COTTON

COTTON CULTIVATION

INTRODUCTION

1. Principal Species.—Cotton is a vegetable fiber—the fruit of a plant belonging to the order of the Malvaceæ, to which belong the mallow, the hollyhock, and the okra. The cotton plant belongs to the genus **Gossypium,** and the number of species from a botanical point of view is variously stated as from four to eighty-eight, according to different botanists. The principal species of the cotton plant cultivated for commercial purposes are: *Gossypium herbaceum*, *Gossypium arboreum*, *Gossypium hirsutum*, and *Gossypium Barbadense.*

The species known as **Gossypium herbaceum** grows from 2 to 6 feet high and is found native or exotic in Northern Africa and in Asia; it is also largely cultivated in the United States of America.

The **Gossypium arboreum** grows to the height of 15 or 20 feet, whence it derives the name of tree cotton. The seeds are covered with a short green fiber. While the plant is found in Asia, it is most largely cultivated in Central and South America.

The **Gossypium hirsutum** is a shrubby plant, its maximum height being about 6 feet. The young pods are hairy; the seeds numerous, free, and covered with firmly adhering green down under the long white wool.

The **Gossypium Barbadense** attains a height of from 5 to 10 feet. The seeds of this plant are black and smooth and the fiber the longest known to commerce. The name is

derived from the fact that the plant is a native of the Barbados, or has been cultivated there for a long time. The sea-island cotton plant of the United States belongs to this species.

Cotton fiber is known to commerce under the simple name of *cotton* in English-speaking countries, although by some people it is spoken of as *cotton wool*. Its German name is *baum-wolle;* in French, its name is *coton;* in Spanish, it is called *algodon*.

2. Growth and Development.—In cultivating cotton in the United States, the time of planting the seed varies according to the latitude of the district in question, but occurs in April in the majority of districts. In some of the favored districts of Mississippi, Louisiana, and Texas, where the season is abnormally long, the seed is planted in the latter part of March. In the heart of the cotton belt, April 1 is accepted as a suitable date; in North and South Carolina and Tennessee it is considered unwise to plant before April 15; while in the extreme northern edge of the belt, as in Virginia, planting is deferred to the last days of April or early in May.

Germination occurs rapidly after the sowing of the seed, the first appearance of the plant above the ground being from 4 to 14 days after sowing. From the germination period until the middle of the summer the stalk and foliage of the plant are developed until the plant attains its maximum size; during this period hot, humid weather with frequent showers is favorable. From the middle of summer and onwards the bearing season of the plant occurs, when more heat and less moisture are desirable.

Usually about 40 days after the plant shows above the ground there appears the first **square,** or bud. From the formation of this bud 24 to 30 days elapse before the appearance of the flower. The flower on the first day of the opening of the bud is yellowish white and has five petals. One peculiarity of the cotton plant is in the change of color of the flower. This, which on the first day is of a shade varying from a dull white to a yellow, is found on the second day to be of a distinctly pink or reddish hue; the flower drops off on the succeeding, or third, day.

After the petals fall, there remains the small boll enveloped in the calyx; this develops until it becomes about the shape and size of an egg, and finally bursts from 50 to 60 days after the appearance of the flower.

When the boll bursts, it exposes from three to five cells divided by membranous walls; each cell contains seeds,

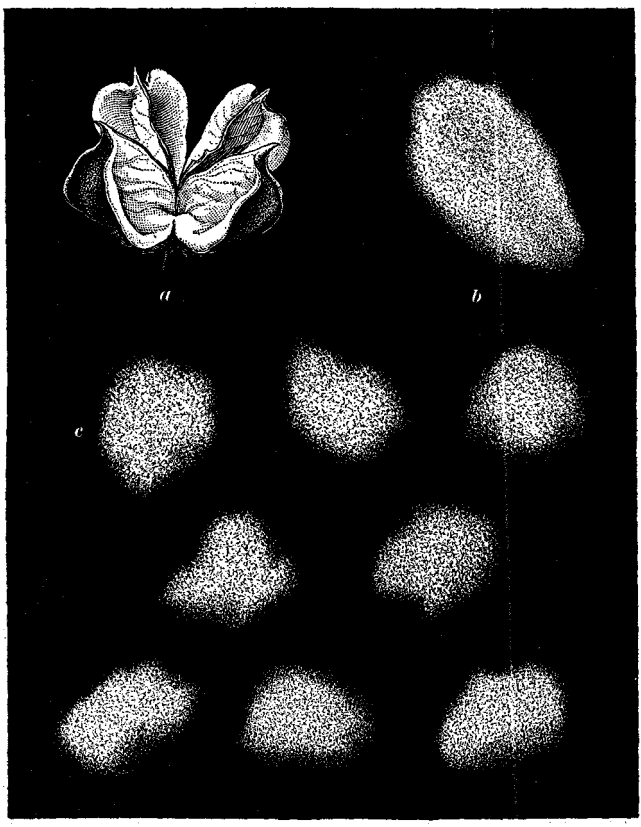

FIG. 1

which are attached by filaments to the membrane of the boll. The filaments ultimately disappear, leaving the seed loose in the cavity and covered with cotton. Each seed is entirely enveloped by the cotton fibers attached to it just as the

human hair is attached to the head. The seeds vary in number from thirty-two to thirty-six in each pod, or boll. The view at *a*, Fig. 1, shows an empty pod, or capsule; *b* is the seed cotton out of one cavity of the pod just as it appears after it has been removed by the fingers of the cotton picker; *c* shows the individual seeds and fibers of which the mass *b* is composed. The next view, Fig. 2, is a reproduction of sections of these seeds with the fibers radiating in all directions, each attached at one end to the seed. Botanists differ as to the exact cause of the bursting of the boll, but it is probably due to the increased space occupied by the fiber as it ripens and dries and the contraction and splitting of the pod from the same cause.

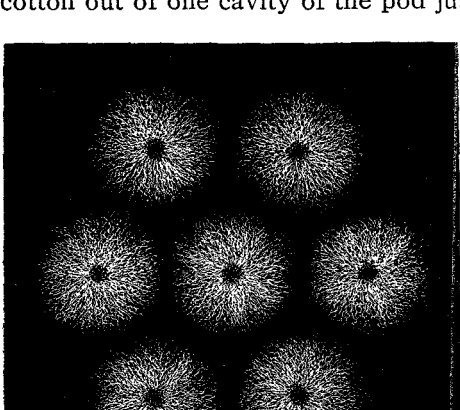

FIG. 2

3. The operations of cotton culture on land that has been previously cultivated, and on well-managed farms, may be summarized as follows, varying according to the latitude of the cotton field: Breaking up, burying vegetation, broadcast manuring, and harrowing, December and January; bedding up, February; fertilizing, March; sowing seeds, April; chopping out to a stand and throwing soil up to the root, May; (considerably more seeds are sown than plants required; the excess of plants are chopped out with hoes); cultivating by plow and hoe, or cultivator, latter part of May or in June; period of rest, part of July and part of August; picking, August, September, October, November, and if the season is an open one, December and even January.

STRUCTURE OF THE COTTON FIBER

4. The cotton fiber, which to the naked eye appears to be a fine, smooth, and solid filament, exhibits a somewhat complicated structure when examined under a microscope. A microscopic view of cotton fibers is shown in Fig. 3. Each fiber appears to be a collapsed tube with corded edges, twisted many times throughout its length and having the appearance of an elongated corkscrew. This semi-spiral construction assists in the formation of a strong thread from such a comparatively weak fiber as cotton. In the formation of a thread, the convolutions interlock with one another and help to resist any tension put on the yarn. These convolutions are less and less frequent as the fiber is less matured, and are almost altogether absent in the immature fiber, which has merely the appearance of a flattened ribbon when examined under a microscope. The immature fiber is transparent and has a glossy appearance, so that when it exists in any quantity in a bale of cotton it can readily be detected with the naked eye. It has the feature of not taking dye so readily as ripened cotton.

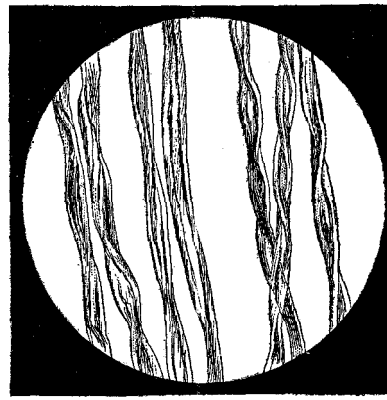

FIG. 3

If examined under a more powerful microscope, the cotton fiber is found to consist of four distinct membranes, or layers of matter. Ignoring the removable foreign matter contained in raw cotton, such as sand and other mineral substances, leaf, pieces of boll, or stalk, and considering the fiber as being entirely cleared from this, it is found to be composed of cellulose, permeated by a small amount of mineral matter, and that each fiber is surrounded by soluble substances present to the extent of from 1 to 2 per cent. The small

amount of mineral matter may be liberated by burning the fiber, the inorganic matter remaining as an ash retaining more or less the formation of the fiber and being about 1 per cent. of the original weight.

Cellulose is the largest constituent of the cotton fiber; in fact, it is the chief constituent of almost everything of vegetable origin, but is found with its most characteristic features in such commercial fibers as cotton, ramie, flax, and so on. It is a carbohydrate, so called because it is composed of carbon, hydrogen, and oxygen, the hydrogen and oxygen being present in the same proportion as in water. It is this cellulose that absorbs and retains moisture, the cellulose in the cotton fiber, when in an air-dry condition, containing about $7\frac{1}{2}$ per cent.

The soluble substances present in the cotton fiber, principally located on the outside, are waxy or oily substances permeated with other material and amounting in the aggregate to from $1\frac{1}{2}$ to 2 per cent. of the weight of raw cotton. The nature of these materials is, as yet, more or less obscure; the portion that is removable by scouring with a weak solution of soda ash is commonly spoken of as *cotton wax*, while others removable by prolonged boiling in distilled water are given the name of *water extract*.

5. The amount of removable foreign matter in cotton varies greatly with the variety, and even in different growths of the same variety. It is present to the extent of from 1 per cent. in carefully cultivated sea-island to 6 per cent. or more in coarse, negligently cultivated East Indian cotton. Assuming 2 per cent. as a fair average, the following data represent the constituent parts of what is commercially known as raw cotton: Cellulose, 87 per cent.; waxy, or other easily soluble substances, 2 per cent.; ash, 1 per cent. (giving 90 per cent. of fiber if absolutely dry); removable foreign matter, 2 per cent.; moisture, 8 per cent. Of course no two analyses give the same result and these figures only represent what would be found in an average of American-grown cotton in an air-dry condition.

6. The property of containing and retaining moisture, even when in an air-dry condition, or *hygroscopicity*, is common to most of the commercial textile fibers, although cotton possesses this property to a smaller extent than most other fibrous materials. There is a quantity of water always present in cotton that cannot be driven out by a moderate heat, and which, even after it has been expelled by excessive heat, is replaced by moisture from the atmosphere when the superheated cotton is allowed to stand in the open air. When in an air-dry state, under ordinary atmospheric conditions, cotton contains about 8 per cent. of moisture.

The expression *air dry* is used to describe the condition of cotton after it has been exposed to the atmosphere for such a length of time and under such conditions as will cause it to lose all excessive moisture or regain deficient moisture, so as to be in a normal condition. The expression *absolutely dry cotton* means cotton that has been heated to such a high temperature and under such conditions that all the moisture has been expelled and the sample being tested will cease to lose weight.

Moisture is necessary to the satisfactory manipulation of the fiber in spinning, and if for any reason a portion of this natural moisture is driven out, the spinning of the yarn is rendered more difficult until it is replaced. Frequently, from 1 to $1\frac{1}{2}$ per cent. of excessive or artificial moisture is found in cotton beyond the amount named. The amount of moisture in raw cotton depends largely on the treatment of cotton after picking and before baling, on the age of the cotton, and where it has been stored. The largest amount of natural moisture in cotton is found immediately after it has been picked from the cotton plant, especially in the case of cotton picked early in the season. In some districts, especially in the sea islands, it is customary to spread the newly picked cotton in the sun, to ripen and dry it, before ginning; but in the main cotton belt no such care is taken, the result being that the cotton is ginned while moist, tending to *gin damage;* but the planter ignores this in his anxiety to have it baled with as little loss of weight as possible.

The determination of the amount of moisture present is commonly spoken of as *conditioning*. The accurate meaning of this expression is the testing of raw stock, yarn, or fabrics as to what should be their true weight if the normal regain of moisture were added to their absolutely dry weight. From this expression, the name *conditioning houses* has been derived to indicate those establishments, very common in Europe, where fibrous substances are tested as to their hygroscopic conditions. At all these, the standard of moisture in cotton is what is known as an *8½-per-cent. regain*. This does not mean that every 100 pounds, or other units of weight of cotton, when in an air-dry condition contains 8½ units of water; the meaning of the term is that if a sample of cotton has been subjected to sufficient heat to render it absolutely dry, each 100 parts by weight when exposed to ordinary atmospheric conditions will regain 8½ parts. Thus, in an absolutely dry condition, such a sample of cotton would contain 7.834 per cent. of water, which is the relation of 8½ to 108½.

7. Measurements of the Cotton Fiber.—Cotton fibers even from the same seed vary considerably in length and in diameter, and only approximate measurements can be given. The diameter of a cotton fiber varies from .0004 to .001 inch, and the length of the fiber from ½ inch to 2¼ inches. Doctor Bowman is the authority for stating that there are 140,000,000 fibers in a pound. The general average measurements for cottons of the United States are given in the United States Government Tenth Census Reports as follows: Length, 1.10 inches (27.89 millimeters); diameter, .00091 inch (.023 millimeter); strength, 125.6 grains (8.14 grams).

The strength of individual cotton fibers varies from 75 to 300 grains, according to the kind of cotton, the distance between the points of suspension in making the test, and the portion of the fiber selected for the test. Usually the long-stapled, fine cottons break with the least strain, and the short coarse cottons stand the greatest strain. The ordinary American cottons have a breaking strain of from 120 to 140 grains.