueso	21.9	8.6	24.2	12.9	20.2	0.67	0.00	12.6	0.93	0.00
Sabanero Ecuatoriano	21.9	14.8	18.4	12.1	21.1	2.52	0.28	20.1	8.42	0.48
Cuzco Ecuatoriano	21.3	13.5	24.1	15.6	24.1	1.47	0.13	12.2	4.40	0.24
Mishca	22.6	11.0	21.3	15.3	22.5	1.53	0.00	10.1	4.90	0.00
Patillo Ecuatoriano	24.7	8.4	15.7	12.1	19.0	1.17	0.11	10.9	2.37	0.04
Racimo de Uva	19.8	9.2	15.7	10.7	16.8	1.30	0.02	10.7	2.70	0.02
Kcello Ecuatoriano	19.1	15.3	21.0	13.2	24.1	2.10	0.20	17.3	7.63	0.17
Chillo	20.4	18.3	20.7	16.3	24.9	2.54	0.54	20.3	9.60	1.24
Chulpi Ecuatoriano	19.7	15.6	17.9	10.9	22.1	3.23	0.97	24.5	8.70	1.43
Morochón	20.1	17.1	17.5	11.9	24.9	3.23	1.15	19.6	8.70	1.80
Huandango	20.9	17.0	21.4	17.6	26.0	2.45	0.38	16.9	7.82	0.72
Montaña Ecuatoriana	22.3	16.5	26.9	19.9	31.2	1.70	0.00	18.8	4.40	0.67
Blanco Harinoso Dentado	19.4	19.3	22.0	15.8	30.6	3.33	0.80	21.6	10.00	1.60
Cónico Dentado	15.2	19.4	17.2	12.5	24.8	2.93	0.73	22.7	10.10	1.67
Uchima	22.1	23.3	43.6	17.0	29.3	3.36	0.93	25.0	9.33	1.60
Clavito	22.2	18.6	41.4	16.9	32.6	3.00	0.85	22.5	7.60	1.90
Pojoso Chico Ecuatoriana	21.4	22.6	17.5	14.2	27.0	3.05	0.82	34.2	12.10	1.80
Tusilla	20.2	18.9	17.4	15.2	28.1	3.05	0.65	27.7	10.90	1.00
Gallina	19.3	21.2	19.0	15.9	26.3	3.20	0.63	32.7	9.33	1.20
Candela	15.6	21.2	20.6	15.4	25.3	2.65	1.00	32.0	12.92	1.45
Chococeño	15.7	19.1	18.0	11.2	20.9	3.05	0.50	36.4	10.95	1.20

TABLE 6. Races of Maize of Ecuador Compared in External Characters of the Ears and Kernels

Race	Ears					Number of Husks		Kernels				
	Row No.	Length (cm.)	Diameter (mm.) Basal	Mid-point	Tip	Total	Condensed	Length (mm.)	Width (mm.)	Thickness (mm.)	Hardness	Denting
Canguil	15.0	11.1	32.6	33.4	23.5	6.8	3.0	7.3	5.6	4.5	1.0	5.0
Sub-raza Grueso	16.8	11.9	42.7	38.7	24.3	7.1	3.0	10.5	4.2	4.4	1.0	5.0
Sabanero Ecuatoriano	12.7	13.9	50.1	46.0	31.6	8.6	3.7	12.4	10.1	6.0	1.5	4.9
Cuzco Ecuatoriano	9.7	15.1	51.0	50.0	36.7	7.6	3.1	14.4	12.7	5.5	4.3	3.3
Mishca	10.2	11.5	44.1	41.6	31.1	7.6	3.7	11.6	5.9	5.3	5.0	4.6
Patillo Ecuatoriano	10.0	9.9	39.3	36.4	28.3	6.3	3.0	11.6	7.6	5.6	1.8	4.9
Racimo de Uva	12.0	12.2	47.9	45.2	34.2	6.6	3.0	13.3	9.4	5.7	4.5	4.9
Kcello Eucatoriano	9.2	12.6	40.6	37.7	30.6	7.9	3.2	12.4	10.4	5.5	2.0	4.9
Chillo	12.0	15.9	64.3	59.1	42.2	9.5	4.4	16.8	12.8	6.3	4.8	4.3
Chulpi Ecuatoriano	16.3	12.6	49.9	47.1	37.7	7.7	3.6	12.2	7.9	5.1	2.2	1.5
Morochón	10.7	16.7	47.3	44.4	35.2	8.2	3.5	12.3	11.2	5.9	1.8	4.9
Huandango	8.3	19.9	41.2	37.6	28.9	8.0	3.3	12.7	11.3	6.0	5.0	5.0
Montaña Ecuatoriana	11.9	26.6	47.4	42.3	32.5	8.0	3.5	12.3	10.6	5.2	1.3	5.0
Blanco Harinoso Dentado	12.4	16.3	54.1	51.9	42.5	9.2	4.1	15.0	11.0	5.4	5.0	1.7
Cónico Dentado	12.5	17.4	47.3	45.6	31.5	8.7	2.9	11.9	12.8	3.2	3.9	2.1
Uchima	12.8	16.7	48.7	44.9	33.4	12.5	6.5	12.1	9.8	4.9	2.4	4.3
Clavito	10.1	13.1	32.0	31.2	24.1	9.4	4.2	9.7	8.4	5.0	1.9	5.0
Pojoso Chico Ecuatoriano	16.4	13.7	45.1	38.7	31.1	18.1	9.4	8.8	7.3	4.8	3.3	4.9
Tusilla	12.4	16.3	35.3	33.1	24.2	14.7	6.3	9.8	7.7	4.5	1.8	4.9
Gallina	15.4	17.5	49.9	46.4	37.7	20.5	11.7	11.0	8.8	4.5	2.9	4.1
Candela	14.3	15.6	43.9	41.8	32.4	22.1	14.0	11.6	8.1	4.2	4.5	4.0
Chococeño	19.6	12.4	43.9	40.8	30.2	14.2	8.2	8.3	6.6	4.2	1.6	5.0

TABLE 7. Races of Maize of Ecuador Compared in Internal Characters of the Ears

	Diameter (mm.)			*Indices*		*Pubescence*			*Induration*
Races	*Ear*	*Cob*	*Rachis*	*Cob/ Rachis*	*Glume/ Kernel*	*Cupule*	*Lower Glume*	*Upper Glume*	*Lower Glume*
Canguil	33.4	20.9	12.6	1.66	.57	1.8	0.4	0.2	2.1
Sub-raza Grueso	38.7	22.3	13.0	1.71	.44	2.0	0.6	0.6	2.0
Sabanero Ecuatoriano	46.0	25.4	16.0	1.59	.38	1.9	0.4	0.2	2.1
Cuzco Ecuatoriano	50.0	22.6	14.8	1.53	.34	1.8	0.1	0.0	3.2
Mishca	41.6	18.7	10.8	1.73	.34	1.3	0.2	0.1	1.2
Patillo Ecuatoriano	36.4	19.5	11.4	1.71	.35	1.4	0.1	0.0	3.1
Racimo de Uva	45.2	22.0	12.9	1.71	.35	1.7	0.7	0.7	2.6
Kcello Ecuatoriano	37.7	19.0	11.7	1.62	.29	1.6	0.4	0.2	2.5
Chillo	59.1	29.7	18.4	1.61	.34	2.0	0.7	0.5	3.0
Chulpi Ecuatoriano	47.1	26.3	17.0	1.55	.38	1.6	2.2	0.1	2.6
Morochón	44.4	25.6	16.3	1.57	.36	1.9	1.0	0.5	2.4
Huandango	37.6	19.6	11.4	1.72	.32	1.4	0.2	0.0	1.9
Montaña Ecuatoriana	42.3	25.3	14.7	1.74	.43	1.8	1.4	0.7	2.4
Blanco Harinoso Dentado	51.9	27.1	18.4	1.53	.29	1.4	0.2	0.1	2.7
Cónico Dentado	45.6	25.2	15.8	1.63	.39	1.7	1.2	0.7	2.6
Uchima	44.9	25.2	16.5	1.53	.36	1.9	1.2	0.4	1.5
Clavito	31.2	16.7	9.3	1.80	.38	2.0	0.4	0.4	2.0
Pojoso Chico Ecuatoriano	38.7	25.9	17.6	1.47	.47	2.0	1.9	2.0	0.8
Tusilla	33.1	18.7	9.4	1.99	.47	2.0	1.2	1.8	0.0
Gallina	46.4	27.2	18.8	1.45	.38	2.0	2.0	1.8	1.0
Candela	41.8	22.3	15.1	1.48	.31	1.9	1.6	1.5	0.2
Chococeño	40.8	27.0	14.7	1.84	.74	2.0	1.9	1.8	0.8

TABLE 8. Races of Maize of Ecuador Compared in Physiological and Genetic Characters

Races	Days to Silking	Rust	Helminthosporium	Pilosity: Intensity	Pilosity: Percent Hard	Pilosity: Percent Medium	Pilosity: Percent Soft	Plant Color: Sun-red	Plant Color: Purple	Plant Color: Brown	Percentages of Ears with Color in: Lemmas	Glumes	Mid-Cob	Pith	Aleurone	Pericarp
Canguil	—	4.0	2.0	2.2	0	0	100	2.2	0.4	0.4	0	0	8	42	0	10
Sub-raza Grueso	138	4.1	2.6	3.3	0	6	94	2.5	0.7	0.9	0	0	100	83	3	7
Sabanero Ecuatoriano	154	3.5	2.9	3.9	0	8	92	3.0	0.4	0.3	5	0	20	33	2	0
Cuzco Ecuatoriano	—	4.0	2.5	2.2	0	4	96	2.3	0.1	1.0	12	0	4	15	13	21
Mishca	134	3.8	3.0	2.6	0	4	96	3.1	0.6	0.1	42	0	0	16	0	20
Patillo Ecuatoriano	134	4.0	4.2	2.7	0	3	97	3.1	1.0	0.2	17	13	7	13	13	10
Racimo de Uva	142	3.4	3.1	2.1	0	5	95	2.3	2.6	0.4	100	100	100	100	100	100
Kcello Ecuatoriano	157	3.8	2.7	2.7	0	10	90	3.0	0.5	0.5	62	20	0	13	28	12
Chillo	167	3.8	2.7	3.5	0	3	97	3.3	0.0	0.2	5	0	0	0	0	2
Chulpi Ecuatoriano	181	3.7	2.2	1.2	100	0	0	2.5	1.0	0.0	7	0	0	11	0	37
Morochón	160	3.4	3.0	3.0	0	2	98	3.5	0.2	0.6	0	0	0	0	0	8
Huandango	146	3.9	2.7	3.1	0	2	98	4.1	0.8	0.5	85	33	8	42	0	2
Montaña Ecuatoriana	184	4.0	2.5	4.0	0	0	100	2.2	0.0	0.0	0	0	0	5	0	0
Blanco Harinoso Dentado	175	3.7	3.0	3.3	0	11	89	2.9	0.0	0.0	50	16	0	0	4	17
Cónico Dentado	—	3.8	3.1	2.0	0	41	59	1.6	0.7	0.8	3	0	0	13	7	0
Uchima	89	3.8	4.0	1.9	0	81	19	3.7	2.0	0.0	18	17	83	0	6	16
Clavito	74	3.5	3.7	1.5	4	33	63	3.0	0.0	0.0	30	0	11	56	4	4
Pojoso Chico Ecuatoriano	81	3.5	2.2	3.7	94	6	0	1.9	0.0	0.0	7	17	58	8	7	2
Tusilla	71	2.2	1.5	3.4	65	35	0	2.6	0.4	0.0	0	33	33	0	0	15
Gallina	75	2.6	1.6	3.6	77	23	0	2.3	0.3	0.0	2	25	42	17	2	10
Candela	67	2.2	1.8	3.4	70	30	0	1.1	2.7	0.0	30	58	67	25	48	15
Chococeño	94	2.7	3.0	3.3	97	3	0	1.9	0.3	0.0	3	42	92	8	0	0

TABLE 9. List of Collections Studied as Representative of Each Race of Ecuadorian Maize

Race	*Accession Number of Collection*
Canguil	Type Specimens: Ecu. 696, 500. Others: Ecu. 943, 703. Canguil Admixtures: Ecu. 375, 396, 400, 412, 534, 642, 658, 666, 688, 909.
Subrace Grueso	Type Specimens: Ecu. 443, 447, 413. Others: Ecu. 432, 663, 503.
Sabanero Ecuatoriano	Type Specimens: Ecu. 496, 433, 473, 479, 408. Others: Ecu. 322, 490, 889, 395, 467, 567, 509, 919, 921, 636, 379, 624, 507, 709, 494, 937, 518, 897, 409, 506, 651, 462, 739, 399, 682, 757.
Cuzco Ecuatoriano	Type Specimens: Sup-group Blanco Harinoso: Ecu. 393, 530, 499, 485. Sub-group Blanco Duro: Ecu. 346, 419, 426, 538. Sub-group Amarillo Harinoso: Ecu. 440. Cuzco Ecuatoriano Admixtures: Ecu. 421, 454, 594, 936, 340, 562, 537, 511, 493, 401, 519, 740, 728, 439, 477, 671, 707, 583.
Mishca	Type Specimens: Ecu. 459, 898, 321, 505. Others: Ecu. 406, 488, 474, 512, 706, 414, 471. Mishca Admixtures: Ecu. 960, 911, 381, 525, 974, 460, 384, 429, 487, 502, 967, 866, 933. Mishca-Chillo Complex: Ecu. 618, 662, 415, 916, 435, 466, 334, 333, 428, 758, 389, 412, 563, 453, 457, 917. Mishca-Huandango Complex: Ecu. 586, 702, 732, 553, 508, 470, 491, 571, 607, 543, 495, 622. with Red Pericarp: Ecu. 392, 521, 425, 430, 546, 588, 551, 556, 436. with Blue Aleurone: Ecu. 570, 592, 953.
Patillo Ecuatoriano	Type Specimens: Ecu. 417, 468, 422. Others: Ecu. 437, 463, 515, 514, 501, 513, 705, 950, 442, 959, 390, 348.
Racimo de Uva	Type Specimens: Ecu. 398, 484, 517, 968. Others: Ecu. 449, 450, 727, 516, 464, 924, 403.
Kcello Ecuatoriano	Type Specimens: Ecu. 712, 719, 768, 766, 589, 704. Others: Ecu. 744, 928, 965, 756, 941, 888. Kcello-Sabanero Complex: Ecu. 536, 603, 533, 966, 661, 486.
Chillo	Type Specimens: Ecu. 481, 894, 480, 458, 411. Others: Ecu. 410, 970, 483, 612, 767, 693, 524. Chillo-Huandango Complex: Ecu. 621, 716, 741, 475, 687, 566, 743, 557, 713, 445, 587, 554, 654, 552, 420, 610, 680, 619, 605, 616, 423, 600. with Red and Variegated Pericarp: Ecu. 456, 667, 561, 596, 730, 539, 455.

TABLE 9. List of Collections Studied as Representative of Each Race of Ecuadorian Maize—Continued

Race	*Accession Number of Collection*
Chulpi Ecuatoriano	Type Specimens: Ecu. 687, 434, 598.
forma "Chico"	Type Specimens: Ecu. 424, 387. Chulpi Admixtures: Ecu. 578, 465, 444, 726.
Morochón	Type Specimens: Ecu. 418, 355, 454, 476, 568. Others: Ecu. 580, 633, 684, 679, 606, 620, 492, 528, 559, 683, 565. With Cuzco Introgression: Ecu. 700, 504, 963, 601, 379, 717, 602, 639, 564, 497, 609, 547, 907.
Huandango	Type Specimens: Ecu. 623, 736, 735, 510. Others: Ecu. 593, 441, 690, 353, 634, 469, 721, 446.
Montaña Ecuatoriano	Type Specimens: Ecu. 575, 631, 573. Others: Ecu. 876, 875, 689, 371, 584, 852, 472.
Blanco Harinoso Dentado	Type Specimens: Ecu. 626, 595, 640. Others: Ecu. 648, 733, 769, 643.
Cónico Dentado	Type Specimens: Ecu. 431, 363, 397, 394, 427. Others: Ecu. 354, 574, 723, 367, 482.
Uchima	Type Specimens: Ecu. 734, 681, 746, 762, 656. Others: Ecu. 905, 644, 724, 650, 725, 755, 695, 529, 751, 677, 675, 664, 742, 632, 582, 714, 715, 591, 608.
Clavito	Type Specimens: Ecu. 884, 366, 890. Others: Ecu. 914, 407, 386, 637, 850, 908.
Pojoso Chico Ecuatoriano	Type Specimens: Ecu. 701, 522, 611, 765, 761. Others: Ecu. 541, 745, 717, 691, 711, 893, 728, 864, 720, 668, 748, 665, 550, 760, 729, 722, 862, 906, 863, 899, 869, 883, 887, 853, 892, 855, 886, 710.
Tusilla	Type Specimens: Ecu. 581, 569. Others: Ecu. 335, 545, 625, 880, 881, 617.
Gallina	Type Specimens: Ecu. 383, 935, 369, 929, 329. Others: Ecu. 585, 749, 841, 915, 934, 949, 847, 848, 839, 865, 372.
Candela	Type Specimens: Ecu. 531, 344, 630, 699, 685. Others: Ecu. 763, 652, 338, 540, 352, 349, 971, 342, 628, 343, 345, 331.
Maíz Cubano	Cuban Yellow Flint Type: Ecu. 326, 904, 770, 975, 669, 370, 957, 698, 759, 872, 327, 350, 653, 926. Tusón Type: Ecu. 542, 856, 660, 843, 659, 874, 764. Cateto Flint Type: Ecu. 339, 325, 368, 330, 678, 877, 558. Others: Ecu. 939, 896, 842, 894, 377, 857, 851, 731, 947, 861, 858, 961, 526, 976, 920, 365, 382, 341, 364, 840, 328.

TABLE 9. List of Collections Studied as Representative of Each Race of Ecuadorian Maize—Continued

Race	*Accession Number of Collection*
Tuxpeño	Type Specimens: Ecu. 604, 535, 629, 627, 942. Others: Ecu. 670, 324, 686, 337, 674.
Chococeño	Type Specimens: Ecu. 891, 978, 332, 964, 979. Others: Ecu. 952, 318, 932, 351, 646, 951, 361, 955, 576, 357, 938, 954, 977, 910, 948, 347, 838, 336, 895, 360, 972, 362, 359, 837. "Poorly Defined Races"
Blanco Blandito	Type Specimens: Ecu. 523, 750, 973. Others: Ecu. 925. Blanco Blandito-Blanco Harinoso Dentado Complex: Ecu, 913, 615, 879, 927, 962, 376, 373. Blanco Blandito-Mishca Complex: Ecu. 956, 958, 378, 405, 391, 448, 901, 946. Blanco Blandito-Chillo Complex: Ecu. 882, 737, 438, 520, 478, 873.
Cholito Ecuatoriano	Type Specimens: Ecu. 718, 579, 692. Others: Ecu. 647, 638, 614, 753, 878.
Yunga	Type Specimens: Ecu. 388, 860, 923, 900. Others: Ecu. 641, 868, 918, 416, 385, 844. with Red Pericarp and/or Blue Aleurone: Ecu. 845, 922, 903, 560, 870, 676.
Enano Gigante	Type Specimens: Ecu. 931, 969, 548. Others: None.
Yunquillano	
forma Andaquí	Type Specimens: Ecu. 892, 710, 855, 886.
forma Venezuelan white-grained pop	Type Specimens: Ecu. 869, 883, 887, 853. Yunquillano Admixtures: Ecu. 645, 906, 863, 899.
Yungeño Ecuatoriano	Type Specimens: Ecu. 549, 672, 572, 527. Others: Ecu. 577, 859, 902.

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