HOPI AGRICULTURAL NOTES

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U. S. Department of Agriculture
Soil Conservation Service

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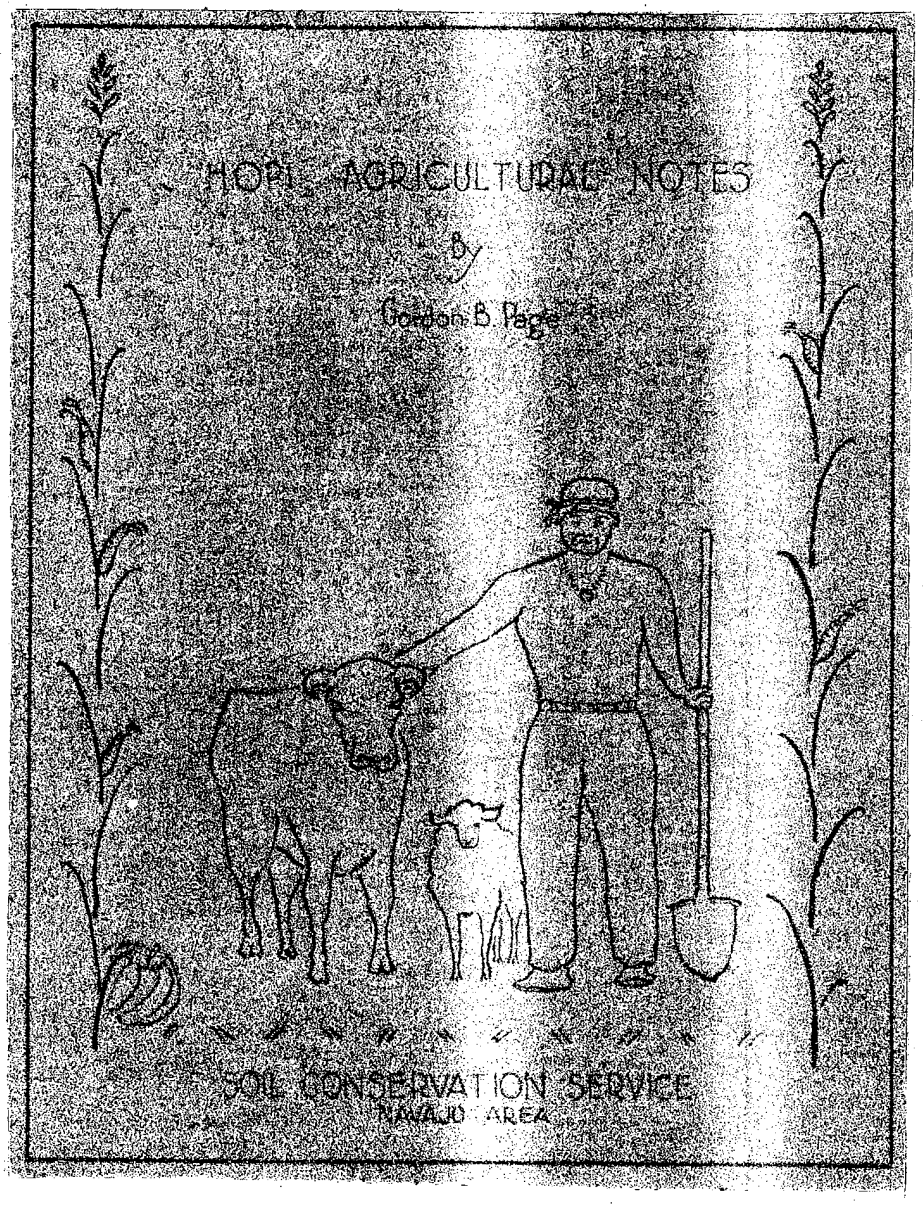

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HP1645

Water for stock purposes has been developed in the past three years by building "Charcos" or water holes. A small dam of earth is thrown across a drainage and when rain falls, the runoff is caught and held until stock, evaporation, or soil absorption uses up the supply.

Water for farming purposes, aside from garden supply, is utilized by clearing ground for fields on a silt fan at the point where the sheet flood may be spread to cover a maximum acreage but not uproot the corn plants.

Various attempts have been made to pump the flow out of the washes in the lower part of the unit, by means of pumps, but the deepness of the arroyos has hindered the attempts.

Waters

First Mesa

"Coyote" spring at the foot of the Tewa Trail.

"Coyote" spring on the north side of the mesa.

Wepo spring at Taylor's ranch.

Second Mesa

Spring at Toreva (a school just below mesa rim).

Shongapovi uses a spring on the southwest side (La Nava) of the mesa and another called "Masepa" on the east side of Second Mesa.

Third Mesa

New and Old Oraibi use a well at the foot of the mesa. (La Nangnva)

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1. Compare Hoover, J. W.: The Hopi Indian Country.

HP1646

The juxta-position of the two groups generated some friction over outlying agricultural lands.

The individual holdings of the Hopis mentioned earlier were, in some cases, along the Jeddito Wash and south of Oraibi near Padilla Mesa. These areas were settled by Navajos and permanent camps built.

The Hopis and Tewas of the villages on First Mesa were directly involved in this settling of lands in the southeastern portion of the Hopi use area. Inter-marriages between these two groups and Navajos occurred in this area creating a colony in Talahogan Canyon, which is unique in the Hopi Unit today. This farming colony is made up of descendents of these inter-marriages, who use the springs in the canyon to water the terraced gardens built below the canyon rim and are constantly expanding the areas planted to corn.

Other Navajo families have settled south of Talahogan Canyon in order to be near the flocks which they herd for Hopis of the First Mesa villages. Small areas of agricultural land are used by these groups to furnish subsistence and in this manner new lands are being developed for dry farming along the Jeddito Wash.

So far the discussion of the land use pattern has been chiefly agricultural, that is the use of land for raising crops not for ranging stock. To the Hopi the use of fields for raising corn and other crops has more than an economic significance. The raising of corn has become an integral part of his inner life, his spiritual life. An infinite number of ceremonials and acts are bound up with his concepts of agriculture.

This is not true of a new stratum of land use which, introduced by Europeans, has now become an important factor in the Hopi economy. This strata is the pattern imposed on the basic agricultural clan - individual

His fields were located close to the toe of the slopes below him and his flocks of sheep, a gift of the Spanish, were kept in corrals located just below the mesa rim.

The fear of raids and the lack of water away from the villages were factors which tended to instill a deep-seated desire to stay on the mesa tops.

This desire remained after the cause for it was removed. The government through the military and later the civilian bureaus concerned with Indian problems subdued the Navajo and threatened retaliation for raids on whites or other Indians. But the harm, from the Hopi viewpoint, had been done. The Navajos seeing the unoccupied areas along the washes away from the towns, ignored the traditional claims of the Hopis and moved in. Once settled, the more aggressive Navajo claimed the land on a prior use basis. The Hopi had no claims to advance to defend this view. It is true his ancestors had lived in a wide area covering the whole Colorado plateau but he had not used the land and thereby lost his "color of title."

Two attempts to establish a boundary on a realistic basis were made by, first, the so-called "military survey" of 1882 and later an allotment plan. Both failed because the Hopi simply ignored the boundaries set.

In 1936, the application of a land management plan through the agencies of the Department of Interior and the Department of Agriculture required that a boundary based on actual use and need of the Hopi be set. Such a boundary was established after an intensive survey and is represented by the series of maps in this report.

The Hopis still cling to the traditional claim so a stratafied arrangement has been advanced. For actual use one boundary defines the

Hopi use area, but for ceremonial purposes the Hopi's right to use areas located far from the Hopi Unit has been recognized. These areas are visited from time to time to perform ceremonies or to trap eagles and gather materials for rites, but the areas can not be used for agricultural and range purposes.

The first boundary is intended to restrict range use but does not prevent a Hopi from farming in fields established before the survey, nor does it prevent him from gathering wood or trading in other areas provided he has the permission of the supervisor of that district.

It must be realized that the Hopis may not acknowledge the boundary for some time. The act of acknowledgment, in the Hopi mind, automatically sets the boundary and blocks all future claims. The fencing of the boundary should be ~~done~~ accomplished, partly because the former boundaries have never been fenced and were, for that reason, ignored, and partly because the range use by Navajos and Hopis would be set apart and areas suceptible to us defined. ~~and definite plans created~~.

HOPI AGRICULTURE

Introduction:

Food determines, to a great extent, the culture of a people; therefore, a brief consideration of the foods of the Hopi people and the means they have of producing foods, by agricultural means, is necessary. To some extent, the kinds of foods people can obtain determine whether they will be nomadic or sedentary, build scattered temporary habitations or permanent well built towns.

In the Hopi area, the sedentary communal life is a direct result of one staple, maize or corn. Around maize a whole culture has been built. The site of a town was determined by the ability of the physical landscape to support the raising of corn in a quantity to supply its people's needs. If for any reason the climatic cycle changed, causing drought, the people moved to an area better suited to their agricultural habit; this may possibly be an explanation of the migrations and abandonment of towns on the periphery of the Hopi Unit. The fluctuations in rainfall may have caused a retreat of the water table and this, coupled with over grazing after the beginning of the 19th Century may have resulted in a change in natural erosion control. After a time, the heavy rains ceased to be absorbed by the scantily covered earth and gullies were formed; thereafter, the water, so necessary for cultivation, continued to cut deeper into the ground until the arroyo was carrying the water twenty feet or more below the former farming level.

HP1650

In good farming regions, maize products have a tendency to stabilize the community. In Basket Maker times, corn culture had just begun. As the knowledge of agriculture increased in the Pueblo Period, the~~ir~~ Indian ~~spare~~ leisure time was used to make beautiful pottery and to develop a highly complex religion based, to a great extent, on corn, the ~~one~~ major food upon which they depended.

Corn is a plant indigenous to the American continent.[1] It was domesticated, probably in Mexico or Central America, ~~a long time ago~~. ~~It is thought that corn is the result of a cross~~ be- expound ~~tween teosinte and an unknown plant~~. ~~This hybrid~~ Corn, probably, reached the Southwest as a cultivated plant, though in a primitive form. To the nomadic people of the~~s land~~ Southwest it gave a crop upon which they could depend, with the result that stability of living was established. In the course of time and experimentation, a variety was developed which was almost drought resistant.[2] This corn was planted with a digging stick which scraped away the sand and exposed the clay soil. The seed was planted and the sand around it acted as a mulch conserving every possible bit of moisture. For this reason the Indians planted the corn on the edge of sand dunes or silt fans with a sand layer, if possible, as the sand mulch absorbed and retained moisture.

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1. Haury, E. Archaeological Theories and Interpretations, Current Anthrop. 1955 p 1
2. Hopi corn is a tough resistant plant compared with other types of corn. It has long tap roots and rarely grows more than three or four feet high.
Compare: Collins, G. N. Pueblo Indian Maize Breeding, Journal of Heredity, Vol. V, pp. 255-267, 1914.

HP1651

Corn found throughout the Pueblo III Period was of four colors, yellow, red blue and white. Today, in the Hopi villages, the blue corn still gives its color to the translucent "Piki" bread, a wafer sheet bread of tissue fineness.

The women of the ancient times must have spent a great deal of their time grinding the corn, on the smooth "metates", into meal. Other ways were found to prepare the kernels - some were parched, and corn which did not find its way to the metates might be prepared, by soaking in lye water obtained from wood ashes, into a hominy.

Although corn was of paramount importance, other plants and fruits were utilized and are still used - notably, orchard fruits, introduced by the Spanish, melons, squash, beans, and pinon nuts as well as wild berries, seeds, and grasses. Up to the time of introduction of modern agricultural tools by the Government, very few Hopi farmers had access to modern methods and the same methods that the ancients used were followed without much change. Indeed, the "dibble stick", or digging stick, mentioned above is still the principal planting tool, although steel hoes have replaced stone and wooden hoes. Very little change has taken place in their religious concepts based, as they are, on their agricultural life and the fertility of the soil.

The Affect of Climate, Soils and Topography Upon Agriculture

The climatic factors which play such an important part in the production of crops in the Hopi country are three in number. First, the occurrence of frost in the fall and spring, second, the occurrence of moisture and third, the affect of the violent wind storms which occur in the spring.

The average length of the growing season is about 133 days with a short frost free period from June to September. Because of the short season the moisture conditions in affect at the time of planting and early growth are decisive factors.

Fluctuations in climatic factors, especially precipitation have a direct affect on the economy of the Hopi. A drop of two or three inches in the total yearly precipitation will lower production in agricultural products 15-30%. A recent example may illustrate this point. The average annual precipitation is about 12 inches, however, during the drought year of August, 1938-July, 1939, the average precipitation was only 7.75 inches. As a result there occurred a 60% drop in agricultural production.[1]

The months of April and May usually have less than 1" of precipitation. As these months are planting months, and the moisture content of the soil is vital to plant growth a deficiency of moisture at this time, especially if the winter months preceding have been dry, will work havoc with the crops. August

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1. Estimate of Resident Agronomist, Soil Conservation Service, Keams Canyon December 1939.

HP1653

is the maximum rainfall month, the precipitation averaging 2.5 inches.

In September the rainy season ends, not suddenly, but by a gradual lengthening of the intervals between storms. Fall weather is very comfortable being cool at night and affording plenty of sunshine for the drying of crops such as peaches and melon strips which are later stored for winter use.

The prevailing winds from the southwest have a drying affect on the soil and unfortunately come during the early planting season. The dry winds usually blow during the months of April and May.

Fortunately for the Hopi farmer, nature and centuries of domestication have developed a corn plant called Zea Mays which has adapted ~~itself~~ to the dry climate. By observation and experience a method of planting has been evolved which affords the maximum benefits of the climate to the plant.

The seeds are planted about ten inches to a foot deep or to a depth at which moisture is held in the sandy soil. This deep planting allows the plant to gain moisture during the dry spring, tapping the moisture left in the ground by the snow melt, and protects it from the very late frosts and early sandstorms.

The Hopi farmer spaces the corn plantings and staggers the rows according to his estimate of the moisture conditions of the previous months and the amount of drying up of that moisture that may have taken place.

After planting, the farmer must depend on the flash rain storms which usually begin in the month of July and extend through August.

HP1654

Soils: The soils of the Unit are derived from the sandstone and shale formations which underlie the surface.

The Mesa Verde, Dakota and Morrison sandstones contribute the bulk of the sandy soils. Lenses of shale in the Morrison and Mesa Verde furnish some of the clays which are to be found in the alluvial soils. The Mancos formation has a great deal of clay and gypsum in it's make up and supplies the balance of the clay to be found in the valley fills.

Sandy loams are the prevailing soils types. The best soils have sufficient capacity for moisture penetration thus allowing very little run off. The water holding capacity is high and alkali content low. These soils are found in the valley flats and have about 3% slope. Soils of coarser texture and higher clay content are to be found in the valley bottoms. These soils are susceptible to wind erosion to a higher degree than the above.

As the clay content increases the value of the soil for agricultural purposes decreases as more water must be used on the clay areas due to the decreased absorption and greater evaporation characterstics, and the crop yields are low.

The Hopi farmer prefers a condition where ten or twelve inches of light sandy material overlie a heavy sub-soil and located so that the flood water will spread evenly over the entire area.

When the light soil or mulch becomes too deep due to wind

action, other areas more adaptable must be found.

Unless additional silt is deposited by the floodwater, every year, to offset the removal of the top soil by the wind the field will eventually be abandoned.

The clay soils are farmed during periods of heavy rainfall but deep sandy soils below the mesa rims are often utilized where there is sufficient moisture in the sand dune for plant growth.

The Hopi clean cultivate by hoeing or by using a horse drawn cultivator. This practise allows the silt laden water to fan out evenly and not be diverted by hummocks created by sand being deposited behind weed clumps.

Topography has some affect on agriculture in that the valley flats at the outflow end of the arroyas which empty into the valleys, are the desirable areas for corn cultivation, due to the deeper soils and lower altitude.

Locations of gardens are influenced by the presence of strata of premeable sandstones which out crop near the villages and act as aquifers

Due to the mesa and valley topography, the bulk of the agricultural operations are confined to the valleys and the habitations are located on the soil barren mesas overlooking the valleys.

The deep arroyas which have, during the past forty years, cut deeply into the alluvial fills of the valleys, have restricted the areas formerly used for agricultural purposes. For this reason, more fields have been broken out on areas away from the

valley centers and nearer the mesa scarps. These fields are not as desirable as the older fields in the valley flat due to more shallow soils and to the fact that sand dunes tend to pile up near the mesa's rims and through wind action eventually cover fields on the leeward side of the dunes.

Sand dunes are common in the Hopi region. They are to be found on the tops and against the sides of the mesas and are especially common in the valleys. An examination of the aerial mosaics covering the area discloses a regular pattern of dunes. Their general strike does not vary much from N 45° E and their orientation parallels the direction of the prevailing winds which blow from the southwest quarter.

The dunes have been skillfully utilized by the Hopis and planted to orchard, melon and squash crops, where there exists sufficient under-dune circulation of moisture and the dunes are so oriented as to be exposed to plenty of sunlight.

Techniques of Farming

Use of flood water by the Hopis of the Southwest may be divided, broadly, into two types: the direct use of the flash flood, and the indirect use of the flood.

The first type, due to lack of money or labor to build storage reservoirs, is more widely used. Preparation for this use involves clearing a field located in a wash at a bend or on the outflow fan.

Hopis have stated that their choice of a new field is based on previous observation of how much flash flood will cover or channel the flat to be used.

The field is planted, and usually the crop has grown and strengthened before the first hard rain occurs. At this time, some plants will have been washed out, necessitating a replanting of the affected areas. Hopi fields, near Polacca, have been observed which had over half the area of the field washed out, but had been replanted and promised a fair yield.[1]

The second use involves some type of structure to break the force of the flood and to hold as much water in storage as possible. Usually, earth and timber dams will be built. These are effective for but a season or two and if not kept repaired soon disappear. These dams are not common in the Hopi Area.

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1. For an excellent discussion of Hopi planting methods see C. Daryll Fordes', "Hopi Agriculture and Land Ownership", in the Journal of the Royal Anthrop. Inst., London, 61, 1931, pp. 357-405.

Structures that may be built for direct flood use are often logs thrown at right angles to the direction of stream flow. Brush may be piled on the upwash side of these barriers. These small dams break the force of the flood and may direct a portion of the water to areas not usually receiving it under normal flood conditions. A certain amount of silt is spread over a field by this means. The silt will afford soil for a good crop, all other factors equal, in the next season if the silt sheet is not too deep or badly channeled.

For the best agricultural use the flood water should contain a minimum amount of silt and colloidal matter.

It is difficult to attain this condition on Hopi fields because to achieve a silt free supply of water it is necessary to let the peak of the flood go by before clear water appears. Due to the Hopi practise of using all of the flood water obtainable a more or less silt free condition cannot be obtained. In fact to do so the farmer would have to have a system of diversion ditches and gates to control the flow of the flood waters.

It is true that the Hopi does attempt some diversion by using small earth dams but has not as yet attempted to store water to be used on valley fields. Storage of water is confined to the garden tanks.

Direct flood use is more or less of a gamble. More fields than the operator expects to mature must be planted. If the floods are not too erosive, and spread the water evenly on his

fields, he may expect a fair crop. However, if the fields are trenched by the force of the flow, some replanting must be done if the season is not too far along. In good years all the fields planted may mature for harvest and a bumper crop may result. The valley lands may be flooded three or four times during the rainy season of late June through August. At this time the more level fields will be flooded to a depth of four or five inches. The water standing until the surplus has disappeared through absorption and evaporation.

The scarp lands have more slope than the valley lands and for this reason the run off is greater and absorption less. Because of the slope erosion is more prevalent and more care in constructing small diversion structures is necessary.

The importance of flood water irrigation may be determined by the acreage under cultivation which depends on this type of irrigation. Of the 6,084 acres under cultivation in 1936, 4,460 acres were dependent on flood water irrigation. The balance of the total acreage was divided into 1,613 acres planted to crops dependent on local rains (dry farms) and 14 acres planted to garden crops and irrigated by water held in storage tanks.

The dry farms are situated on the mesa tops and in the "Outland", the balance of them being situated in the latter area.

The gardens, although their acreage is small play an important part in the Hopi economy. They are discussed in greater detail in the section entitled Gardens.

Away from villages and located on the valley floors are to be found extensive cornfields. The Hopi farmer utilizes any flat or gently sloping area which can be flooded easily, for his field. A thin sand mulch is desirable as a moisture conserving blanket. Because the westerly winds cause the sand to shift, a Hopi farmer will each year plant a row or two more on the leeward side of the field and perhaps abandon a row or two on the windward side of the field. This condition is particularly noticeable on the field south of the Hotevilla-Tuba City highway bridge crossing the Dinnebito Wash.

Corn is planted by digging a trough like hole in the sandy loam. A "dibble stick", a piece of wood two or three feet long and an inch and one-half in diameter with one end flattened is used for this action. The farmer, kneeling, swings the stick over his head, in an arc, the flattened end penetrating some ten inches. This stick is rocked back and forth to loosen the dirt and withdrawn. The seeds are deposited and a sweeping movement of the hand fills the hole. The hills are made about four or five paces apart and between last year's rows. A low earthen mound may be raised around each hill to retain flood water. Weeds are hoed and attention is paid to each hill, during the growing season, to keep the green cut-worms from injuring the plant.

Corn is the most important crop raised by the Hopi, constituting 70 per cent of the value of all the crops raised.

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Corn fields lie below the gardens. Conservation structures employed here are limited to the building of spreader dikes, diversion ditches and occasionally some gully plugging.

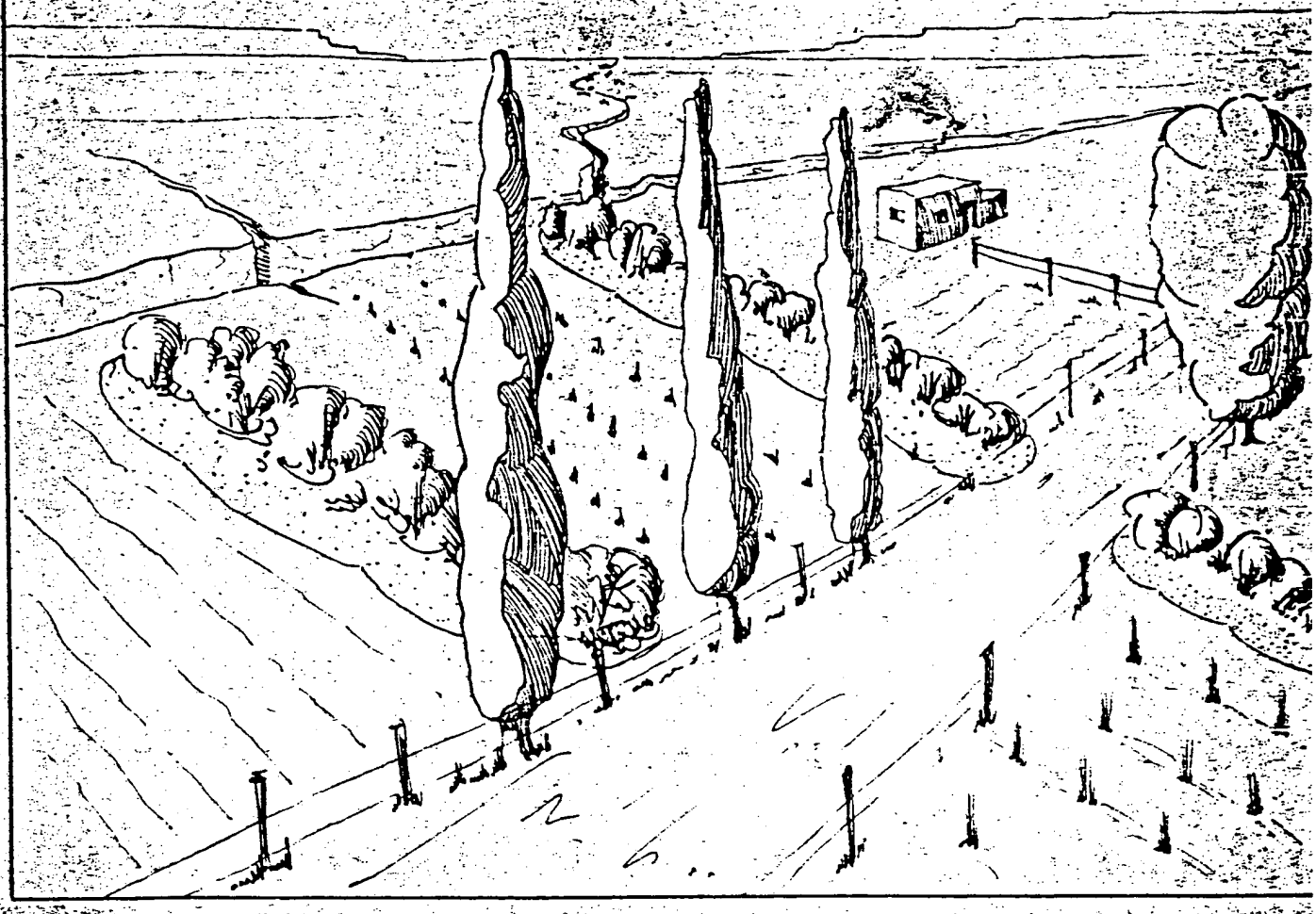
Windbreaks

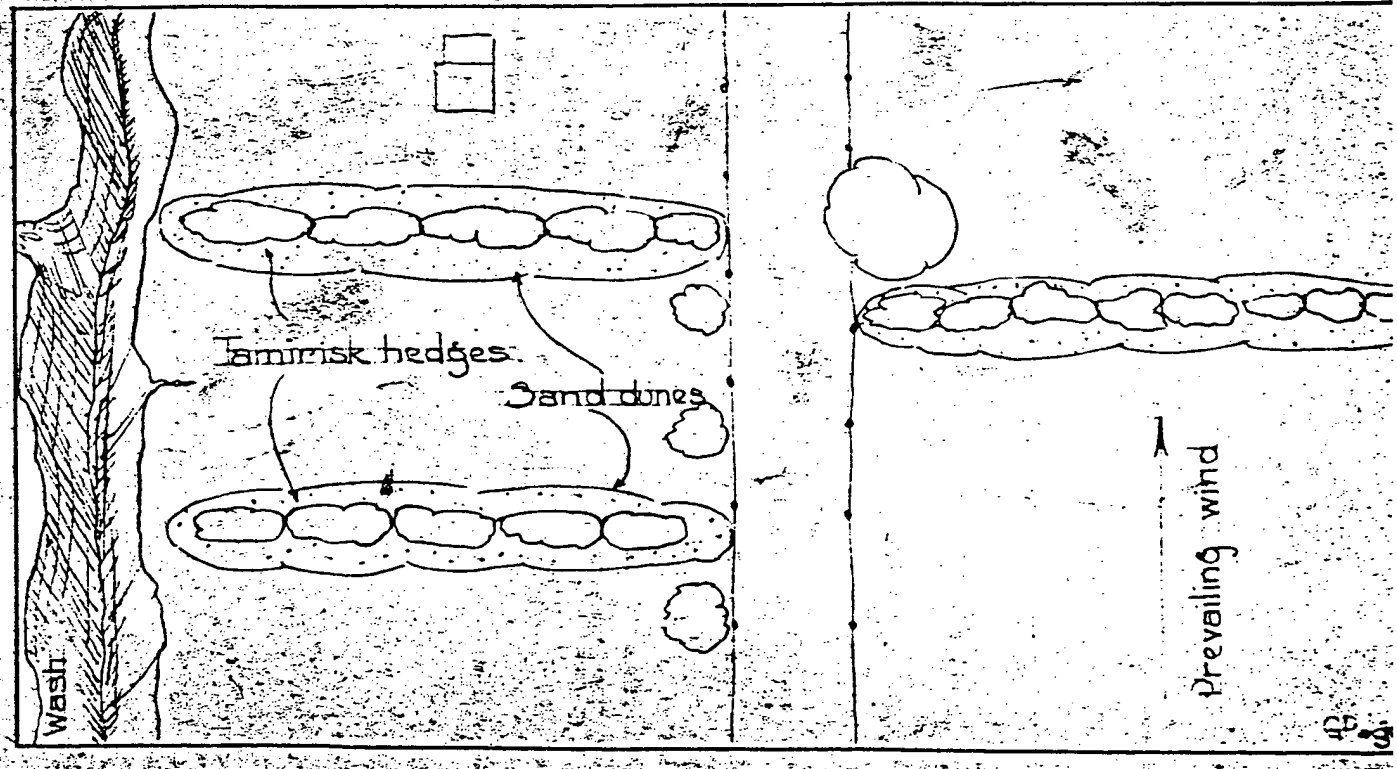
The prevailing winds, which blow from the west and southwest, have a cutting effect on the young corn plants which, during the spring, are beginning to appear above the surface of the ground. The Hopis use several means to protect the plants. A few farmers at First Mesa have obtained poplar cuttings and planted these along the windward side of the field. Greasewood, rabbit brush, snakewood, or sage brush branches are thrust into the ground, forming a continuous hedge extending across the field, and sheltering the corn or bean plants (See plate). The brush may be so woven or piled as to form low brush fences, or individual shelters may be formed behind each plant by thrusting twigs into the earth to form a crescent shaped wind barrier. Stones may be piled behind each plant to achieve the same effect. Tin cans with the ends punched out may be placed over the plant to protect it from the wind. These also serve to keep cut-worms away from the plant. The practice of planting many seeds in one hill is actually a form of windbreak protection. Obviously, if fifteen corn kernels are planted in one "dibble" hole the outer shoots, when the plants begin to appear, will shelter the inner plants. Thus the outer plants are sacrificed to the sand-laden wind in order to protect the inter plants. Good examples of windbreaks may be observed on Second Mesa and on Third Mesa just out-

USE OF TAMARISK AS A WINDBREAK

Taylor Ranch

PLATE XIII





HP1663

side of the village of Hotevilla.

Other windbreaks are formed by the stalks of the past season's corn planting. By planting on the lee side of the dead stalks, the young plant is protected by the sand which piles up behind the old stalk and forms a shelter. The mound thus formed over the new plant forms a mulch which conserves the moisture. In order to locate the plant covered by the sand a stick is often stuck in the mound. Beans and other plants are also protected by the same type of shelters in fields on the mesa tops of all three mesas.

The Hopi have utilized tamarisk plantings as windbreaks. On the Bacabi fields in the Oraibi Wash and in the Polacca valley near First Mesa Tamarisk hedges were planted some years ago.

On the Taylor Tabo farm in the Polacca valley the plantings are 12 to 15 feet high and sand dunes five to eight feet high have collected along the axis of the hedges.

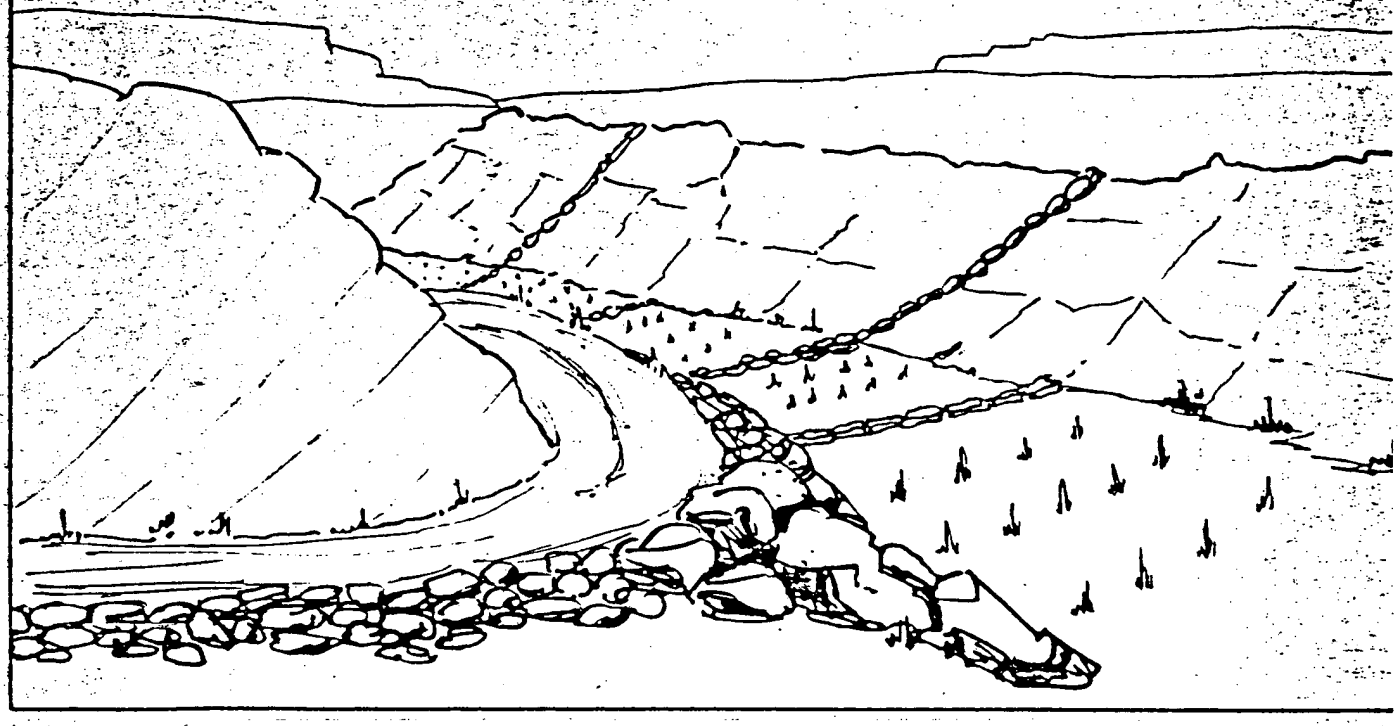
The tamarisk are planted on the windward side of the corn field (see plate).

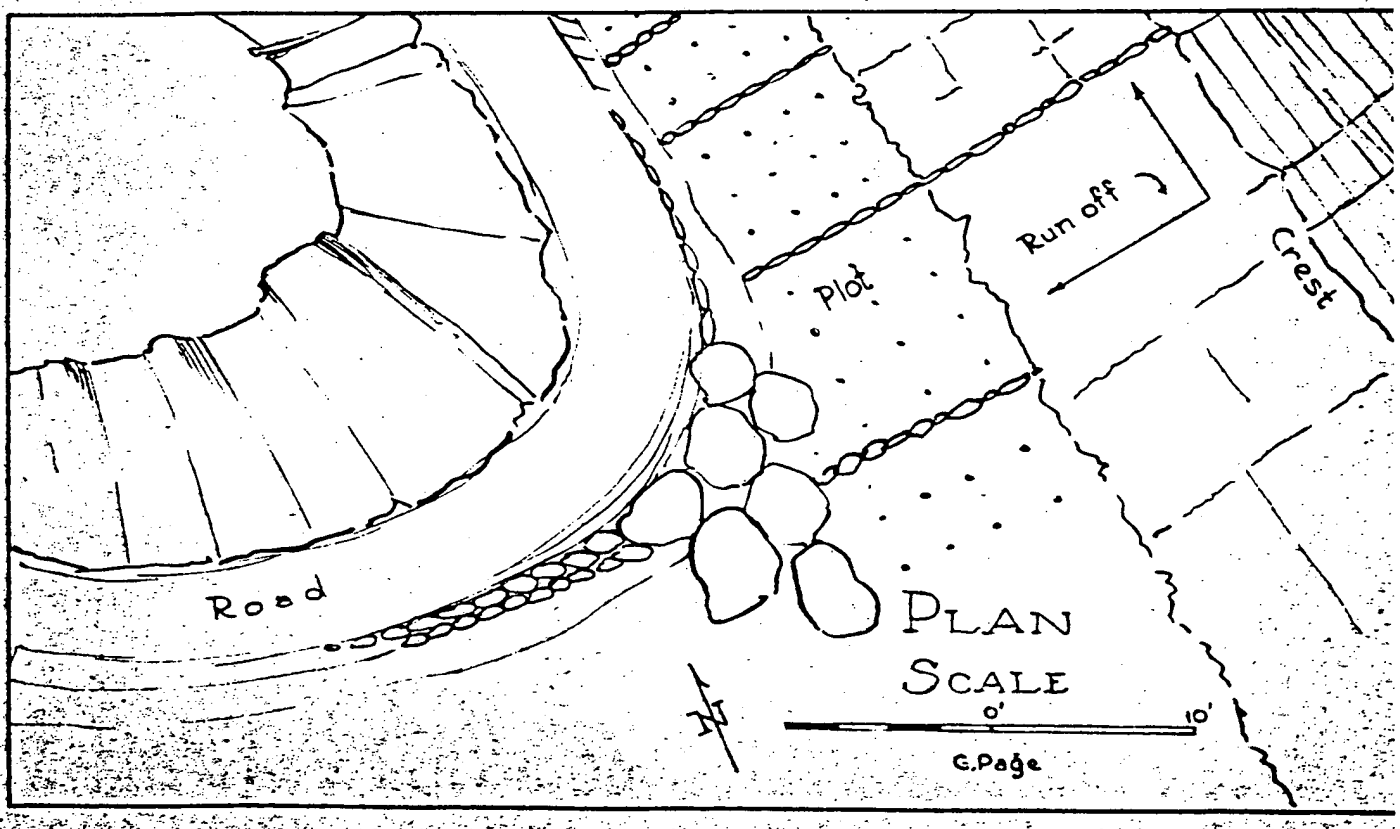
Dikes and Dams

Dikes for diversion purposes are constructed by heaping earth up into low mounds a foot or a foot and a half high and as long as the diversion area demands. By orienting the dikes at angles to the flow of the flash flood, a water-spreading effect

CHECK DAMS
MUSANGNOVI
HOPI RESERVATION

PLATE XIV





is achieved. Such a dike may be observed south of Musangnovi.

Occasionally a Hopi farmer will borrow a scraper and build a small dam across a wash to raise the water to the level of his fields. This is intentionally a temporary structure. A flood will usually sweep out the dam, but it may be rebuilt again for the next flood.

Dikes are sometimes used to mark the division of an agricultural area into two portions, indicating separate use by two operators, but so placed that both receive equal portions of the flood water sheet.

Poles are scarce, but are sometimes used to reinforce a brush earth dam or dike so placed that the impact of flowing water will be heavier than that for which the low earth dam is built. Stones are often used, piled in rows across the width of a shallow, narrow wash at right angles to the direction of the flow of water when the arroyo floods. Clumps of sage brush or withes of cottonwood may be rammed in place behind the stones. Silt carried down the wash by summer floods will collect behind each row of stones and eventually form a small silt plane in which early corn may be planted.

This type of structure is usually found near the villages, and close to the homes of the farmers. By utilizing small washes near the foot of the mesas, areas are created for small plots which had not been susceptible of cultivation before and have the added advantage of not being located as far from the village as are main corn fields.

The Hopis of Musangnovi, a village on Second Mesa, have built a series of check dams along the inner face of a tilted "Toreva Block".[1] The road to the village parallels the slope and one may observe the check dams from the ~~car~~ ~~automobile~~ road. Water flowing down the face of the tilted block is checked and spread over small plots of soil, ten or twelve feet square. The dams are built by laying three or four layers of small boulders one upon the other and extending across the "V" bottom of the drainage. Corn has been planted in these plots for many years, and the plots guarded by the check dams continue to supply food to the Hopi.

The Musangnovi dams differ from check dams constructed at the other villages in that a line of rock extends from one side of the dams up along the face of the tilted rock wall. The rock wall acts as a catchment basin and the wall extension directs the water flowing down the rock surface to the plot (See Plate VI).

Gardens

There are three large gardens in the Hopi country, one of which is available to inhabitants of each of the three mesas. In addition, there are a few small gardens operated by individuals. The total acreage of areas planted to gardens is approximately 14 acres.

The location of each garden is determined by the water supply. The three Hopi mesas are actually three southward extending

1. "Toreva Block" - a tilted faulted strata of a sedimentary rock. Reiche, Parry - "The Toreva Block - a Distinctive Landslide Type", Journal of Geology, Vol. XLV, No. 5, July and August, 1937.

tongues of a more extensive mass known as "Black Mesa". The northern portion of Black Mesa rises to an elevation of seven to eight thousand feet, or one to two thousand feet higher than the elevation of the villages on the southern tongues. Due to elevation of the northern part there is greater annual precipitation here than at the villages. The precipitation falling upon the upper portion is conducted to the southern part of the mesa through the southward dipping permeable Mesa Verde sandstone which, underlain by impermeable Mancos shale, acts as an aquifer. Due to the slope and the confining action of the underlying shale, the water moves south and emerges from the formation about 30 feet above the base of the cliffs adjacent to the villages. Along this line of emergence are to be found seeps and springs which supply the water needed for cultivation and domestic use.

The junction of the shale and sandstone strata determines the upper limit of the gardens. At this level the storage tanks are built. Originally built of rough rocks piled around scooped out hollows, they are now built of well-cut rock laid up with mortar. A bung located in the lower part of the tank controls the supply of water.

The slopes below the mesa rims are steep and for that reason bench terraces[1] have been built (Plate III) across the slopes following the contour.

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1. Hamilton, C. L., "Terracing for Soil and Water Conservation", Farmer's Bulletin No. 1789, U.S.D.A., April 1938, Wash., D.C., p. 18. "The bench terrace is one of the oldest mechanical methods of erosion control, having been used for many years in thickly populated countries where economic conditions necessitated the cultivation of steep slopes."

HP1668

A MODERN TERRACED GARDEN

of the

HOPI INDIANS

HP1669

Vertical risers in the form of stone laid in a wall without mortar retain the earth which is piled behind the wall. The walls vary in height from two and one-half feet to five feet. The widths of the terraces vary from five to ten feet. Each terrace is divided into plots about five feet long and five to ten feet in width, the width of the terrace being the determining factor in each case. The length of each terrace is determined by the amount of cultivable land. The average length is about 150 feet.

Each plot is separated from the others by a low mound of earth. These mounds serve to hold and direct the water which is conducted to the plot by channels, from the master ditch. The channels are dug at the foot of each wall and serve all plots on the same terrace.

The Hopi gardens of the present depend on a constant supply of water held in storage and originating in springs which are to be found below the mesa rim, near the towns. A bung in the storage pool is removed and water needed for plants allowed to trickle down small ditches, which follow the grade of the slope. The flow falls from level to level and finally irrigates the peach trees planted on the lowest terraces. (See plate of Hopi Terraced Gardens.) The care of the gardens usually falls to the women. The men work in the cornfields.[1]

1. Mr. A.E. Jenks describes a similar type of terraced garden, the "sementeras" of the Phillippine Igorot. The construction of the walls is similar to that of the terraces of Red House and the Hopi gardens. Climatic conditions, being entirely different, due to increased rainfall, enable the Igorot to build miles of these garden terrace walls as he is not forced to localize the garden around a particular spring as the Hopi is forced to do. Jenks, A.M.: "Terrace Agriculture in the Phillippines", Source Book in Anthropology, Kroeber, A.L. and Waterman, T.T.: Harcourt Brace and Co., New York, 1931.

HP1670

The use of the gardens at First Mesa and Talahogan is controlled by the clan. Bear clan at First Mesa and Badger clan at Talahogan. "Control" is used in the sense that the clans named above were the first groups to use the springs and the area around the springs at the time of original settlement. By this act the groups achieved squatters right which were sanctioned by other groups entering the area later and the use rights thus consolidated.

Today, a member of another clan may regularly obtain water or use land and water together in the garden area only through permission of the clan "mother".

Women usually work in the gardens although old men have been observed, planting, repairing walls and directing the water into the various channels.

The other small gardens at Hotevilla and Bacabi are used by members of the villages and are not controlled by clan. This also applies to the gardens which have been developed by individuals away from the villages.

Safflower, Turban squash and wheat were introduced by the Mormons.[1] Wheat was introduced by Mormons and planted at Moencopi, a Hopi village outside the area under consideration.

In pre-historic times, corn, lima beans, kidney beans, sunflower, squash, aztec bean, tepary bean and cotton were probably the garden crop. Now, crops of chili, onions, sweet

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1. Whiting A. F. Ibid.

GARDENS

Garden	Acreage	Number of Operators
Talahogan	$4\frac{1}{2}$ acres	5 Hopis, 4 Navajos
First Mesa	4 "	20 "
Bacabi	$\frac{1}{4}$ "	20 "
Hotevilla	5 "	57 "
Lollama	1/10 "	3 "
Burro	1/10 "	4 "
Approximately	14 acres	113 Operators

Garden Crops[1]		In or adjacent to Garden
Coxcomb	Pea	Peach
Peanut	Radish	Pear
Beet	Safflower	Apple
Cauliflower	*Onion	Almond
Cabbage	*Chile	Apricot
Turnip	*Watermelon	Cherry
Coriander	Cress	Grapes
Cucumber	*Sweet Corn	
Carrot	Potato	
Lettuce		
Tomato		

* Bulk of Garden Produce.

1. Whiting, A. F. "Ethnobotany of the Hopi", Museum of N. Arizona Bull V # 15, June 1939, pp. 12-13.

corn, beans, and cress are raised in the plots. Peach trees are planted in areas not susceptible to terracing, or they may occupy the lowest terrace. Peach trees are also planted on the sand dunes which pile up against the mesa slopes near the gardens. Moisture from seepage along the mesa wall may supply a portion of the moisture held in the dune. At any rate, peach trees, melons, and squash seem to thrive on the dune slopes.

HP1673

Planting

There are two corn plantings, one takes place late in April and is designed to furnish corn for ceremonial purposes, specifically the departure of the Katchinas in July.[1] The main or second planting takes place later to avoid the early frosts and ~~avoid~~ the spring sand storms.

The early corn is planted in warm, sheltered locations and reaches maturity about July 25th.

The second planting has been described earlier but may be elaborated on here.

A typical corn plot varies in acreage but is usually about 50 paces wide and 70 to 100 paces long. The planter places the first hole between the rows of last year's stalks, then moves 3 to 5 paces down the new row and makes a second planting. This is repeated until the end of the plot has been reached. The planter then moves over to the next row, skipping the old row and moves back toward the starting point.

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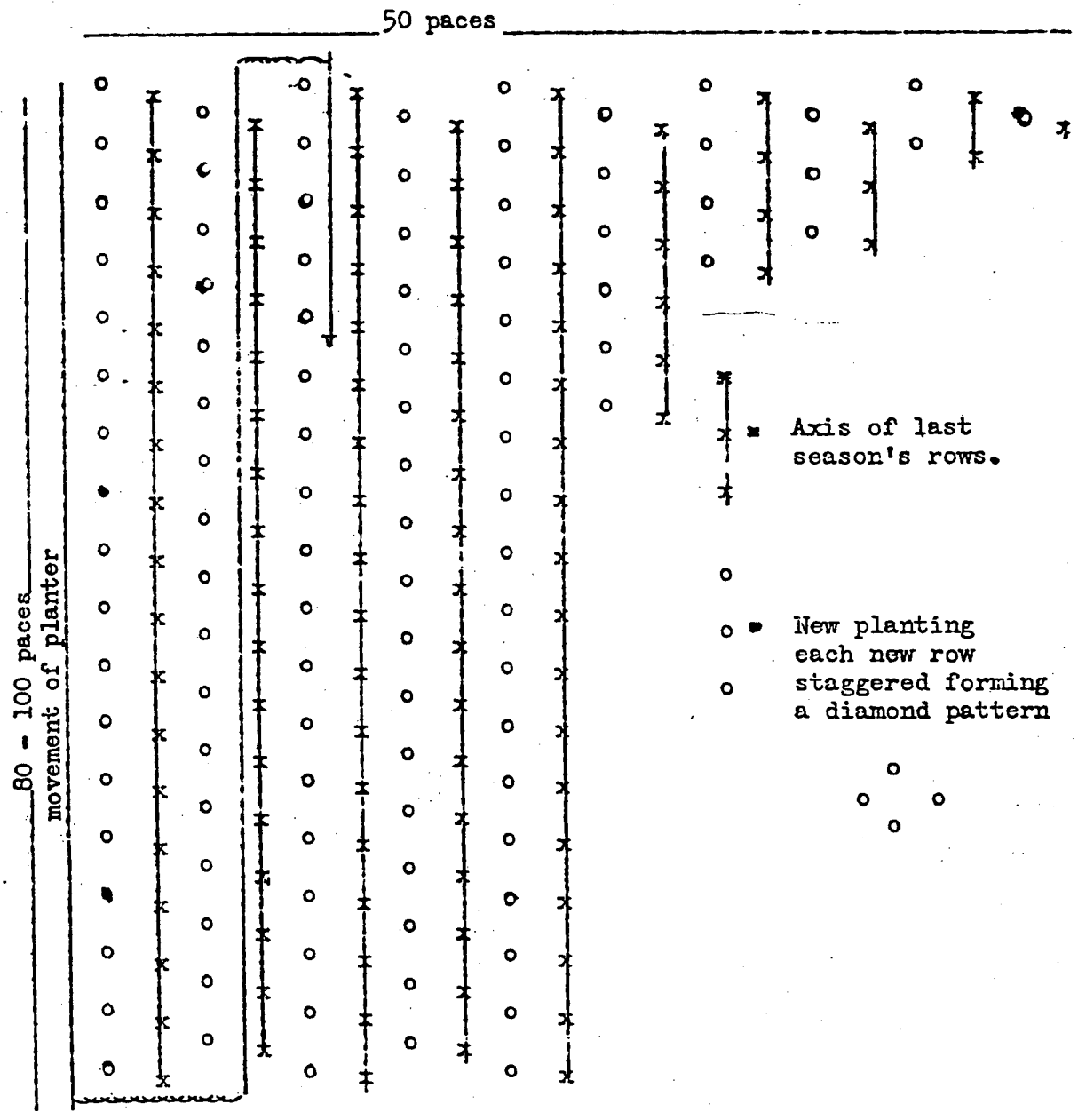
1. Forde, C. Daryll - Hopi Agriculture and Land Ownership.

TYPICAL PLANTING



A man may plant alone or he may exchange his services with other men, that is, a man will assist others in their planting in exchange for their help on his field. There is, in the majority of group's planting, a kinship tie either through the maternal clan or through friendships with members of the same religious clan. Too, groups may be organized within villages to plant fields for priests of the religious clans in exchange for their services during the year in the various societies.

Helpers, if not members of the operator's household group are paid with presents of food, reciprocal services or a promise of a share in the crops.

Beans, squashes, and melons are also planted in alternate rows and are usually planted in plots devoted to each crop and are rarely planted in with the corn. If the sprouts are not noted after the usual period of sprouting, the rows will be replanted to the same crop.

Beans are planted in "flats" or boxes in January and kept in the warm kivas. Watered carefully, and kept below the shaft of sunlight which comes through the kiva entrance, they may ~~are~~ attain a height of 10 or 12 inches before being picked. In ~~27~~ twenty one days they will be picked for use in fertility ceremonies.

Planting Dates

Corn:

Quoah ca-o - - - - - White corn, kernnels black and white, grows 5 to 6 feet high.

Ma-sie ca - - - - - Gray corn, grows about 4 to 5 ft. high
Note: Corn is planted June 15, and 12-15 corn seeds are sowed in each hill and when thinned, only seven to nine stalks remai

Beans:

Quocha hadigo - - - White lima bean, planted second week in May.

Pala hadigo - - - Red bean, planted last week in May.

Masie hadigo - - - Gray bean, spotted with black, planted about same time as red bean. Growing season is about 130 days.

Bacay Morize - - - White bean, planted about 15th of May.

Seka Morize - - - Yellow bean, planted about 15th of May.

Cabisun Morize - - Light red bean, planted about 15th of May Growing season is about 110 days.

Jiji Morize - - - Tiny white bean, planted 15th of May.

Mohmvi Morize - - - Black bean, planted 15th of May.

Pavitch Morize - - Cream color bean, planted in June. Growing season less than 100 days. Abou 8 beans are planted to a hill and when thinned only 4 bean stalks remain. Cut worms usually kill half of the bean plan

Mowesga- Morize - - String bean,
Red string bean)
White string bean) Growing season
Black string bean) about 80 days

Pumpkin Squash & Melons:

Pumpkin and Squash are planted about June 15th.[1]
Melons and Musk melons are planted about April 25th.

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1. Informant: Conrad Quoshena, New Oraibi, March 17th, 1939.

Planting Dates:- Second Mesa[1]

CROP	PLANTED		TIME TO RIPEN
Early corn	April 6-15	Ceremonial Use	70-75 days
Yellow corn	April 6-15		80-90 days
White, Blue, Red	April 6-15		120 days
Dark red	April 6-15		105 days
Lima beans	May 1		115 days
Beans	May 25		110 days
Melons	May 15		75 days
Pumpkins	May 15		75 days
Muskmelons	May 15		60-70 days

1. Informant: Cecil Calvert, Toreva, August, 1937.

HP1678

Importation of Seed

Whiting made a sample study of sources of seeds used by the Hopis and determined that about 1/3 of the crops raised are from seeds or slips obtained off of the reservation.[1]

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1. Sources:
   a. Barter among Hopis
   b. Seeds from eaten fruit (neighbors or other)
   c. Seeds purchased in the form of fruit to be eaten and seeds saved; from trading posts or stores. 16% of all seed planted comes from this source.
   d. Seed or stock bought off of reservation - 16% (of this 7% equals nursery stock, peaches, apples and nursery onion sets)

   Thus about 1/3 of the crops raised are (seeds or slips) obtained off of reservation.

   80% of beans are raised from local seed.
   50% of all crops planted are obtained by inheritance from older women of the household or from husbands or son's-in- law in family.

Of the 46 households sampled:

Distribution of Principal Crops

corn - 26%
beans - 20% melons - 22% fruit trees - 25% vegetables - 9%

Whiting, A. F. "Hopi Importation of Seed" - Museum of N. Arizona Notes Vol. 10, #5, pp. 15, Nov., 1937.

Harvesting and Storage of Crops

The early sweet corn, which has been planted early in warm sheltered spots or in the irrigated gardens, is cut green in July and roasted in pit ovens (See Plate) in the fields. The early roasted corn is usually eaten at the time but some may be stored for winter use.[1]

In September the main harvest begins. Parties work in the fields from early morning to sunset harvesting the corn which is then placed in "pickups", wagons or in bags thrown over a burro's back and carried to the villages.

The stalks are left for the foraging cattle and horses but loads of stalks and leaves may be carried to the villages to be used for winter feed for domestic livestock kept in the village.

The corn is stored in windowless, dry rooms in or under the living quarters, A custom which has not changed in a thousand years.

The corn is usually stacked by segregating it by colors, red, white, blue or parti-colored and by harvest years as an effort is made to keep at least two year's harvest in the storage rooms.

Seed corn may be stacked in a separate room.

Pumpkin and sweet squash are cut spirally into long strips and hung over wires or poles and allowed to dry in the sun.

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1. Forde, C. Daryll: Hopi Agriculture and Land Ownership.

HP1680

When dry they are stored away.

Peaches are cut into halves and placed on the bare rock surfaces in front of the storage houses which are to be seen along the edges of the mesas, back of the towns, and above the orchards. A watcher sits in front of the house, watching the sky and in the event of rain, carrying the partially dried peaches inside until the shower passes.

After the peaches are throughly sun dried they are stored away in bins for winter use or for barter with Navajos.

The peach grown by the Hopi ~~is~~ usually ~~either~~ a freestone variety ~~or a cling~~. It is small but very sweet and is highly prized by the Navajos.

Very few of the trees in the orchards have been pruned. My informant told me that the older people believed that harm would come to the tree's spirit if the tree was cut.

The branches, as a result of lack of care, grow low on the ground and the trees appear scrawny. Lower branches and the trunks are often wrapped in cloth to prevent burros and goats from nibbling at the outer bark.

HP1681

Cotton

In modern times the ~~tendency for Hopis to not raise cotton has been marked~~ Hopis have stopped raising cotton as a cro. Cotton batting is purchased from traders instead, with consequent loss of interest in cotton as a garden crop.

The Hopis apparently abandoned raising cotton later than the villagers of the Rio Grande as mention is made by Harrington that cotton embroidered goods were imported from Hopis by the people of the Upper Rio Grande Pueblos. [White cotton blankets with red and black woolen borders were woven at Nambe within living memory. Only fifty years ago, the last man to weave ceremonial blankets died.] delete

Casteneda and Espejo mention "towels" and mantels, embroidered and having tassels as being worn by the Moquis (Hopi).

Fewkes found cotton in the ruin of Awotobi, a former Hopi town abandoned in 1760. Other fragments of cloth were found in an earlier ruin of the Hopis "Kawauakuh" near Keams Canyon, Arizona.

Ives, an army officer on survey duty, while in Oraibi in May, 1878, mentioned that the men wore trousers of cotton which they grew locally and spun in their homes.

A little cotton is reputed to be raised in the Hopi gardens for purely ceremonial use, i.e. pahos and strings used in ceremonies. All pahos are tied together with such strings and all prayer offerings and cotton strings placed in the trails leading to the villages, when ceremonials are in progress, must be made of

cotton. Whether enough cotton is raised to meet this demand is doubtful.

Maenkopi raised cotton ~~as~~ abundant springs and ease of irrigation made such a crop easy to raise. A long arm of the Upper Sonoran life zone reaches this far north and allows cotton to grow.

Jeffers, an Indian Superintendent stationed at Tuba City, two miles from Maenkapi reported that considerable cotton was grown at Maenkopi in the early 1880's, but that its importance was decreasing rapidly.

Voth reported cotton being raised at Old Oraibi as a garden crop without irrigation but an agricultural survey in 1936 failed to reveal such a garden crop, at least of such size as to warrant mention by the Indians acting as guides.

Lorenzo Hubbell, trader at Oraibi, says that ease of trading for cotton batting at the trading posts has probably caused abandonment of the crop.

The Havasupai traded with the Hopis for cotton up to late times. The cotton, as raised by the Hopi, was a distinct species with the outstanding characteristics of being very sturdy and having a short early growing period, 84 days from ripening to weaving.

With the aid of early accounts we may then draw the con-

HP1683

clusion that cotton was raised in the Southwest among the Hopis, the Rio Grande villages, and the Pimas. Other tribes not located in locations favorable to cotton cultivation, trad~~ing~~ed other goods in exchange for cotton or cotton products. A continuous cultivated crop prior to 1540 (Pedro de Tabor's account) and up to the early 1880's.

APPENDIX A

Historical References
to Livestock and Agriculture
in the Hopi Unit
1540 - 1936

HP1685

the expeditions would be brought to the Hopi missions as well as sheep and fruit trees and new seeds to bolster the native agricultural economy of beans, maize and squash. Blackmar notes that "Onate petitioned to take 7,000 cattle and horses on his expedition of January, 1598."[1]

In July or August of 1629, a party of three priests and 10 soldiers left Santa Fe for Tusayan with peach seeds, melons, wheat, apricots and garden vegetables, a herd of sheep, a drove of cattle and some horses.

After the revolt of 1680, no attempt was made to reestablish contact with Hopis until the reoccupation of New Mexico in 1692 by Diego de Vargas who visited Awatobi. Eight years after this event a padre, Juan Garaicoechea visited Awatobi in 1700 by invitation of the Oraibi chief. A mission was not established, but the act of friendliness on the part of the inhabitants of Awatobi cost most of them their lives. Hopis of other villages burned and killed and totally destroyed Awatobi in 1701.[2]

Remnants of the Badger clan from Awatobi now exist at Mishongovi and Shipaulovi and their head, Luke, still has a voice in division of land at Talahogan garden, a walled garden on the north side of Antelope mesa about two miles west of

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1. Compare: Blackmar, Frank: Spanish Institutions of the Southwest, pp. 223; Baltimore, John Hopkins Press, 1891.

2. Harvard University, under direction of Mr. J. O. Brew has prepared for study, possible grains which might have been incorporated in adobe blocks. Wheat straws and peach stones were found. Bones of two domestic sheep were found in a kiva near the mission quarter, indicating that sheep were kept at the mission.

HP1686

Awatobi.[1]

Sometime between 1680 and 1692 a group of Tewas from Payupke (now known as Sandia) on the Rio Grande settled among the Hopi until the consequences of the revolt were over, but returned to Sandia in 1742.[2]

In the ten years between 1700 and 1710 another group of Tewas from the Rio Grande settled on First Mesa between the "notch" and Sichomovi, ostensibly as a buffer group between the Hopis and the Utes and Navajos who were constantly raiding for corn and women.[3] Their descendents still live in the original quarters, the town of Hano. The Tewas had a reputation as warriors and were induced to move their families to First Mesa. As a reward the Hopis gave them grants of land in the Wepo and Polacca washes for farming purposes.[4] These Tewas brought their own cattle with them.[5]

Escalante noted that they " . . . raised fruit, various kinds of garden vegetables, corn, beans, chili, and cotton, apt at weaving and spinning. . . . They also raised cattle and

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1. Page, G. B.: Unpublished Mss.

2. Coues, E.: pp. 395.

3. Tewa informant--B. Cooka.

4. Page, G. B.: Report of Study Group C, Department of Agriculture, Soil Conservation Service, Gallup, N. Mex., 1936.

5. Hodge, F. W.: Handbook of American Indians North of Mexico, Vol. 2, pp. 687; Washington, D.C., 1907-1910.

sheep and made vaious kinds of useful implements. In these, as well as fabrics, they had commercial relations with neighboring tribes, especially the Yumas and Mohaves of the Colorado River."[1]

Fray Garces saw implements of Moqui make among the Colorado River Indians on his journey from Mohave to Moqui.

Espejo's entrada to Tusayan brought horses as noted " . . . and the people do not leave the villages except to go to their farms, especially at this time, when they heard that Cibola had been captured by very fierce people who traveled on animals which ate people . . . "[2], evidently the Hopis had forgotten the horses of the Coronado party.

After de Vargas' resumption of Spanish rule, an expedition was sent to Moqui to pacify them. The Moqui, influenced against the Spanish by the Apache de Navajo, drove in their cattle and prepared for war.[3]

Jesuits attempted to ~~usurp~~ occupy the Hopi Franciscan mission

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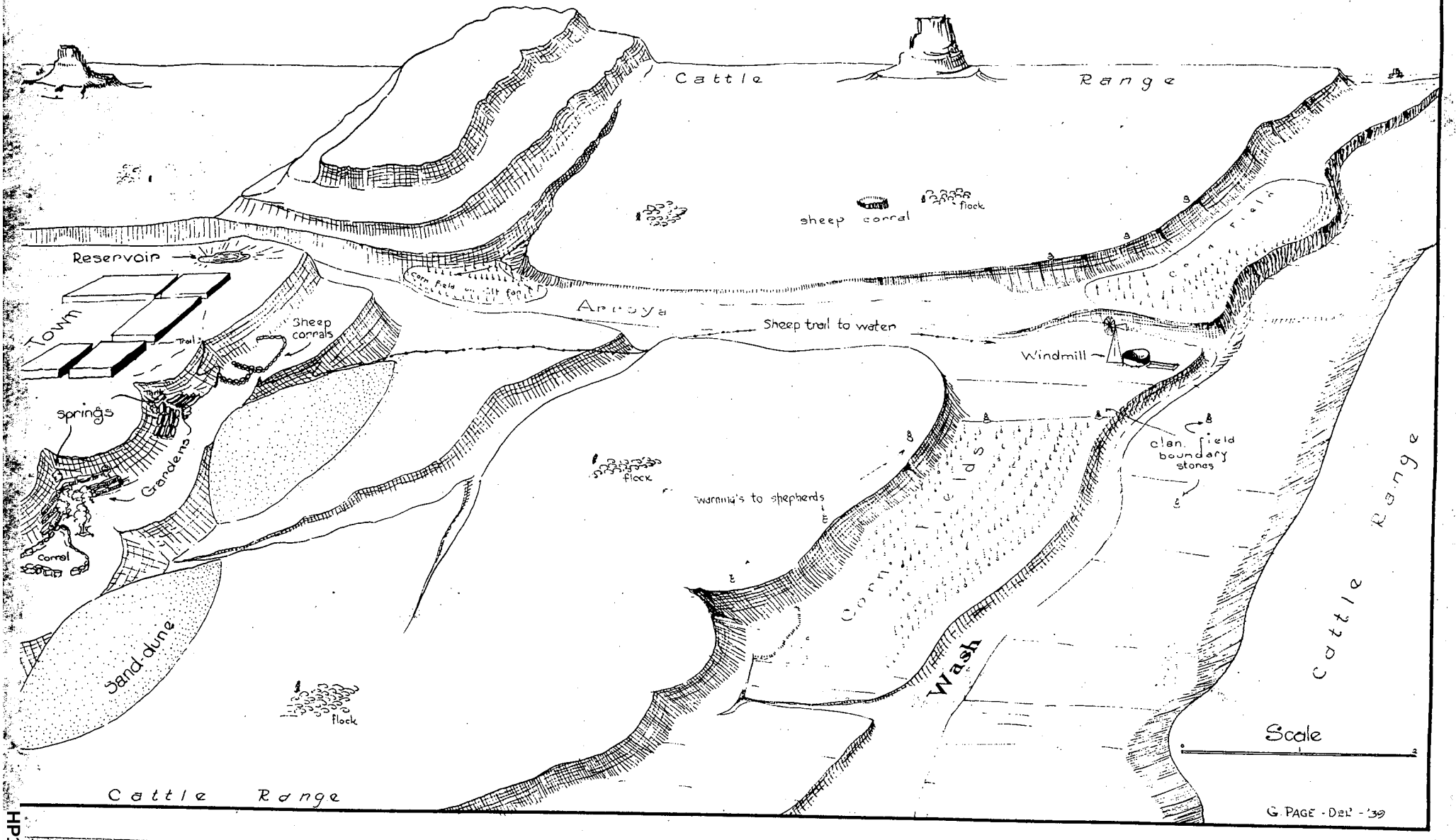
1. Escalante, Silvestre Velez de; Diary of a Journey to Moqui in June 1775, Mss. in Archivo General de Indies Seville--Maas Vicyces de Misioneras Francisco printed form.

2. Winship: Journey of Coronado, 1540-42, pp. 33.

3. Archives of New Mexico. In Documentary History Series, iii, pp. 134-40, 168-71.

THE RELATION OF VILLAGE TO ECONOMIC BASE



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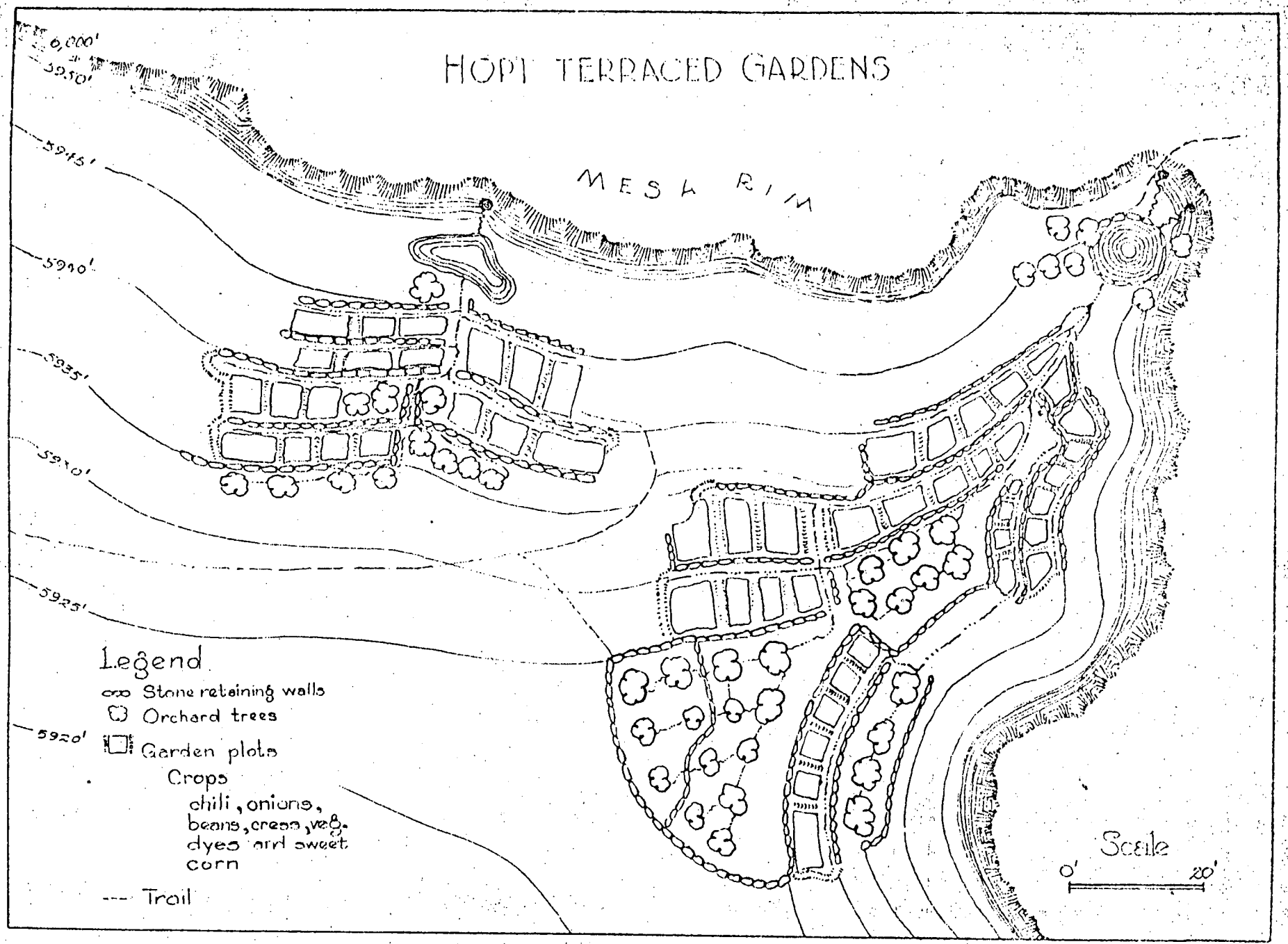
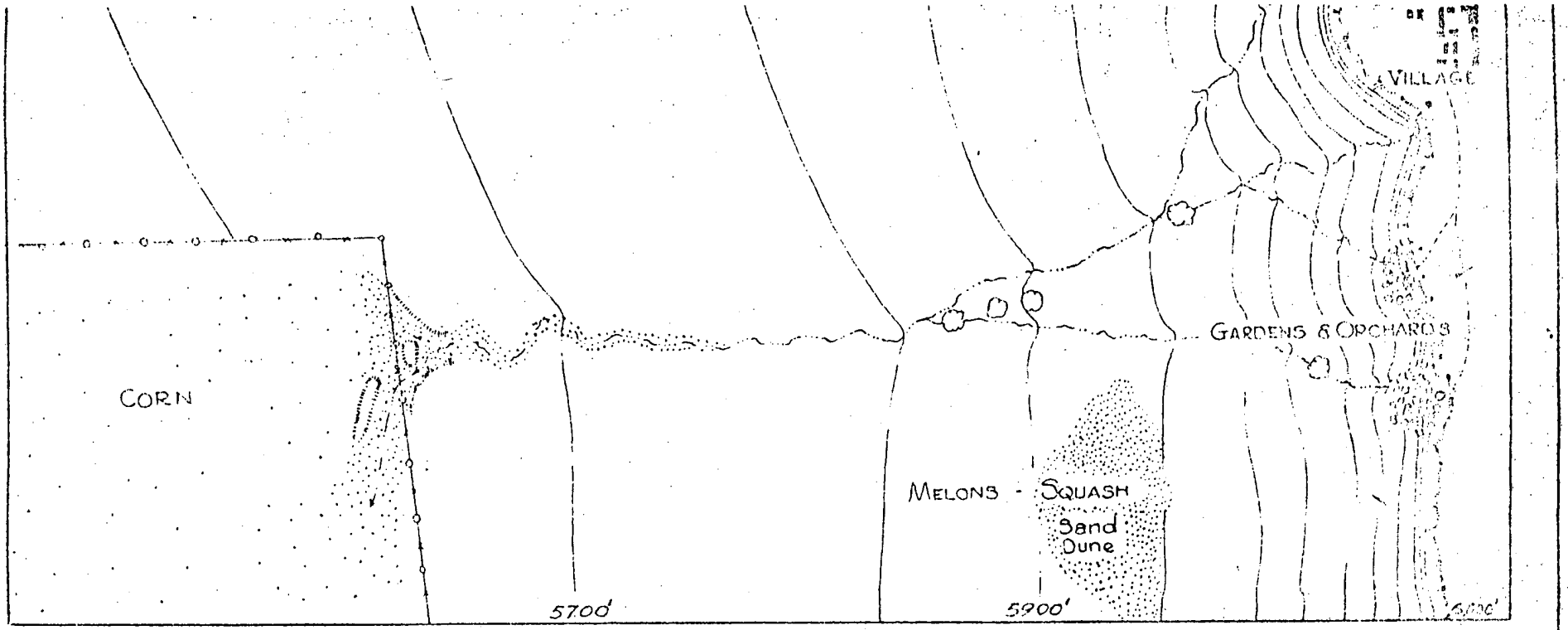


GARDEN PLOTS

HP1690



TRANSITION ZONES

0' 400'

GORDON B. PAGE '39

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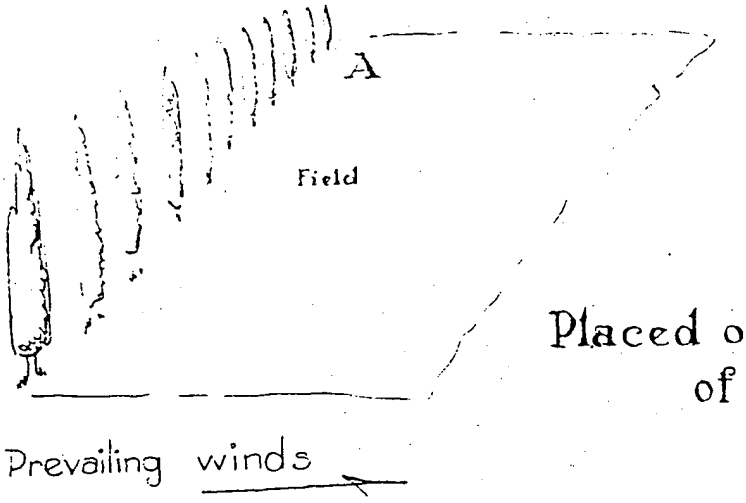
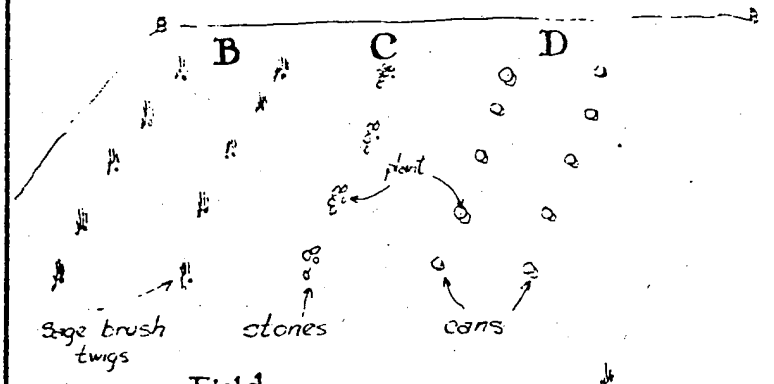
HP1691

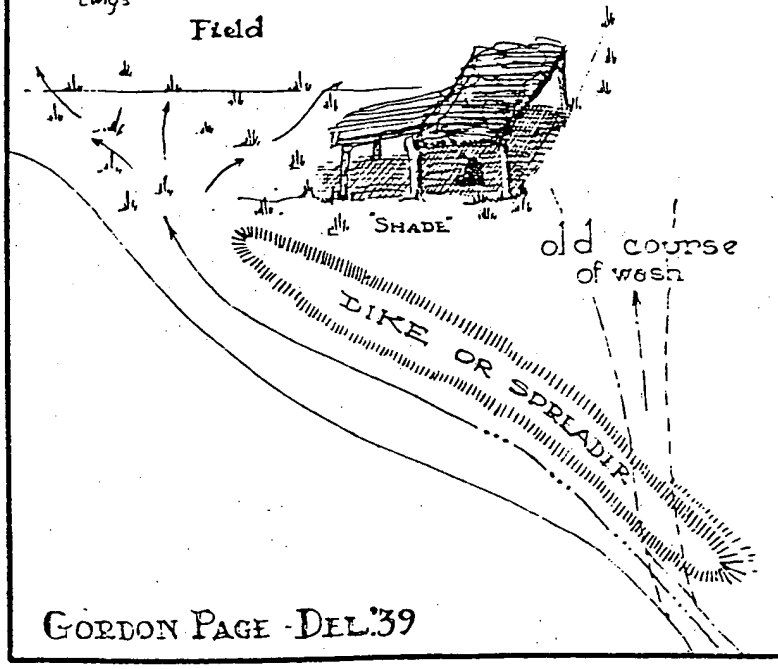
METHODS OF PROTECTING CROPS

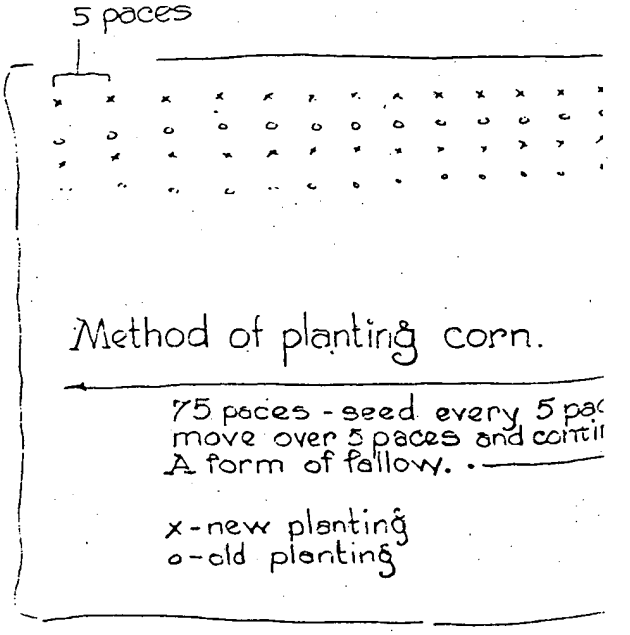


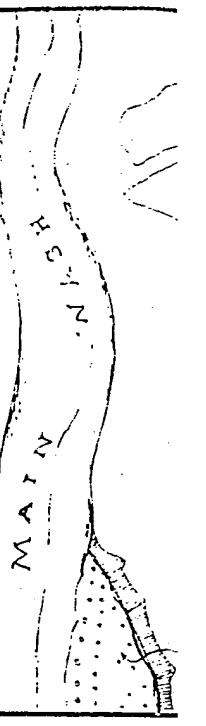
A trees
B shrubs-twigs
C stones
D tin cans

Placed on windward side of plants









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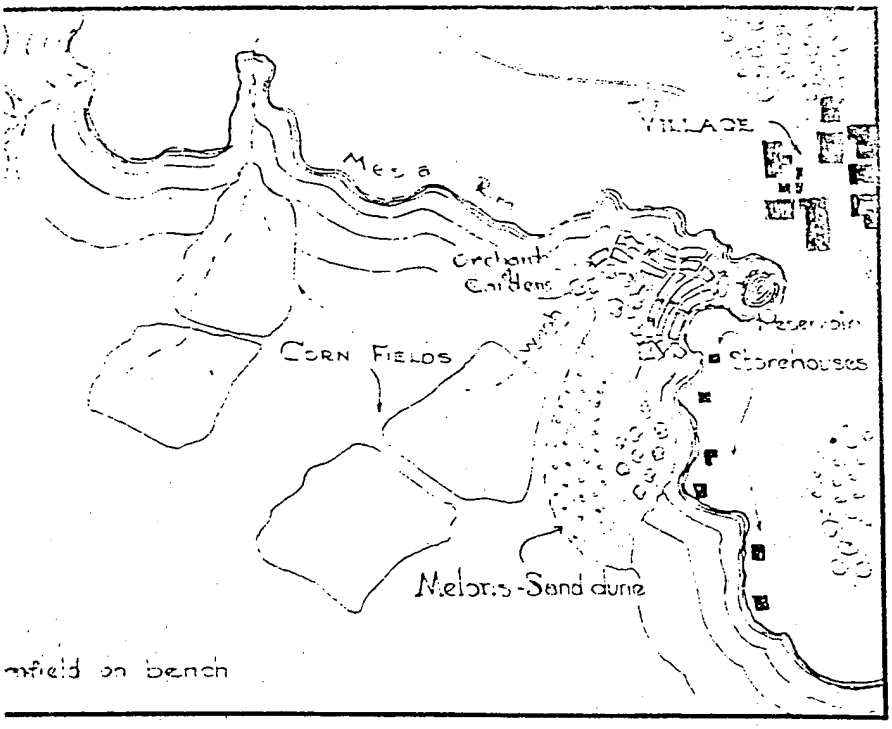
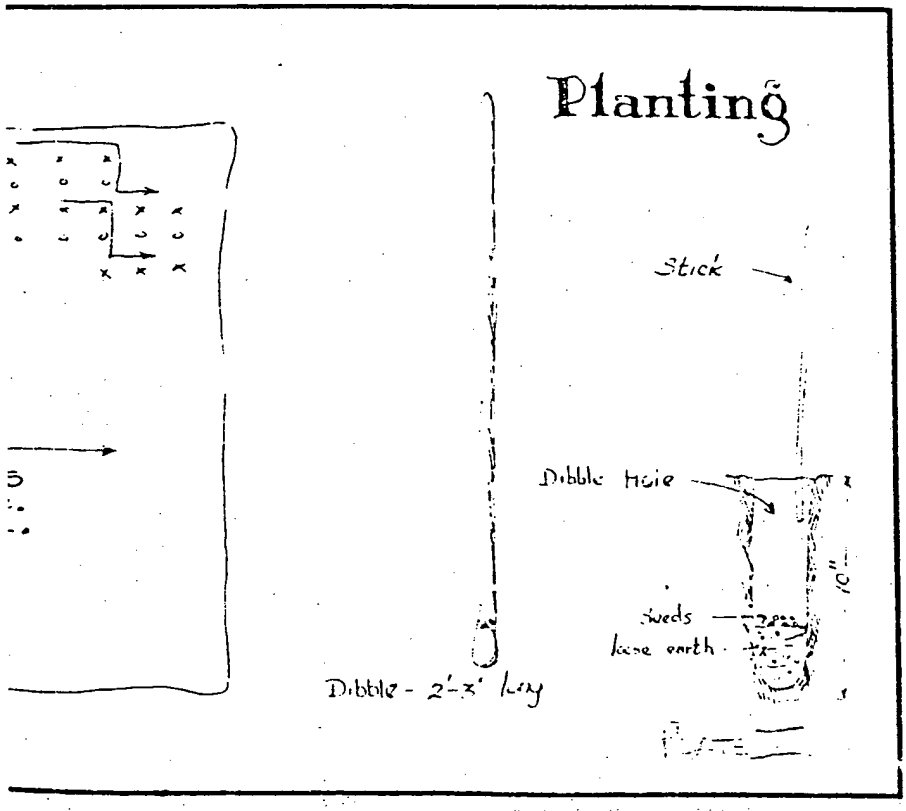


CK OF A HOPI VILLAGE TO GARDENS
AND CORN FIELDS



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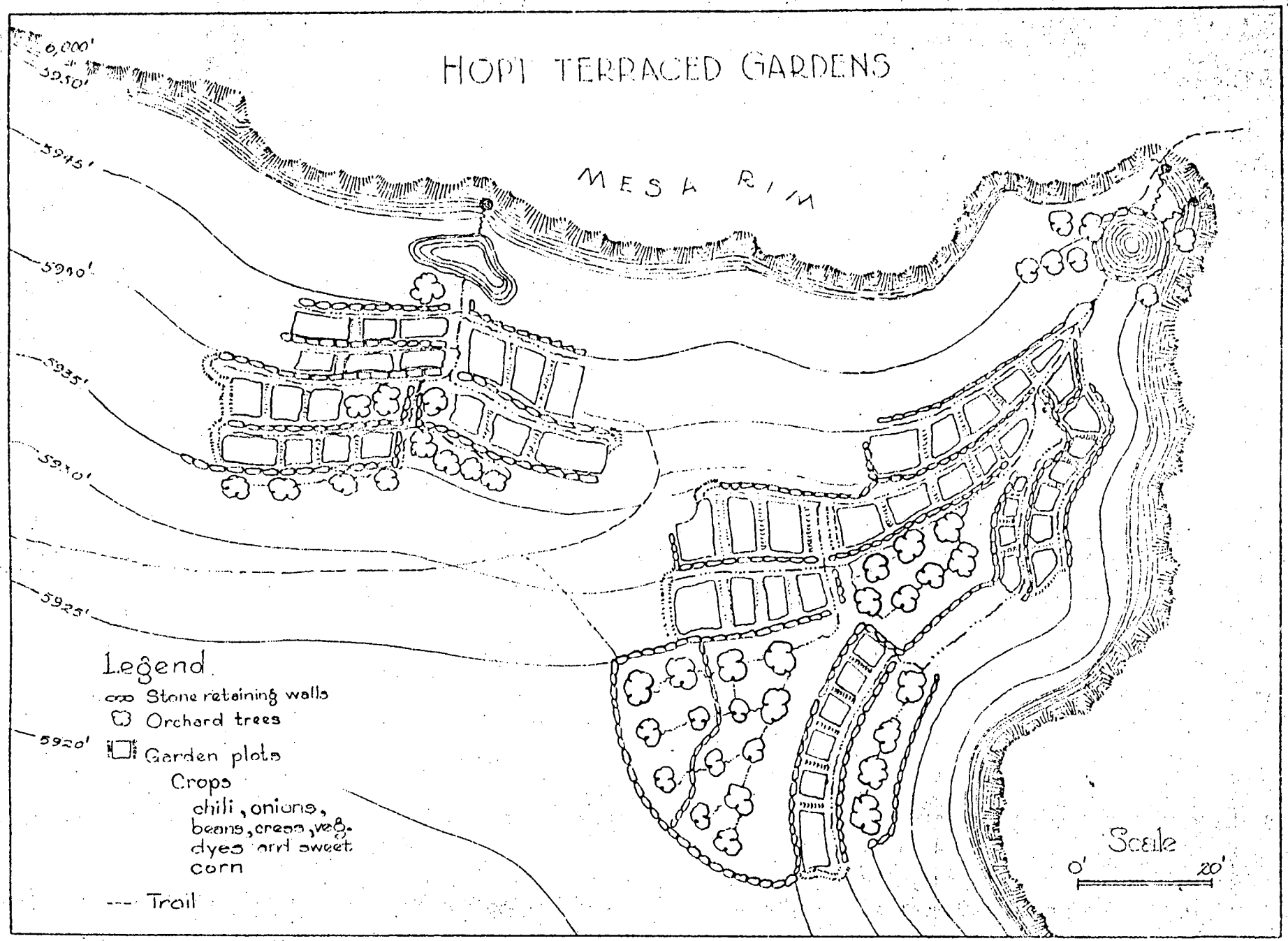

GARDEN PLOTS

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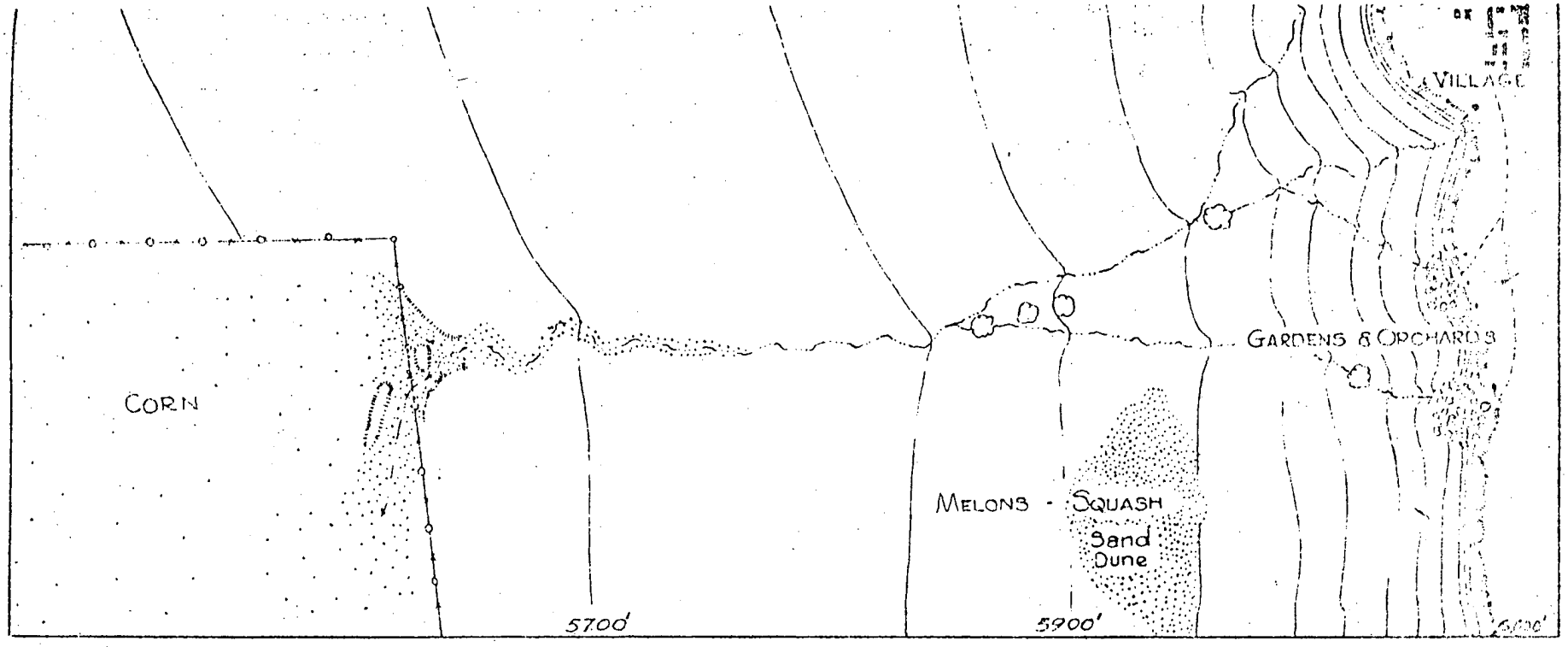


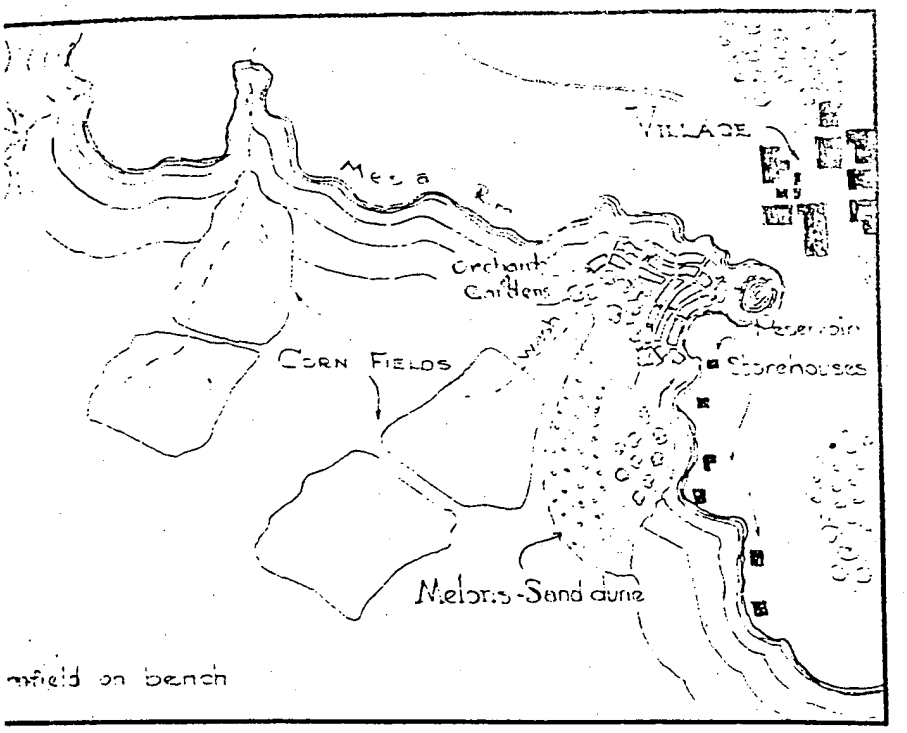
TRANSITION ZONES

0' 400'

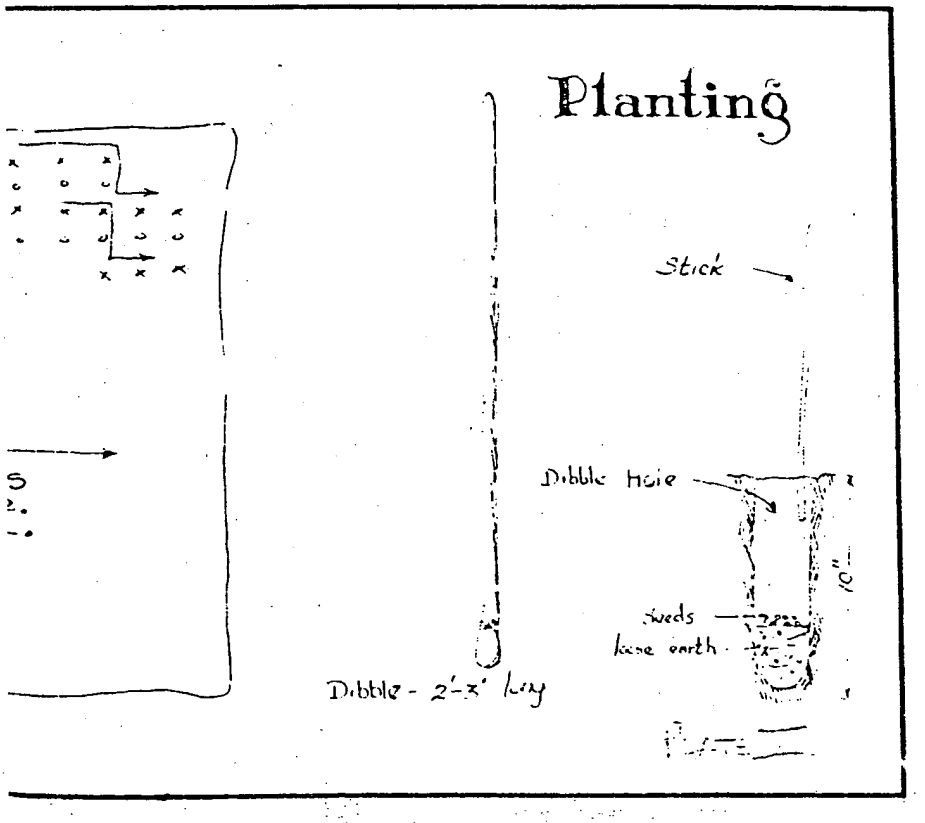
GORDON B. PAGE '39

N-2326

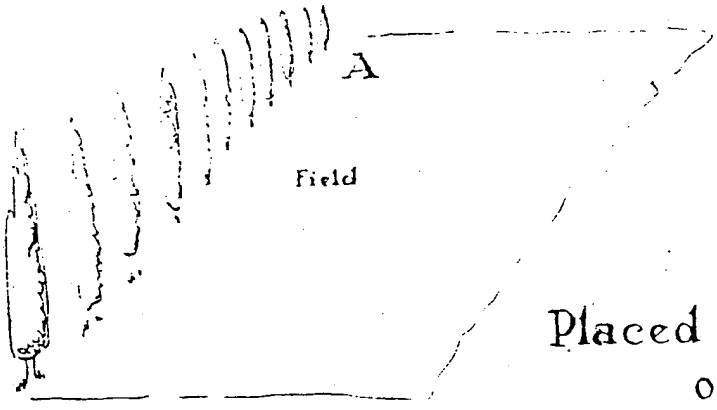
HP1695



CK OF A HOPI VILLAGE TO GARDENS
AND CORN FIELDS



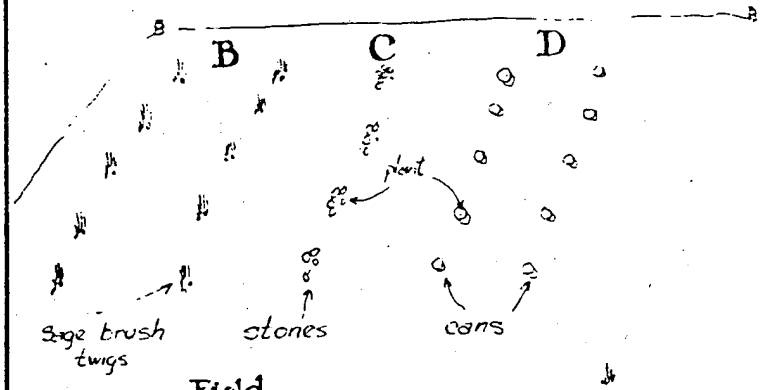
METHODS OF PROTECTING CROPS

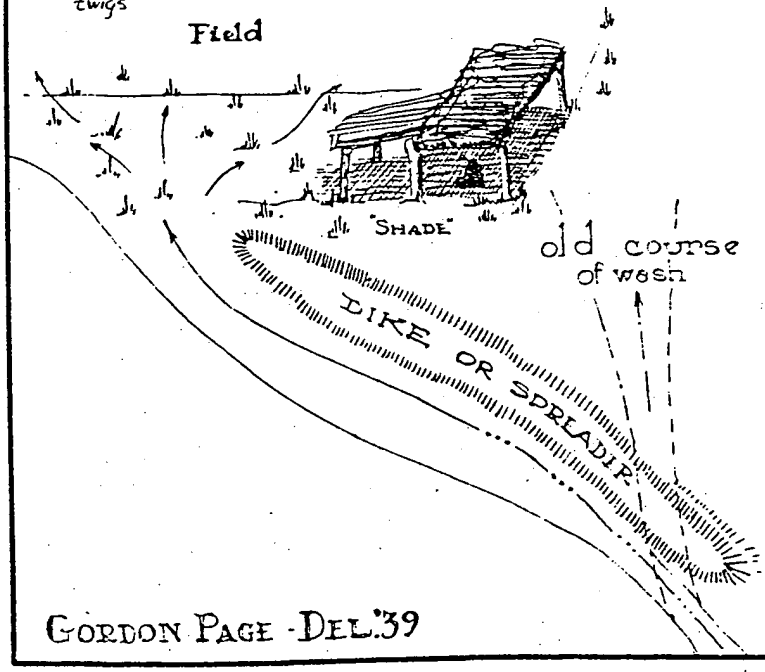


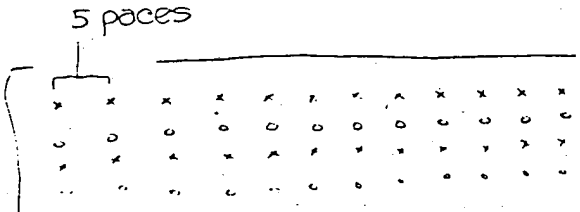
A trees
B shrubs-twigs
C stones
D tin cans

Placed on windward side of plants

Prevailing winds



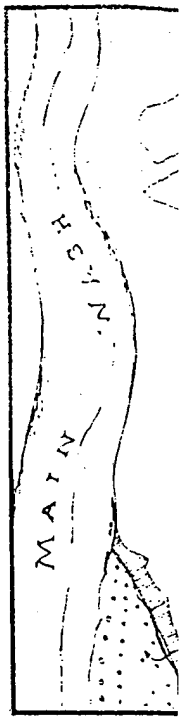




Method of planting corn.

75 paces - seed every 5 p
move over 5 paces and co
A form of fallow.

x - new planting
o - old planting



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