

SMITHSONIAN MISCELLANEOUS COLLECTIONS

VOLUME 60, NUMBER 6

THE COTTON OF THE HOPI INDIANS: A  
NEW SPECIES OF GOSSYPIUM

WITH FIVE PLATES

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(PUBLICATION 2146)

CITY OF WASHINGTON  
PUBLISHED BY THE SMITHSONIAN INSTITUTION  
OCTOBER 23, 1912

The Lord Baltimore Press  
BALTIMORE, MD., U. S. A.

# THE COTTON OF THE HOPI INDIANS: A NEW SPECIES OF GOSSYPIUM

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(WITH FIVE PLATES)

## INTRODUCTION

The origin and growth of cotton cultivation in the United States has received the careful attention of historians, ethnologists, statisticians and others, and much has been written concerning the development of this great industry of our country.<sup>1</sup> The identity and description of those varieties which laid the foundation of the American Upland cotton are questions which have received the attention of several writers, notably Watt,<sup>2</sup> Fletcher,<sup>3</sup> and de Lasteyrie.<sup>4</sup> The types of plants which compose the field crop as it is grown to-day have been systematically studied only within the last few years.<sup>5</sup>

To what extent the cotton cultivated at the present time in the United States has been influenced by the types introduced by the colonists of several European nations, by the tropical species imported from Mexico, Central America and the West Indies, or by the types of cotton native within the present boundaries of the United States when the white man came, it would be difficult to say. It is believed, however, that the last-named factor has had, if any, the least effect upon the present-day field crop. The following notes on a type of cotton long in cultivation by the Pueblo Indians of the Southwest are offered as a contribution to the study of American cottons:

## ANTIQUITY OF COTTON CULTURE IN THE SOUTHWEST

That cotton was used and cultivated in the southwestern part of the United States in prehistoric times has been shown by several explorers

<sup>1</sup> Payne, E. J.: *History of the New World Called America*, 1892, pp. 406, 408-411, 416.

Handy, R. B.: *Office of Experiment Stations, U. S. Dept. Agriculture, Bulletin 33*, 1896, pp. 17-43.

Donnell, E. J.: *Chronological and Statistical History of Cotton*, 1872.

<sup>2</sup> Watt, Geo.: *Wild and Cultivated Cotton Plants of the World*, 1909, pp. 17-22.

<sup>3</sup> Fletcher, F.: *Cairo Sci. Journ.*, 1909, vol. 3, pp. 263-268.

<sup>4</sup> de Lasteyrie, C. P.: *Du Cotonnier et de sa Culture*, 1868.

<sup>5</sup> Tyler, F. J.: *Bur. Plant Industry, U. S. Dept. Agric., Bull. 163*, 1910.

Duggar, J. F.: *Alabama Agric. Exp. Sta., Bull. 140*, 1907.

of the villages of the cliff-dwellers, those wonderful relics in the Mesa Verde National Park which were in ruins when first seen by the white man.

The Swedish explorer, G. Nordenskiöld,<sup>1</sup> and Dr. J. Walter Fewkes,<sup>2</sup> of the Bureau of American Ethnology, both report finding fragments of cotton cloth as fairly common in most of the cliff-dwellings. Nordenskiöld says:

Cotton was used by the cliff-dwellers as the raw material of superior textile fabrics. Numerous fragments of cotton cloth have been found. The cotton shrub was probably cultivated by the cliff people, at least in some localities, for in the cliff-dwellings of southern Utah, the seeds of this shrub have been observed. On the Mesa Verde no such find has been made.

Dr. Fewkes reports finding cotton cloth in the ruins at Casa Grande in southern Arizona<sup>3</sup> and in the cliff villages of the Red Rock country in the Rio Verde Valley of Arizona.<sup>4</sup> The ruins of the latter region closely resemble those of Tusayan, the limited area now inhabited by the Hopi Indians, and seem to support the claim of the Hopi that some of their ancestors formerly lived in that region. Dr. Fewkes says of these finds:

Fabrics made of cotton are common in the ruins of the Red-rocks, and at times this fiber was combined with yucca. Some of the specimens of cotton cloth were finely woven and are still quite strong, although stained dark or almost black. Specimens of netting are also common, and an open-mesh legging, similar to the kind manufactured in ancient times by the Hopi and still worn by certain personators in their sacred dances, were taken from the western room of Honanki. There were also many fragments of rope, string, cord, and loosely twisted bands, resembling head bands for carrying burdens. A reed in which was inserted a fragment of cotton fiber was unlike anything yet reported from cliff houses, and as the end of the cotton which projected beyond the cavity of the reed was charred, it possibly was used as a slow-match or tinder box.<sup>4</sup>

#### REFERENCES TO COTTON BY THE FIRST SPANISH EXPLORERS

Francisco Vasquez de Coronado was appointed governor of the province of New Galicia in April, 1539, by the good viceroy of Mexico, Antonio de Mendoza. A few months later he was sent on an expedition to explore the country north of Mexico and verify the reports of the great riches of the region which had been brought back by

<sup>1</sup> Nordenskiöld, G.: *The Cliff-Dwellers of the Mesa Verde*, 1893, pp. 94, 104.

<sup>2</sup> Fewkes, J. Walter: *Bur. Amer. Ethnol., Bull. 41*, 1909, pp. 43, 45, fig. 17; *Bull. 51*, 1911, p. 76.

<sup>3</sup> 28th Ann. Rep. *Bur. Amer. Ethnol.* (in press, 1912).

<sup>4</sup> 17th Ann. Rep. *Bur. Amer. Ethnol.*, 1898, p. 573.

Padre Marcos de Niza and Melchior Diaz. Coronado's expedition resulted in the discovery of the Pueblo Indians of New Mexico and Arizona, the Grand Canyon of the Colorado and the bison of the plains. Pedro Casteñada de Najera, the historian of the Coronado expedition, mentions the Pueblo Indians as wearing cotton blankets and giving them presents of cotton cloth.<sup>1</sup>

In Coronado's letter to Mendoza, dated August 3, 1540, and in other papers of the Coronado expedition there is mention of cotton raising by the natives of the region<sup>2</sup> extending from the present southern to the northern boundaries of Arizona and eastward to the Rio Grande.

#### EVIDENCES OF FORMER CULTIVATION BY THE HOPI INDIANS

In 1895 Dr. J. Walter Fewkes made explorations in Awatobi, an historic Hopi ruin which was destroyed in 1700, and reports finding evidence of the use of cotton by the inhabitants.

In the very earliest accounts which we have of Tusayan, the Hopi are said to raise cotton and to weave it into mantles. These mantles, or "towels" as they were styled by Espejo, were, according to Casteñada, ornamented with embroidery, and had tassels at the corners. . . .

The historical references which can be mentioned to prove that the Tusayan people, when they were first visited, knew how to spin and weave are numerous, and need not be quoted here. That the people of Awatobi made cotton fabrics there is no doubt, for it is distinctly stated by early visitors that they were acquainted with the art of weaving, and some of the presents made to the first Spanish explorers were of native cotton. Archeological evidence supports the historical in this particular, and several fragments of cloth were found in our excavations in the western mounds of the village. These fragments were of cotton and agave fiber, of cotton alone, and in one instance of the hair of some unknown animal.<sup>3</sup>

Later, Dr. Walter Hough, of the U. S. National Museum, in making excavations in the large ruin of Kawaiokuh, near the Keam's Canyon road, found offerings of cotton and other seeds accompanying burials. The cotton seed resembled that still raised by the Hopi Indians of Oraibi village at Moenkopi.<sup>4</sup>

Lieut. Joseph C. Ives explored in 1858 the Colorado River and the country occupied by the Hopi (Moqui) Indians. At the Pueblo of Tegua, east of Oraibi, May 17, 1858, he wrote as follows:

The unpassable cañons west of the territory of these Indians have thrown them out of the line of travel and exploration, and there has been no record

<sup>1</sup> 14th Ann. Rep. Bur. Amer. Ethnol., 1896, pp. 480, 517.

<sup>2</sup> 14th Ann. Rep. Bur. Amer. Ethnol., 1896, pp. 550, 560, 569, 574, 575.

<sup>3</sup> 17th Ann. Rep. Bur. Amer. Ethnol., 1898, p. 620.

<sup>4</sup> Ann. Rep. U. S. Nat. Mus., 1901, pp. 341, 345.

concerning them since the accounts of the early Spanish missionaries, who visited the country, and described the "seven cities" which they found there. . . . The men wear loose cotton trousers, and frequently a kind of blouse for an upper garment, over which they throw a blanket. The dress of the women is invariably a loose black woolen gown with a gold-colored stripe around the waist and bottom of the skirt. The stripe is of cotton which they grow in small quantities.<sup>1</sup>

#### EVIDENCES OF FORMER CULTIVATION BY THE PIMA INDIANS

The Spanish missionary, Padre Pedro Font, who accompanied Padre Francisco Garcés in his fifth journey from the San Xavier Mission to the Pima Indians on the Gila River, kept an extended diary of the journey. On November 1, 1775, he wrote:

I also saw how they wove cloaks of cotton, a product which they sew and spin; and the greater number of them know how to weave.<sup>2</sup>

Mr. John R. Bartlett, U. S. Commissioner of the United States and Mexican Boundary Commission during the years 1850 to 1853, also records the Pimas on the Gila as raising cotton:

Cotton is raised by them (the Pimas), which they spin and weave. Their only manufactures consist of blankets of various textures and sizes; a heavy cloth of the same material used by the women to put around their loins; and an article from 3 to 4 inches wide, used as a band for the head, or a girdle for the waist. The blankets are woven with large threads, slightly twisted and without any nap. They are made of white cotton, and are without ornament of colors or figures, save a narrow selvage of buff. . . . The weaving is generally done by the old men.<sup>3</sup>

Lieut. A. W. Whipple, U. S. A., also of the Mexican Boundary Commission, in an official report of the survey of the Gila River, dated January 10, 1852, describes finding an Indian garden in the Cascade Grotto, where were melons, maize, beans, and to his great surprise, a field of cotton. He also states that the banks of the Gila from the Pima settlement to the junction of the Salt River, were fertile, producing crops of cotton of the first quality.<sup>4</sup>

The suitability of this region for growing cotton and the familiarity

<sup>1</sup> Ives, Jos. C.: Report upon the Colorado River of the West, 1861, pp. 116, 127.

<sup>2</sup> 26th Ann. Rep. Bur. Amer. Ethnol., 1908, p. 29.

See also Coues, E.: On the Trail of a Spanish Pioneer, 1900, vol. 2, p. 386.

<sup>3</sup> Bartlett, John R.: Personal Narrative of Explorations and Incidents in Texas, New Mexico, California, Sonora and Chihuahua, 1854, vol. 2, p. 224.

<sup>4</sup> Bartlett, John R.: Personal Narrative of Explorations and Incidents in Texas, New Mexico, California, Sonora and Chihuahua, 1854, vol. 2, pp. 598, 599.

of the Indians with the plant led to an experiment a few years later, when at the close of the Civil War, cotton was bringing such a very high price. Charles D. Poston, who, in 1864, was appointed Superintendent of Indian Affairs for Arizona, stated in that year that he had recently furnished the Pimas with 500 pounds of cotton seed.<sup>1</sup> This experiment resulted in but little and the introduction of foreign varieties of cotton into the agriculture of these Indians brought a source of confusion to any later studies of the type grown by them from time immemorial.

Mr. Frank Russell, writing in 1908 of the Pima Indians on the Gila River, says that the cotton plant is no longer raised by them, but that from pre-Spanish days down to the last quarter of a century it was cultivated both for the fiber and the seeds. The latter were pounded up with mesquite beans in a mortar, or they were sometimes parched and eaten without grinding.<sup>2</sup>

#### MODERN USES BY THE HOPI INDIANS

The Hopi Indians of Arizona highly esteem the cotton plant and its fiber enters into many of their ceremonial services as well as into daily practical use. The Indians consider that all strings used in the services must be made of native cotton. The most important uses of cotton in the ceremonials are as follows:

All prayer sticks (*pahos*) must be tied together with cotton string; prayer offerings of all kinds must be tied with cotton string; cotton strings are placed in the trails entering the pueblos when ceremonials are in progress; the badges of chiefs (called *tiponis*) are wrapped in native rough-spun cotton strings; light, fluffy cotton to represent snow or clouds; cotton also used to weave ceremonial kilts, large cotton belts and wedding blankets.<sup>3</sup>

When a Hopi girl is to wed, all the men of the bridegroom's clan meet and make for the bride a complete outfit of clothing, consisting of the following:

A wedding blanket of cotton embroidered on one edge to be used by the bride on ceremonial occasions, as dedication of children to the sun, etc.; a large cotton belt, called the "knotted belt," because of the knots tied in the warp strings at each end of the woof; a woolen blanket for everyday use; moccasins, etc.

<sup>1</sup> 26th Ann. Rep. Bur. Amer. Ethnol., 1908, pp. 33, 77.

<sup>2</sup> 26th Ann. Rep. Bur. Amer. Ethnol., 1908, pp. 77.

<sup>3</sup> For the list of ceremonial uses I am indebted to Dr. J. Walter Fewkes of the Bureau of American Ethnology.

Nordenskiöld refers to the use of cotton by the Hopis as follows:

Among the productions of the Moki industry we first remark the textile fabrics. Both of wool and cotton they weave mantles, blankets and rugs of artistic designs. Cotton they formerly cultivated at home, but now find it more convenient to buy the cloth ready made at the store.<sup>1</sup>

#### MODERN CULTIVATION BY THE HOPIS

At the small village of Moenkopi, which is now included in the Western Navajo Reservation, there are abundant springs and water available for the irrigation of the Indians' fields. A long arm of the Upper Sonoran life zone here projects up from the south and makes cotton raising possible.

According to Mr. C. R. Jefferis, Superintendent of the Western Navajo School at Tuba, Arizona, a considerable amount of cotton was formerly grown at this point and it was spun and woven into garments by the Indians living here and in other villages of the reservation, but at present very little is grown.

Near the village of Oraibi, on the Moqui Reservation<sup>2</sup> about fifty miles to the eastward, the cultivation of cotton on a small scale is carried on by the Indians as a regular crop in their pueblo gardens near the village, without any irrigation whatever. This is corroborated by Mr. Frank A. Thackeray, Supervisor of Schools, and by the Rev. H. R. Voth, for several years a missionary at Oraibi.

The cotton raised at Oraibi is worthy of careful study as that is probably the only Tusayan pueblo, at present inhabited, which occupies practically the same site that it did in 1540, when it was discovered by Pedro de Tobar of Coronado's expedition.

Mr. Lorenzo Hubbel, who conducts the trading post at Kean's Canyon, Arizona, writes that the Hopi Indians have given up the cultivation of cotton. According to Mr. Hubbel, they have for some time past been buying cotton batting from the traders and spinning it instead of that of their own raising, and that at present they are giving up the custom of buying the raw cotton in favor of cotton yarn spun at the mills.

#### EXPERIMENTS WITH HOPI COTTON

The Hopi cotton has been grown for study and for breeding experiments by the U. S. Department of Agriculture for the past seven

<sup>1</sup> Nordenskiöld, G.: *Cliff-Dwellers of the Mesa Verde*, 1893, p. 141.

<sup>2</sup> The official designation of the Office of Indian Affairs in the Interior Department. The Indians and the ethnologists much prefer the name "Hopi" (the good people), instead of "Moqui" (dead man), which is used as a term of reproach.



years, and when protected by isolation from hybridization with other cottons by bees, has shown itself to be a very distinct species, having certain well-marked characteristics. The original seed for this study was obtained in 1901, 1907 and 1911 from the Moqui and Western Navajo Reservations in northern Arizona by three different persons.

The first lot of seed tested was turned over to the Department of Agriculture by Dr. Walter Hough, of the U. S. National Museum. Dr. Hough, while engaged in studies on the Hopi Indian Reservation in Arizona for the Bureau of American Ethnology, obtained the cotton seed from a Hopi Indian named Sam Pawiki, living at Oraibi, Arizona, who stated that the seed was raised at Tuba, about 25 miles to the northwest.

The second stock of this truly American cotton was grown from a few bolls also raised at Tuba, Arizona, and obtained in 1907 by Mr. J. G. Kent, an agent sent by the Office of Indian Affairs on a mission to the Hopi Reservation. Mr. Kent sent the bolls to Dr. Hough, of the U. S. National Museum, who gave them to the writer.

The third lot of seed was procured for the writer by Mr. Frank A. Thackeray, Supervisor of Schools, from the Hopis of Oraibi village.

While the plants grown from these three lots of seed show some variation, one dominant type runs through all and is described on page 9.

This cotton is remarkable for its earliness; plants have ripened bolls in 84 days from the sowing of the seed. In a test of several hundred species and varieties of cottons from all parts of the world, it was the first to bloom. A study of the branching habits of this species shows that this precocity is due to the appearance of fruiting branches at a very early period in the growth of the plant. The following tabulation of a group of 44 normal plants, grown at San Antonio, Texas, 1911, shows the node at which the first fruiting branch appears, counting from that which bears the cotyledons. The first fruiting branch appeared at the 3d node in one plant, at the 4th node in six plants, at the 5th node in twenty-seven plants, at the 6th node in nine plants, at the 7th node in one plant.

As is usually the case with most wild or little-cultivated types of cotton, there is a great preponderance of 3- and 4-locked bolls. A count of 19 plants at San Antonio, grown from the original seed obtained by Mr. Kent, showed a total of 519 bolls, of which 30.05 per cent were 3-locked, 59.35 per cent were 4-locked and 10.6 per cent were 5-locked.

Seed of Hopi cotton was furnished Professor W. Lawrence Balls

for use in experiments on Mendelian inheritance in cotton. He reports<sup>1</sup> this species as blooming earlier than the others in the experiment, the plants being in full bloom in 70 days and the first boll ripening 100 days after the planting of the seed.

In spite of the small bolls and short, sparse lint of the Hopi cotton, its extreme earliness and prolificness under very arid conditions may make it of value in breeding new types of cottons for special conditions.

#### DESCRIPTION OF HOPI COTTON

The plants studied and from which the description given on page 9 is drawn were all grown from the seed obtained by Dr. Hough and Mr. Kent from Tuba, Arizona, and Mr. Thackeray from Oraibi, to which reference has already been made. Seed of Hopi cotton was also received from Mr. C. R. Jefferis, Superintendent of the Western Navajo School at Tuba, Arizona; from Mr. Lorenzo Hubbel, trader, of Keam's Canyon, Arizona, and from Dr. J. Walter Fewkes, of the Bureau of American Ethnology. The last lot of seed was collected by Mr. Thos. B. Keam at Oraibi village in 1889 and was included in the Keam collection purchased by Dr. Fewkes for the Hemenway collection in the Peabody Museum at Cambridge, Mass. Other specimens of what appears to be the same cotton have been received from Mr. E. W. Hudson, at the Pima Reservation, Sacaton, Arizona; and Mrs. Matilda Coxe Stevenson from Tonyo Camp, Española, New Mexico.

The Hopi cotton is so conspicuously different from other species and especially the American Upland cottons that it is believed to represent a new species, the particular diagnostic characters of which may be expressed as follows:

- (1) Yellow green color of the whole plant; even the pulvinus of the leaves is yellow or orange instead of red.
- (2) Low branching, almost prostrate habit; fruiting branches often as low as the third or fourth node.
- (3) Paired fruiting branches, and often an axillary vegetative branch from the same node on the stem.
- (4) Zigzag character of stem and branches.
- (5) Swollen nodes of the stem and especially the branches.
- (6) Numerous entire leaves, especially upon secondary branches.
- (7) Leaf nectaries close to base of leaf blade, 5-7 mm. distant.
- (8) Large size of scars left by fallen leaves and flowers.

<sup>1</sup> Yearbook Khedivial Agricultural Society, Cairo, 1906, p. 18.

(9) Flowers developed on secondary fruiting branches simultaneously with those on the primary fruiting branch.

(10) Lemon yellow color of flowers and absence of red from claws of petals.

(11) Very short style.

(12) Smooth, unpitted surface of bolls.

(13) Extreme early appearance of the flowers.

## TECHNICAL DESCRIPTION OF HOPI COTTON

### GOSSYPIUM HOPI Lewton, new species

*Plant* small, spreading widely, compact, branching very low.

*Stem* ascending, almost prostrate, crooked or zigzag with swollen nodes, coarsely hairy, yellowish-green.

*Limbs* at base usually 1, sometimes 2 or 3, horizontal or ascending; axillary limbs very small and weak, developing later in the season from the lower nodes of the leaning stem, those from the upper nodes often adnate to small extra branches for nearly their entire length.

*Branches* usually a pair at each node, those of each pair often of the same length and diverging from each other at an angle of  $90^\circ$ , when one is much smaller it is usually adnate with the small axillary limb from the same node; secondary branches almost always developed, blooming with the primary ones; nodes much swollen; scars left by fallen leaves or flowers large and conspicuous.

*Leaves* flat, rather thick, yellowish-green, usually 3-lobed, but often cordate and entire or with one or two blunt lobes (the smaller leaves on the secondary branches almost always entire), the lobes broad and blunt; basal sinus very shallow and open; soft hairy both sides, with coarse hairs; pulvinus very small, green or orange, never red; petioles short, very hairy; nectaries on leaves of both stem and branches 1, close to base of leaf blade (5-7 mm. distant), small, round or oval, deep, the edges but slightly raised.

*Bracts* of *involucre* small, triangular-cordate or long-oval, hairy, thick, stiff leathery and much reticulated; laciniae 5 to 9, coarse, short, hairy; nectaries 3, very large, round, smooth; bractlets sometimes present.

*Calyx* closely appressed to corolla, slightly lobed or undulate, smooth; black dots evenly distributed; external nectaries 3, small, triangular, smooth; internal nectary with narrow band of hairs above.

*Flowers* small, one-third longer than the involucre.

*Petals* lemon yellow, rarely almost white, without spots on claws, conspicuously black dotted.

*Stamens* many, long; staminal tube dentate at top, often petaliferous; filaments lemon yellow; pollen cream or white, plentiful.

*Style* very short, not exerted beyond stamens.

*Bolls* small, round or somewhat oval, blunt-pointed, 3- to 5-locked, smooth as if waxed; the black oil glands well below the surface.

*Seeds* dark brown, devoid of fuzz, except for a crown of brown or olivaceous hairs on the pointed end; rather sparsely covered with lint.

*Lint* white, strong, fine and silky, 18 to 25 mm. long, the ratio of lint to seed varying from 20 to 30 per cent.

Type in U. S. National Herbarium, No. 691075. Collected at Victoria, Texas, August 4, 1909, by F. L. Lewton (No. 1009), the plants grown from seed obtained from Hopi Indians at Tuba, Arizona.

#### REFERENCES TO HOPI COTTON AND SPECIMENS IN HERBARIA

The specimens of Hopi cotton in the U. S. National Herbarium, the Economic Herbarium of the U. S. Department of Agriculture, and those supplied Sir George Watt by Mr. L. H. Dewey, of Washington, D. C., and Mr. W. Lawrence Balls, of Cairo, Egypt, are all descended from the original seed given Dr. Hough by Sam Pawiki.<sup>1</sup> Professor Balls in his experiments on Mendelian inheritance in cotton used seed of Hopi cotton supplied by the U. S. Department of Agriculture, which was grown in Waco, Texas, from the original Arizona seed.<sup>2</sup> This accounts for the close similarity of the Egyptian and Washington specimens which evidently puzzled Dr. Watt and shows the fallacy of his theory of the origin of the "Hindi weed" cotton of Egypt as "but an older acclimatized (and possibly recessive) hybrid of Moqui."<sup>3</sup>

<sup>1</sup> The original seed was received under the name "Moqui" and the specimens grown therefrom, which are now in several herbaria and mentioned in the two works referred to below, were so labelled. See footnote 2 on page 6.

<sup>2</sup> Yearbook Khedivial Agricultural Society, Cairo, 1906, pp. 17-18, 38, 56.

<sup>3</sup> Watt, Sir George: *The Wild and Cultivated Cotton Plants of the World*, 1909, p. 181.



TYPICAL PLANT OF HOPI COTTON (*GOSSYPIUM HOPI*)  
Cultivated at San Antonio, Texas



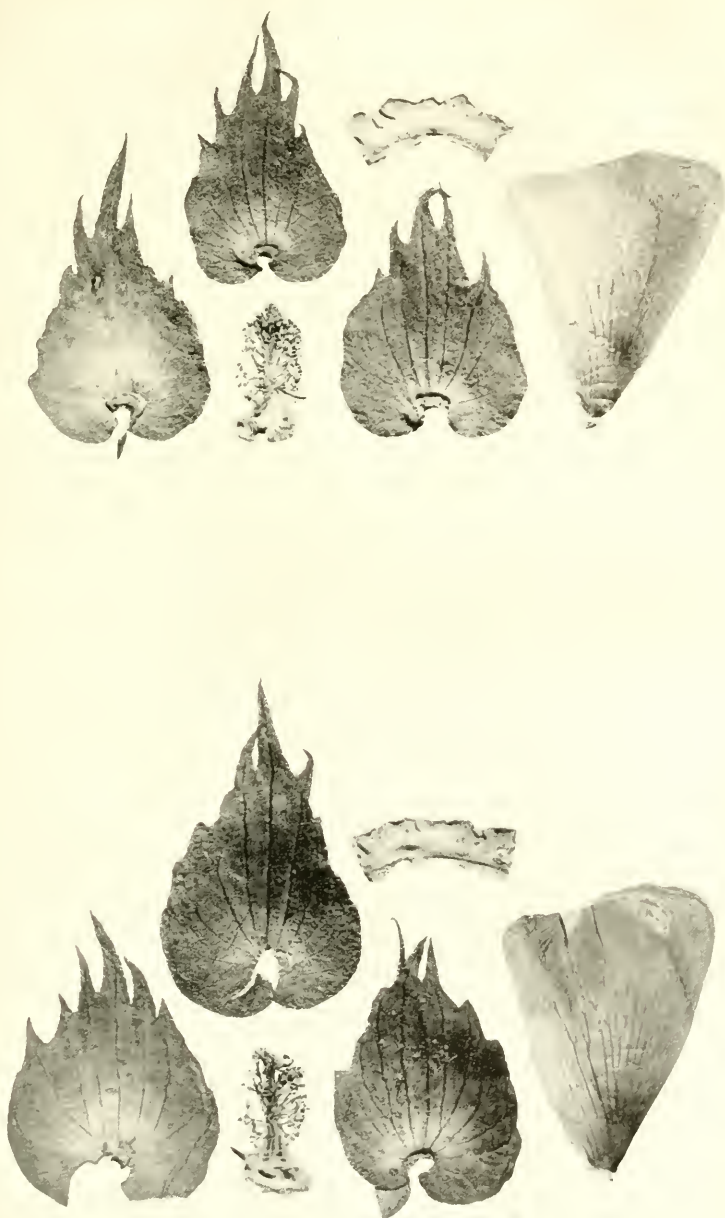


TYPICAL PLANT OF HOPI COTTON (*GOSSYPIMUM HOPI*)

Leaves removed to show paired branches and low fruiting habit  
A specimen cultivated at San Antonio, Texas

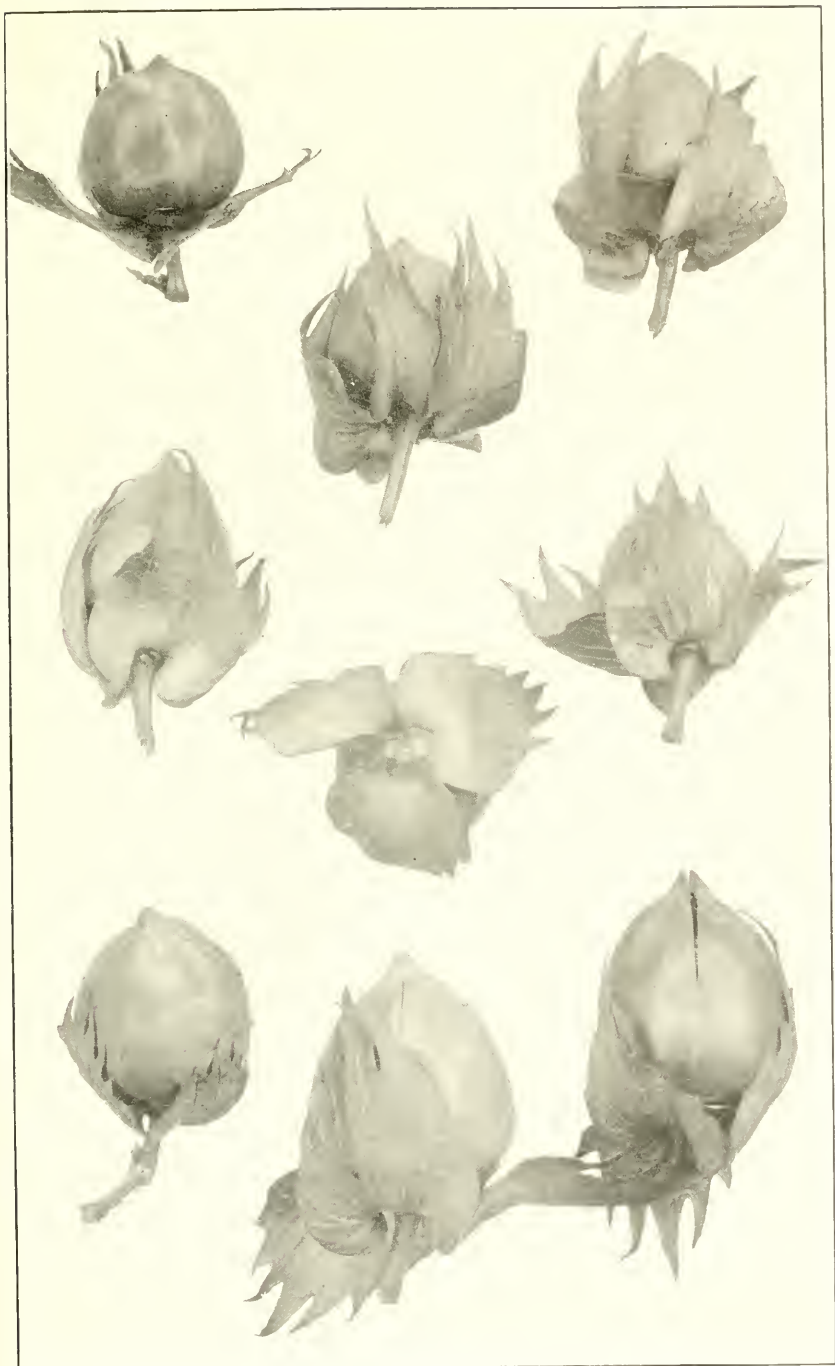




TWO FLOWERS OF HOPI COTTON (*GOSYPIUM HOPI*)

Dissected to show involucral bracts, inner and outer surface of calyx, staminal column and petals  
(Natural size)

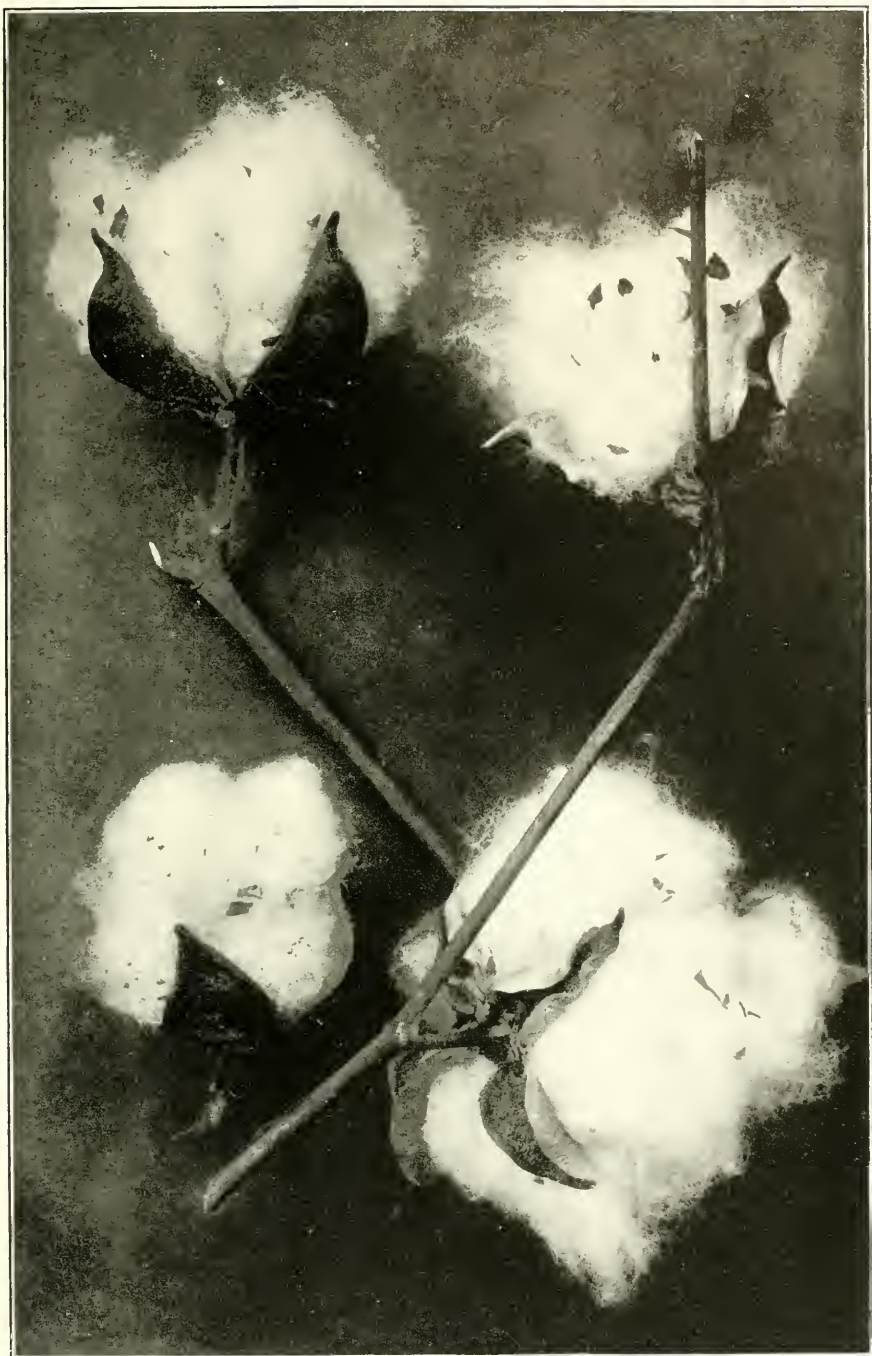




MATURE BOLLS OF HOPI COTTON (*GOSSYPIMUM HOPI*)

Showing unpitted surface of bolls, reticulation of involucral bracts and extra-floral nectaries  
(Natural size)





RIPE BOLLS OF HOPI COTTON (GOSSYPUM HOPI)

Collected by Mr. J. G. Kent from Hopi Indians at Tuba, Arizona  
(Natural size)