RACES OF MAIZE IN CHILE

David H. Timothy
Bertulfo Peña V.
Ricardo Ramírez E.

in collaboration with

William L. Brown
Edgar Anderson

NATIONAL ACADEMY OF SCIENCES—
NATIONAL RESEARCH COUNCIL

Publication 847

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.

The AGRICULTURAL BOARD, a part of the Division of Biology and Agriculture of the National Academy of Sciences—National Research Council, studies and reports on scientific problems of agriculture in relation to the national economy. Financial support for the meetings and publications of the Board is derived primarily from the Agricultural Research Institute, which is an organization composed of representatives of industry, trade organizations, academic institutions, and governmental agencies concerned with agriculture. Members of the Agricultural Board and of its committees serve without compensation beyond their actual expenses. Funds for the work of the Agricultural Board are received and administered by the Academy.

RACES OF MAIZE IN CHILE

RACES OF MAIZE IN CHILE

David H. Timothy, Bertulfo Peña V., and Ricardo Ramírez E.
in collaboration with
William L. Brown, and Edgar Anderson

Publication 847
NATIONAL ACADEMY OF SCIENCES—
NATIONAL RESEARCH COUNCIL
Washington, D. C.
1961

Other publications in this series

RACES OF MAIZE IN CUBA
William H. Hatheway
NAS–NRC publication 453 1957 Price $1.50

RACES OF MAIZE IN COLOMBIA
L. M. Roberts, U. J. Grant, Ricardo Ramírez E., W. H. Hatheway, and D. L. Smith *in collaboration with* Paul C. Mangelsdorf
NAS–NRC publication 510 1957 Price $1.50

RACES OF MAIZE IN CENTRAL AMERICA
E. J. Wellhausen, Alejandro Fuentes O., and Antonio Hernandez Corzo *in collaboration with* Paul C. Mangelsdorf
NAS–NRC publication 511 1957 Price $1.50

RACES OF MAIZE IN BRAZIL AND OTHER EASTERN SOUTH AMERICAN COUNTRIES
F. G. Brieger, J. T. A. Gurgel, E. Paterniani, A. Blumenschein, and M. R. Alleoni
NAS–NRC publication 593 1958 Price $2.00

RACES OF MAIZE IN BOLIVIA
Ricardo Ramírez E., D. H. Timothy, Efráin Díaz B., and U. J. Grant *in collaboration with* G. Edward Nicholson Calle, Edgar Anderson, and William L. Brown
NAS–NRC publication 747 1960 Price $1.50

RACES OF MAIZE IN THE WEST INDIES
William L. Brown
NAS–NRC Publication 792 1960 Price $1.50

Previously published by the Bussey Institute, Harvard University, in 1952

RACES OF MAIZE IN MEXICO
E. J. Wellhausen, L. M. Roberts, and E. Hernandez X. *in collaboration with* Paul C. Mangelsdorf

Library of Congress Catalog Card Number: 61-60014
Price $1.50

CONTENTS

ACKNOWLEDGMENTS

We wish to express our appreciation to all who have shared in the work of making, growing, storing, assembling, and studying the collections upon which this report is based. It was initiated largely through the efforts of the Committee on Preservation of Indigenous Strains of Maize, of the National Academy of Sciences —National Research Council in Washington, D. C. It was sustained through the collaboration of the Chilean and Colombian governments, the International Cooperation Administration, and The Rockefeller Foundation.

Although the seed storage center is located in Medellín, Colombia, the plants were grown in Mexico and the United States after repeated trials had shown that they could not be grown successfully in Colombia. We are grateful to the corn program of The Rockefeller Foundation Oficina de Estudios Especiales, and the Secretaria de Agricultura y Ganaderia in Mexico, and to the directors, administrators, and staffs of the experiment stations there at which the collections were grown. We are indebted to the Plant Breeding Department of the Pioneer Hi-Bred Corn Company for growing the lowland collections and for assistance in recording the plant data. The responsibility of receiving, cataloging and storing the collections properly was borne in large part by Drs. L. M. Roberts and U. J. Grant. We are extremely grateful to them for their help, encouragement, assistance and contributions throughout the course of this study.

Ing. Agrs. Bertulfo Peña V., Fernando Arboleda R., and Ricardo Ramírez E. of the Corn Improvement Program of the Colombian Ministry of Agriculture collected the sporocytes. The bulk of the data were summarized by Ing. Agr. Pedro R. Oñoro C., Sr. Luis Mahecha T., Stas. Nora Rivera U. and Marina Duque B., of the Statistical Section of the Departamento de Investigación Agropecuaria of the Colombian Ministry of Agriculture. We are indebted to Sr. Rafael Rodríguez L. for photographs of internode patterns, distribution maps and cob diagrams. The distribution maps were drawn by Srs. Víctor M. Pinzón R., Julio García G., Héctor H. Escobar L., and Sta. Berta Escobedo G. We are grateful to Drs. R. D. Osler and E. C. Johnson and their assistants for recording plant data of the collections grown in Mexico.

We wish to express our appreciation to the chairman of the Committee on Preservation of Indigenous Strains of Maize, Dr. R. E. Cleland; its Executive Secretary, Mr. J. Allen Clark, and to the disbursing officers of the National Academy of Sciences and The Rockefeller Foundation. Mr. Clark has ably supervised the editing and publishing of the English edition. For the Spanish edition we are grateful to Dr. Milcíades Martínez G. and others of the Publications Office of the Department of Agricultural Investigations of the Colombian Ministry of Agriculture.

Laboratory facilities for Dr. Barbara McClintock, who did most of the chromosome knob studies, were provided by the Universidad Nacional, Facultad de Agronomía at Medellín. Dr. McClintock was assisted by Sta. Rocío Díaz Palacio. We are also grateful to Dr. William H. Hatheway and Ing. Alexander Grobman for their help, comments, and suggestions throughout the course of the study.

Making representative collections of indigenous varieties of maize requires both agronomic and ethnographic insight, as well as the ability to deal effectively with many kinds of people. Sr. Víctor Manuel Patiño served as the principal collector of Chilean maize. He was ably assisted by Messrs. H. Gacitua, B. Bapaport, and L. Hevia P.

Sr. Pablo E. Daza B. has been of great assistance in receiving, cataloging, and storing the collections. He was also responsible for organizing the collections for laboratory study and taking many of the data on the internal characteristics of the ears. A large number of students from the Facultad de Agronomía at Medellín and Palmira assisted in note taking and summarizing the data for the external ear characters.

Stas. Eloisa Rivera E. and Elvia Quinceno A. assisted in locating records, photographs, and in typing preliminary notes on the races. We are indebted to Sta. Cecilia Cancelado S. for typing of the first draft of the manuscript. We also wish to extend our thanks to Pauline Waddell of the clerical staff of the Plant Breeding Department of Pioneer Hi-Bred Corn Company for typing the final draft of the manuscript.

RACES OF MAIZE IN CHILE

David H. Timothy, Bertulfo Peña V. and Ricardo Ramírez E.[1]
in collaboration with
William L. Brown and Edgar Anderson

INTRODUCTION

This report, like others in this series of studies, is the result of a cooperative effort of many organizations and individuals. The project: to collect, classify and preserve the indigenous races of maize of the western Hemisphere, was initiated by a committee of the Agricultural Board of the National Research Council. It was through this organization that funds for collecting and subsequent study were obtained from the Institute of Inter-American Affairs of the International Cooperation Administration. The Rockefeller Foundation's Agricultural Program in Latin America and cooperating Latin American Governments have provided facilities, encouragement and leadership for the project since its beginning.

By comparison with other papers of this series, our treatment of the races of maize of Chile is more in the nature of a progress report than a finished monograph. There are numerous reasons for this, the foremost of which is perhaps the difficulty of growing the Chilean collections in those areas of Colombia and Mexico where the studies have been centered.

Attempts were first made to grow the Chilean material in Colombia. This met with almost complete failure because of the poor adaptation of these collections to Colombian conditions. Later, through the cooperation of The Rockefeller Foundation Agricultural Program in Mexico, the Chilean races were grown in that country, those from the lowlands at Cotaxtla near Veracruz and the highland races at La Piedad. The collections from high elevations in Chile did reasonably well at La Piedad. However,

---

[1] The authors are respectively: Associate Geneticist, Colombian Agricultural Program, The Rockefeller Foundation; Geneticist, Colombia Ministry of Agriculture; Co-director and Geneticist, Maize Improvement Program, Colombian Ministry of Agriculture.

a copy of the data was lost in the mail and the original data were destroyed by severe floods at La Piedad. Because of these difficulties, plant data for the highland races are not available. At Cotaxtla the races from lowland Chile were severely attacked by *Helminthosporium* spp. at the time of flowering. The damage resulting was so great that the plants were of little value for critical study. The only data used were those for the race Harinoso Tarapaqueño. Finally, the lowland races were regrown by the Plant Breeding Department of the Pioneer Hi-Bred Corn Company in south central Iowa. Here, for the most part, the lowland Chilean races were well adapted and developed normally. It was from this planting that our plant data for the lowland races were taken.

A further handicap in this study arises from the fact that none of the authors has had opportunity to study Chilean maize in its native habitat or to investigate at first hand methods of culture or uses of maize in that country. For this reason, subjects of this nature are treated only briefly in this report.

Notwithstanding the difficulties encountered in this study, we believe our knowledge of Chilean maize is enough to make a tentative classification of the races present in that country. It is our hope that this report may serve as a point of departure and a stimulus for those workers with facilities for growing Chilean maize, to look further into the race problems of this most interesting group of corns.

GEOGRAPHY AND CLIMATE

The estimated area of Chile, the seventh largest country in South America, is 286,000 square miles.[1] It is the longest north-south country in the world with a length of 2,660 miles and an average width of 110 miles. The country is bounded on the north by Peru, on the east by Bolivia and Argentina, on the south by the Drake Strait, and on the west by the Pacific Ocean.

Temperature usually varies with altitude and latitude whereas rainfall is more closely correlated with latitude. From the northern desert area, where practically no rain falls, gradual increases

[1] Figures for area, altitude, climate, etc. vary among different sources (1, 4, 5, 6, 10, 27).

in precipitation occur with increasing degrees of latitude. Over 200 inches of rain have been recorded annually at 53° S. in Tierra del Fuego.

Chile is a mountainous country, composed of two principal ranges. The Coastal Range, rising abruptly from the ocean, extends from about the lower third of Peru to south of Chiloé Island. The Andes mountain system runs from the great Bolivian plateau in the north, southward along the eastern border of the country to Tierra del Fuego. The region between these two mountain chains is composed of a long valley (Valle Longitudinal or Valle de Chile) and a series of basins. The mountains make up about seventy per cent of the country; elevations range from sea level to about 22,000 feet. Chile has been divided into four principal parts by Sauer: West Patagonia, Old Chile, The Bolivian Plateau, and the Arid West Coast (27).

West Patagonia is the southernmost part of the Andes, south of the Gulf of Ancud. The young mountain range has been subjected to violent glaciation, developing along the coast one of the finest fiord systems in the world. This wild rugged region is composed of hilly islands, deep fiords, erratic channels; it is isolated by mountain crests and ice fields along the eastern margin. Land travel is impossible or, at best, very difficult. In the northern section of this area, damp cloudy days are predominant with high rainfall in all seasons, and a yearly mean of 80 inches. Temperatures are cool and accentuated by strong to violent prevalent westerly winds. The southern area has a rainfall of 120 to 200 inches with lower temperatures than those in the northern portion. At Fuegia in the Magellan Strait the mean annual temperature is 43° F. with slight daily or seasonal flucuations. Although the snowfall at sea level is light and of short duration, the summer snow line is at about 1,500 to 2,000 feet elevation. South of Temuco, the mountains are traversed by low east-west basins. Morainic dams across these basins have formed many lakes, and provided a system for diverting water from the Patagonian Plateau to the Pacific Ocean. Beyond 46° S., glaciers reach the heads of various fiords and basin lakes (6, 10, 27).

Old (or Middle) Chile extends from Coquimbo south to the Island of Chiloé at 43° S., and consists of three parallel strips (1):

(a) the interior high (15,000 to 20,000 feet average) simple Andean chain is composed mostly of sedimentary rocks. The sierra has been deeply excavated by streams, and the region south of Santiago is superimposed by a series of volcanos. On the Chilean side of the chain, the southern snow line is at about 4,900 feet, and the northern line at about 15,000 feet, (b) the *Valle Longitudinal*, or Central Valley, about 20 to 50 miles wide, begins at the western foot of the Andes, at the latitude of Valparaiso, as a discontinuous depression and extends southward to the Gulf of Ancud. It is continued northward to Coquimbo as a string of basins, deeply aggraded mainly by the wastes of the coalescent fans of the Andes. Productive chestnut-brown soils have been weathered in the northern area, while the area South of Concepción is characterized by soils of increasing podzolization and decreasing fertility. The Central Valley, the heart of contemporary Chile, is about 600-700 miles long, sloping from an elevation of 2,300 feet in the north to sea level in the south. It is the richest agricultural region in the country. The valley can be divided into two environmental zones at the latitude of Concepción. North Middle Chile, from the Río Aconcagua to the Río Bio-Bio, has a Mediterranean climate of winter rains and summer drought; South Middle Chile, from the Bio-Bio to Chiloé Island has a wet climate with heavy precipitation throughout the year. (c) The Coastal Range, containing a core of old crystalline rock, stretches from Coquimbo to Chiloé Island. The streams from the Andes have maintained their seaward courses during the late upheaval of the coastal mountains, by cutting directly across them to form drainage valleys. The range has an average elevation of 1,000 feet with a maximum elevation of 7,000 feet. Impressive discontinuous terraces are characteristic of the coast line (27). Some of the more important rivers flowing westward through these mountains are the Maule, Maipo, Bio-Bio, Imperial, Valdivia and the Bueno.

The Bolivian Plateau extends into northwest Chile, where, north of 28° S., the Andes change into a northerly double and multiple chain, exceeding 100 miles in width in places. The entire region is cold, arid, and barren. Two of the largest salt basins in Chile, Atacama and Pedernales, are situated at about 8,200 feet between two of the northwestern chains. Peaks in this area average from 10,000 to 15,000 feet, although a number of them may exceed 20,000 feet. Most notable of these are Mt. Llulliallco (22,145 feet) and Mt. Ojos del Salado (22,420 feet). East across the main Andean Cordillera and extending into Bolivia and Argentina is the 11,500 foot high Puna de Atacama. The small streams draining into this area end in numerous salt flats. A series of undrained and undissected plateaus and basins extend from southern Peru, through Bolivia, and south to about 28° S. in Chile (27).

The Arid West Coast contains the Atacama Desert, which stretches from the Peruvian border to the Copiapó River some 600 miles to the south. North of Taltal, at about 25° S., is one of the driest deserts in the world. From the Pacific Ocean rises a low (2,000 to 3,000 feet) north-south coastal range, worn by waves into precipitous escarpments. The plateau between the Coastal Range and the Andes is composed of old lake beds and basins deeply filled with alkali-impregnated alluvium which has been carried westward as runoff from Andean torrents. These basins contain the famous nitrate deposits of Chile. The Andean slopes are often bare to 8,000 feet and the only rivers of any importance are the Loa and the Azufre. Rainfall has never been recorded in some places and no permanent stream reaches the Pacific. The inhabitable oases, watered by temporary mountain streams or underground seepage, are by no means extensive or numerous. The oasis at Calama, the largest, contains about 12 square miles of cultivable land at an altitude of 7,000 feet. Temperatures in this region range between 65° F. and 75° F. during the summer months, and seldom fall below 52° F. in the winter.

NATURAL VEGETATION AND AGRICULTURE

Chile, although primarily an agrarian country, has most of its agriculture confined to the Central Valley. Limited agricultural activities are carried out around small oases in the northern desert, a few isolated areas along the northern coast, and also on Chiloé Island. Approximately 30 to 45 per cent of the population is engaged in this industry.

Many regions of the Atacama desert are practically devoid of vegetation except for cacti (*Cereus* spp.). However, scrub and algarrobo *(Prosopis* spp.) are found around the seepage areas and oases.

The highland region behind the desert is characterized by scrub steppe; the Bolivian Plateau by heath puna and grasslands which supports tola *(Lepidophyllum quadrangulare)*, ichu *(Stipa pungens)* and *(S. ichu)*.

In this whole northern area, grazing of the punas and llanos, or pampas, by sheep, goats, llamas, and alpacas is an important enterprise. Where water and altitude permit, maize, beans, potatoes, squash, chili peppers, *(Capsicum* spp.) and quinoa *(Chenopodium quinoa)* are grown (5).

South of Copiapó, rainfall increases somewhat, and the uplands are covered with a scrub steppe. Vegetation includes algarrobo, molle *(Schinus molle)*, which are used for fermented drinks and medicinal purposes, litre *(Lithrea caustica)*, and chañar *(Gourlica decorticans)* (17). From Coquimbo to the Bio-Bio, the winter rains and summer droughts form a Mediterranean climate, with its corresponding cacti, grasses, and various species of *Acacia*, *Mimosa*, and *Puya* (27, 28). The coquito palm *(Jubaea chilensis)*, whose fruit and growing tips were used in the diet, is restricted to this area (17).

Temperate rain forests begin roughly south of the Río Bio-Bio along the coast; further inland they begin on the Andean slopes at about 25° S. and extend southward to about 47° S., where the transition into the south coastal tundra occurs. The rain forest exhibits a great deal of diversity of trees, vines and epiphytes. Typical species include *Nothofagus obliqua*, *N. dombeyi*, *Libocedrus chilensis*, *Fitzroya cupressoides*, and *Drimys winteri*. Near Temuco, in the northern region of this forest are small areas of *Araucaria araucana* (11, 27). The cones from these pehuén trees were collected by the aborigines, and the seeds were toasted for eating, making soup, or grinding into flour. The sap of the tree was used for treating bruises and cuts (17).

The Indians of the dry north constructed irrigation systems at the oases and small coastal areas, and were thus able to cultivate a large variety of crops. There is considerable evidence from grave excavations that agriculture arose simultaneously with the industries of coiled basketry, pottery making, and weaving. Remains from these diggings indicate that maize, cotton, and calabash *(Crescentia cajete)* appeared together. Beans seem to have been cultivated slightly later, and potatoes are found only in still later graves (7).

The Indians of Middle Chile cultivated maize, which was the most important staple, potatoes, beans *(Phaseolus vulgaris)*, squash *(Curcurbita maxima)*, madi *(Madia sativa)*, chili pepper *(Capsicum annum)*, quinoa, oca *(Oxalis* spp.), mango *(Mangifera indica)*, peanuts *(Arachis hypogaea)* and other crops (11, 28). Their diets were supplemented by various wild plant parts, such as roots and tubers of ligtu *(Alstroemeria ligtu)*, huanqui *(Dioscorea* spp.), illmu *(Conanthera bifolia)*, and *Sisyrinchium* spp.; fruits and berries of uñi *(Myrtus ugni)*, luma *(M. luma)*, michai *(Berberis darwinii* and *B. congestiofolia)*, maqui *(Aristotelia maqui)* and *Cryptocarpa rubra;* leaves and greens from *Gratiola peruviana* and *Mimulus luterus;* and seeds from lleque *(Podocarpus andinus)* which were used in the same manner as those from *Araucaria araucana* (11, 17). Today this area supports most of the agriculture in Chile. Vineyards and olive groves are numerous, as well as field crops, such as wheat, barley, corn, potatoes and tobacco.

Among the *Chilotans* of Lower Middle Chile, potatoes were a much more important crop than corn. South of Chiloé Island there was no systematic agriculture, except for sporadic potato culture. After contact with the Spanish, however, some maize and barley were grown (10). Below about 48° S., the people were boat users, subsisting on fish, shellfish, seals and other marine life as a basic diet, supplemented with birds, eggs, numerous berries and fuchsia seed pods. The large stemmed pangue *Gunnera chilensis)* was available to the northern *Alacaluf* people in limited quantities (6). Pangue leaf juices were used for drinking, the stem juice for alleviating diarrhea and hemorrhages, and the root extract as a black cloth dye (17). The inhabitants of Tierra del Fuego, the *Yahgan,* were hunters, fishers, and gatherers.

CORN PRODUCTION

Most of the corn in Chile is planted in small plots rather than in large scale, extensive plantings. From about 32° S., in Coquimbo to the Island of Chiloé, corn is planted in the narrow land strip between the coast and the Andean foothills. North of Coqumibo, corn is planted in the isolated oases and irrigated regions of the northern desert area. The area of land in maize for recent years is shown in Table I.

TABLE 1.—Hectares planted to corn in Chile.
From Departamento de Economia Agraria, Ministerio de Agricultura, Santiago.

	Hectares planted	
Region	*1958-1959*	*1959-1960*
Tarapacá—Colchagua	36,400	33,200
Curicó—Linares	13,000	14,100
Maule—Chiloé	18,000	18,000
Total	67,400	65,300

MAIZE AND THE INDIGENOUS PEOPLE OF CHILE

The people of Chile, a people of coastal and highland deserts, temperate rainforests, semi-arctic tundra, fertile valleys and mountain slopes, have cultural patterns and agricultural systems almost as varied as their environment. The main indigenous groups of Chile are usually recognized as the *Atacameño* of the northern desert, the extinct *Diaguita* of the provinces of Atacama and Coquimbo, the Araucanian tribes of Central Chile to as far south as Chiloé Island, and the small disappearing ethnic groups of the extreme south, the *Ona, Yahgan,* and *Alacaluf.* Maize was the basic staple of the people from the Peruvian border to Chiloé Island, a distance marked by 23 degrees of latitude. Maize husbandry in northern Chile was similar in most respects to that in other areas controlled or influenced by the Inca Empire. The cultural pattern of the *Araucanians* also demonstrates outside influence, mainly from Argentina and the more advanced centers of the Central Andes. It is surprising that cultural influences from outside of Chile are so pronounced because the desert and the high Andean chain tended to isolate the *Chileans* from their eastern and northern neighbors. The *Ancients,* however, were capable of travel under difficult conditions, even in the wild area of southern Chile.

At the time of Spanish contact, the *Chilean* tribes to the south of Chiloé Island were primarily hunting, fishing and gathering peoples. In the extreme southern Magellan Strait area lived the *Ona* and the *Yahgan*, now both practically extinct (15). Immediately north of them lived the vanishing *Alacaluf* who were the southern neighbors of the *Chono*. The latter, inhabiting the area from about 48° S. to 43° 30′ S. on the Corcovado Gulf, had contact with the *Chilotans* of Chiloé Island, whom they raided for iron and other types of plunder; the *Chilotans*, in turn, raided the southern groups of the agricultural *Araucanians* (15). Although no systematic agriculture was practiced in the entire area south of Chiloé Island before the conquest, some maize and barley were grown after contact (10).

As a result of the Inca conquest and the movement through the Andean passes to the Argentine, the cultural pattern of the *Araucanians* was a mixture of that diffused from the Central Andes and Patagonia (4, 12). The *Araucanians* did not commemorate agricultural cycles with ceremonies. In general, crafts, construction pottery and other types of material culture were similar to those of the Central Andes; the social, religious and political systems were strongly influenced by the hunting pattern of the peoples of the Pampas and Patagonia (4). In addition to the remnants of the *Araucanians* presently found in Chile, others are also found in Argentina, scattered throughout the Pampa in the province of Mendoza and the territories of La Pampa, Río Negro and Chubut (11, 12).

The different *Araucanian* tribes depended upon maize with varying degrees of necessity, although it was generally recognized as their staple. The most important to the *Mapuche* was maize, that of the *Chilotans*, potatoes, while the *Huilliche* considered maize and potatoes to be of equal importance (11). Molina, as cited by Cooper (11), said that at the time of the Spanish conquest there were eight or nine varieties of maize being cultivated by the *Mapuche-Huilliche*.

Apparently maize was cultivated in abundance from Copiapó to Maule, and from Maule penetrated into the present day confines of the *Araucanian* territory (13). Valdivia sent a number of troops and ships to various parts of this area and obtained large stores of maize (13, 17). Latcham (17) cites various references indicating that the Indian granaries were found well stocked with maize and other comestibles. Corn grew as tall as a spear, and the best ears were the length of half a vara (today often considered to be about 80 centimeters in length), with the poorest ears about a quarter of a vara long; harvests were in the proportion of 300 units harvested to each unit planted (17, 21). Apparently, other groups did not fare so well and according to Carvallo, cited by Medina (21), did not plant a sufficiently large area to meet their needs.

The *Atacameño* and *Diaguita* of northern Chile reflect considerable influence from the Central Andean centers of Bolivia and Peru, and from the hunters of the Argentina Pampas. In addition there is a great deal of cultural similarity between these Chilean tribes and those of northwestern Argentina. All are agriculturists and great emphasis is placed on herding (4).

The widely distributed *Diaguita,* or *Calchaquí,* occupied the southern basins of Tucumán, Catamarca, San Juan, and La Rioja in the eastern cordillera of Bolivia, which extends into northwest Argentina (4). They also inhabited the valley flats of the Chilean provinces of Atacama and Coquimbo in areas large enough to support a basically agricultural subsistence. Their culture was eliminated by the Inca occupation, but vestiges indicate it was partially contemporaneous with the Highland *Tiahuanaco* (4). Their cultivated plants were similar to those of the central Andes although terracing was not as common as it was to the north (4).

The *Atacameño,* or *Lican-antai,* lived in the desert area of northern Chile and in northwest Argentine regions of Jujuy and Salta. The Chilean culture, influenced by *Tiahuanaco,* was preceded by preagricultural and agricultural-pottery periods. Archeological evidence indicates that maize, cotton and calabash appear simultaneously with coiled basketry, weaving and pottery at about the beginning of the Christian era, and that life was of a village farming nature (4, 7, 30). Agriculture was concentrated in the favorable oases where irrigation was possible; remnants of good irrigation systems are still evident (5). Surplus food was stored in house or cave granaries (5, 7). Some type of belief of after life is indicated, because maize and beans have been found in graves (7). Llama and alpaca herding were major activities, and the *Atacameño* therefore became involved in trading; they are often referred to as the middleman of the Andes who traveled over unpaved roads as wide as ten feet (5).

While it appears that corn was not grown on the extremely high Punas of Jujuy and Atacama, there is evidence that it must have been brought up to those heights from lower nearby valleys, or brought in by the *Atacameño* traders (17). This does not seem to be too far out of the question, particularly since marine shells from the Pacific have been found in northwest Argentine at La Paya (5).

From Bird's material excavated at Arica, Anderson (2) described the corn as ". . . a tough, slender stalked popcorn. It had little kernels, more rounded than pointed, set tightly together in an almost honeycomb pattern and the characteristic row number was 14. . . ." "The tassels were small and very much branched," ". . . the husks were evenly and tightly wrapped about the ears." From later deposits at Playa Miller, the recovered corns were essentially the same as the earlier ones but had more variation, particularly toward higher row numbers and larger grains, and were similar to the measured corn at Paracas from the Paracas Necropolis Period of Tello (2).

A large grained yellow corn called *llampu* by the Indians was also widely grown in Peru and in north and central Chile (17).

Latcham (17) has expressed the opinion that the corn *morocho* of Peru and *curahua* or *curagua* of Chile were originally the same variety. The Quechuan meaning of *morocho* is hard; *cura* (rock) and *hua* (maize) in Araucanian would refer to a hard grained corn. The names originally applied to a corn of small round grains with a thin pericarp, dark red to purple in color. Upon grinding, *llalli* or *gullil* (an extremely white flour) and a relatively small amount of bran was obtained. When popped, the kernels characteristically exploded into the shape of a four point star. Latcham compared excavated ears from Ancon, Peru with others from Calama, Chiu Chiu, and Quillagua in northern Chile. He concluded that all were of the same type of maize and that the excavated samples would fit his description of *curahua.*

At the time of the conquest, a great deal of corn was grown on the mainland south of Valdivia, some also was grown on Chiloé Island. In relatively few places within this zone, will corn mature today, which is probably due to the degeneration of corn culture after wheat and barley were introduced, and the subsequent loss of adapted varieties (17). Latcham (17) found one of the best adapted varieties in this region to have a fairly short plant, small leaves and ears, and little round compressed grains. He is of the opinion that this is the old variety *curahua* or *morocho.*

To define the types of corn by local or Indian name may be very misleading because of local interpretation affixed to the name. For example, *morocho* or *curahua,* while used to define the type described by Latcham (17), is also used in various areas to describe the following types: in Melipilla it means a dark rounded grain; near Copiapó, a large relatively soft grain; the coastal area of Curicó, also a large grain; near Catamarca, a purple hard kerneled corn. In northern Chile, the small round kernel popcorn of the *curagua* or *curahua* type is also called pululo (17). Baraona (3) in his description of the corns presently grown near Socaire points out that the Aymaran equivalent of *curahua* or popcorn is *pisingallo,* also *pisinkallo. Morocho* also indicates a white flint corn in Ecuador.

While some authors report that corn was not grown in large quantities, most agree that there were abundant harvests (13, 14, 17, 21). Surplus supplies of the *Atacameño* were stored in house-corner granaries about four feet high, with a door at the base, and probably had a roof or cover of sticks or rushes (5). Grain was also stored in caves, on elevated platforms, in leather sacks, or in underground granaries lined with stone slabs (5, 11). The *Araucanian* stored grain in hillside cave granaries *(cojiruca)* or in bundles supported by sticks or twigs (21).

Cortés Ojea, cited by Medina (21), one of the first Europeans to describe corn on the islands south of Chiloé, said that the corn was large, as were the tassels, the grains were dented and completely distinct from the varieties cultivated by the *Atacameño.* In this region there are, at most, three months of favorable temperature for development, and it was often necessary to harvest early and dry the corn. Keller (16) suggests that possibly the corn of the *Atacameño* was taken to Guatemala, later brought back to Chile with the mayoide immigration, and adapted to regions as far south as Chiloé Island by the *Araucanians.*

Mesa Bernal (22), in reviewing the natural history of maize in America from the time of the Spanish chroniclers to the present, dismisses Chile as being important where the origin of maize is concerned. However, he emphasizes that the study of the Chilean archeological remains, as well as the study of modern corns, may shed some light on the problem of the origin. Guevara (13) states that the chroniclers and moderns who have studied the Inca influence in Chile generally concede that corn, as well as quinoa, was imported by the Peruvians. He further suggests that it is also probable that before the *Aymara* and *Chincha-Atacameño* civilizations arose, corn could well have been introduced into Chile from the north and east, but that there is no doubt that the Incas increased its cultivation, by using methods previously unknown and by introducing better varieties.

CULTIVATION AND USES OF MAIZE

In some parts of Chile, particularly in the northern area, corn is still an important item in the life of the people. In Socaire, even today, nearly everyone plants at least a small garden plot of maize (23). To the south, however, maize is of secondary importance to such crops as wheat, barley, alfalfa, potatoes, and peas, as well as vineyards, and deciduous orchards. Although corn did not attain the significance, religious or otherwise, that it did in the other Andean countries, it was regarded as the staple crop, except in the areas near Chiloé Island, where potatoes were of primary concern.

Cultivation was done by the use of primitive tools. Corn husbandry, however, was advanced, particularly in the north where it was modeled after the systems used by the Central Andean peoples.

The uses of maize were many. Green ears were boiled in earthen pots or roasted over a fire or in the embers (11). Stews and broths prepared with corn and meat or potatoes were common (11). Cakes were made from raw or parched flour. Parched flour was put into water and taken upon awakening in the morning (11). A fermented drink, *chicha,* was made from a large portion of the harvest. The plant parts were even utilized in the dry regions of the north. The stalks were used as llama feed, while the tassels and cobs took the place of firewood (17).

Most of the ancient cultures of Chile, with the exception of the *Araucanian*, disappeared some time ago by absorption and contamination. Our knowledge of these people is based on remnant culture and archeological evidence. The *Araucanians*, still numerous, have been studied since the days of the conquest and it is from them that most of the known uses and means of cultivating maize in Chile have been ascertained.

The *Araucanians* lived mostly in settlements, in which the houses were within reasonable proximity to each other, but yet distant enough to afford ample space for cultivation. Each family, or close-kinship group, claimed a specific parcel of land, usually inherited from its ancestors, of the territory held jointly or communally by the settlement (11). At the time of the conquest, both men and women participated in agricultural activities; the men would prepare the land, but leave planting and other cultural procedures to the women (4, 11).

Land preparation was done by an elementary type of plow made of two pointed poles about ten feet long and six inches in diameter (21). One end of the pole was elevated so that the pointed end would penetrate the soil. A man, protected by an abdominal pad of doubled hide, pushed the poles with his stomach, a few feet at a time. Every two or three feet, a companion inserted another pole under one side of the "plow" and, by applying leverage, turned over a sod about 18 inches wide and three inches deep.

Land was also prepared by using pointed digging sticks which were sometimes weighted, wooden shovels, and on Chiloé Island by a small adze, similar to the Spanish hoe (4, 5, 21, 28). After the land was prepared, the women went along with pointed digging, or dibble sticks and made holes to receive the *cogi* (kernels). Three or four kernels were put into each hole and the earth was then firmed by trampling (11).

Irrigation was advanced and extensively used in the north (4). South of the desert area, plantings were made in open clearings, or areas were cleared by slash and burn techniques (11). Irrigation and terracing were not practiced, and planting was usually done in humid or wet areas, or on hillsides, and the area seeded did not often exceed two or three acres (4, 11, 21).

As today, time of planting was largely dependent upon latitude and the maturity of the corn. Near Copiapó, planting was done in October, and the *gulorcüyen* (harvest) took place in April or May (21). In the slash and burn areas of South Chile, planting was done in September and October, and harvested in January or February, to take advantage of moderate rains and to escape the frost which began in April (17).

In South Middle Chile the Indians did not harvest more than they needed for the near future. The unharvested ears were stored on the plant. To prevent damage by water and insects, the apical ends of the husks were twisted to form a seal (17, 21). In this slash and burn area, the land was generally fallowed for one to three years after cropping (11).

There were a number of crops and methods employed to make the intoxicating *chicha*. One of the more elaborate methods of making *maiz chicha* was described by Molina, cited by Medina (21). For a large or special festival, the women sat in a circle grinding corn in time with one another, all the while singing with the rhythm of the grinding stones. The older women and children would chew the grits and spit the mess into large jars or pots, containing water and heating over a fire. After a few days of fermentation, the *chicha* was ready to drink. From the sediment left in the bottom of the jars, they made *curanthum* (a type of bread or cake) or balls the size of an egg, which were relished by the children (21). Various types of *mudai* (chicha) were distinguished; *púlcu* (strong and well fermented), *muscu* (turbid chicha) and *huycon* (clear chicha)(17).

The Peruvian influence upon the peoples of Chile is apparent from the grinding stones. Guevara (13) says that the stone for grinding toasted corn, flat and semicircular in shape, was probably imported from the cultural centers of the north, particularly since the type of stone was used among the Peruvians until recent times. Other types of *muncudi* (pestle) were a flat circular stone and a two handed cylindrical pestle (11, 21). The mortar was called *cudi* (21).

Sieves or cloths were used to separate the *amchi* (bran) from the flour. Cakes, usually made with raw grain flour *(rugo),* were cooked in excavated earth ovens, or in glowing embers or ashes (11, 17). Leavening was apparently unknown to these people. A meal of *pidcu* was prepared by mixing the flour of toasted grain *(murque* or *musvque)* with beans and cooking them together in fat or grease (17, 21). Other dishes included *ched-chan*, a thick maize porridge prepared with hot water (*ulpúd* if it was prepared with cold water), and *muti (mote)* prepared by cooking corn in lye solution and then rinsing it (17, 21). Whole toasted grains were also eaten.

Burial was accompanied by the relatives putting plates of corn balls and cakes in the grave, as well as jars of *chicha;* in the case of a woman's death, her grinding stones were also interred (21). The *chicha* and food were often replaced a year after the funeral (21). A few cases of adult urn burial among the *Diaguita* may indicate influence from the tribes of the Amazon region (4).

Munizaga and Gunckel (23) state that until a few years ago, corn was used in the marriage ceremonies of the people of Socaire. Among the presents given to the newlyweds were collars strung with corn ears of various colors, potatoes, and a type of bread which is probably connected with the ceremonial bread from the prehistoric tombs near Chiu-Chiu. Although these collars may not seem like much of a present, they represented a valuable seed stock for the economic future of the newly married couple. Popped corn of a type of *Pisingallo* was also thrown into the air with shouts of "Vivan los novios" (23) ("Long live the sweet-hearts!").

COLLECTING PROCEDURES

The great majority of the collections were made directly from farmers fields at harvest time. An effort was made to obtain a minimum sample of fifteen ears and to include as much as possible of the variation in plant and ear type from each individual collection site. At the time of collection, an attempt was made to note pertinent information such as locality, altitude, local name of the variety, and temperature and rainfall data whenever possible. The localities at which the collections were made are shown in Figure 1.

Each collection received at Medellín, Colombia was catalogued, dried, photographed, and data on ear and kernel characteristics of ten ears (when available) were then recorded. From each

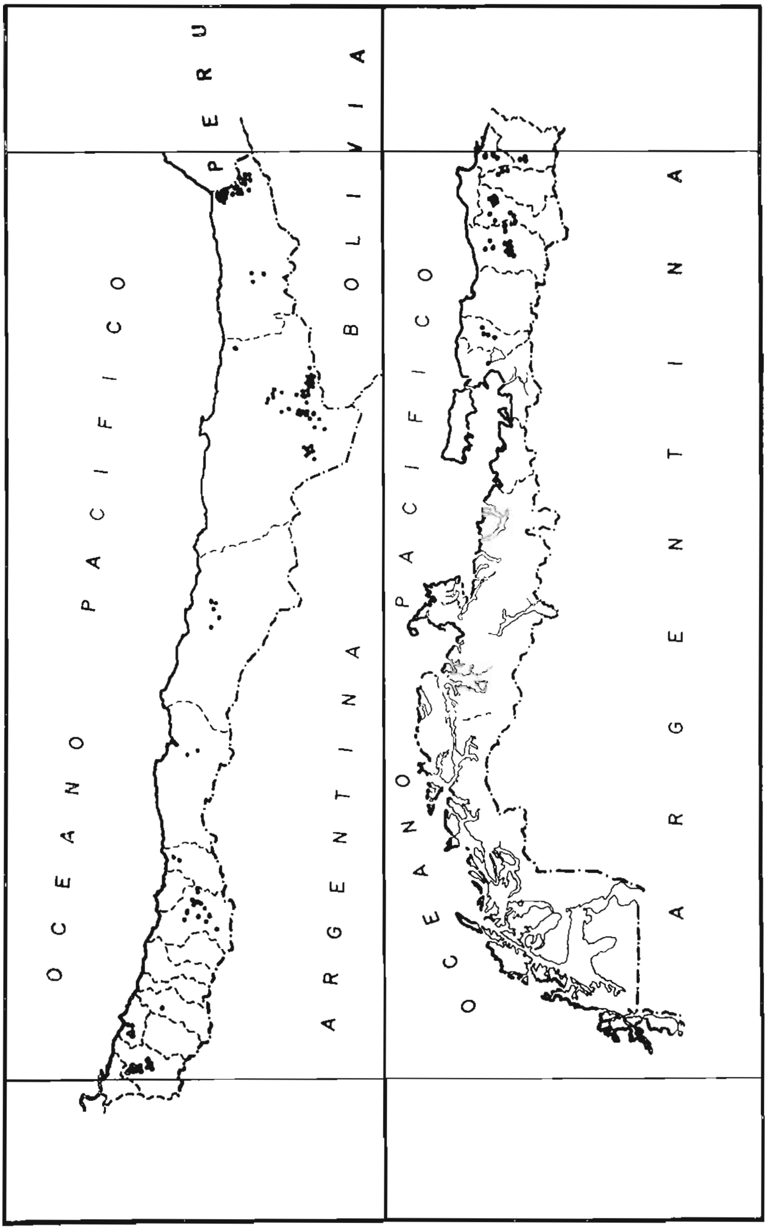


Fig. 1. Distribution map of all collections.

collection, two rows of grain were then shelled from each of three or four ears selected for a museum specimen. This seed was mixed with that from the completely shelled ears constituting the remaining portion of the collection. These large samples of seed were put into cold storage for maintenance purposes. As a precaution against unforeseeable loss, duplicate samples of four ounces each were put in cold storage at Medellín and at the seed storage center at Glenn Dale, Maryland, which is maintained by the Division of Foreign Plant Introduction of the United States Department of Agriculture.

CHARACTERS USED IN CLASSIFICATION

The characters used in classifying the Chilean races were essentially those used previously in studies of the races of maize of Bolivia (24) and Colombia (26). We are repeating here the descriptions of characters only because some workers interested in maize may not have access to the earlier reports.

All measurements of ear characters were made on the original ears, thus these characters are from plants grown in their native habitats. All other measurements or scores were made on plants grown either in Mexico at Cotaxtla or at Johnston, Iowa, in the United States.

VEGETATIVE CHARACTERS OF THE PLANT

Height of Plant—Plant height was not recorded directly in the field but was calculated from the internode measurements of the typical collections. This figure represents height from the ground level to the base of the tassel.

Height to Ear—Ear height was not recorded directly in the field but was calculated from the internode measurements of typical collections.

Stem Diameter: Maximum and Minimum—The means by races for this character are averages of measurements made at the midpoint of the first internode above the ground on the main stalk. Also to obtain a picture of the relative shapes of the main stalk at the midpoint of the first internode, two measurements were taken at this point. One was taken of the maximum diameter and the other of the minimum. The relationship between the averages of the two serves to give a fairly good idea of the cross-sectional shape of the main stem slightly above ground level. Some races have slightly elliptically shaped stems; others have stems which are almost round. The majority have stems that fall somewhere 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 on the leaf arising immediately below the ear-bearing node. The means of the representative collection were averaged to derive the racial means for this character.

Width of Leaf—The same procedure was followed as for length of leaf, the measurements being made at the midpoint in the length of each leaf.

Venation Index—The procedure described in the study of the races of Mexico (29) was used to derive this index. It consists of the quotient of the average number of veins, counted at mid-point in the length of the leaf immediately inferior to 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. *Mediums* 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.

Internode Patterns—After the modal number of internodes for each race had been chosen as characteristic, the pattern was determined by using the measured 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 which also indicates the position of the uppermost ear of the plant. 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.

Ears per Plant—Self explanatory.

CHARACTERS OF THE TASSEL

Length of the Peduncle—The distance between the terminal node of the main culm and the lowermost primary branch of the tassel.

Length of Branching Area—The distance between the basal and uppermost primary branches of the tassel.

Length of the Central Spike—Distance between the uppermost primary branch and the apex of the tassel.

Length of the Uppermost Primary Branch—Self explanatory.

Length of the Best Developed Primary Branch—Usually the lowermost primary branch except in some plants with inserted tassels.

Number of Secondary and Tertiary Branches on Best Developed Primary—Self explanatory.

Total Number of Primary Branches with Secondaries—Self explanatory.

Total Number of Primary Branches with Tertiaries—Self explanatory.

Total Number of Primary Branches—Self explanatory.

CHARACTERS OF THE EAR

EXTERNAL CHARACTERS

When available, ten normal ears were used for the following characteristics:

Ear Length—The measurements were made on normally developed ears in the collections.

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 determination.

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

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

Kernel Denting—This is a visual estimate recorded on an arbitrary scale: from 0 = maximum to 5 = none. Observations were individually recorded for the ears of each collection, the scores being averaged.

Kernel Hardness—Visual estimates were made on the total sample of ears of each collection and these were recorded on an arbitrary scale from 1 (hard) to 5 (soft).

INTERNAL CHARACTERS

The measurements and observations on these characters which will be described below are presented in Table 7. 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 from the center of the upper surface of the upper 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 kernel.

Cupule Hairs—The cupule is almost invariably hairy. The hairs vary both in number and length from a few short prickles to many long, sometimes appressed hairs. 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 glumes is estimated by probing or puncturing with a dissecting needle. In some races the glumes are chartaceous or 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 the glumes are distinctly indurated and are difficult to puncture. Induration is scored by numbers, from 0 = none to 2 = strong.

Lower Glume: Hairiness—The hairs of the lower glumes 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 numbers, length and position and are scored in the same way.

Rachis Induration—The surface of the rachis tissue varies in the degree of induration. This is probably a matter of degree to which the tissue is schlerenchymatized. An estimate of the induration of the rachis, like that of the lower glume, can be made by probing the rachis tissues with a dissecting needle. The induration has been arbitrarily scored as follows: 0 = no induration, 1 = intermediate, 2 = strong.

PHYSIOLOGICAL, GENETIC AND CYTOLOGICAL CHARACTERS

The characters included in this category are as follows:

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 rust, *Puccinia sorghi, P. polysora* and *Angiospora zeae,* have been identified on maize grown in

Iowa and Mexico. 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 of susceptibility on the scale of 1 to 4, 1 being highly resistant and 4 highly susceptible. The various races of maize, when grown at Johnston, Iowa exhibited considerable differences in reaction to *P. sorghi*.

Helminthosporium—This disease, like rust, is very common and damaging in certain areas. To date, it is now fairly clear that *Helminthosporium turcicum* largely predominates with *H. carbonum* being present, but to a minor degree. All of the collections have been scored for resistance or susceptibility to this disease although in this report no distinction is made between the two species of leaf blight. The scale used for recording the visual estimates was from 1 = resistant to 4 = susceptible.

Pilosity—Pubescence in Table 7 is arbitrarily scored from 1 to 5 for both frequency and intensity, the higher number indicating the stronger pubescence. Texture of pubescence was scored arbitrarily into classes of 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 in Table 8 do not distinguish between these two genes for color. Color, like pubescence, reaches its maximum in the high-altitude corns. Sun-red, purple, and brown plant color were noted on an individual plant basis and the figures converted to per cent.

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 (Table 8) as percentage of ears with lemma color among the ears which were 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 studied.

Midcob Color—Midcob color effects the tissues between the pith and epidermis of the rachis. It is seen only when the cob is broken and for this reason its widespread distribution in Latin American races has been largely overlooked. The data recorded represent an average percentage of the ears that had midcob color. Approximately ten ears of each collection were read 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 nature of 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 the ears of the original collections and expressed in percentage.

CHROMOSOME KNOB NUMBERS AND POSITIONS

Chromosome knobs in maize have long been recognized as a racial characteristic and have been found to be of considerable usefulness in clarifying racial relationships. The studies of Longley (18) and Reeves (25) demonstrate a fairly good negative correlation between numbers of knobs and distance from Central America. Mangelsdorf and Cameron (19), working with Guatemalan varieties, found an association between numbers of knobs and altitude and also an association between knobs and various morphological characters of the plant. Brown (9), in his studies of long established maize varieties of the United States and inbred lines of Corn Belt origin, demonstrated an association between knobs and various morphological characters associated with the Southern Dents. Some investigators, particularly Mangelsdorf and his collaborators (19, 20), have suggested the presence of knobs to be an indication of the introgression of teosinte or *Tripsacum* into maize. Mangelsdorf and Reeves (20), in discussing the evolution of modern races of maize, state, "Nor can there be any doubt that chromosome knobs are associated with tripsacoid characters." We agree that this is true for many races of maize but it is equally true that some of the most highly tripsacoid varieties of maize known to us have very few knobs. What may appear here to be conflicting evidence may in fact be due to our limited knowledge of the knob constitution of *Tripsacum*. We already know that knob numbers and positions vary widely in *Tripsacum* and the problem of association of knobs and tripsacoid characters in maize will not likely be clarified until we have as much information on the knob constitution of all species of *Tripsacum* as we now have for maize.

While information on knob number is of some value in clarifying racial relationships, the distribution of specific knob patterns is of far greater importance. Fortunately, for Chile, we have not only total knob numbers but positions as well for each of the ninteen races included in this report.

Knob determinations were made by Dr. Barbara McClintock for sixteen of these nineteen races. We are most grateful for her kindness in allowing us to use these data. Knob determinations for the remaining three races, Cristalino Norteño, Dentado Comercial and Dulce, were made by Dr. W. L. Brown.

Except for the race Polulo, of which only one collection was available, two to six collections of each race were sampled. The number of plants examined from each collection ranged from one to seven.

As noted in Table 2, each of the highland Chilean corns have strikingly similar chromosome knob patterns. A medium to small knob is *always* present in the long arm of chromosome 7. In addition, chromosome 6 is either knobless or has a small knob at the lower position (position 3) in the long arm. All other chromosomes are knobless. This pattern is a duplicate of that previously shown to be characteristic of all but one of the high altitude races of Bolivia (24). It is clear, therefore, that this pattern, which has previously been termed "Andean" (24), is definitely concentrated in the South American highlands and seemingly had its origin somewhere in this region. The demonstration of a knob pattern typifying highland South American maize should make it possible to use cytology even more effectively in determining the extent of infiltration of maize from one area to another. The occurrance in lowland races, for example, of typically highland knobs would, on the simplest hypothesis, suggest the introgression of germ plasm of the possibly more primitive highland races into varieties of the lowlands.

The highland races of Chilean maize, although differing among themselves, have a number of characteristics in common which distinguish them as a group from those of the lowlands. It is interesting to note that differences between the highland and lowland Chilean races are further reflected in the cytology of the two groups. This, it seems to us, provides considerable support to the validity of classification of these corns, a classification which was made almost entirely prior to the availability of any cytological data.

A majority of the lowland Chilean corns possess the knobs in chromosomes 6 and 7 which are characteristic of the highland races. However, in contrast to the highland races, these knobs when present in the lowland races are frequently in the heterozygous condition. In addition to the knobs in chromosomes 6 and 7 most plants of the lowlands possess additional knobs in other chromosomes. A very small knob is usually present at the terminal position in the short arm of chromosome 9 and at position 2 in the long arm of chromosome 6. In the races Camelia, Curagua, Curagua Grande and Dentado Comercial, chromosome 8 frequently carries a knob in the long arm (Table 3). Also occurring with considerable frequency in the lowland races are knobs in the long arm of chromosomes 2, 4 and 5. Approximately 17% of the plants examined possessed a knob, usually heterozygous, in the long arm of chromosome 1 and among 86 plants examined, 7 had a heterozygous knob in the long arm of choromsome 3.

It is clear, therefore, that in contrast to races of the Chilean highlands where a definite and consistent knob pattern has been shown to occur, no such pattern is evident in the lowland races. This may well indicate that most lowland races are the products of multiple introgression and are still heterozygous and segregating for numerous characteristics, including knobs. The frequent occurrence in most lowland races of knobs characteristic of highland maize suggest the latter to be one of the elements involved in the evolution of the modern races of maize of lowland Chile.

B TYPE CHROMOSOMES

B type chromosomes are present in both the highland and lowland Chilean races. Approximately 20% of the plants examined among highland races contained one or more B type chromosomes whereas almost 40% of the plants from lowland races contained B's. Only five of the highland races included plants containing

B types while among the lowland races all but one included some plants possessing B type chromosomes. This is in direct contrast to the situation in Bolivia where the frequency of B chromosomes in races from high altitudes is considerably higher than those from the lowlands (24).

The maximum number of B type chromosomes encountered in any one plant was 5. This number was present in each of two races, Curagua Grande and Capio Negro Chileno.

DESCRIPTIONS OF RACES

Nineteen provisional races of Chilean maize are recognized in this preliminary report. The descriptions of these, which follow, are brief, primarily because of the difficulty encountered in growing plants for study. However, the descriptions are supplemented by ear photographs, cross section ear diagrams and distribution maps for each of the races. Internode diagrams are also included for those races from the lowlands. Detailed ear data for each of the races are included in tabular form in the Appendix.

Chile, in contrast to Bolivia, Colombia and Peru, contains in addition to typically South American maize, a considerable amount of germ plasm from North America. Among the collections, a few were encountered which were still carrying names common in the United States corn belt a half century ago.

Most of the ear data included in this report are from ears of the original collections and are, therefore, representative of specimens grown in Chile. The plant data, on the other hand, were taken from plants grown either in Mexico or Iowa.

It should be emphasized that our classification of Chilean maize is presented as a preliminary and tentative treatment. It has not been possible for any of the authors to study Chilean maize in its native habitat. Neither have we been able to carry out experiments in inbreeding and crossing—a technic which is of immeasurable value in any critical evaluation of the genetic relationship between races. We, therefore, look upon this study as a first step in our understanding of Chilean maize.

The descriptions of races which follow are arranged roughly according to altitude, from highest to lowest.

MARCAME

Ear Photograph,	Figure 2	Distribution Map,	Figure 4
Ear Diagram,	Figure 3	Tables 2, 6, 7, 8, 9, 10	

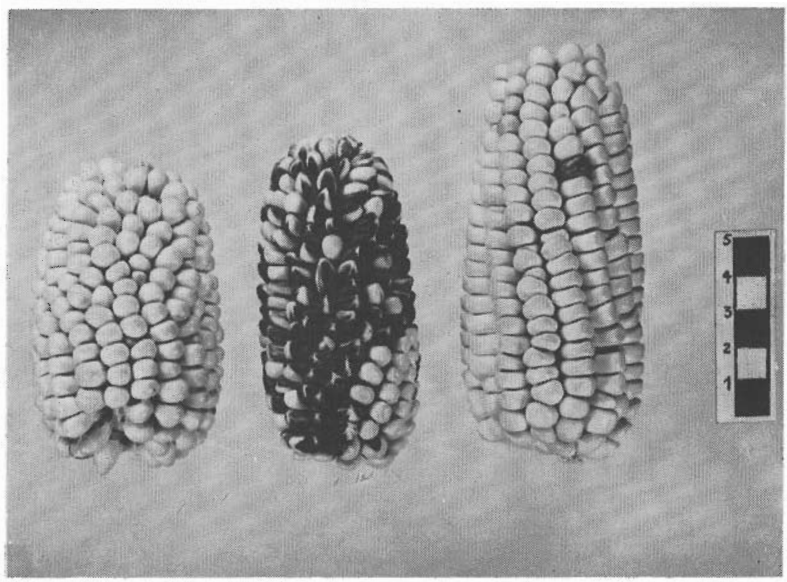


FIG. 2. Representative ears of Marcame.

Altitude 3200 to 3600 meters. Typical collections: Chi. 436, Chi. 439, Chi. 446. Ears short, roundly conical with indefinite rowing. 14 to 16 rows. Kernels roundly tapered. Floury endosperm. No husk compression. Yellow (or blue aleurone), some variegation. Cobs white or red. Ears of similar type are found in the Bolivian and Peruvian collections.

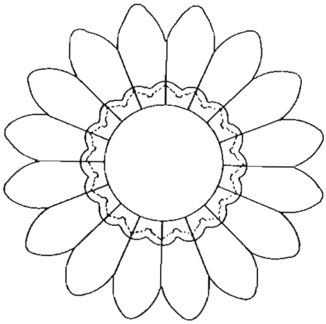


Fig 3. Ear cross-section diagram of Marcame.

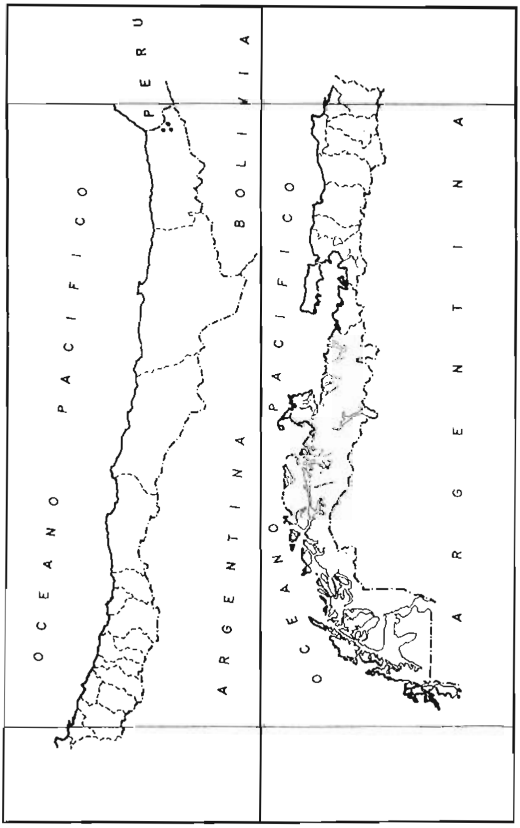


Fig. 4. The distribution of Marcame.

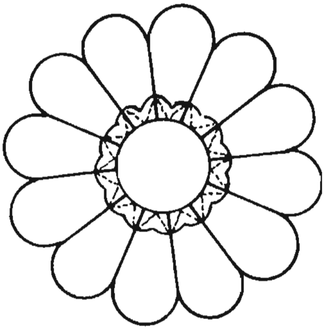


FIG. 6. Ear cross-section diagram of Polulo.

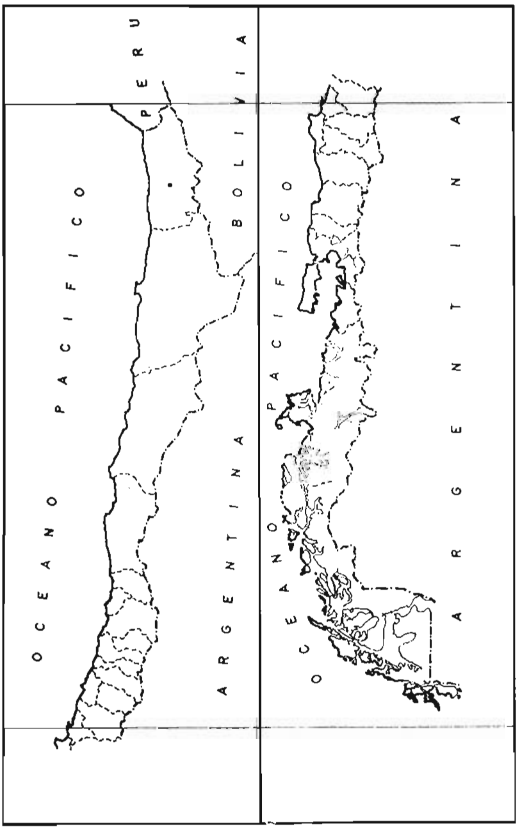


FIG. 7. The distribution of Polulo.

NEGRITO CHILENO

Ear Photograph,	Figure 8	Distribution Map,	Figure 10
Ear Diagram,	Figure 9	Tables 2, 6, 7, 8, 9, 10	

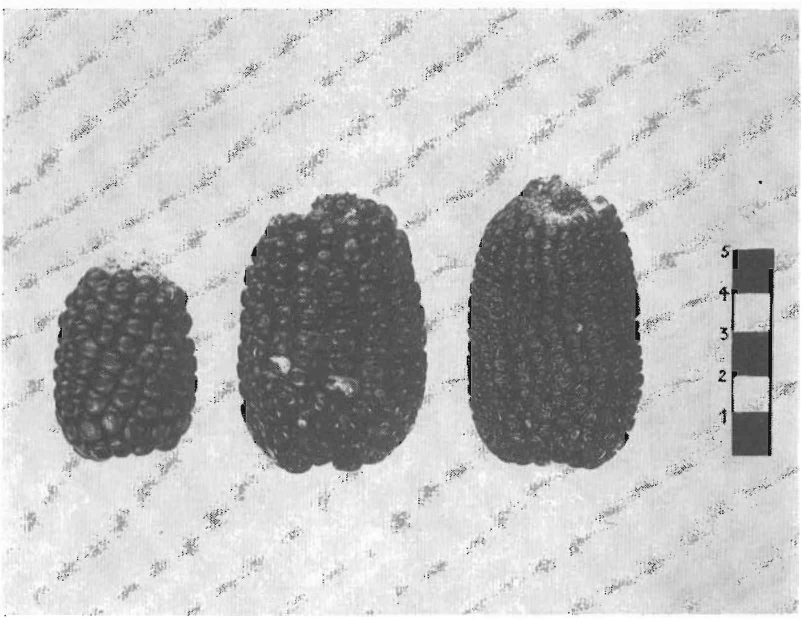


FIG. 8. Representative ears of Negrito Chileno.

Altitude 2260 to 4090 meters. Typical collections: Chi. 371, Chi. 374, Chi. 377, Chi. 388. A uniform and apparently specialized high altitude dye corn. One collection named "negrito medicinal," others carried the local names "azul," "colorado" and "negro." Ears small and rounded. Rows many but indefinite. Kernels short, floury with some denting. Pericarp deep cherry. Cobs red or cherry, a few white. Negrito Chileno appears to be similar to Baraona's race "Kebir." Similar ear types are also found among the collections from Bolivia and Peru.

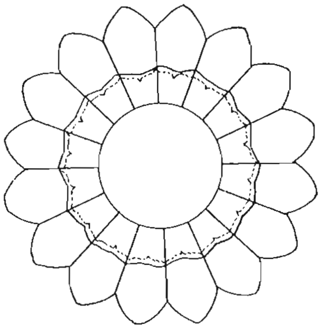


Fig. 9. Ear cross-section diagram of Negrito Shileno.

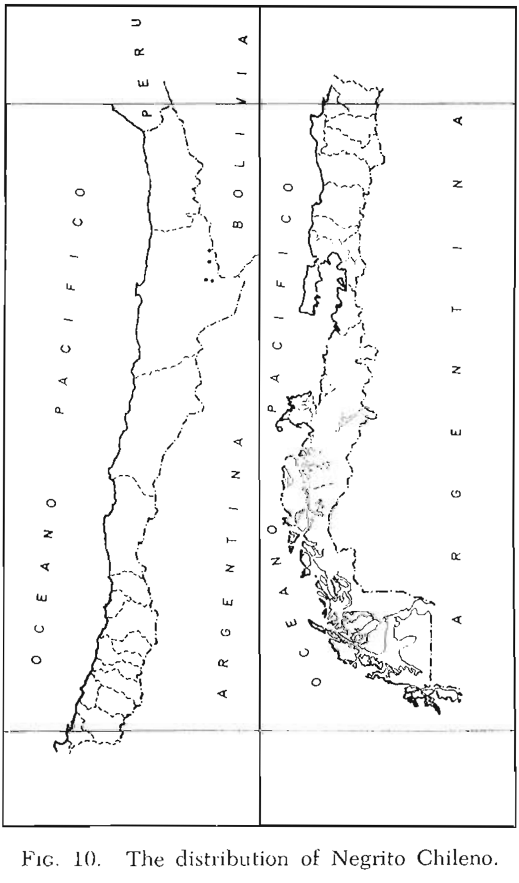


Fig. 10. The distribution of Negrito Chileno.

CHULPI

Ear Photograph,	Figure 11	Distribution Map,	Figure 13
Ear Diagram,	Figure 12	Tables 2, 6, 7, 8, 9, 10	

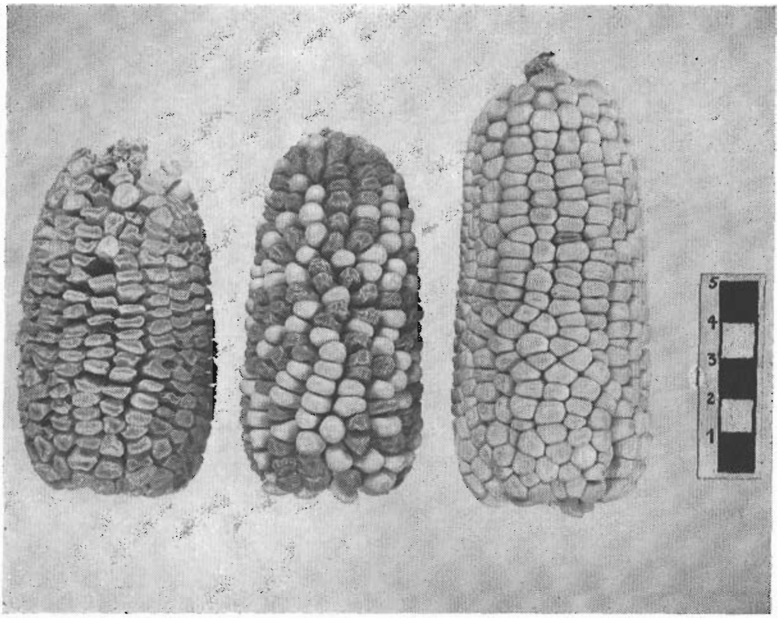


FIG. 11. Representative ears of Chulpi.

Altitude 2260 to 3200 meters. Typical collections: Chi. 385, Chi. 435, Chi 429. Apparently related to *Chuspillu* of Bolivia and similar types from Peru. Less ball-shaped, however, than the Bolivian and Peruvian collections. All collections mixed with floury endosperm and varying in ear shape and kernel size. Short, rounded conical ears. Kernel long, sugary, floury, some with soft dent. Yellow or pale yellow endosperm. White cobs. Mean row number 17.4.

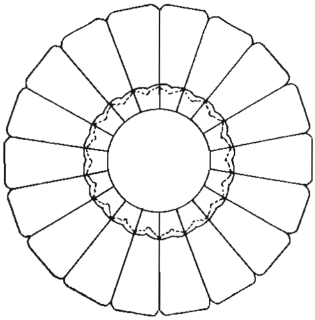


FIG. 12. Ear cross-section diagram of Chulpi.

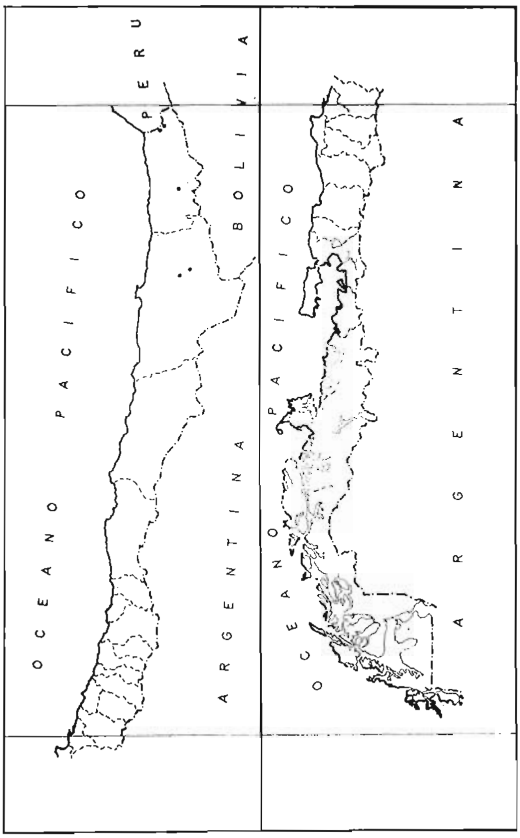


FIG. 13. The distribution of Chulpi.

CAPIO CHICO CHILENO

Ear Photograph,	Figure 14	Distribution Map,	Figure 16
Ear Diagram,	Figure 15	Tables 2, 6, 7, 8, 9, 10	

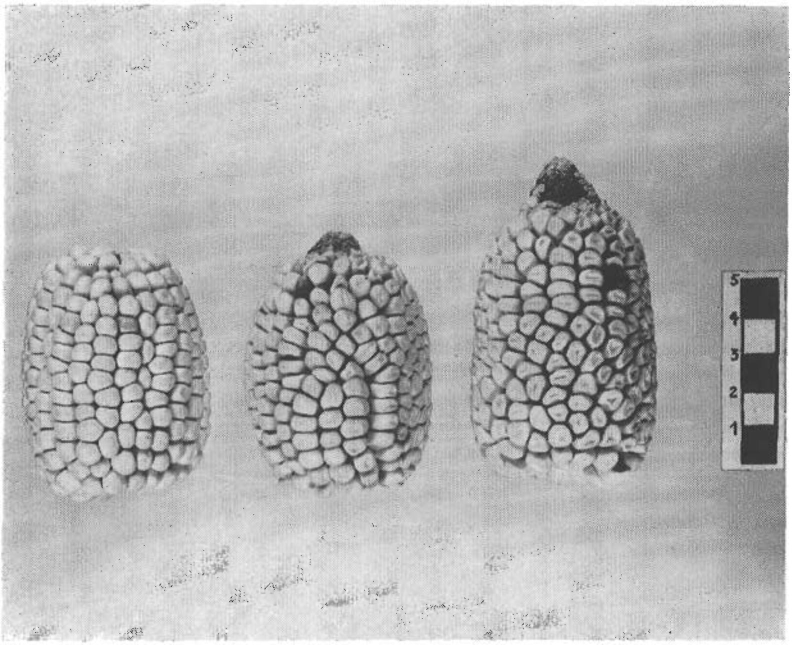


FIG. 14. Representative ears of Capio Chico Chileno.

Altitude approximately 2260 to 2500 meters. Typical collections: Chi. 389, Chi. 373, Chi. 380, Chi. 383#, Chi. 382#. Ears small, rounded to conical. Strong husk compression. Endosperm white or yellow. Occasional red pericarp. Kernels floury or slightly dented. Sixteen to 22 rows. Rowing frequently indistinct. Cobs white. This race is not to be confused with *Capio* of Colombia, a very different kind of corn. The name Capio is of Quechuan origin and means soft, floury maize. Baraona's group No. 7, Blanco, is probably of this race. So far as we know it is not duplicated among other South American collections.

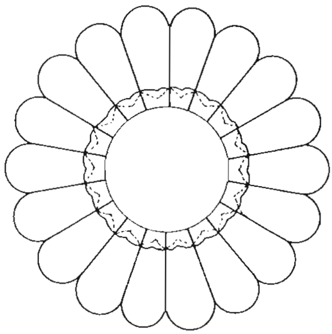


Fig. 15. Ear cross-section diagram of Capio Chico Chileno.

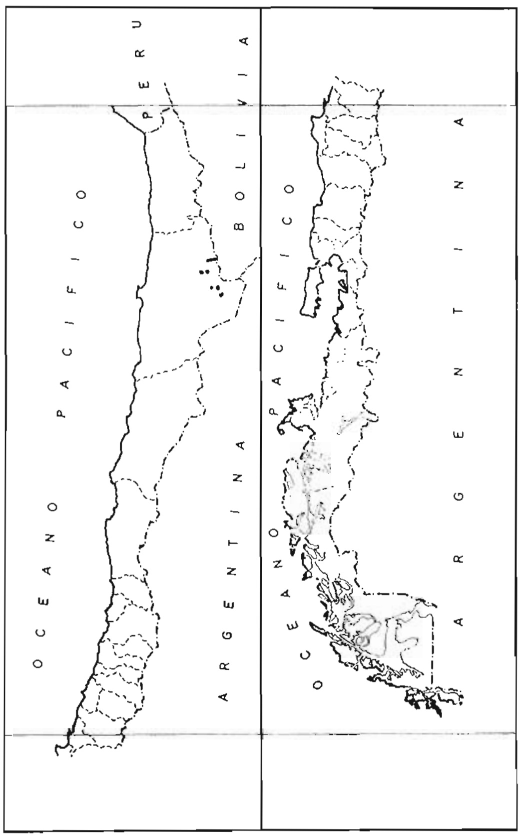


Fig. 16. The distribution of Capio Chico Chileno.

CAPIO GRANDE CHILENO

Ear Photograph,	Figure 17	Distribution Map,	Figure 19
Ear Diagram,	Figure 18	Tables 2, 6, 7, 8, 9, 10	

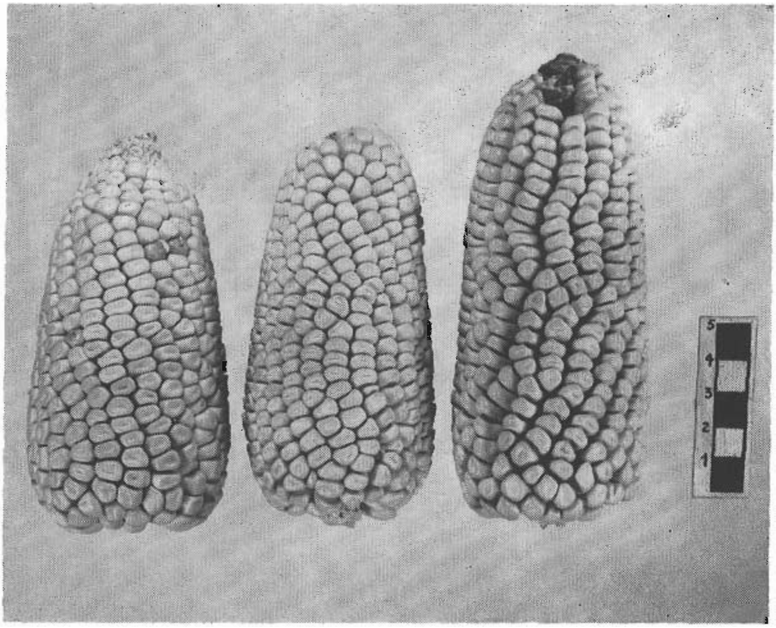


FIG. 17. Representative ears of Capio Grande Chileno.

Altitude 2260 to 2600 meters. Typical collections: Chi. 362, Chi. 356, Chi. 396, Chi. 358#, Chi. 378#. This race grades into *Capio Chico Chileno* to which it is closely related. Ears are longer and more tapered than are those of *C. Chico Chileno.* Also has larger cobs and more distinct rowing. Mostly 16 rowed. Cobs usually white. Yellow endosperm, floury or slightly dented. Locally referred to as amarillo, capio, capio blanco, capio overo, capio rosado, choclero blanco and bisiseño. Baraona's No. 3 appears to be similar to this race.

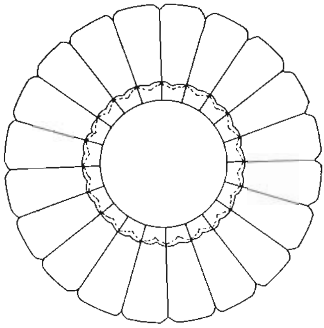


FIG. 18. Ear cross-section diagram of Capio Grande Chileno.

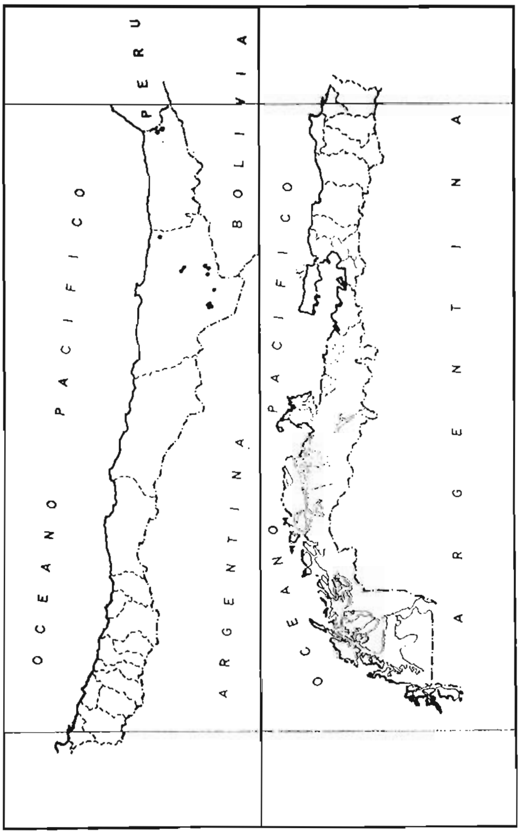


FIG. 19. The distribution of Capio Grande Chileno.

CAPIO NEGRO CHILENO

Ear Photograph,	Figure 20	Distribution Map,	Figure 22
Ear Diagram,	Figure 21	Tables 2, 6, 7, 8, 9, 10	

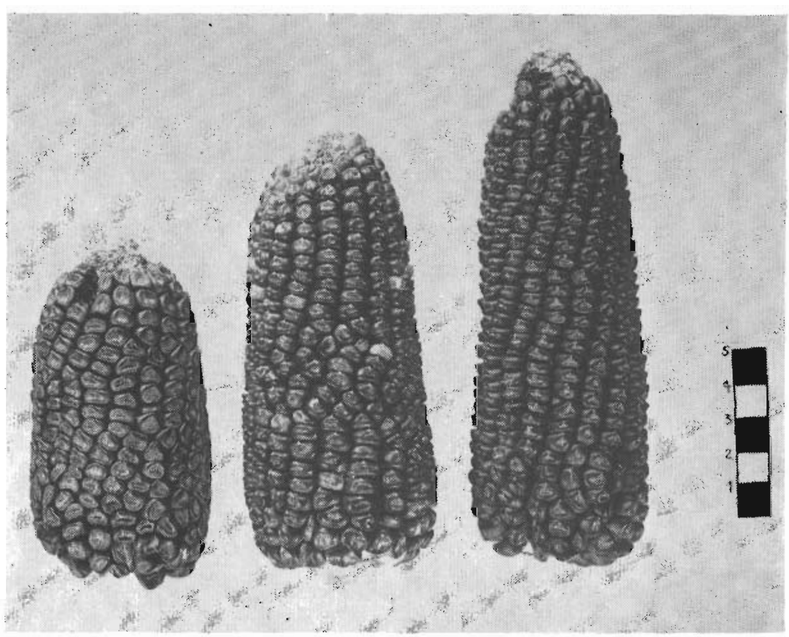


FIG. 20. Representative ears of Capio Negro Chileno.

Altitude about 2500 meters. Typical Collections: Chi. 359, Chi. 406. Ears somewhat longer and larger than the two previous Capios. Ears tapered. Rows 16 to 20 and distinct. Most kernels dented and slightly pointed. Blue aleurone. Cobs white or red. Frequently referred to by the local name "negro overo."

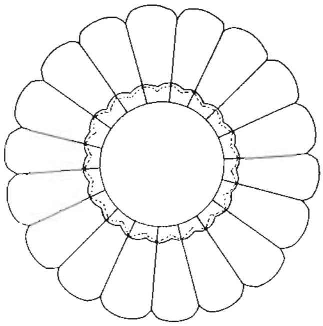


FIG. 21. Ear cross-section diagram of Capio Negro Chileno.

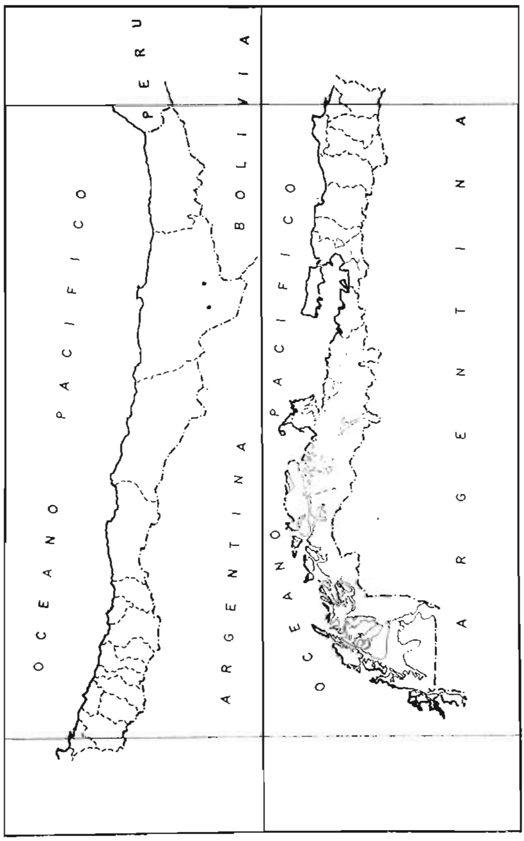


FIG. 22. The distribution of Capio Negro Chileno.

CHUTUCUNO CHICO

Ear Photograph,	Figure 23	Distribution Map,	Figure 25
Ear Diagram,	Figure 24	Tables 2, 6, 7, 8, 9, 10	

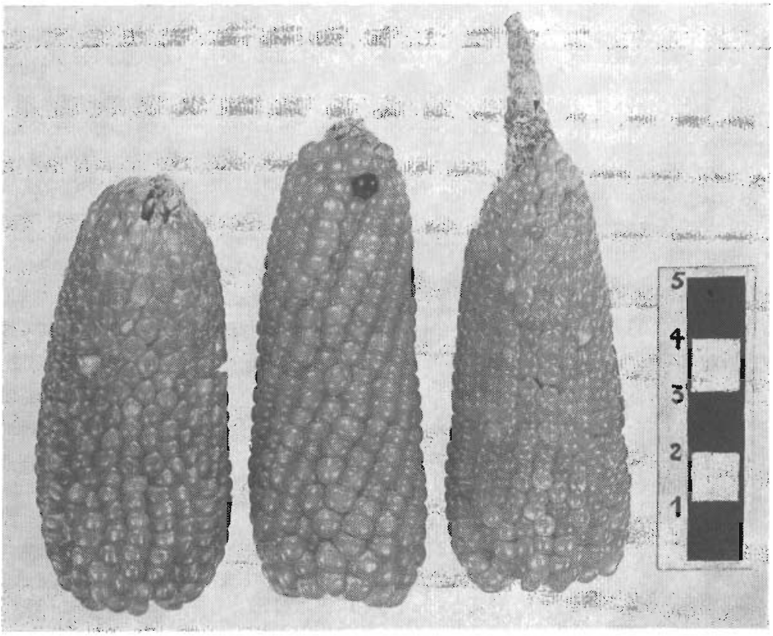


FIG. 23. Representative ears of Chutucuno Chico.

Altitude approximately 2260 to 2500 meters. Typical collections: Chi. 376, Chi. 390, Chi. 381, Chi. 360#, Chi. 391#. Small yellow popcorns with proportionately large cobs. Ears tightly packed with kernels and rounded at butt. Kernels more or less hexagonal; rowing indistinct, approximately 16 to 22 or more. Kernels longer than wide. Three of the samples show mixing with pointed kernels and red cobs. The others have rounded kernels on white cobs. Three of the samples (typicos) uniform both within and between collections. Several (3-4) ears per plant. Leaves with slight central channel. Short internodes (seldom more than 11 c.m.). Rachis flaps indistinct. Pedicels massive. Terminal internode (below tassel) usually shorter than longest internodes preceding it. Plant color slight and variable. The name "Chutucuno" is probably of Quechuan origin. *Chutu* usually refers to peaks or rocky mountains. *Cuna* or *cuno* is best translated as our article *the.*

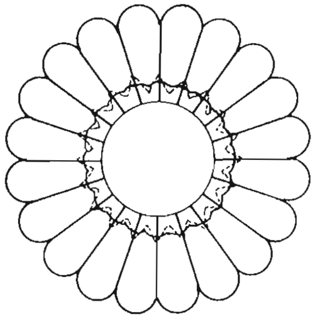


FIG. 24. Ear cross-section diagram of Chutucuno Chico.

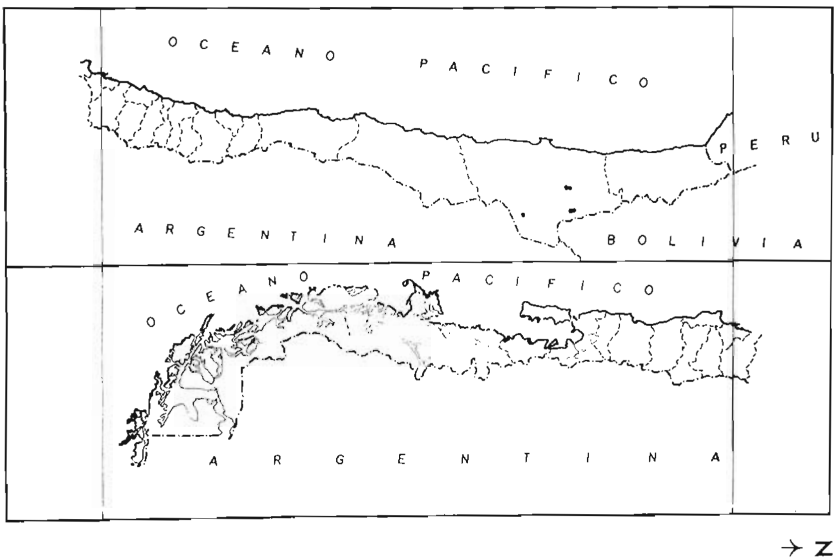


FIG. 25. The distribution of Chutucuno Chico.

CHUTUCUNO GRANDE

Ear Photograph,	Figure 26	Distribution Map,	Figure 28
Ear Diagram,	Figure 27	Tables 2, 6, 7, 8, 9, 10	

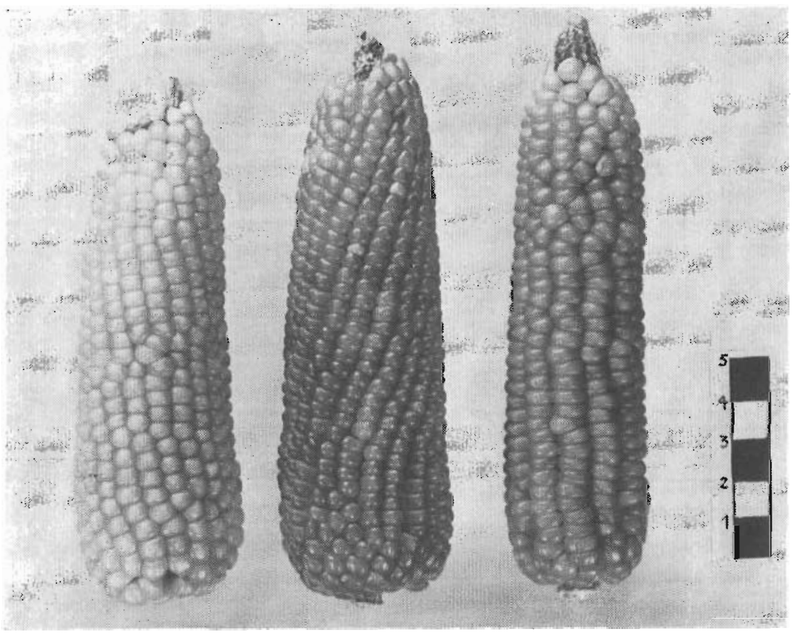


FIG. 26. Representative ears of Chutucuno Grande.

Altitude 2260 to 2500 meters. Typical collections: Chi. 355, Chi. 361, Chi. 394. Includes obvious intermediates between *Chutucuno Grande* and other Chilean varieties. Small kerneled flints varying in row number from 12 to 18 or more. Mostly yellow endosperm. Cylindrical to tapered. Some kernels round at the top, others more or less pointed. Strong husk compression in some ears. Some of the collections of Chutucuno Grande were received under the names "Morado" and "Pisankalla." The name Chutucuno was chosen to avoid confusion with the races *Morado* and *Pisankalla* described from Bolivia (24).

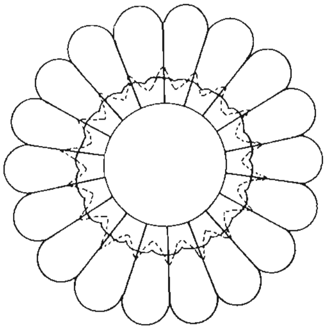


FIG. 27. Ear cross-section diagram of Chutucuno Grande.

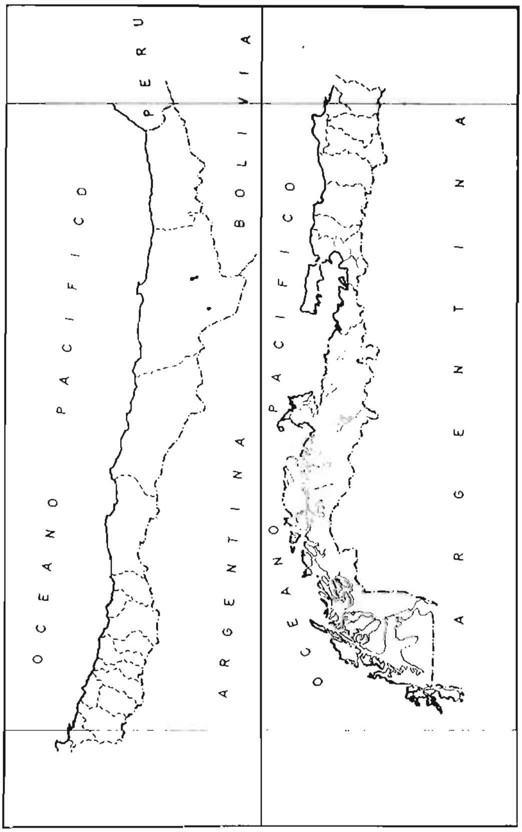


FIG. 28. The distribution of Chutucuno Grande.

HARINOSO TARAPAQUEÑO

Ear Photograph,	Figure 29	Internode Diagram,	Figure 31
Ear Diagram,	Figure 30	Distribution Map,	Figure 32

Tables 2, 4, 5, 6, 7, 8, 9, 10

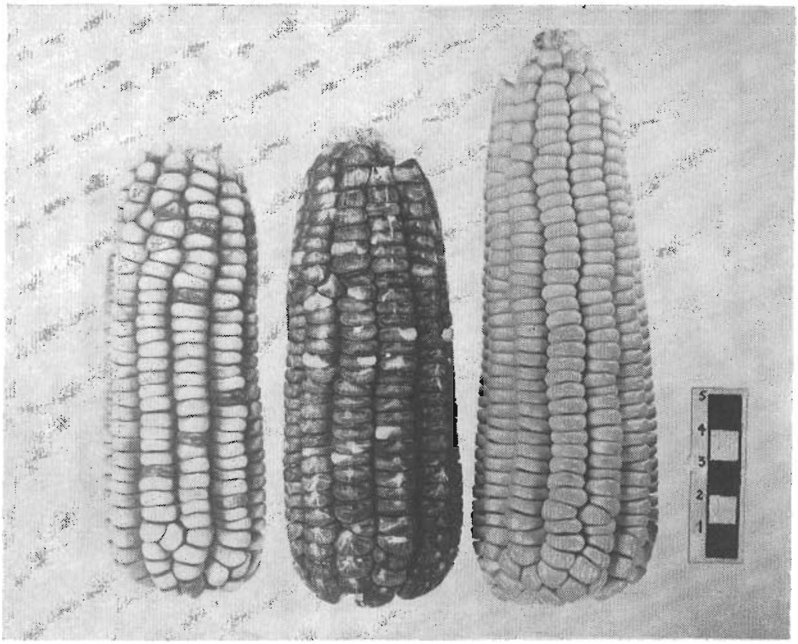


FIG. 29. Representative ears of Harinoso Tarapaqueño.

Altitude 800 to 1500 meters. Typical collections: Chi. 419, Chi. 428, Chi. 430, Chi. 421#, Chi. 418#. Ears of medium length, gently tapering. Kernels wide, with floury endosperm; more or less wedge shaped. Some ears with slightly dented kernels, others pointed. Row numbers 12 to 16. Kernels yellow, blue or variegated. Cobs white or red. Name refers to flour corn from Tarapaca.

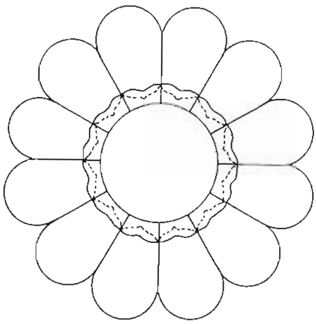


FIG. 30. Ear cross-section diagram of Harinoso Tarapaqueño.

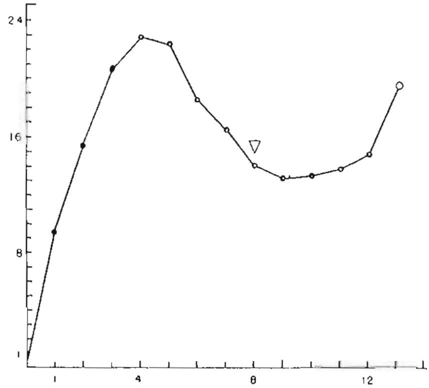


FIG. 31. Internode pattern of Harinoso Tarapaqueño.

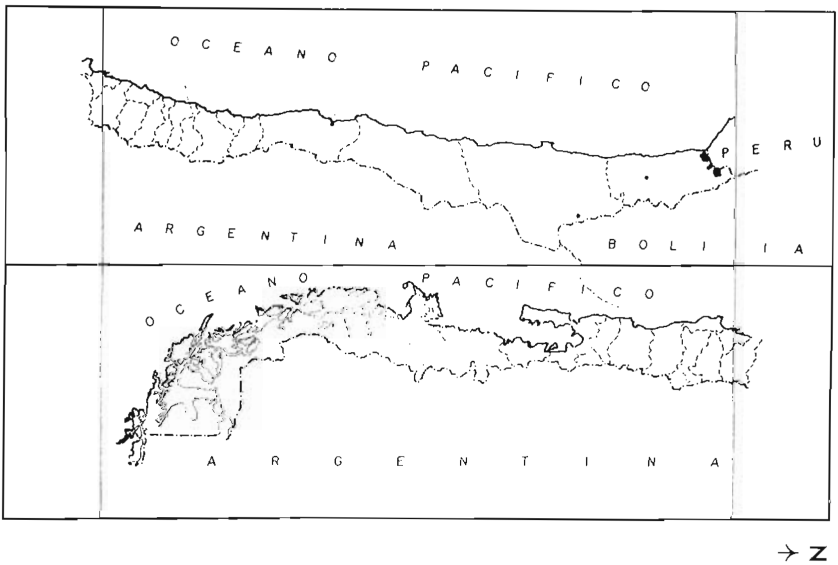


FIG. 32. The distribution of Harinoso Tarapaqueño.

CHOCLERO

Ear Photograph,	Figure 33	Internode Diagram,	Figure 35
Ear Diagram,	Figure 34	Distribution Map,	Figure 36

Tables 3, 4, 5, 6, 7, 8, 9, 10

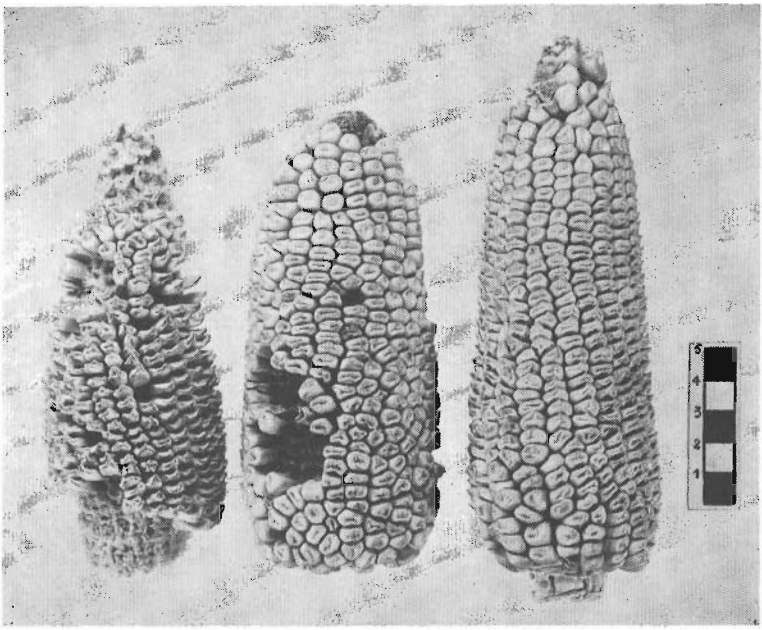


FIG. 33. Representative ears of Choclero.

Altitude 58 to 600 meters. Typical collections: Chi. 405, Chi. 306, Chi. 312. A strongly tapering, rough dent. Uniform within samples; varying in taper and depth of color between samples. Yellow endosperm. No pericarp or aleurone color. Kernels pointed and somewhat beaked in some ears. Twenty or more rows. Plants short with few tillers. Sun red culms. Sheaths loose and bulging. Internodes inserted. Tassels exhibit high degree of condensation and many are pyramidal in shape. Plants very susceptible to root lodging. "Choclero" refers to a corn used for its "choclos" or green roasting ears. *Choclero* is probably the result of the introgression of dent germ plasm from the United States into a conical eared South American corn.

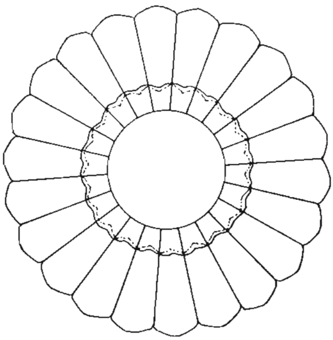


FIG. 34. Ear cross-section diagram of Choclero.

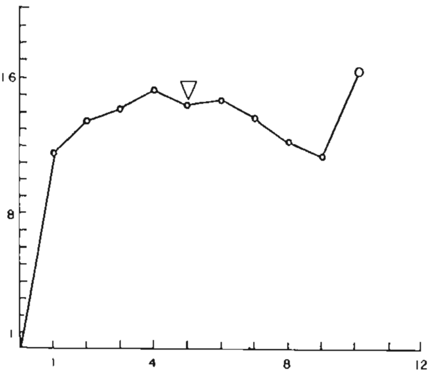


FIG. 35. Internode pattern of Choclero.

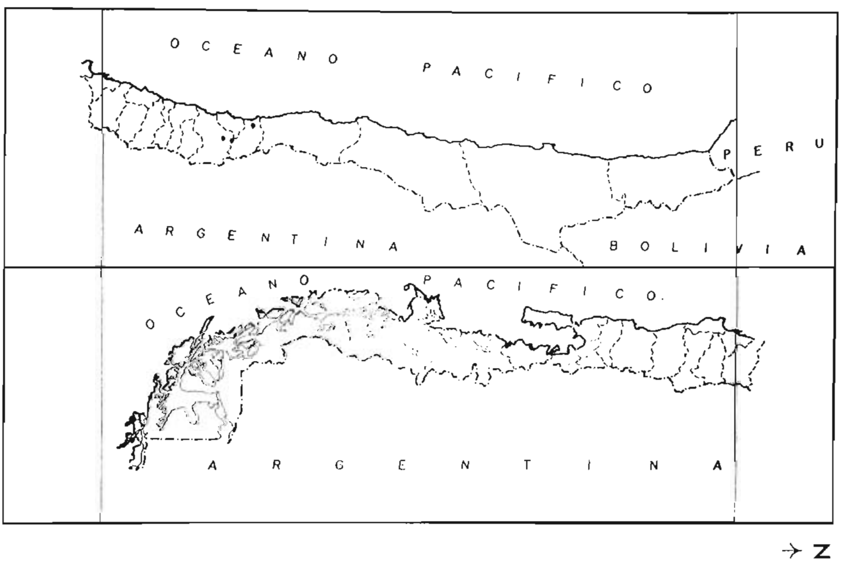


FIG. 36. The distribution of Choclero.

CAMELIA

Ear Photograph,	Figure 37	Internode Diagram,	Figure 39
Ear Diagram,	Figure 38	Distribution Map,	Figure 40

Tables 3, 4, 5, 6, 7, 8, 9, 10

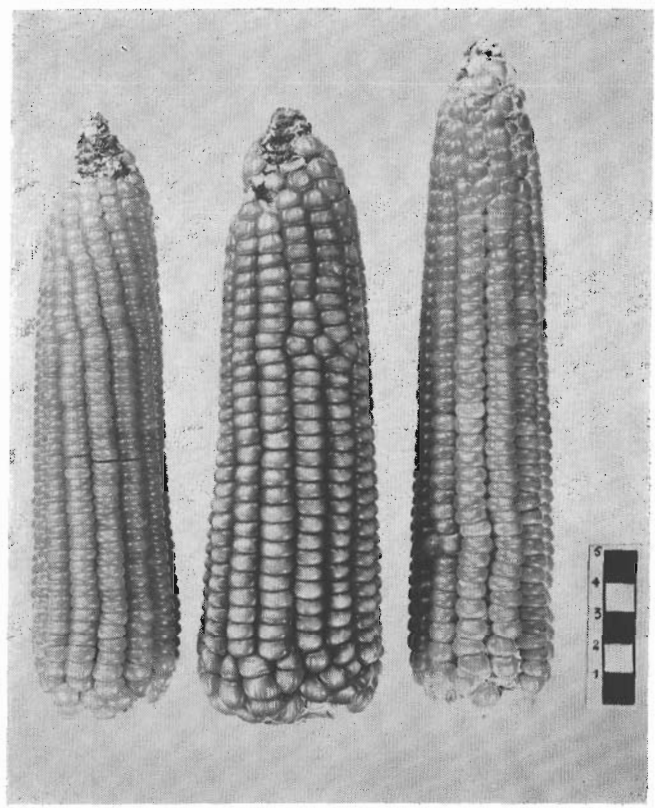


FIG. 37. Representative ears of Camelia.

Altitude 338 to 606 meters. Typical collections: Chi. 404, Chi. 411, Chi. 417#, Chi. 395#. Ears of medium length with gentle, even taper; 14 to 16 rows. Kernels rounded, in straight, even rows; flinty; bright orange yellow in color. Cobs white. Pericarp and aleurone colorless. Plants of medium height. Very few tillers.

Medium to dark green color. Ears placed high on plant. Sheaths tight. Some plants with upright tassel branches, others gently curved. This is apparently a highly selected commercial variety. It resembles very closely the deep orange flints of Argentina and parts of Venezuela (8).

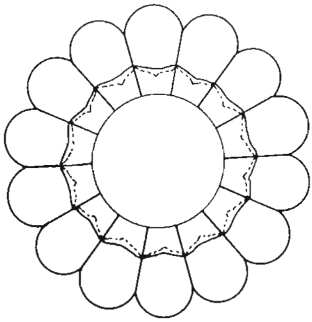


FIG. 38. Ear cross-section diagram of Camelia.

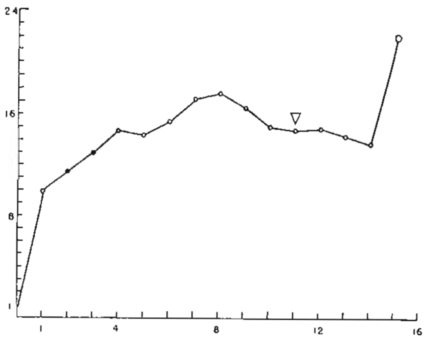


FIG. 39. Internode pattern of Camelia.

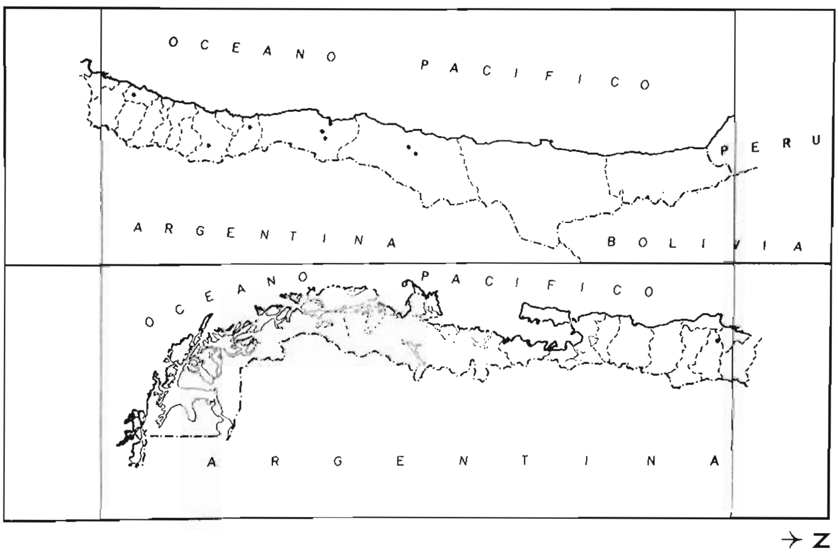


FIG. 40. The distribution of Camelia.

CURAGUA

Ear Photograph,	Figure 41	Internode Diagram,	Figure 43
Ear Diagram,	Figure 42	Distribution Map,	Figure 44

Tables 3, 4, 5, 6, 7, 8, 9, 10

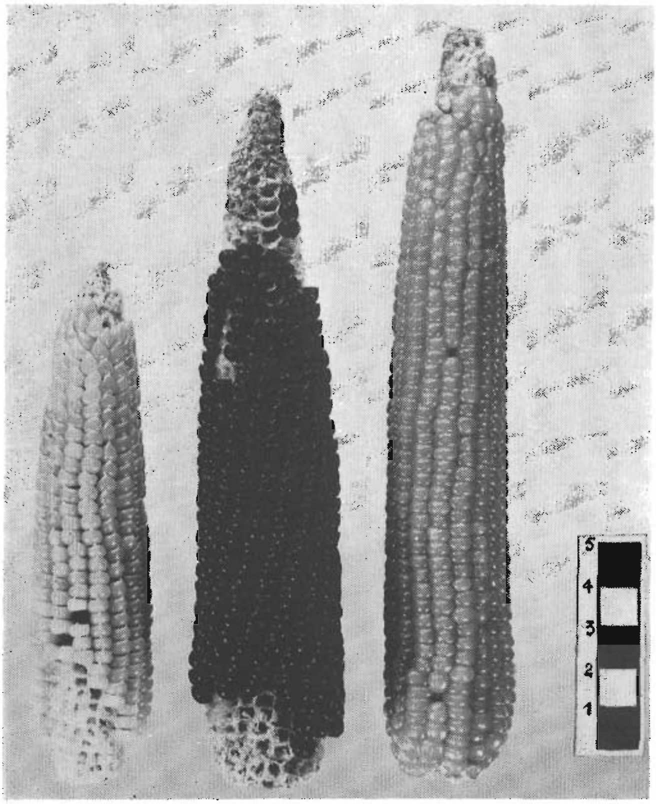


FIG. 41. Representative ears of Curagua.

Altitude 500 to 800 meters. Typical collections: Chi. 301, Chi. 311, Chi. 314, Chi. 316#. Small kerneled, long eared popcorns with strong resemblances to *Pira* of Colombia and *Pororo* of Bolivia. Kernels round or pointed, white or yellow endosperm, red pericarp frequent. Row numbers variable, from 14 to 18 or more. Mostly white cobs. Plants 6 to 7 feet in height. Medium low ears. Medium loose sheaths. Some tassel condensation. Curagua also spelled *curahua* which means cura (rock), hua (maize) in Araucanian.

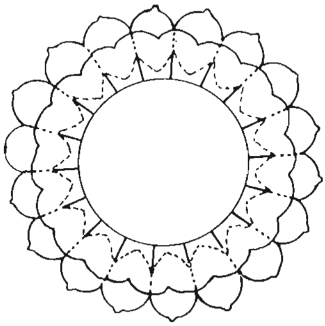


FIG. 42. Ear cross-section diagram of Curagua.

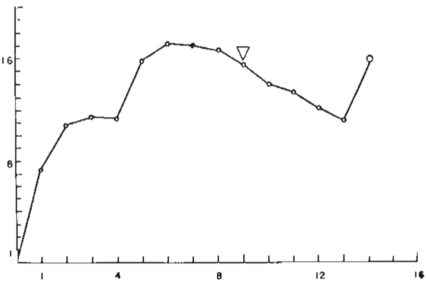


FIG. 43. Internode pattern of Curagua.

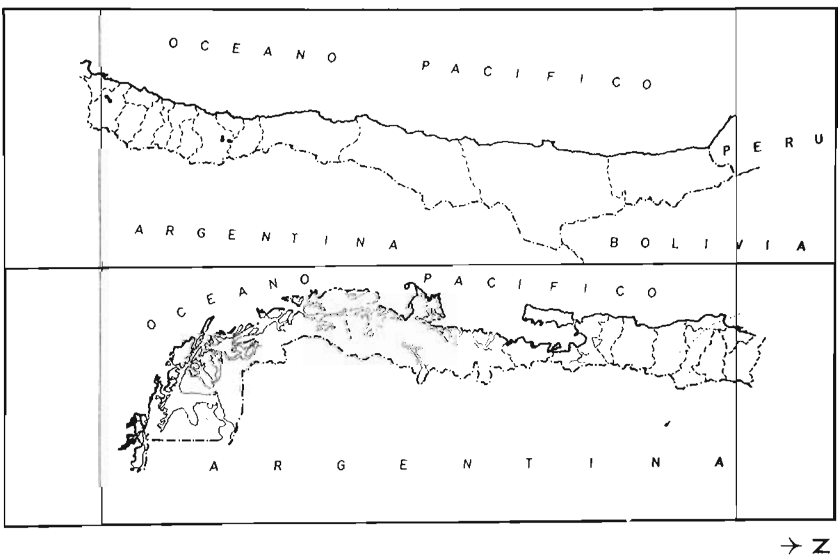


FIG. 44. The distribution of Curagua.

CURAGUA GRANDE

Ear Photograph,	Figure 45	Internode Diagram,	Figure 47
Ear Diagram,	Figure 46	Distribution Map,	Figure 48

Tables 3, 4, 5, 6, 7, 8, 9, 10

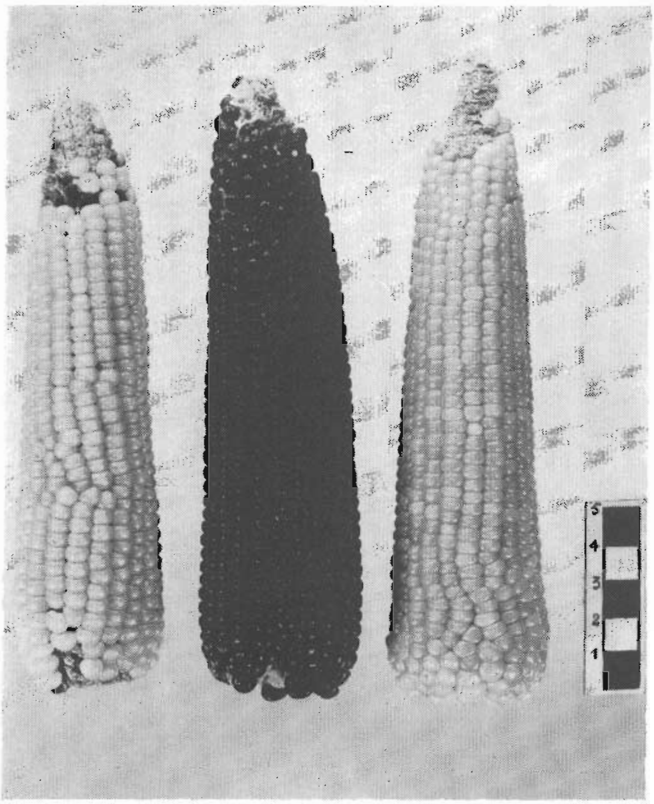


FIG. 45. Representative ears of Curagua Grande.

Altitude 450 to 500 meters. Typical collections: Chi. 315, Chi. 310, Chi. 303#, Chi. 305#. The collections are uniform and intermediate between *Curagua* and *Cristalino Chileno*. It is not unlikely that Curagua Grande is the result of hybridization between these two races. Ears medium long, tapered. Flinty endosperm, yellow or white. Some red pericarp. Sixteen to 18 rows. Plants of medium height and with many tillers. Many plants with two well developed ears. Tassels variable, some with many, others with few branches. Branched area of tassel long in comparison with central spike. Culm internodes above ear short and condensed. Some plants exhibit considerable purple plant color. Somewhat pubescent leaf sheaths. No flag leaves. Quite susceptible to *Helminthosporium turcicum.*

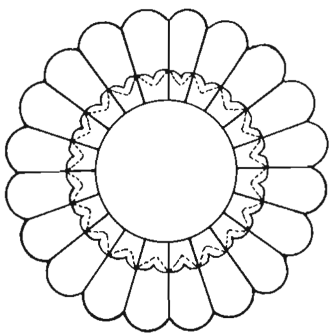


FIG. 46. Ear cross-section diagram of Curagua Grande.

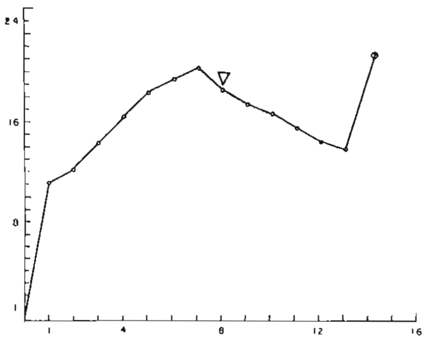


FIG. 47. Internode pattern of Curagua Grande.

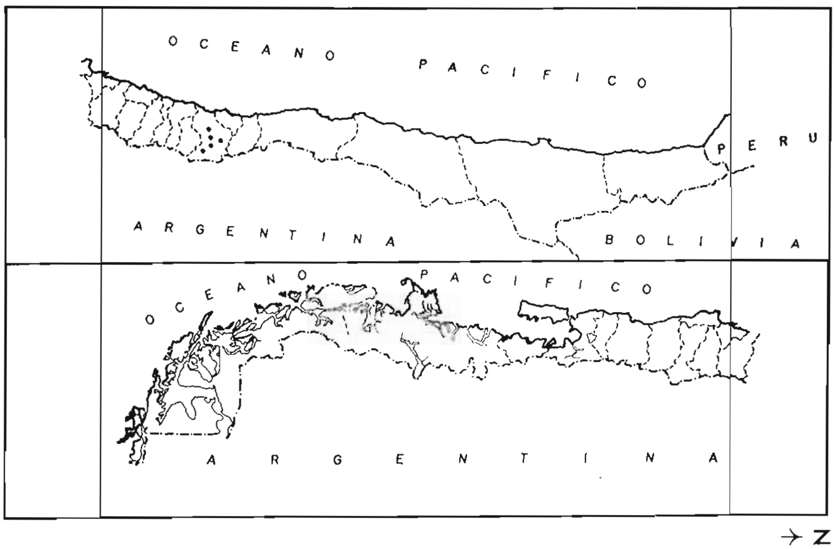


FIG. 48. The distribution of Curagua Grande.

CRISTALINO CHILENO

Ear Photograph,	Figure 49	Internode Diagram,	Figure 51
Ear Diagram,	Figure 50	Distribution Map,	Figure 52

Tables 3, 4, 5, 6, 7, 8, 9, 10

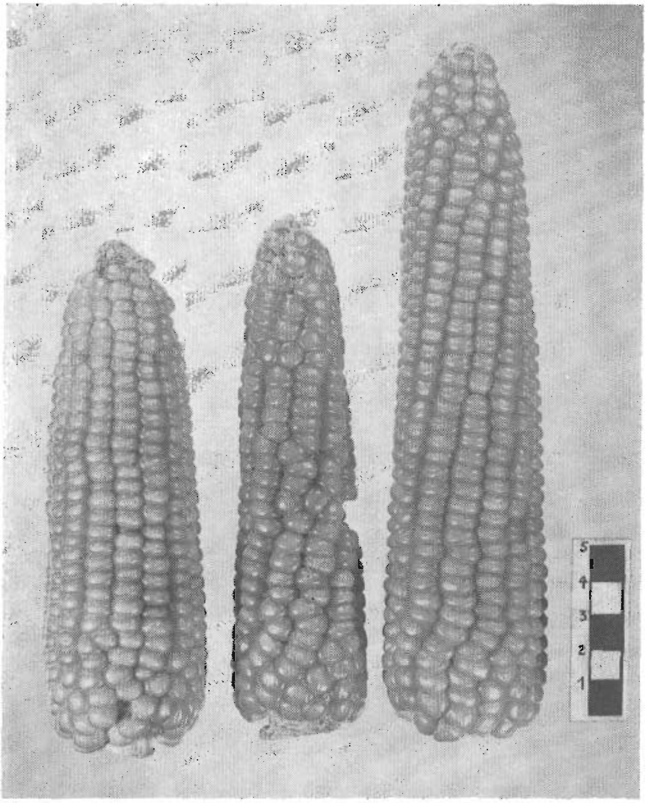


FIG. 49. Representative ears of Cristalino Chileno.

Altitude 50 to 120 meters. Typical collections: Chi. 334, Chi. 437. Ears long with even taper. Prevailing 16 rows. Kernels flinty with some capping but no denting. Endosperm light yellow in color. Pericarp and aleurone colorless. Cobs white. Plants medium short in height. Few tillers. Tassels thin, highly branched. Primarily branches long and drooping. Leaves dark green. Slight sun red color in leaf sheaths. Sheaths frequently longer than culm internode. Susceptible to *Helminthosporium turcicum* when grown in Iowa.

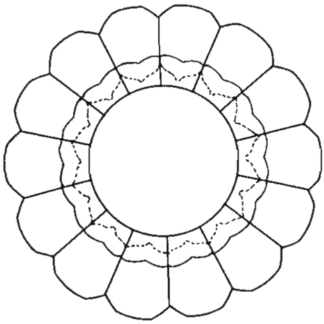


FIG. 50. Ear cross-section diagram of Cristalino Chileno.

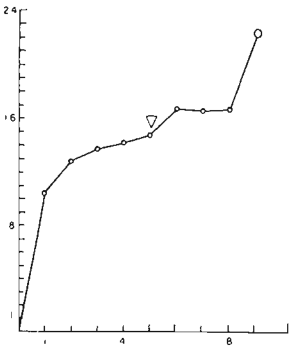


FIG. 51. Internode pattern of Cristalino Chileno.

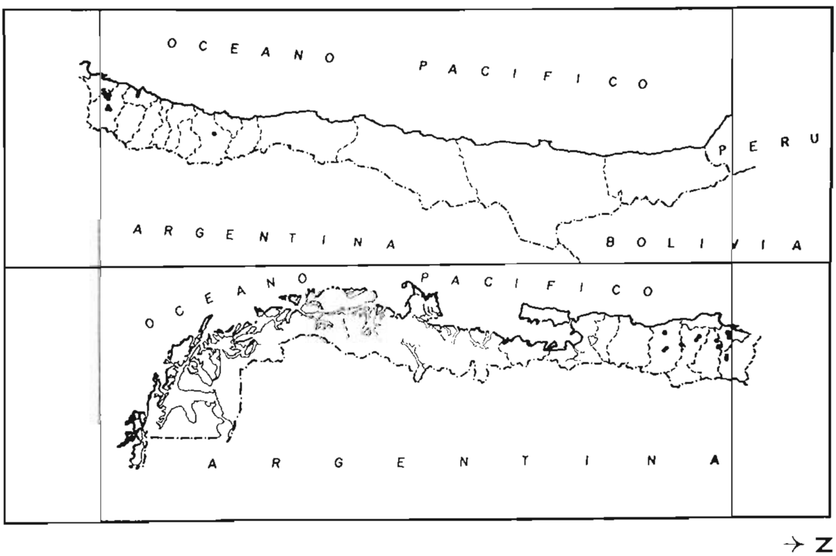


FIG. 52. The distribution of Cristalino Chileno.

DENTADO COMERCIAL

Ear Photograph,	Figure 53	Internode Diagram,	Figure 55
Ear Diagram,	Figure 54	Distribution Map,	Figure 56

Tables 3, 4, 5, 6, 7, 8, 9, 10

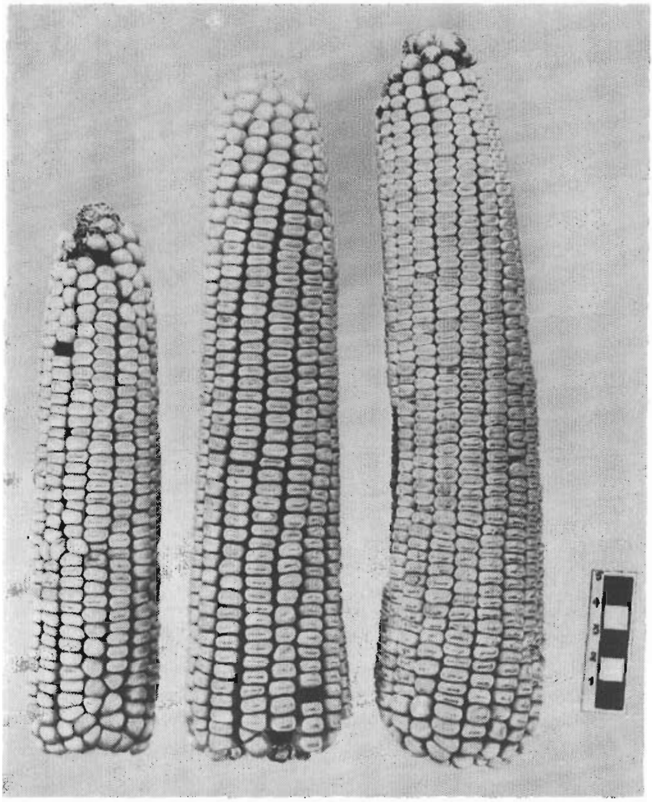


FIG. 53. Representative ears of Dentado Comercial.

Altitude approximately 70 meters. Typical collections: Chi. 416, Chi. 412, Chi. 448#, Chi. 326#. Ears long, cylindrical to slightly tapered. 14 to 18 rows of well dented kernels. Yellow endosperm. Pericarp and aleurone colorless. Tassels with few to many branches. The primary branches more or less horizontal to main axis. Plants 7 to 9 feet in height. Medium to dark green. Leaves of medium width with long graceful curve. Few tillers. Predominately single eared. Most shanks relatively long and curved outward. This race is an introduction of United States Yellow Dent corn but which during its interim in Chile has apparently picked up small amounts of Chilean germ plasm. One of the collections was still carrying a name which was common to the United States corn belt a quarter of a century ago.

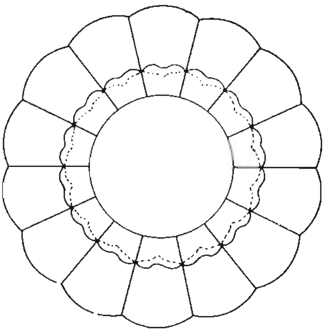


Fig. 54. Ear cross-section diagram of Dentado Comercial.

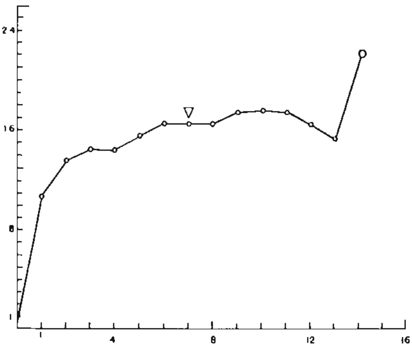


Fig. 55. Internode pattern of Dentado Comercial.

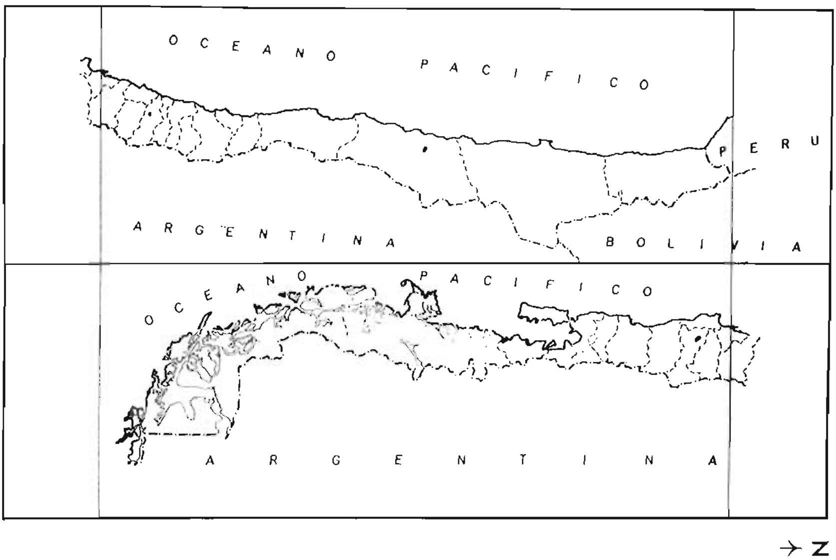


Fig. 56. The distribution of Dentado Comercial.

ARAUCANO

Ear Photograph,	Figure 57	Internode Diagram,	Figure 59
Ear Diagram,	Figure 58	Distribution Map,	Figure 60

Tables 3, 4, 5, 6, 7, 8, 9, 10

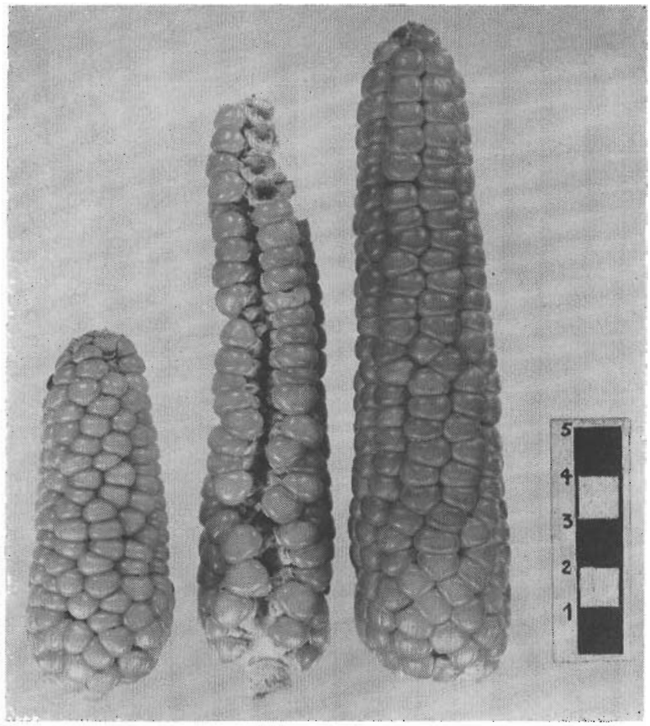


FIG. 57. Representative ears of Araucano.

Altitude 50 to 150 meters. Typical collections: Chi. 345, Chi. 354, Chi. 320#, Chi. 325#. Primitive (or degenerate) small yellow flints. Row numbers range from 4, among smaller ears, to about 12. Stiff, slender cobs, usually white. Plants short with slight purple anthocyanin coloration. Several tillers. Low ear placement. Many plants with two to three ears. Long flag leaves. Tassels possess few thin, wiry branches, well exserted. The ear and plant appearance of Araucano resembles very closely the early maturing flint and flour corns of the United States Great Plains. The collections of Araucano were received under a host of names such as "Andiano," "Mapuchano," "Curahuilla," etc.

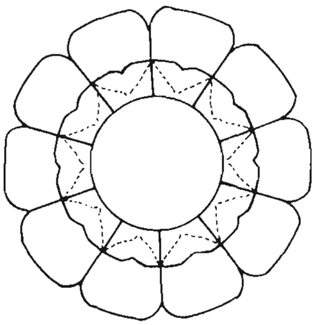


Fig. 58. Ear cross-section diagram of Araucano.

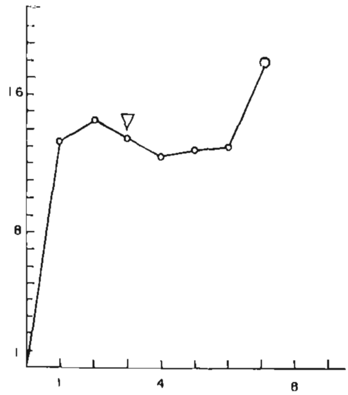


Fig. 59. Internode pattern of Araucano.

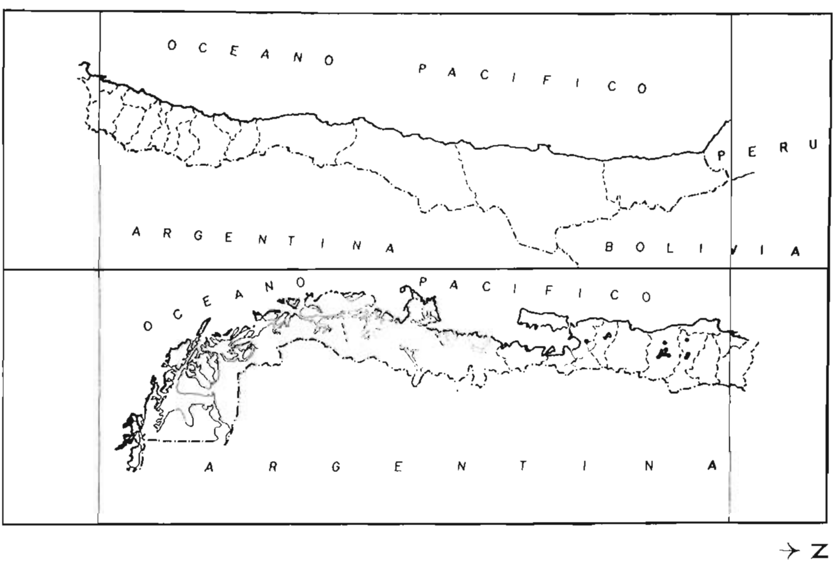


Fig. 60. The distribution of Araucano.

CRISTALINO NORTEÑO

Ear Photograph,	Figure 61	Internode Diagram,	Figure 63
Ear Diagram,	Figure 62	Distribution Map,	Figure 64

Tables 3, 4, 5, 6, 7, 8, 9, 10

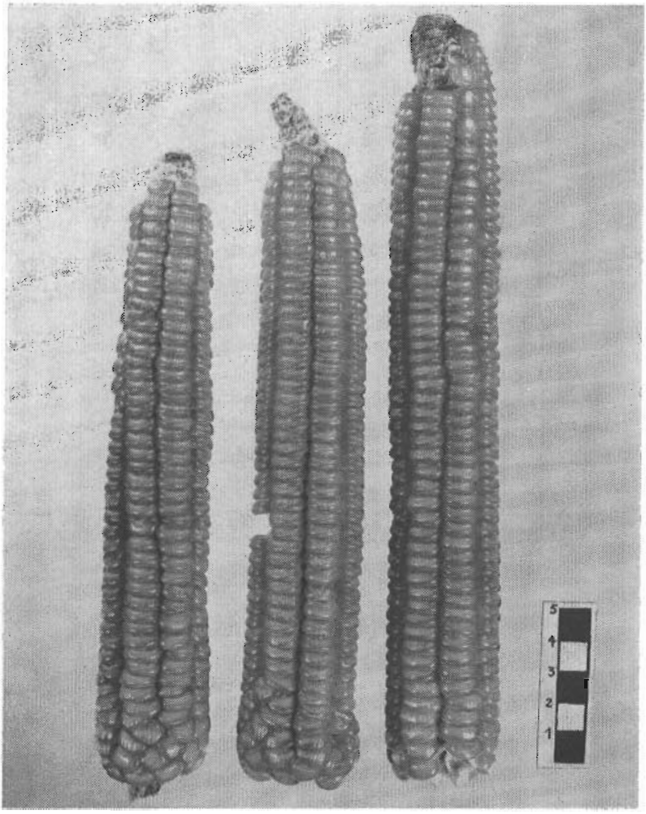


FIG. 61. Representative ears of Cristalino Norteño.

Altitude 8 to 72 meters. Typical collections: Chi. 338; Chi. 349. Ears long, cylindrical with slightly enlarged butts. Kernels flinty, short, very wide and crescent shaped. Typical ears have 8 rows of kernels. Yellow endosperm. Pericarp and aleurone colorless. Tassels well exserted, with long, slender and relatively few primary branches. Plants highly tillered, of medium height. Leaves narrow and light green in color. Ears placed low on the plant and with conspicuous husk leaf blades (flag leaves). This race is typical of the 8-10 rowed flints of northeastern United States and it is assumed it reached Chile from North America. Since the race is hardly distinguishable either in plant or ear characters, from New England Flints being grown in North America today, it apparently has not been altered through hybridization with other races of Chilean maize.

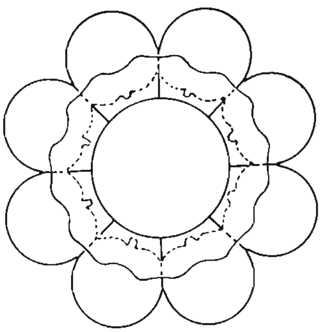


FIG. 62. Ear cross-section diagram of Cristalino Norteño.

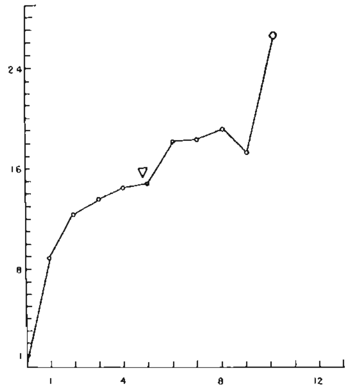


FIG. 63. Internode pattern of Cristalino Norteño.

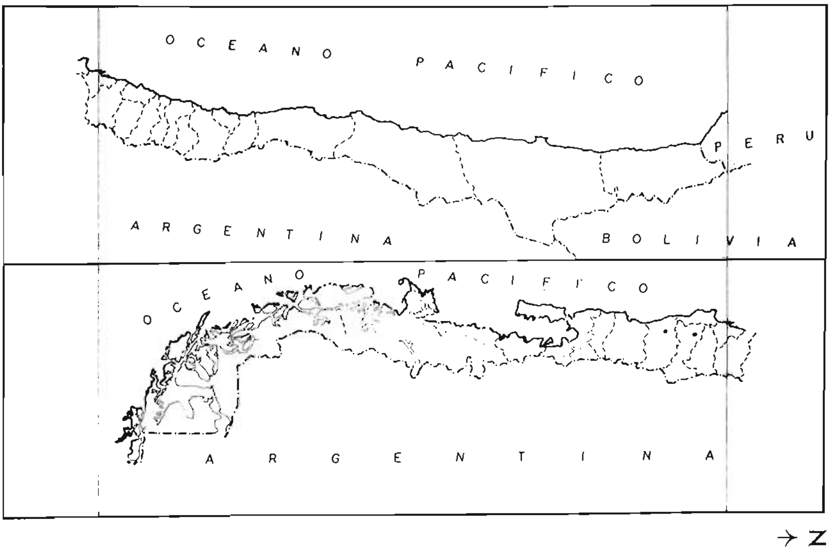


FIG. 64. Distribution of Cristalino Norteño.

DULCE

Ear Photograph,	Figure 65	Internode Diagrams,	Figure 67, 67a
Ear Diagram,	Figure 66, 66a	Distribution Map,	Figure 68

Tables 3, 4, 5, 6, 7, 8, 9, 10

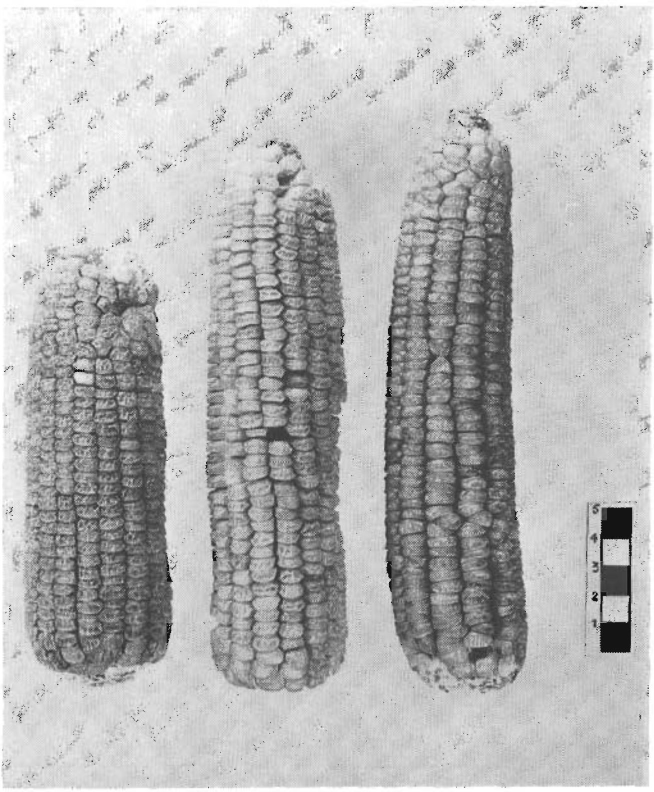


FIG. 65. Representative ears of Dulce.

Altitude approximately 70 meters. Typical collections (Evergreen): Chi. 332, (Gol. Bantam): Chi. 335, Chi. 339. Among the Chilean collections there are two distinct types of sweet corn both of which were probably introduced originally from North America. In fact one of the collections was still bearing the name

"Stowells" which is one of the older varieties of evergreen sweet corn of the United States. The two types of Dulce are described separately.

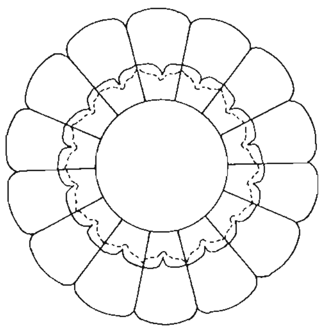


FIG. 66. Ear cross-section diagram of Dulce (Golden Bantam).

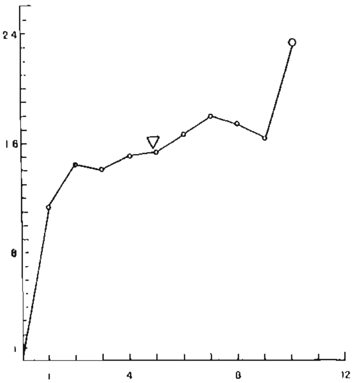


FIG. 67. Internode pattern of Dulce (Golden Bantam).

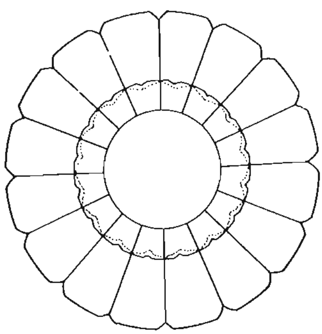


FIG. 66a. Ear cross-section diagram of Dulce (Evergreen).

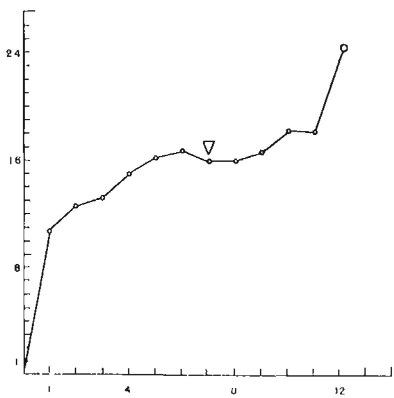


FIG. 67a. Internode pattern of Dulce (Evergreen).

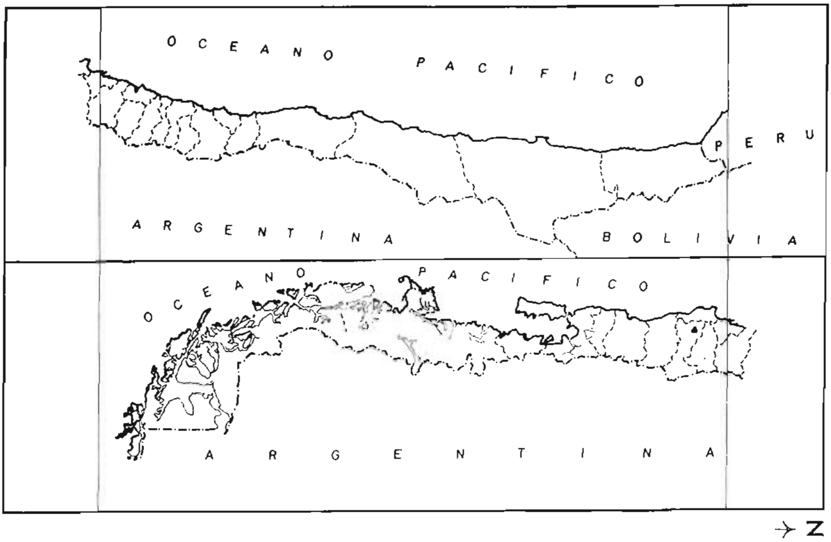


Fig. 68. The distribution of Dulce.

"Evergreen"

Ears cylindrical to slightly tapered. Kernels sugary, relatively narrow. Endosperm yellow and white. Aleurone and pericarp colorless. Cobs white. Row numbers 14 to 18. Tassels inserted with relatively few branches. Plants of medium height (about 165 cm.), light green in color and with 1 to 2 tall tillers. Sheaths of the culm frequently longer than the accompanying internodes. Leaves frequently drooping resulting in generally unattractive plant appearance.

"Golden Bantam"

Ears slightly tapered. Kernels sugary and wider than in the evergreen type. Endosperm yellow. Cob white. Aleurone and pericarp colorless. Row numbers 8 to 14. Tassels exserted. Number of primary branches somewhat less than in Dulce "Evergreen." Plants short, each with several tillers. Light green in color and very susceptible to root lodging. Flag leaves frequent and well developed. This subrace probably stems from introductions of Golden Bantam or other similar types from the United States but during its sojourn in Chile has undoubtedly intermixed with other races, including Evergreen.

SUMMARY

1. Nineteen provisional races of Chilean maize are recognized in this report. These are based on a study of collections whose distribution extends from the Peruvian border on the north to near Puerto Montt on the south, a distance of approximately 1,600 miles. The classification is based primarily on a study of the ears of the original collections but is supplemented by plant data for those races which were adapted to growing areas available to the Maize Committee at the time of this study.
2. General descriptions, tabular data on ears, ear cross-sectional diagrams, distribution maps and ear photographs are presented for each race. Internode diagrams and tabular data on plants and tassels are included only for those races from the lowlands.
3. The geography and climate of Chile, its natural vegetation and agriculture are reviewed. A brief summary is given of the culture and uses of maize and its role in the economy of the indigenous peoples of Chile.
4. Chromosome knob numbers and positions were determined for each of the nineteen races included in the study. Each of the races from the Chilean highlands possess strikingly similar chromosome knob patterns. A small to medium knob is always present in the long arm of chromosome 7, and chromosome 6 sometimes has a small knob at the lower position in the long arm. All other chromosomes are knobless. This pattern is identical with that previously shown to be characteristic of all but one of the high altitude races of maize of Bolivia. The knob situation in lowland Chilean maize is more complicated. Most of these races also contain knobs in chromosomes 6 and 7 but, in addition, knobs are usually present in other chromosomes, including 2, 3, 4, 5 and 9.

LITERATURE CITED

1. Almeyda Arroyo, Elías. 1946. Síntesis Geográfica de la República de Chile: Atlas Geográfico de Chile. (Anesi, Compilador) Ediciones Peuser, Buenos Aires, Argentina.
2. Anderson, E. 1947. Corn Before Columbus, Pioneer Hi-Bred Corn Co., Des Moines, Iowa.

3. Baraona, L., Rafael. 1958. Informe sobre los maíces de Socaire. Appendix to Notas Etnobotánicas del Pueblo Atacameño de Socaire by Carlos Munizaga L. en colaboracion con Hugo Gunckel L. Publicación No. 5. Centro de Estudios Antropológicos. Universidad de Chile. Santiago.
4. Bennett, Wendell C. 1950. The Andean Highlands. Handbook of South American Indians. Vol. 2. (Steward, Ed.).
5. ______. 1950. The Atacameño. Handbook of South American Indians. Vol. 2. (Steward, Ed.).
6. Bird, Junius B. 1950. The Alacaluf. Handbook of South American Indians. Vol. 1. (Steward, Ed.).
7. ______. 1950. The Cultural Sequences of the North Chilean Coast. Handbook of South American Indians. Vol. 2. (Steward, Ed.).
8. Brieger, F. G., J. T. A. Gurgel, E. Paterniani, A. Blumenschein and M. R. Alleoni. 1958. Races of Maize in Brazil and other Eastern South American Countries. Nat'l. Acad. Sci.-Nat'l. Res. Council Pub. No. 593.
9. Brown, William L. 1949. Numbers and distribution of chromosome knobs in United States maize. Genetics. Vol. 34:524-536.
10. Cooper, John M. 1950. The Chono. Handbook of South American Indians. Vol. 1. (Steward, Ed.).
11. ______. 1950. The Araucanians. Handbook of South American Indians. Vol. 2. (Steward, Ed.).
12. Frau, Salvador Canals. 1950. Expansion of the Araucanians in Argentine. Handbook of South American Indians. Vol. 2. (Steward, Ed.).
13. Guevara, Tomás. 1925. Historia de Chile: Chile Prehispánica. Universidad de Chile. Tomo 1. Santiago.
14. ______. 1927. Historia de Chile: Chile Prehistórica. Universidad de Chile. Tomo 2. Santiago.
15. Henckel, Carlos. 1950. The Anthropometry of the Indians of Chile. Handbook of South American Indians. Vol. 6. (Steward, Ed.).
16. Keller, R., Carlos. 1952. Introducción. Los Aborígenes de Chile. Fondo Histórico y Bibliográfico José Toribio Medina. Santiago de Chile.
17. Latcham, Ricardo E. 1956. La Agricultura Precolombina en Chile y los Países Vecinos. Ediciones de la Universidad de Chile.
18. Longley, A. E. 1938. Chromosomes of maize from North America Indians. Jour. Agr. Res. Vol. 56:177-195.
19. Mangelsdorf, P. C. and J. W. Cameron. 1942. Western Guatemala, a secondary center of origin of cultivated maize varieties. Bot. Mus. Leafl., Harvard Univ. 10:217-256.
20. ______ and Robert G. Reeves. 1959. The origin of corn, III. Modern races, the product of teosinte introgression. Bot. Mus. Leafl., Harvard Univ. 18: No. 9, 389-411.
21. Medina, José Toribio. 1952. Los Aborígenes de Chile: Fondo Histórico y Bibliográfico José Toribio Medina. Santiago de Chile.
22. Mesa Bernal, Daniel. 1957. Historia Natural del Maíz. Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales. Vol. X, No. 39.
23. Munizaga, A., Carlos, en colaboración con Hugo Gunckel L. 1958. Notas Etnobotánicas del Pueblo Atacameño de Socaire. Publicación No. 5. Centro de Estudios Antropológicos. Universidad de Chile. Santiago.
24. Ramírez, Ricardo E., D. H. Timothy, Efraín Diaz B. and U. J. Grant, in collaboration with G. Edward Nicholson, Edgar Anderson and William L. Brown. 1960. Races of maize in Bolivia. Nat'l. Acad. Sci.-Nat'l. Res. Council Pub. No. 747.

25. Reeves, R. G. 1944. Chromosome knobs in relation to the origin of maize. Genetics. Vol. 29:141-147.

26. Roberts, L. M., U. J. Grant, Ricardo Ramírez E., W. H. Hatheway and D. L. Smith, in collaboration with P. C. Mangelsdorf. 1957. Races of maize in Colombia. Nat'l. Acad. Sci.-Nat'l. Res. Council Pub. No. 510.

27. Sauer, Carl O. 1950. Geography of South America. Handbook of South American Indians. Vol. 6. (Steward, Ed.).

28. ______. 1950. Cultivated Plants of South and Central America. Handbook of South American Indians. Vol. 6. (Steward, Ed.).

29. Wellhausen, E. J., L. M. Roberts and E. Hernandez X., in collaboration with P. C. Mangelsdorf. 1952. Races of maize in Mexico. Their origin, characteristics and distribution. Bussey Inst. of Harvard Univ., Cambridge, Mass.

30. Willey, Gordon R. 1960. New World Prehistory. Science. Vol. 131, No. 3393.

APPENDIX

TABLE 2. Numbers and Positions of Chromosome Knobs of Highland Races

Race	*Collection No.*	*Elevation (Meters)*	*Chromosome 7*	*Chromosome 6*	*Other Knobs*	*B Type Chromosomes*
Marcame	436	3600	m-s	0	0	0
	436	3600	m-s	het. s	0	0
	439	3200	m-s	0	0	0
	446	3200	m-s	0	0	1
Pululo	444	2700	m-s	homo. s	0	0
Negrito Chileno	371	3500–4090	m-s	?	0	0
	377	2500	m-s	homo. s	0	0
	388	2500	m-s	homo. s	0	0
Chulpi	435	2740	m-s	homo. s	0	0
	438	3200	m-s	0	0	0
	438	3200	m-s	0	0	0
	438	3200	m-s	0	0	1
Capio Chico Chileno	380	2260	m-s	homo. s	0	0
	380	2260	m-s	homo. s	0	0
	382	2500	m-s	homo. s	0	0
	383	2500	m-s	?	0	0
	383	2500	m-s	?	0	0
Capio Grande Chileno	358	2500	m-s	0	0	0
	362	2600	m-s	0	0	0
Capio Negro Chileno	406	2500	m-s	0	0	5
	359	2500	m-s	homo. s	0	0
Chutucuno Chico	360	2500	m-s	homo. s	0	0
	360	2500	m-s	homo. s	0	0
	376	2260	m-s	?	0	1
	376	2260	m-s	0	0	1
Chutucuno Grande	355	2500	m-s	homo. s	0	2
	361	2500	m-s	homo. s	0	0
	361	2500	m-s	homo. s	0	1
Harinoso Tarapaqueño	418	?	m-s	homo. s	0	0
	419	1000	m-s	homo. s	0	0
	428	1500	m-s	0	0	0
	428	1500	m-s	0	0	0
	430	800	m-s	0	0	0
	430	800	m-s	0	0	0

Explanation: m-s = medium-small
s = small
homo. = homozygous knob
het. = heterozygous knob

TABLE 3. Numbers and Positions of Chromosome Knobs of Lowland Races

Races	Chromosome No. 1	2	3	4	5	6	7	8	9	10	B type Chromosome
CHOCLERO											
Coll. 306–1	0	0	0	0	0	0	Homo. m-s	0	0	0	0
Coll. 306–2	Het. L	Homo. very L	0	0	0	Het. s pos. 3.	Homo. m-s/s	0	Homo. s T.S.	0	0
Coll. 312–1	0	0	0	0	0	Homo. s pos. 3	Homo. m-s	0	0	0	1
Coll. 312–2	0	0	0	0	0	Homo. s pos. 3	Homo. m-s	0	0	0	0
Coll. 405–1	0	0	0	0	0	0	Homo. m-s	0	0	0	2
Coll. 405–2	0	0	0	0	0	0	Homo. m-s	Het. L	0	0	0
Coll. 405–3	0	0	0	0	0	0	Homo. m-s	0	0	0	0
CAMELIA											
Coll. 395–1	0	Het. L.	0	0	0	Het. s pos. 3	Het. L.	Homo. L. Homo. s	Homo. s. T.S.	0	0
Coll. 395–2	0	Het. L.	0	Het. L.	0	Het. s pos. 3	Het. L	Homo. L. Het. s	0	0	0
Coll. 404–1	0	0	0	Homo. L.	Het. m-s	Het. m-s Homo. m-s/s	Het. L.	Het. m	Homo. m T.S.	0	0
Coll. 404–2	0	Homo. L.	0	0	0	Homo. s pos. 3	Homo. L.	Homo. m	Homo. s T.S.	0	0
Coll. 404–3	0	0	0	0	Het. m-s	Het. s pos. 3	Homo. L/m-s	Homo. m	Het. s T.S.	0	3
Coll. 404–4	0	Het. L.	(Het.) s	Homo. L.	Homo. m-s	Het. s pos. 3	Homo. very L.	Homo. L. Homo. s	Homo. s T.S.	0	0
Coll. 407–1	Homo. L.	0	0	Homo. L.	Homo. L.	Homo. s pos. 2			Homo. very L.		
						Homo. s pos. 3	0	Homo. very L.	Homo. very L. T.S.	0	0
Coll. 407–2	Homo. L.	Homo. very L.	0	0	Het. m	Homo. m-s pos. 2	Homo. m-s	Homo. m Homo. s	0	0	0
Coll. 407–3	Het. L.	Het. L.	0	Homo L.	0	Het. s, pos. 3	Het. m-s	Het. s Het. s	Homo. very L. T.S.	0	0
Coll. 411	Het. m-s	0	0	Homo. L.	0	Homo. s pos. 3	Het. L.	Homo. L.	Homo. very L. T.S.	0	0
Coll. 417–1	0	0	Het. m-s	Het. L.	Het. L.	Het. s pos. 2	Homo. very L.	Het. very L. Het. s	Homo. s T.S.	0	2
Coll. 417–2	0	0	Het. m-s	0	0	Homo. s pos. 2 Het. s pos. 3	Homo. very L.	Homo. L. Homo. s	0	0	0
CURAGUA											
Coll. 301	Homo. m	Het. L.	0	0	Homo. s	Het. s pos. 3	Het. m-s	0	Homo. s T.S.	0	1
Coll. 311–1	0	0	0	Het. L.	0	0	Het. L.	0	0	0	0
Coll. 311–2	Homo. m-s	Het. L.	0	0	0	0	Homo. L.	Het. very L.	Homo. s T.S. Het. L.	0	2
Coll. 311–3	0	0	0	0	Het. L.	0	Homo. m-s	Homo. m-s	Homo. s T.S.	0	0
Coll. 314–1	Het. m-s	Homo. L.	0	0	0	Homo. m-s/s pos. 3	Homo. m-s	0	Het. very L. T.S.	0	0
Coll. 314–2	Het. m-s	0	0	0	Het. s	Homo. s pos. 2 Homo. s pos. 3	Homo. m-s	Het. very L.	Homo. s T.S.	0	0

TABLE 3. Numbers and Positions of Chromosome Knobs of Lowland Races—Continued

Races	Chromosome No. 1	2	3	4	5	6	7	8	9	10	B type Chromosome
CURAGUA											
Coll. 314–3	0	Het. L.	0	Het. m	Het. s	Homo. s pos. 2 Het. s pos. 3	Het. m-s	Homo. very L.	0	0	1
Coll. 316–1	0	Het. L.	0	Het. m	0	0	Het. m-s	0	Homo. s T.S.	0	3
Coll. 316–2	0	Homo. L.	0	Homo. L.	0	Homo. s	Het. m-s	0	Homo. s T.S.	0	2
Coll. 399–1	0	0	0	0	0	Het. s pos. 3 Het. s pos. 2	Homo. m/m-s	0	Homo. L. T.S.	0	3
Coll. 399–2	Het. m-s	0	0	0	0	Het. s pos. 2 Het. s pos. 3	Het. m-s	0	Het. very L. T.S.	0	2
Coll. 403–1	0	0	0	0	0	0	Het. m-s	0	0	0	4
Coll. 403–2	Het. m-s	0	0	0	0	Het. m pos. 2	0	0	0	0	1
Coll. 403–3	0	0	0	0	0	Het. m pos. 2 Homo. s pos. 3	Homo. m-s	0	0	0	1
CURAGUA GRANDE											
Coll. 303–1	0	Het. very L.	Het. L.	Homo. L.	(0)	Homo. s pos. 3	Het. m	Homo. very L.	Het. very L. L.A.	0	0
Coll. 303–2	Het. m-s	Homo. very L.	0	0	0	Het. s pos. 3	Het. L.	0	Homo. L./s T.S.	0	2
Coll. 305–1	0	0	0	0	Het. m-s	0	Homo. m-(L.)	Homo. m/s Homo. s	Homo. s T.S.	0	0
Coll. 305–2	0	Het. m	0	0	Het. s	0	Homo. m-(L.)	Het. L., Het. s	Homo. s T.S.	0	1
Coll. 308	0	Het. m	0	Homo. L.	(0)	Het. s pos. 2 Het. s pos. 3	Het. m-s	Het. m	Homo. s T.S.	0	1
Coll. 310–1	0	Het. m	0	0	0	Homo. s pos. 3	(Het.) m-s	Het. L., Het. s	0	0	2
Coll. 310–2	0	(Het.) very L.	0	0	0	0	Het. m-s	Homo. very L.	Homo. s T.S.	0	3
Coll. 310–3	Het. m-s	Het. L.	0	0	0	Homo. s pos. 2 Het. s pos. 3	Het. m-s	Homo. L. Homo. s	0	0	1
Coll. 310–4	0	Het. L.	0	0	Het. m	0	Homo. L.	Homo. L.	Homo. s T.S.	0	5
Coll. 315–1	0	0	0	Het. L.	Homo. s	Homo. s	Het. L.	Het. L., Het. s	Homo. s T.S.	0	1
Coll. 315–2	0	Homo. L.	0	0	0	Homo. s pos. 3	Het. s	Het. L.	Homo. s T.S.	0	1
Coll. 315–3	0	0	Het. m	(0)	Het. s	Homo. s pos. 3	(Homo.) m-s	0	Homo. s T.S.	0	0
CRISTALINO CHILENO											
Coll. 334–1	0	Het. L.	0	Het. L.	0	Homo. s pos. 3	Het. m-s	0	Homo. s T.S.	0	3
Coll. 334–2	0	Het. L.	0	0	0	Homo. s pos. 3	Homo. L.	0	Homo. s T.S.	0	1
Coll. 334–3	0	0	0	0	0	Het. m pos. 3	0	0	Homo. m-s T.S.	0	1
Coll. 336–1	0	0	0	Homo. very L.	0	Homo. m-s	Homo. L.	Het. very L., Het. s	0	0	0

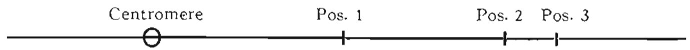
TABLE 3. Numbers and Positions of Chromosome Knobs of Lowland Races—Continued

Races	*Chromosome No.* 1	2	3	4	5	6	7	8	9	10	B type Chromosome
CRISTALINO CHILENO											
Coll. 336–2	0	Homo. very L.	Het. s	0	0	0	Het. m-s	0	Homo. *s* T.S.	0	2
Coll. 397–1	0	(Homo.) m	0	0	Het. m-s	0	Homo. L.	0	Homo. *s* T.S.	0	0
Coll. 437–1	0	0	0	0	Het. m-s	0	Het. L.	0	Homo. *s* T.S.	0	0
Coll. 437–2	0	Het. m	0	0	0	Homo. *s* pos. 3	Homo. L.	0	0	0	0
Coll. 437–3	0	0	0	0	0	Homo. *s* pos. 3	Homo. m-s	0	Homo. *s* T.S.	0	2
Coll. 447–1	0	0	0	0	Het. L.	0 or *s*	Het. m-s	0	Homo. *s* T.S.	0	2
Coll. 447–2	0	0	0	Het. L.	Het. m-s	*s* pos. 3	Homo. L./m-s	0	Homo. *s* T.S.	0	2
Coll. 447–3	0	0	0	0	Homo. m-s	0	Homo. L./m-s	0	Homo. *s* T.S.	0	0
DENTADO COMERCIAL											
Coll. 327–1	0	0	0	0	0	Homo. s pos. 3	Homo. m-s	Homo. L.	0	0	0
Coll. 327–2	0	0	0	0	0	Homo. s pos. 3	0	Homo. L.	Homo. s T.S.	0	0
Coll. 416	0	0	0	0	Homo. m-s	Het. s pos. 2 Homo. s pos. 3	0	0	Homo. s T.S.	0	0
ARAUCANO											
Coll. 320–1	Het. *s* short arm	0	0	0	0	0	Homo. m-s	0	Homo. *s* T.S.	0	0
Coll. 320–2	0	0	0	0	Homo. L.	0	Het. m-s	0	Homo. m/*s* T.S.	0	1
Coll. 325–1	0	0	0	0	Homo. m	*s* pos. 3	Homo. m-s	0	0	0	0
Coll. 325–2	0	Het. L.	0	0	0	*s* pos. 3	Homo. m-s	0	Homo. *s* T.S.	0	0
Coll. 325–3	0	0	0	0	Het. m	0	Homo. m-s	0	Homo. *s* T.S.	0	0
Coll. 325–4	0	0	0	0	Homo. m	Het. *s* pos. 3	Het. m-s	0	0	0	0
Coll. 325–5	0	0	0	Het. m	0	Het. *s* pos. 2 Homo. *s* pos. 3	Homo. m-s	0	0	0	0
Coll. 344–1	0	0	0	0	0	Homo. *s* pos. 3	0	0	0	0	0
Coll. 344–2	0	Het. m	0	0	Het. m	Homo. *s* pos. 3	Het. m-s	0	Het. *s* T.S.	0	0
Coll. 344–3	0	Het. m	0	0	Het. m	Het. *s* pos. 3	0	0	Homo. *s* T.S.	0	1
Coll. 344–4	0	0	0	0	0	*s* pos. 3	Het. m-s	0	Homo. *s* T.S.	0	1
Coll. 344–5	0	0	0	0	0	0	0	0	0	0	0
Coll. 354–1	0	Het. m	0	0	0	Homo. *s* pos. 3	Homo. m-s	0	0	0	0
Coll. 354–2	0	Het. m	0	0	0	(Het.) *s* pos. 3	Homo. m-s	0	0	0	0
Coll. 354–3	0	0	0	0	0	*s* pos. 3	Homo. m-s	0	Het. *s* T.S.	0	0
Coll. 354–4	0	0	0	0	0	0	Homo. m-s	0	0	0	0
Coll. 354–5	0	Het. m	0	0	0	Het. *s* pos. 3	Homo. m-s	0	0	0	0
Coll. 354–6	Het. s	0	0	0	0	Het. *s* pos. 3	Homo. m-s	0	Homo. *s* T.S.	0	0
Coll. 354–7	0	0	0	0	0	Homo. *s* pos. 3	Homo. m-s	0	0	0	0

TABLE 3. Numbers and Positions of Chromosome Knobs of Lowland Races—Continued

Races	*Chromosome No.* 1	2	3	4	5	6	7	8	9	10	B type Chromosome
CRISTALINO NORTENO											
Coll. 338–1	0	0	0	0	0	0	0	0	Homo. s T.S.	0	1
Coll. 338–2	0	0	0	0	0	Homo. s pos. 3	0	0	Homo. s T.S.	0	0
Coll. 349	0	(Het.) m	0	0	0	Homo. *s* pos. 3	0	0	Homo. s T.S.	0	0
DULCE											
Coll. 339	0	0	0	0	0	Homo. s pos. 2 Homo. s pos. 3	Het. m	0	Homo. s T.S.	0	1
Coll. 335	0	Het. m-s	0	0	0	0	0	0	Homo. *s* T.S.	0	0
Coll. 332–1	0	0	0	0	Homo. m-s	Homo. s pos. 2	Homo. s	0	Homo. s T.S.	0	0
Coll. 332–2	0	Homo. m	Het. L.	0	(Het.) m	Homo. s pos. 3	Homo. m	0	Homo. *s* T.S.	0	0

[1] Chromosome 6



EXPLANATION:
L.—large.
m—medium.
m-s—medium-small.
s—small.
s—very small.
Homo.—Homozygous.
Het.—Heterozygous.
L.A.—Long Arm.
T.S.—Terminal position, short arm.
(   )—indefinite.
L./m-s—one chromosome with L, other chromosome with m-s knob.

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

	Height (cm.)		*Stem Diameter (mm.)*		*Leaves*				*Tillers*			
										Height %		
Race	*Plants*	*Ears*	*Minimum*	*Maximum*	*Length (cm.)*	*Width (cm.)*	*Venation index*	*Ears per plant*	*Number*	*Tall*	*Medium*	*Short*
Harinoso Tarapaqueño	199.3	135.7	23.3	29.2	80.0	9.9	2.67	1.30	0.00	—	—	—
Choclero	145.4	82.5	27.4	32.0	63.2	9.8	3.59	0.94	0.42	11	38	51
Camelia	221.7	145.4	34.9	36.6	100.1	11.7	3.63	0.97	0.34	100	0	0
Curagua	174.8	110.5	27.8	29.9	89.1	10.2	4.23	0.96	1.04	93	0	7
Curagua Grande	201.7	131.3	27.8	30.7	93.1	10.5	4.20	1.00	1.20	96	0	4
Cristalino Chileno	134.0	69.3	25.8	29.6	78.5	12.7	3.01	1.00	1.09	76	16	8
Dentado Comercial	184.9	105.6	30.7	34.2	86.1	11.7	4.06	1.00	0.53	55	7	38
Araucano	70.4	37.8	17.2	19.6	48.5	8.5	3.50	1.00	0.55	29	38	33
Cristalino Norteño	153.2	66.5	26.7	29.6	82.8	8.7	4.62	0.95	2.85	96	0	4
Dulce (Evergreen)	165.8	94.1	27.6	29.9	90.1	10.0	3.99	1.00	1.25	83	0	17
Dulce (Golden Bantam)	128.5	56.6	23.2	26.0	76.4	7.7	4.88	0.85	2.65	92	6	2

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

	Length (cm.)				Best developed primary branch			Number of primary branches		
Race	*Peduncle*	*Branching portion*	*Central Spike*	*Uppermost primary branch*	*Length (cm.)*	*Number of secondaries*	*Number of tertiaries*	*Total*	*With secondaries*	*With tertiaries*
Harinoso Tarapaqueño	19.3	15.3	19.6	19.3	21.6	15.99*	1.75*	19.9	9.28	1.45
Choclero	16.1	11.5	22.8	21.6	20.0	2.02	0.11	24.8	7.34	0.33
Camelia	22.0	20.6	24.1	25.7	26.4	2.88	0.88	23.8	8.18	1.13
Curagua	15.7	18.4	23.8	22.6	21.8	2.51	0.29	36.3	6.94	0.44
Curagua Grande	21.0	19.2	24.8	26.8	26.1	2.49	0.51	27.9	6.08	0.27
Cristalino Chileno	22.1	16.3	25.2	24.3	26.6	2.10	0.27	24.2	5.55	0.13
Dentado Comercial	21.5	18.6	26.1	27.7	27.2	2.54	0.63	27.4	6.06	0.57
Araucano	17.7	14.3	14.4	17.3	16.8	1.74	0.05	18.6	4.34	0.05
Cristalino Norteño	26.3	16.8	22.3	26.6	25.4	1.82	0.00	16.9	3.77	0.00
Dulce (Evergreen)	24.3	15.3	26.4	28.1	27.6	1.25	0.00	18.9	3.38	0.00
Dulce (Golden Bantam)	23.0	15.0	22.8	22.8	22.2	2.29	0.10	17.0	3.45	0.10

*Total number in tassel rather than on best developed primary branch.

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

Race	*Ears*					*Kernels*				
	Row No.	*Length (cm)*	*Diameter (mm)*			*Length (mm)*	*Width (mm)*	*Thickness (mm)*	*Hardness*	*Denting*
			Basal	*Mid-point*	*Tip*					
Marcame	15.4	10.9	48.0	50.3	36.0	14.62	8.65	5.42	5.0	4.5
Polulo	12.0	9.6	24.7	23.7	17.3	8.44	5.25	3.47	1.6	5.0
Negrito Chileno	17.0	6.8	39.0	39.5	33.9	8.61	8.40	4.74	4.8	4.4
Chulpi	17.4	10.1	47.4	47.2	37.7	13.43	7.42	4.49	3.1	1.2
Capio Chico Chileno	17.2	8.6	45.5	45.4	37.6	12.50	7.34	4.54	5.0	2.4
Capio Grande Chileno	19.1	12.2	53.9	52.5	44.1	13.52	6.27	3.92	5.0	2.6
Capio Negro Chileno	18.5	12.7	55.2	33.6	46.1	14.24	7.97	4.38	5.0	3.0
Chutucuno Chico	19.6	8.3	32.9	32.1	25.3	9.54	4.79	3.44	1.4	5.0
Chutucuno Grande	17.6	12.7	42.1	39.5	34.1	10.24	6.69	4.02	1.7	5.0
Harinoso Tarapaqueño	12.4	14.8	55.0	54.0	38.9	15.32	11.06	4.46	4.6	4.2
Choclero	22.1	14.9	59.3	55.7	42.4	12.67	7.14	4.09	4.7	1.3
Camelia	14.3	19.1	49.1	44.8	36.4	9.93	8.26	4.27	1.2	5.0
Curagua	18.8	13.9	35.4	29.0	28.5	8.54	6.17	3.79	1.2	5.0
Curagua Grande	19.0	18.0	43.3	39.5	32.7	9.38	6.37	4.91	1.1	5.0
Cristalino Chileno	13.6	19.7	46.5	43.1	33.6	10.06	9.08	4.62	1.2	5.0
Dentado Comercial	14.4	20.3	55.6	51.1	41.2	11.23	9.96	4.77	2.3	2.4
Araucano	9.7	10.4	30.4	27.8	23.3	7.51	7.84	4.97	2.2	5.0
Cristalino Norteño	8.0	23.1	36.2	34.7	29.7	9.72	10.95	4.43	1.7	5.0
Dulce (Evergreen)	16.4	20.5	50.0	48.7	42.9	11.66	8.53	3.88	1.8	1.8
Dulce (Golden Bantam)	13.4	18.2	45.3	43.1	37.2	9.87	9.26	3.97	1.0	1.6

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

Race	Diameter (mm)			Indices		Pubescence			Induration	
	Ear	Cob	Rachis	Cob/ rachis	Glume/ kernel	Cupule	Lower glume	Upper glume	Lower glume	Rachis
Marcame	50.3	25.9	18.5	1.40	0.25	1.7	0.0	0.0	0.0	2.0
Polulo	23.7	9.1	5.4	1.68	0.22	2.0	0.0	0.0	1.0	2.0
Negrito Chileno	39.5	22.2	14.4	1.54	0.45	0.9	0.0	0.0	0.6	1.5
Chulpi	47.2	22.7	15.6	1.46	0.26	2.0	0.0	0.0	0.2	1.8
Capio Chico Chileno	45.4	23.0	17.4	1.32	0.22	1.3	0.2	0.0	0.2	1.8
Capio Grande Chileno	52.5	27.6	21.1	1.31	0.24	1.4	0.0	0.0	0.0	1.7
Capio Negro Chileno	53.6	26.8	20.1	1.33	0.24	2.0	0.5	0.0	0.5	2.0
Chutucuno Chico	32.1	15.3	11.2	1.37	0.21	1.8	0.5	0.2	0.0	1.9
Chutucuno Grande	39.5	21.3	15.0	1.42	0.31	1.2	0.2	0.0	0.2	2.0
Harinoso Tarapaqueño	54.0	26.3	19.4	1.36	0.22	1.8	0.0	0.0	0.2	2.0
Choclero	55.7	28.9	19.5	1.48	0.38	2.0	0.8	0.0	0.8	2.0
Camelia	44.8	26.9	18.5	1.45	0.42	2.0	0.2	0.0	0.1	2.0
Curagua	29.0	24.0	15.0	1.60	0.53	2.0	0.5	0.0	0.2	2.0
Curagua Grande	39.5	24.9	17.1	1.46	0.42	2.0	1.0	0.2	0.0	1.9
Cristalino Chileno	43.1	28.8	19.9	1.45	0.44	2.0	0.0	0.0	0.0	2.0
Dentado Comerical	51.1	31.9	22.2	1.44	0.43	2.0	1.2	0.7	0.3	2.0
Araucano	27.8	18.4	11.9	1.55	0.43	2.0	0.7	0.2	0.2	2.0
Cristalino Norteño	34.7	23.4	14.0	1.67	0.48	2.0	0.5	0.0	0.5	2.0
Dulce (Evergreen)	48.7	26.8	17.4	1.54	0.40	2.0	0.5	0.0	0.5	2.0
Dulce (Golden Bantam)	43.1	27.2	17.9	1.52	0.47	2.0	0.5	0.2	0.2	2.0

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

Race	Adaptation to Altitude	Days to Silking	Rust	Helminthosporium	Pilosity				Plant color (per cent)			Percentages of ears with color in:					
					Intensity	Per Cent Hard	Per Cent Medium	Per Cent Soft	Sun-red	Purple	Brown	Lemmas	Glumes	Mid-cob	Pith	Aleurone	Pericarp
Marcame	2450	—	—	—	—	—	—	—	—	—	—	17	9	19	9	20	30
Polulo	2700	—	—	—	—	—	—	—	—	—	—	10	14	29	43	0	0
Negrito Chileno	2970	—	—	—	—	—	—	—	—	—	—	70	75	13	0	25	75
Chulpi	2730	—	—	—	—	—	—	—	—	—	—	7	4	19	0	0	22
Capio Chico Chileno	2450	—	—	—	—	—	—	—	—	—	—	34	31	14	0	0	0
Capio Grande Chileno	2420	—	—	—	—	—	—	—	—	—	—	24	25	35	6	0	4
Capio Negro Chileno	2500	—	—	—	—	—	—	—	—	—	—	95	100	36	6	50	50
Chutucuno Chico	2310	—	—	—	—	—	—	—	—	—	—	36	34	52	10	0	20
Chutucuno Grande	2420	—	—	—	—	—	—	—	—	—	—	30	21	52	0	0	0
Harinoso Tarapaqueño	1100	—	2.0	3.6	1.0	0	79	21	39	0	61	34	53	21	7	6	46
Choclero	390	68	1.8	2.2	1.1	11	38	51	78	0	0	69	0	31	2	0	4
Camelia	510	80	1.4	1.8	1.1	0	30	70	41	2	0	0	18	34	18	0	0
Curagua	600	78	2.2	2.2	1.2	0	36	64	54	10	0	30	29	78	21	25	50
Curagua Grande	490	78	2.4	2.3	1.2	2	21	71	71	2		3	0	77	14	10	25
Cristalino Chileno	60	66	3.2	2.8	1.0	0	24	76	76	0	0	0	5	50	0	0	0
Dentado Comercial	70	75	3.0	2.6	1.0	6	13	81	100	0	0	39	36	49	11	0	6
Araucano	70	54	2.9	2.6	1.0	0	14	86	89	0	0	10	9	52	22	3	7
Cristalino Norteño	40	64	2.2	2.5	1.2	0	20	80	100	0	0	0	7	57	8	0	0
Dulce (Evergreen)	72	74	1.9	2.1	1.8	0	0	100	100	0	0	0	0	57	27	0	0
Dulce (Golden Bantam)	72	61	3.0	3.4	1.0	0	28	72	100	0	0	0	0	92	22	0	0

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

Race	Accession Number of Collection
Marcame	Type Specimens: Chi. 436, 446, 439. Others: None.
Polulo	Type Specimens: Chi. 444. Others: None.
Negrito Chileno	Type Specimens: Chi. 371, 388, 374, 377. Others: None.
Chulpi	Type Specimens: Chi. 385, 435. Others: Chi. 429.
Capio Chico Chileno	Type Specimens: Chi. 389, 373, 380, 383, 382. Others: Chi. 363, 372, 387.
Capio Grande Chileno	Type Specimens: Chi. 362, 356, 396, 358, 378. Others: Chi. 357, 367, 369, 379, 386, 392, 434, 443.
Capio Negro Chileno	Type Specimens: Chi. 406, 359. Others: None.
Chutucuno Chico	Type Specimens: Chi. 376, 390, 381, 360, 391. Others: None.
Chutucuno Grande	Type Specimens: Chi. 355, 361, 394. Others: None.
Harinoso Tarapaqueño	Type Specimens: Chi. 419, 428, 430, 421, 418. Others: Chi. 365, 408, 420, 423, 424, 425, 426, 427, 440, 441.
Choclero	Type Specimens: Chi. 405, 312. Others: None
Camelia	Type Specimens: Chi. 404, 411, 417, 395. Others: Chi. 307, 407, 413, 414, 415, 445.
Curagua	Type Specimens: Chi. 301, 311, 314, 316. Others: Chi. 399,
Curagua Grande	Type Specimens: Chi. 315, 310, 303, 305. Others: None
Cristalino Chileno	Type Specimens: Chi. 334, 437. Others: Chi. 304, 313, 317, 322, 328, 329, 330, 333, 347, 350, 352, 398, 400, 402, 442, 450, 452.
a) Cristalino Chileno Grande: Chi. 340, 409, 323, 331, 449, 302, 410.	
b) Cristalino Chileno Chico: Chi. 401, 324, 318, 337, 393, 451, 341.	
Dentado Comercial	Type Specimens: Chi. 416, 412, 448, 326. Others: None
Araucano	Type Specimens: Chi. 345, 354, 320, 325. Others: Chi. 319, 321, 342, 343, 346, 348, 351, 353.
Cristalino Norteño	Type Specimens: Chi. 338, 349. Others: None.
Dulce (Evergreen)	Type Specimens: Chi. 332.
(Golden Bantam)	Type Specimens: Chi. 339, 335. Others: Chi. 454.

TABLE 10. Number of Collections of Each Race Which Were Studied for Various Characters

		Ears				
		External		Internal		Chromo-some Knobs
Race	Plants	Measured	Observed	Color	Other	
Marcame	0	3	3	3	3	3
Polulo	0	1	1	1	1	1
Negrito Chileno	0	4	4	4	4	3
Chulpi	0	3	5	3	3	2
Capio Chico Chileno	0	5	8	5	5	3
Capio Grande Chileno	0	5	13	5	5	2
Capio Negro Chileno	0	2	2	2	2	2
Chutununo Chico	0	5	5	5	5	2
Chutucuno Grande	0	3	3	3	3	2
Harinoso Tarapaqueño	4	5	15	5	4	4
Choclero	2	3	3	3	2	3
Camelia	4	4	10	4	4	5
Curagua	2	4	6	4	2	6
Curagua Grande	4	4	5	4	4	5
Cristalino Chileno	2	2	36	2	2	5
Dentado Comercial	3	4	5	4	3	2
Araucano	3	3	13	3	3	4
Cristalino Norteño	2	2	2	2	2	2
Dulce (Evergreen)	1	1	1	1	1	1
Dulce (Golden Bantam)	2	2	2	2	2	2

NATIONAL ACADEMY OF SCIENCES—
NATIONAL RESEARCH COUNCIL

The National Academy of Sciences—National Research Council is a private, nonprofit organization of scientists, dedicated to the furtherance of science and to its use for the general welfare.

The Academy itself was established in 1863 under a Congressional charter signed by President Lincoln. Empowered to provide for all activities appropriate to academies of science, it was also required by its charter to act as an adviser to the Federal Government in scientific matters. This provision accounts for the close ties that have always existed between the Academy and the Government, although the Academy is not a governmental agency.

The National Research Council was established by the Academy in 1916, at the request of President Wilson, to enable scientists generally to associate their efforts with those of the limited membership of the Academy in service to the nation, to society, and to science at home and abroad. Members of the National Research Council receive their appointments from the President of the Academy. They include representatives nominated by the major scientific and technical societies, representatives of the Federal Government, and a number of members-at-large.

Today the over-all organization has come to be known as the Academy—Research Council and several thousand scientists and engineers take part in its activities through membership on its various boards and committees.

Receiving funds from both public and private sources, by contribution, grant, or contract, the Academy and its Research Council thus work to stimulate research and its applications, to survey the broad possibilities of science, to promote effective utilization of the scientific and technical resources of the country, to serve the Government, and to further the general interests of science.