RACES OF ZEA MAYS: I. THEIR RECOGNITION AND CLASSIFICATION

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It is now half a century since E. Lewis Sturtevant ('85, '86, '87, '94, '99) reviewed the variability of Zea Mays and cataloged it in six main groups, five of which were based upon the composition of the kernel. There are now available two new kinds of facts in addition to those which were at his disposal. In the first place, archeological research has made great advances and the museums of this country have numerous collections of prehistoric corn, the best of them in a remarkable state of preservation, their age approximately dated by dendrochronology (Guernsey and Kidder, '21). In the second place, the rise and development of corn genetics have provided us with a large body of technical information concerning the relationships of different kinds of corn. We know, for instance, that the change from flint corn to flour corn is controlled by a single gene difference, whereas the change from a flint to a dent is the result of many genes, so that in working out the relationships of corn the difference between flint and flour is trivial compared to the difference between flint and dent.

Mangelsdorf and Reeves have recently ('38, '39) advanced a new theory as to the relationships between corn and its closest relatives. For the examination of this hypothesis, or of any hypothesis dealing with the history of corn, it is important that the classification of the varieties of maize be re-examined in the light of our present knowledge of their history and relationships. For this purpose Sturtevant’s classification has another disadvantage in addition to the fact that it does not incorporate the modern evidence. It is largely artificial rather than natural, as he himself was well aware ('94, p. 320).

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It is not only in the classification of maize that one has to choose between these two methods, the natural and the artificial. Which to choose is one of the fundamental problems of all attempts at classification. Each method has its advantages and disadvantages. An artificial classification is an efficient catalogue and nothing more; it sets up a comprehensive series of pigeon-holes. A natural classification attempts in addition to put closely similar objects in adjacent pigeon-holes. An artificial classification may be simple, objective, rapid and complete, but it tells us little more than the pigeon-hole number of the catalogued object. A natural classification is often difficult, incomplete, and more or less subjective, but in addition to cataloguing an object it tells something about what kind of an object it is.

In most taxonomic work natural classifications are seldom attempted within the limits of a species or sub-species. Though a monographer may often realize that the individuals which he is lumping together as one species are grouped into more or less well-defined natural races, nevertheless he seldom has the time or the special training for attempting intra-specific classification. But though the problem may be difficult it cannot be ignored by those who work with man or domesticated plants and animals. While, for such problems, a wholly natural classification would be desirable, a more or less artificial one usually has to be adopted for practical reasons. In dealing with the people of a community, for instance, the telephone company lists them alphabetically. Like any good artificial classification, the telephone book is complete, objective, and requires no special training either to make or to use. It is convenient but it does not put similar people in adjacent positions. The O’Connors find themselves next to the Ochsners and the Cabots to the Cabrillas. When a sociologist studies the same community he might like to have a complete natural classification in which the O’Connors would go near the Kellys, and the Cabrillas with the Oldanis. In practice he must be satisfied with a few large natural groupings such as nationality, occupation, income, etc. Anything more elaborate than this is seldom put down on paper because it is too difficult.

Sturtevant’s classification of corn was both artificial and natural, principally the former. It had six main subdivisions. One was pod corns. The other five considered only the composition of the kernel: the pop corns, the flint corns, the dent corns, the flour corns, and the sweet corns. To the extent that any two corns with the same kind
of kernel are by that very fact somewhat alike, it did put similar kinds of maize together. On the other hand, as Sturtevant himself pointed out, by ignoring other features of the maize plant, it often separated varieties which naturally belonged together. This system had exactly the advantages and the disadvantages of a classification of mankind based entirely on hair color. Such a classification would be rapid and complete and would, to a certain extent, group like peoples together, but it would separate a black-haired Norwegian from his fair-haired relatives and put him in the same class with Sicilians and gypsies.

The problem of races and their recognition is indeed almost the same in *Zea Mays* as in mankind. In both cases it is not easy to work out the racial composition of the whole and it is difficult to give a precise definition to the term "race." The latter problem has been discussed by Coon ('39) in the introduction to his book on the races of Europe:

"Since man is the oldest domestic animal . . . any attempt to classify him by a rigid scheme is immensely difficult and the scheme must be elastic if it is to work at all. Hence the term 'race' must also be elastic. We may recognize if we like, certain major races of the Old World such as the Bushman-Hottentot, the Pygmy, the Australoid, the Negro, the Mongoloid, and the White. Within each of these major racial groups there are, or have been, smaller entities, which may deserve the designation of race in a lesser sense. These smaller entities consist, for the most part, of groups of people reasonably isolated, and developing into local physical enclaves . . . At what border point such an entity becomes a major race it is not always possible to say."

For the classification of *Zea Mays* we shall define the word race as loosely as possible, and say that a race is a group of related individuals with enough characteristics in common to permit their recognition as a group. The last three words should be emphasized. As Hooton has said in his discussion ('26) of racial analysis, "races are great groups and any analysis of racial elements must be primarily an analysis of groups, not of separate individuals. One must conceive of race not as the combination of features which gives to each person his individual appearance, but rather as a vague physical background, usually more or less obscured or overlaid by individual variations in single subjects and realized best in a composite picture."

From the standpoint of genetics a race is a group of individuals with a significant number of genes in common, major races having a smaller number in common than do sub-races. The degree to
which a species can be divided into recognizable races and sub-races will depend upon the degree to which it has been divided into distinct intra-breeding groups with distinctive combinations of genes.

In the recognition of race in *Zea Mays* it is therefore essential that we rely upon characters with a broad genetic background (such as cob shape and kernel size) rather than those which are indicators of but a single locus (as starchy vs. sweet or flint vs. flour). A natural classification of the races of *Zea* based upon characters like cob shape, kernel size, and tassel type will be incomplete, and one must expect disagreement as to details, even among authorities. For some time to come it must be a goal to work towards rather than a project to be completed. As a basis for understanding the history and genetics of corn, it is worthy of such long-continued effort. Since it is an attempt at a classification based upon the entire germ-plasm, it will integrate the maximum number of genetic facts.

This does not mean that the races defined in this paper will supplant Sturtevant's classification as a cataloguing device. Any large enumeration of the varieties of corn must still be indexed by his system or by some such artificial system, though eventually some of the features of a natural system should be worth incorporating in a new comprehensive classification. For that reason no Latin names or precise diagnoses are given to the races of corn tentatively recognized in these papers. We have instead given short descriptive names to some of those groups of varieties in our collections with a recognizable core of common features.

A person who is acquainted with *Zea Mays* only in one section of the world will be amazed at a collection of varieties from another region. In the United States, for instance, maize is so variable that one who has not seen it elsewhere would think that it could not ever be much more variable. Yet a collection from a single Mexican state will show at least one and sometimes two or three new races. Each will have a variability of its own and will differ from the maize of the American corn belt. A discussion of the North American races of *Zea Mays* must therefore begin with a description of its total variability, with special reference to those features which distinguish the maize of one region from that of another.

**A SURVEY OF INTER-RACIAL VARIABILITY IN MAIZE**

For purposes of description (see Weatherwax, Chapters v–ix, xiv–xv) we may divide a plant of *Zea Mays* into root and shoot. The
Shoot consists of a primary axis, which often gives rise to secondary axes at its base. The primary axis is composed of a variable number of nodes with a leaf at each, and is prolonged into a compound male inflorescence, commonly called the tassel. At one or more of the nodes, short secondary branches arise with short wide foliar organs (the husks) and terminated by a condensed compound female inflorescence (the ear). Smaller ears arise in the axils of these foliar organs but they seldom develop to a functional stage.

Root.—
Though variation in the root is not as conspicuous as that in the shoot, it certainly exists (see Collins, 1918). Some Mexican and southwestern races of corn have much longer mesocotyls and many of the varieties of the Mexican plateau have poorly developed root systems as reported by Kuleshov ('30). We have not as yet been able to work out any standardized measurement of these characters which can be used as a criterion of race.

Branching of the Primary Axis.—
The degree of branching of the primary axis and the relative development of the primary and secondary axes vary greatly in different races of corn. They are so unlike in the same variety of corn when it is planted in widely separated localities or at different times of year that we have not found it practicable to use this character as a criterion. The proportionate development of primary and secondary axes (stalk and tiller) is a more stable character and, with a little more study, might be found useful.

Node Number and Internode Length.—
Races of corn differ significantly in node number, but it is too affected by the environment to be useful as a racial criterion. The fundamental pattern of internode length is perhaps more stable and with a little further study might be found useful. Figure 1 shows the pattern of internode lengths in four different races of corn. It will be seen that there are considerable differences in the degree to which the internodes lengthen immediately above the uppermost ear.

Leaves (Blade and Sheath).—
The leaves of the various races differ greatly not only in their absolute size but in their proportions, as has already been commented upon by Kuleshov (loc. cit.). There is so much variabil-
ity upon each plant that we have not been able to determine an efficient method of scoring leaf shape. The leaf sheaths differ in their hairiness from race to race, and this we have been able to score in three qualitative grades, slight or none, evident, and heavy.

Male Inflorescence.—

The tassel of Zea Mays presents us with more easily measured characters than all the rest of the plant combined. While the homologues of its variation are present in the ear, the mature cob is so grown together and lignified that it is difficult to dissect and recognize the component parts.

![Graph showing successive internode lengths for representative plants](image)

**Fig. 1.** Successive internode lengths for representative plants of Mexican Pyramidal, Pueblo, a dent corn from Missouri, and Pima-Papago. All grown out-of-doors at St. Louis. Circles represent tassels, and triangles represent ears.

The tassel is composed of a central axis and a varying number of secondary axes, the lowest of which are themselves compound (Weatherwax, pp. 100–102). The spikelets tend very strongly to be arranged in pairs, one sessile and one pedicellate. The spikelet pairs are arranged distichously upon the secondary axes and polystichously upon the central spike. Although all these features are subject to variation, the general plan remains remarkably constant in different races of corn. The number of tassel branches is a surprisingly stable character (Weatherwax, p. 102) and is one of the most useful criteria of race. To be sure, it is a character which is affected by the vigor of the plant and for that reason we did not consider using it until experience forced its general stability upon our attention. It was first brought to our notice in connection with Cutler’s collections of maize from the Mexican Plateau for which we had (1) tassels collected in the Mexican corn fields, (2) tassels
grown in the greenhouse at St. Louis, (3) tassels from corn started in the greenhouse and ripened out of doors, (4) corn planted out of doors in St. Louis in May. While for each of these four lots the material was variable, the variation in each was from 0 to 4 branches. At the same time we also had in cultivation corn from Guatemala which bore a very large number of tassel branches though planted at the same time and in adjacent rows.

It was also found to be generally true that the range of variation in number of tassel branches was roughly the same for those cultures grown in triplicate at College Station, Cuba, and St. Louis (see pl. 11, tassels D and E).

In one characteristic Mexican race there are no branches or only a few, while in South American corns there may be 30 or more branches. The stiffness of the entire tassel and the angle at which its branches depart from the primary axis is useful in the field but we have not been able to score it effectively on herbarium specimens. The size of the outer glumes of the spikelet is also important. It varies from 8 or 9 mm. in some South American corns to 15 or 16 mm. in corn from the Mexican plateau. The length of the sterile zone at the base of the branches is also significant. This varies from 1 or 2 mm. in some Mexican corn to 10 or 20 mm. in certain South American varieties. Two technical characters are highly diagnostic of certain races, the condensation of internodes and the degree to which the pedicel on the upper spikelet is developed. In Peruvian corn successive internodes are equal in length and exhibit a characteristic, regular zigzag arrangement. In many North American varieties the internodes vary in length and are often so short that the spikelets appear as if borne four at a node. Two successive nodes may be so close together that they appear as one. In the corns of the Mexican plateau this condensation is sometimes quite regular, every second internode being condensed (fig. 2).

The spikelets, as has been said, occur in pairs, the upper spikelet of each pair being more or less pedicellate. The relative length of this pedicel varies greatly, however. In some South American corns it may be as long as the spikelet. In many Mexican corns it is subpedicellate and may even be quite as sessile as the lower spikelet. Plate 11 A shows an extreme example, a corn from Xochimilco in which all the spikelets are sessile and the alternate internodes condensed so that it has the appearance of bearing spikelets in whorls of four.
Female Inflorescence.—
Next to the tassel the most important criteria of race are to be found in the female inflorescence (the ear). The number of husks and their shape are highly diagnostic but we have not used it because ears with husks attached are difficult to store and to study. Ear and kernel were the basis of Sturtevant’s classification and we have merely selected those of his criteria which seemed most diagnostic;

row number, ear length, kernel width, thickness and length, and cob width. The composition of the kernel is an important racial criterion only to the extent that it is based upon a large number of genes. Starchy vs. sweet or flint vs. flour are simple gene differences and therefore of minor importance. Denting and capping, on the other hand, are the results of larger numbers of genes and are therefore more important though they are difficult to measure. Color differences, for the most part, are the results of a few gene differences and are somewhat superficial. However, it will be seen that when the races of maize have been separated on other grounds that each has its own characteristic color range.
In addition to these readily scored features, there are a number of general differences in ear shape, kernel pattern and kernel texture which are easily perceived by the trained eye but which are difficult to score objectively and commensurately (i.e., in a graded series). These include: (1) the general shape of the cob, cylindrical, long-tapering, short-tapering, (2) the shape of the butt, appressed, rounded or enlarged, (3) the extent to which the kernels are arranged in evident rows, (4) the sulci between the rows, (5) the regularity of the kernels (i.e., the amount of variation in size and shape from kernel to kernel), (6) the degree to which the kernels have been compressed by the husks.

The general problem of recognizing and measuring races has been discussed by Hooton ('26) in one of his classic contributions to the subject. Though he was considering mankind rather than Zea Mays, the problem is fundamentally the same and our techniques differ from his only in detail. Our material, however, had the advantage that we had two sets of complicated organs for analysis rather than one. His work was mainly limited to skulls. Ours had not only the ear but also the associated tassel. We followed his method in sorting out the ears by general perception, using the total impression given to the trained observer by its totality of characters. Having grouped his crania by this method, Hooton then measured them and computed averages for each recognized race, sub-race, etc. We had a somewhat better check on our conclusions since we first sorted the ears and then measured and averaged the associated tassels. In every case the exact data derived from the tassels confirmed our judgments with regard to the ears. Both of these conclusions received additional confirmation when the distributions of the races and sub-races were determined and were found to agree with recognized geographical and ethnic barriers. We had an added advantage in that much of our material was grown in triplicate at St. Louis, Mo., College Station, Texas, and Cienfuegos, Cuba, so that we had a rough idea of what differences were purely environmental. We are indebted to Dr. Paul C. Mangelsdorf and the Arnold Arboretum for the Cuban collections and to Dr. R. G. Reeves and the Texas A. and M. College for that grown at College Station.

The general method of work can be illustrated by our procedure with the collections from the southwestern United States. (These are to be discussed in greater detail in a forthcoming article by Anderson and Carter). For this area we had about fifty collections
made in the Southwest over a series of years by the junior author and by George F. Carter, to whom we are greatly indebted not only for a comprehensive collection but for much pertinent information. The tassels were collected and numbered by an assistant to reduce the personal equation to a minimum. The ears (some of them collected in the Southwest, others grown from seed collected there) were spread out on a large table and were carefully examined. It was almost immediately apparent that there were at least two centers of variation: (1) the large-cobbed, straight-rowed varieties grown by the Pueblo Indians, and (2) the small-cobbed mosaic-seeded type grown by the Pima and Papago Indians. We therefore sorted the material into three piles, "Pueblo," "Pima-Papago," and unknowns. By study it was possible to reduce the third pile little by little and we soon came to the conclusion that, aside from a few obvious recent admixtures such as pop corns and dents, there were only these two basic races of corn in the Southwest. The ma-
terial lent itself to classification in four groups: (1) Pueblo, (2) obviously intermediate, (3) Pima-Papago, but somewhat intermediate, and (4) Pima-Papago. We then studied the numbered tassels and measured five features previously chosen as racially diagnostic. Averages for each of the four groups were then computed and are shown diagrammatically for all 5 characters in fig. 3. It will be seen that five measured characters of the tassels agree with our total impression of the ear and kernel. The Pima-Papago and Pueblo are extreme for each of the five tassel characters, the intermediates occupy an intermediate position, and the averages of class 3 depart only slightly from those of the Pima-Papago.

The distribution of these two races among the southwestern Indians was then examined and found to agree with geographical and ethnic barriers. The Pueblo varieties are grown by the pueblo-dwelling Indians of the plateaus, the Pima-Papago by the Indians inhabiting the intensely hot deserts near the delta of the Colorado. The Pima-Papago varieties are not grown at all by the eastern Pueblos and are found only among those western Pueblos (most particularly the Hopi) which have for some centuries been isolated from the main group of Pueblo Indians and which are geographically much closer to the territory of the Pima and the Papago.

After the classification of the southwestern maize had been completed the Mexican and Guatemalan collections were studied in the same way. For these areas, in addition to the material collected by Cutler, we had extensive collections which came to us through the courtesy of Prof. Carl Sauer and Prof. Ralph Beals of the University of California, and a small but extremely useful collection of tassels and associated ears made in Mexico by our colleague, Mr. B. W. Schery. For these areas our collections are not so comprehensive and the variation of Zea Mays is much more complex. There are undoubtedly numerous sub-races which we have not yet recognized and some of those which we are now recognizing may ultimately prove to be intermediates. They are put forward tentatively as a basis for the discussion that may eventually give us a comprehensive yet natural classification of the races of Zea Mays.

The three Central American races (or sub-races) which we are describing below under the names of “Guatemalan Big Grains,” “Mexican Pyramidal” and “Guatemalan Tropical Flints” are advanced merely as a basis for study. Their relations to each other and to the other races of Central and South America remain to be
determined. They do not constitute the only races in our collections and it is not even suggested that the three groups are of the same rank. It is quite possible that when the racial composition of corn has been thoroughly worked out one of these three might constitute a major race and the other two would be of subordinate rank. Though all three are variable each one has enough of a core of common features and a definite enough distribution in space and time to be thought of as an entity.

In the southwestern United States the corn situation is simpler and we have much more comprehensive collections. The two races, "Pima-Papago" and "Pueblo," which we are describing below, are certainly the two main entities in the maize grown by the Indians of that region. Aside from the obvious intermediates discussed above, the only other perceptible influences are admixtures derived from the American and Spanish communities and various Mexican types brought in by Apache raids.

**Mexican Pyramidal** (fig. 4; pl. 11 A, B, C).

This is the common corn of the region about Mexico City and was probably therefore closely associated with the Aztecs. It is so distinctive in leaf and habit that it was named *Zea hirta* over a hundred years ago by Bonafous (1836) and was described in detail by Kuleshov (’30), who called it the "central Mexican type" and described its pubescent leaf sheaths, drooping leaves, poorly branched tassels, and weak root systems. He also called attention to the fact that this type might have kernels which were pop or flour or dent "as well as any other form of maize." In addition to the characters described by Kuleshov, the Mexican Pyramidals have long harsh glumes in the tassel and a high percentage of condensed internodes and subsessile upper spikelets (pl. 11 and fig. 4). The ears are equally distinctive. Though varying greatly in size they all have the same general shape. They are relatively short and taper sharply and regularly, hence the name "Pyramidal." Row pattern varies from regular to irregular with mixtures of both being common. They most generally show little husk compression; there are wide spaces between the rows and often between individual grains. The kernels are prevalingly long though they vary in shape, usually on the same ear, pointed to dented to rounded kernels often occurring together. The kernel is nearly always elongated, however, and the denting is usually a slight depression towards the tip of the grain. White is the commonest color, accom-
panied by heavy white capping, but dark reds and blue-blacks are also met with.

This race is of particular importance not only because of its probable association with Aztec civilization but because it apparently has entered into the make-up of our corn-belt dents. Any one who will examine large fields of non-inbred dent corn can find (in a greatly reduced degree) much of the same variation which characterizes the ears and tassels of the Mexican Pyramidals. Many of the inbreds derived from dent corns exhibit in an exaggerated form certain of the characters to be found in Mexican Pyramidals though in any one inbred they are usually combined with other quite different features. The Mexican pop corns apparently form a sub-race of the Mexican Pyramidals since in our material their tassels are indistinguishable and their cob shapes (as distinct from cob size) and kernel shapes are practically the same. More material must be examined before this conclusion can be accepted.

**Guatemalan Tropical Flints** (fig. 5; pl. 11 D, E, F).

Apparently a considerable number of tropical varieties have been classified under the general category of "Tropical Flints." For the present we are restricting the term Guatemalan Tropical Flints to a fairly homogeneous race of which we have one collection from Mexico, several from Cuba, and a number from Guatemala, principally on the Caribbean side. The cobs are short to medium but proportionately broad and the seeds are small. The kernels are regular in size and shape and the rows are very straight and sulci evident though not very large. The tassel is much larger than in most North American varieties and there are more branches (the average number is over 20) but the rachises are more slender and the spikelets smaller. Condensed internodes are very rare as are also sessile spikelets, and the tassel branches by comparison with those of most North American corn look more delicate and more regular.

The race is characteristically flint but slight indications of denting are frequently seen. A small cap of white or light yellow is characteristic and there is variation in color.

**Guatemalan Big Grains** (fig. 6; pl. 11 G, H, I).

The outstanding characteristic of this race is the shape of the cob, which is large, sub-cylindrical with a more or less conspicuously enlarged base. The rows are usually straight in the cylindrical portion and too irregular to be recognizable in the enlarged portion. In color the race varies greatly, bright colors being the rule. The
Figs. 4-7. Ear and tassel characters for 5 races of maize: fig. 4, Mexican Pyramidal; fig. 5, Guatemalan Tropical Flint; fig. 6, Guatemalan Big Grain; fig. 7, Racial averages (GBG, Guatemalan Big Grain, PP, Pima-Papago, GTF, Guatemalan Tropical Flint, MP, Mexican Pyramidal).
In figs. 4–6 each line represents an individual plant and shows its value for 7 different characters as follows: A, median cob width in cm.; B, kernel width x thickness in sq. mm.; C, kernel length in mm.; D, number of tassel branches; E, length of sterile zone in mm.; F, % greatly condensed internodes; G, % sub-sessile spikelets.
majority are flints though we have some flour varieties and a number of semi-dented flints. The tassels are similar to those of the Tropical Flints but are even larger and, in our material at least, were characterized by their lax drooping habit. They tend to have very long sterile zones at the base of the branches even up to 10 or 20 cm. in length. The only plant to show sub sessile spikelets had already been suspected on ear characters of having been crossed with a Mexican Pyramidal. Condensed internodes are occasionally seen, but, on the whole, the tassels look very much like those of the Tropical Flints as defined above.

**Pima-Papago.—**

With very few exceptions these varieties are either white or a bright light yellow. Flour corn is the rule, though flints are occasionally found, while denting is unknown. The kernels are small but the cob is proportionately even smaller. This is particularly noticeable at the base. The ear tapers slightly, usually toward both ends, and there is evidence of compression in the narrow base and in lengthwise striations across the kernels. The inner husks are proportionately wide. While the rows are often straight, the individual seeds vary so much in shape that when looking at an ear one notices the kernels rather than the rows. For this reason they look more or less like tiles in a pavement and we have used the term “mosaic-seeded” to describe this effect. The tassels are stiff and harsh and though of medium size have very large glumes. While sub-sessile spikelets are not as common as in Mexican Pyramidal corn, about a tenth of the internodes usually show them. Condensed internodes also occur, though less frequently. As was stated above, these varieties are grown by the agricultural Indians of the deserts near the delta of the Colorado, the Pima, Papago, Yuma, etc. To archeologists this maize is of particular interest because it is very similar to the prehistoric Basketmaker corn which is the oldest recognized type of corn in the Southwest. The habit of the plant is distinctive. Compared to corn-belt dents the stem is slender and the internodes are long for their width, as are also the leaves. Tillers are usually sub-equal with the main stalk.

**Pueblo.—**

This race is very different from the above and is apparently allied to the Big Grains of Central America. It is characteristically big-cobbled and big-shanked. The ears are long and straight-rowed and the sulci are distinct. While the kernels are by no means so
wide as those of the Central American Big Grains, they are larger than the Pima-Papago and more regular. The base of the ear is usually square or slightly rounded though an enlarged base is occasionally seen. The kernel is either flour or flint and a very faint semi-dent is quite common. The kernel is usually colored, and most white varieties show obvious influence of Pima-Papago in other characters beside color. The tassel is larger than that of the Pima-Papago race with nearly twice as many tassel branches on an average but with slightly smaller glumes. Sub-sessile spikelets are rare but nearly every tassel shows irregular internodes and about one out of ten is obviously condensed. Some plants have a peculiar growth habit. The internodes tend to be short and the leaves wide. The tassels are not greatly exserted and the ears are long, giving the whole plant a curious “squatty” appearance.

SUMMARY

The need of a modern natural classification for the kinds of maize is discussed. Natural and artificial classifications are contrasted and illustrated by simple examples. It is pointed out that each has its advantages and disadvantages; artificial classifications are simple and comprehensive but do not integrate a large number of facts; natural classifications are often difficult to make and cumbersome to use but when they can be achieved they integrate the maximum number of facts.

The difficulties of grouping Zea Mays into natural races and subspecies are discussed. For the purpose of this paper a race or subspecies is defined as a number of varieties with enough characters in common to permit their recognition as a group; in genetical terms it is a group with a significant number of genes in common.

The external morphology of the corn plant is outlined with reference to those characters which might be used as criteria for the recognition and description of race, and the application of these criteria to the classification of maize is illustrated by examples. Indian varieties of maize from the Southwest belong to two main races, the Pueblo and the Pima-Papago, with a few recent admixtures and some obvious intermediates. The first of these races is grown chiefly by the Pueblo-dwelling Indians of the plateaus, the second by desert peoples near the delta of the Colorado River. The latter is very similar to the corn of the prehistoric Basketmakers.

Three Central American groups are described and illustrated,
though their exact relationships are as yet uncertain: (1) the Guatemalan Big Grains, (2) the Guatemalan Tropical Flints, and (3) the Mexican Pyramidals. The last is of particular interest because of its association with the territory of the Aztecs and its relation to modern corn-belt varieties.

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PLATE 11

Photographs of ears and tassels (to different scales) of representative plants of three races of maize, as follows: upper row, Mexican Pyramidal; middle row, Guatemalan Tropical Flint; bottom row, Guatemalan Big Grain. The ears were collected by Cutler at the points listed below, and the tassels are from seeds taken from the ears and grown at College Station, Texas, and Cienfuegos, Cuba. Except in one instance (E on the plate), the tassel associated with each ear was grown from seed taken from that particular ear. The ears have been somewhat mutilated in measuring mid-cob width. The scales in the center of the figure each represent 5 cm.; the scale to the left is for the ears, the one to the right for the tassels.

<table>
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<th>Source of ear</th>
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