U. S. DEPARTMENT OF AGRICULTURE

BUREAU OF PLANT INDUSTRY—BULLETIN No. 62.

B. T. GALLOWAY, *Chief of Bureau.*

NOTES

ON

EGYPTIAN AGRICULTURE.

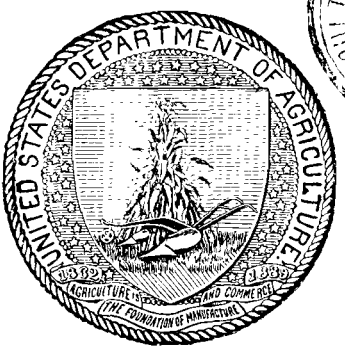
BY

GEORGE P. FOADEN, B. Sc.,

SECRETARY OF THE KHEDIVIAL AGRICULTURAL SOCIETY,
CAIRO, EGYPT.

VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.

ISSUED JULY 9, 1904.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1904.

BUREAU OF PLANT INDUSTRY.

B. T. GALLOWAY, *Chief.*
J. E. ROCKWELL, *Editor.*

VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.

SCIENTIFIC STAFF.

ALBERT F. WOODS, *Pathologist and Physiologist.*

ERWIN F. SMITH, *Pathologist in Charge of Laboratory of Plant Pathology.*
GEORGE T. MOORE, *Physiologist in Charge of Laboratory of Plant Physiology.*
HERBERT J. WEBBER, *Physiologist in Charge of Laboratory of Plant Breeding.*
WALTER T. SWINGLE, *Physiologist in Charge of Laboratory of Plant Life History.*
NEWTON B. PIERCE, *Pathologist in Charge of Pacific Coast Laboratory.*
M. B. WAITE, *Pathologist in Charge of Investigations of Diseases of Orchard Fruits.*
MARK A. CARLETON, *Cerealist in Charge of Cereal Investigations.*
HERMANN VON SCHRENK,[a] *in Charge of Mississippi Valley Laboratory.*
P. H. ROLFS, *Pathologist in Charge of Subtropical Laboratory.*
C. O. TOWNSEND, *Pathologist in Charge of Sugar Beet Investigations.*
P. H. DORSETT, *Pathologist.*
RODNEY H. TRUE,[b] *Physiologist.*
T. H. KEARNEY, *Physiologist, Plant Breeding.*
CORNELIUS L. SHEAR, *Pathologist.*
WILLIAM A. ORTON, *Pathologist.*
W. M. SCOTT, *Pathologist.*
JOSEPH S. CHAMBERLAIN, *Physiological Chemist, Cereal Investigations.*
R. E. B. MCKENNEY, *Physiologist.*
FLORA W. PATTERSON, *Mycologist.*
CHARLES P. HARTLEY, *Assistant in Physiology, Plant Breeding.*
KARL F. KELLERMAN, *Assistant in Physiology.*
DEANE B. SWINGLE, *Assistant in Pathology.*
A. W. EDSON, *Scientific Assistant, Plant Breeding.*
JESSE B. NORTON, *Assistant in Physiology, Plant Breeding.*
JAMES B. RORER, *Assistant in Pathology.*
LLOYD S. TENNY, *Assistant in Pathology.*
GEORGE G. HEDGCOCK, *Assistant in Pathology.*
PERLEY SPAULDING, *Scientific Assistant.*
P. J. O'GARA, *Scientific Assistant.*
A. D. SHAMEL, *Scientific Assistant, Plant Breeding.*
T. RALPH ROBINSON, *Scientific Assistant, Plant Physiology.*
FLORENCE HEDGES, *Scientific Assistant, Bacteriology.*
CHARLES J. BRAND, *Scientific Assistant in Physiology, Plant Life History.*

---

[a] Detailed to the Bureau of Forestry.
[b] Detailed to Botanical Investigations and Experiments.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., April 20, 1904.

SIR: I have the honor to transmit herewith, and to recommend for publication as Bulletin 62 of the series of this Bureau, a paper entitled "Notes on Egyptian Agriculture," prepared by Prof. George P. Foaden, Secretary of the Khedivial Agricultural Society, Cairo, Egypt.

The experiments which this Department is conducting in the introduction of Egyptian cotton, berseem, and other Egyptian crops into this country make it highly important to have a knowledge of the methods employed in the cultivation of these crops in Egypt.

The six plates accompanying the paper are considered essential to a full understanding of the text.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

ILLUSTRATIONS.

TEXT FIGURES.

NOTES ON EGYPTIAN AGRICULTURE.

INTRODUCTION.

Nature may be truly said to smile in the Valley of the Nile, and ancient Eastern writers were never weary of sounding the praises of Egypt. From early times her antiquities have excited imagination and curiosity, yet her system of agriculture is of still more ancient date.

Though the total area of Egypt proper is about 400,000 square miles, only some 12,000 square miles are cultivated and settled. Agriculturally, the country consists of the Nile Valley itself, a comparatively narrow strip of land on each side of the river, together with that part known as the Delta, of which Cairo may be taken as the apex. The width of the Nile Valley is variable; in some districts the desert impinges on the river bank itself, while in others the valley may attain a width of 10 or 12 miles. Its length is about 550 miles, and the number of acres under cultivation and in process of reclamation is about 2,320,000. This, roughly speaking, is the region where basin irrigation is practiced, while the Delta proper is under a system of perennial irrigation. The number of acres under cultivation and in process of reclamation in the Delta is 3,430,000, thus making a total of 5,750,000 acres for the whole country.

Basin irrigation, which has been typical of the country from earliest times, is now being gradually replaced by perennial irrigation, a change which entirely alters the system of agriculture. It is needless to say that at one time the whole of the country was under the basin system, but about the year 1820 the Khedive, by excavating a number of deep perennial canals capable of discharging water during the period of low water in the Nile, began that change which resulted in a complete revolution of the irrigation system of lower Egypt. As long, however, as the canals merely drew their water from the Nile the supply naturally diminished as the summer advanced and the Nile fell.

In the year 1842 the Nile Barrage, which is situated about 12 miles downstream from Cairo, was commenced. Here the Nile bifurcates. Across the two branches two immense masonry bridges were built, provided with sluice gates, by closing which the stream is dammed. The level is thus raised to such an extent that 12 feet of water are held

up, over and above the natural level of the river, and the amount of water discharged into the various distributing canals is enormously increased. The bed of the river below the Barrage is to all intents and purposes dry. This provision of water during the summer months permitted the cultivation of cotton, which from this date gradually increased. At the present time the whole of lower Egypt is under a perennial system of irrigation, while upper Egypt, though largely under basin irrigation, is in a transition stage.

The ancient system of basin irrigation, whereby the land received annually a deposit of rich mud, will soon be, comparatively speaking, a thing of the past. It is unnecessary here to enter into any details regarding this ancient type of irrigation, but merely to state that under this system the land is divided by means of banks into basins (of which there are 212), whose areas range from as few as 500 to as many as 75,000 acres. For convenience in the regulation of the flood water, these basins are divided into various sections, 11 of which are on the left bank of the river, while 13 are on the right. During flood time, when these basins are filled, the water is charged with suspended matter, which during its sojourn in the basin is to a great extent deposited on the land. The filling of the basins generally begins about mid-August and is completed in the southern basins by the end of September. The escapes are opened and the water discharged into the river by the middle of October. The more northerly basins are filled and emptied later, the last basin north of the Delta Barrage not becoming dry until the end of November.

When the time for emptying the basins has arrived, the escapes are opened and the water discharged. In some years, when the flood is low and the basins are not full, the upper series of basins are drawn upon to complete the operation; the water passes, that is to say, through the lower series and is then discharged. The water remains in the basins for a period of about sixty days.

The water of the Nile at the time of flood contains from 150 to 200 parts per 100,000 of suspended matter. If 170 parts are assumed to be an average, about 130 parts are actually deposited in the basins, while the remaining 40 parts are returned to the river in the water of discharge. These figures can only be regarded as approximations, the amount of mud deposited on any given area depending to a certain extent on the position of that area in the basin. Again, the water entering all the basins is not equally rich in sediment. Further, water is continually passing through the basins, even though they are full, and consequently the actual quantity which passes through them and deposits its mud is not equivalent to the capacity of the basin itself. The nature of the sediment also varies, being more valuable, relatively speaking, in a low flood, and more sandy and consequently less valuable during a high flood. It is calculated that when the basins are full they contain on an average between 3 and 4 feet of water and the deposit is equal to between 14,000 and 15,000 pounds of

sediment per acre, or between 6 and 7 tons. The soil thus receives annually this coating of mud, the chemical nature of which has given rise to very divergent views on the part of chemists, chiefly owing, it is believed, to the manner in which samples for analysis have been taken. The analyses made by Doctor Mackenzie at the School of Agriculture are considered the most reliable obtainable and are the average of many determinations.

COMPOSITION OF NILE MUD DURING FLOOD.

The addition of 15,000 pounds per acre per annum of sediment consisting of nitrogen, 0.12 per cent, phosphoric acid, 0.21 per cent, and potash, 0.68 per cent, would give to the soil 18 pounds of nitrogen, 31½ pounds of phosphoric acid, and 102 pounds of potash. These quantities, when compared with the general composition of Egyptian soils and with the results which have been obtained by actual manurial experiments, are quite consistent. Egyptian clover, as is well known, is very extensively grown in Egypt, and the deficiency of Nile mud in nitrogen has, no doubt, to a very great extent been compensated for in this manner. Roughly speaking, cultivation in the basins means one crop yearly, the flood providing sufficient water and manure for the raising of this crop under a system of rotation. In the basins, where the chief crops are cereals, beans, and clover, this is true as regards the matter of manure supply, but when irrigation is practiced by means of wells or from the Nile the need for manure at once becomes pressing. In fact, this interdependence of manure and water is always most prominently brought out in any irrigated country.

An examination of the manurial ingredients added to the soil during the inundation of the basins will at once indicate that while sufficient phosphoric acid and potash are added to grow an ordinary crop of wheat or barley, this is not true as regards nitrogen, and were it not for the alternation of clover and beans with the cereal crops the growth of the latter without nitrogenous manures would be impossible. The fact that it is found impossible to grow two wheat crops satisfactorily in succession is an indication that so far as nitrogen is concerned the Nile mud does not supply a sufficient quantity. A bean crop, which removes more phosphoric acid and more potash, but which obtains its nitrogen largely from the air, is successfully alternated with it.

IRRIGATION AND FERTILIZERS.

As the crops in the basins are generally grown without irrigation, manures, as already mentioned, are but seldom used. The wheat crop under such circumstances will average some 30 or 35 bushels per acre, and often grows to the height of a man's shoulder. The bean crop is a most important one in Upper Egypt, providing, as it does, the staple food during the summer and flood months, not only for Upper Egypt, but to a considerable extent also for Lower Egypt, while the export

trade assumes considerable proportions. Beans are extremely luxuriant, and they produce on an average 35 or 40 bushels per acre on good land.

It is quite unnecessary to state that the cultivation of basin lands is extremely primitive. The seed is merely broadcasted on the silt left by the Nile, covered in by hand-hoeing or scraping, and left until harvest time. The cost of sowing does not exceed 40 cents per acre. Harvest is in the spring, and the land is then generally left bare for the few months which elapse until the Nile again rises, when, in place of fields of waving corn, we have, as it were, inland lakes of red silt-laden water. Though the net return per acre from basin irrigated lands is not as great as on perennially irrigated lands, yet they return to the cultivator a large margin of profit, as the cost of cultivation is reduced to an absolute minimum.

Upper Egypt is thickly populated, in some provinces amounting to as many as two persons per acre. This has led to the cultivation of some of the basin lands during the interval which elapses between the removal of the ordinary winter crop and the arrival of the Nile flood. Such crops have to be irrigated, and this is usually accomplished by means of primitive water wheels lifting the water as much as 15 or 20 feet. This cultivation is generally carried on where a supply of manure is available, an application of which is imperative. The soil is capable of raising only the ordinary winter crop without manure, and the summer crop, which is generally millet, is heavily fertilized. Scattered throughout the country and in use throughout the whole of Egypt are large mounds, sites of antiquity, which are drawn upon to supply manure to grow these summer crops. They contain a nitrogen equivalent of about 2 or 3 per cent of nitrate of soda. As would naturally be expected, however, the best supplies are being exhausted, and many of the poorer ones which remain scarcely pay for transport. The summer crop, when grown in the basins by irrigation, is therefore practically always manured, and this, together with the watering, entails a considerable outlay on the part of the cultivator, though a good margin of profit remains. In some districts corn is grown on basin land which, lying high or being protected by small embankments, does not become inundated until later in the season, when the crop has become sufficiently advanced to stand a certain amount of flooding. It may be mentioned that in the southern provinces, where the basin land is poor, it is often found more profitable to irrigate the winter crop of wheat and barley instead of trusting to the moisture in the soil after the flood. In this case the crop is always manured.

Such, then, is an outline of the system of agriculture practiced in the basins of Upper Egypt, and some idea of its primitive nature can thus be obtained. Nearly 1,750,000 acres of land are under this system of irrigation, a system which will now, to a great extent,

disappear and give way to perennial irrigation, whereby two crops at least will be annually raised.

Although basin irrigation is characteristic of Upper Egypt, yet there is a belt of high land between the river and the basins protected from flooding by the dike running along the river bank. This belt could be inundated only in years of exceptionally high flood. The Nile Valley slopes away from the river, not toward it, the river bed thus extending, as it were, along a ridge and not along a depression. The breadth of this high land varies greatly. In some places the basin reaches practically up to the river bank, while in others the high inclosed land possesses a width of a few miles, its area having been increased by the construction of banks, which shut off the flood waters from its farther side. This land, not being flooded, can be cultivated either during summer or during flood, or both; in fact, in intensity of culture it is comparable to that of the Delta proper. The greatest width of this inclosed and artificially irrigated land is found in the provinces of Beni-Suef and Minieh, which are, with the exception of Gizeh, nearest the apex of the Delta. It is on this land in these two provinces and in the province of Fayum (which is an oasis) that the bulk of the cotton known as "Ashmouni" is cultivated. These high lands have, therefore, to be artificially irrigated, and cultivation can be carried on the whole year round.

One great difference, as already pointed out, between the cultivation of these lands and the basin lands is the necessity for manure, large quantities of which are employed. Barnyard manure is obtainable only in limited quantities, and recourse must be had to the ancient mounds to which reference has already been made. In the southern provinces, where millet is characteristic of this inclosed area during the flood season, millions of tons of a nitrate-bearing clay are found. To the agriculture of this tract and to that of Nubia this is of vital importance; in fact, it is difficult to see how the land could support its present population were it not for the existence of this clay. The basin lands, as mentioned, are of poor quality and are often irrigated, while the inclosed area is large; consequently large quantities of manure are required. As soon as the winter crops are removed, the whole population is occupied in the transport of this nitrate-bearing clay. When the material is near it is transported by the owner's own camels and donkeys, but when far away it is brought to the river banks and sold to cultivators who come in boats for it. It is a common sight in summer to see the river bank lined with heaps of this fertilizer, while hundreds of camels and donkeys may be seen wending their way to and from the river.

As already mentioned, the fertilizer is a mixture of clay and nitrate of soda, the percentage of the latter reaching in exceptional cases to as much as 20 per cent and in others dwindling to as little as 2 or 3 per cent. The richest material is found on the surface, and,

generally speaking, it would be difficult by quarrying in bulk to obtain material containing as much as 5 per cent of nitrate. Of one fact, however, there can be no doubt, viz, that it forms a most valuable manure for a large tract of land, permitting better crops to be grown in the basins and the raising of a profitable crop of millet, which without it would practically be an impossibility.

Farther north, on this inclosed land, the whole of the sugar crop of Egypt is grown, and, including the Fayum, the Ashmouni cotton crop. Nearly 600,000 acres of land are thus perennially irrigated, chiefly by means of a large canal (Ibrahimia) taking its water direct from the Nile. A branch of this canal waters the Fayum, a deep depression in the desert which lies outside the Nile Valley, and is divided from the river by a range of low hills. Through a break in these the Nile water is admitted. The Fayum is the only oasis in Egypt in direct communication with the river, and is surrounded by desert on all sides. The canal which conveys water to the Fayum is split up on entering the province into a number of radiating canals, like the fingers of an outspread hand.

The Ibrahimia Canal, completed in the year 1873, is the only perennial canal in Upper Egypt which takes its water direct from the Nile. It has a length of about 170 miles, and not only supplies summer water to a large tract, but also water during flood to the basins. In perennially irrigated tracts the seasons are divided, as in the Delta, into summer, flood, and winter.

The chief summer crops are sugar cane, cotton, and summer sorghum, which occupy along the Ibrahimia Canal tract about one-half the area. About 40 per cent of the land is under flood crops, which are chiefly flood sorghum, rice, and corn, while the winter crops (about 60 per cent) are clover, wheat, barley, beans, etc. The cultivation of these crops will be dealt with in detail subsequently, the few remarks which have been made being merely intended to convey an idea of the general system of agriculture in vogue in Upper Egypt. The completion of the new reservoirs will bring large tracts of land under perennial irrigation, and from what has preceded it will be gathered how, under such a system, a much more intensive system of agriculture is practiced. These reservoirs allow a great increase in the area planted to such crops as cotton and sugar cane, while Lower Egypt will also receive its share of water to supplement the summer supply, which is taxed to its utmost to irrigate the gradually extending cotton area.

In Lower Egypt, or the Delta, as already mentioned, perennial irrigation is practiced, by which is meant that the land is irrigated by canals which supply water during the whole year. Under this system, Egypt, favored with an excellent climate and a soil of great natural fertility, may be reckoned upon to produce on an average as much per acre as is possible in any quarter of the globe. When to these

conditions a plentiful supply of cheap labor is added, there exists everything necessary for the carrying on of an extensive and profitable system of agriculture. The vast improvements which have been made during recent years in the irrigation system of the country have been the means of greatly increasing the amount of water available during the summer months of low supply, and thus not only have made possible a considerable extension in the area of summer crops (chiefly cotton), but will in the future provide a supply of water for carrying on the reclamation (washing) of large tracts of land in the lower part of the Delta.

Drainage, which is an all-important problem, has received at the hands of the government its due share of attention, and enormous sums of money have been expended in making a complete network of drains throughout the country. Increased supplies of water necessarily involve more complete drainage schemes, and to Egypt, with its practically level soil lying but little above the level of the Mediterranean Sea, it is a question of first importance. In fact, increased supplies of irrigation water without better drainage and a more plentiful supply of manure are of doubtful benefit.

It would be beyond the province of the writer and beyond the object of the present bulletin to deal in any way with the irrigation system of the Delta, and attention will be entirely confined to those matters which are of purely agricultural interest.

SOILS.

Unfortunately, no soil survey of Egypt has ever been made, nor has any series of extensive inquiries been made into the general mechanical composition or chemical nature of the soils of the Delta.

It is needless to say that the soils are all alluvial in origin, and, generally speaking, are of a clayey nature, differing only in the density of the clay. A heavy, dense black clay, extending to a depth of 18 or 20 feet or more, is perhaps the typical soil. This soil is very difficult to work, but is fertile, yielding good crops of cotton. It is not easily injured by infiltration and saturation, on account of the difficulty with which water penetrates it. It can be understood that when canals are running with water practically throughout the whole year, there is always danger of saturation and infiltration, especially so when the water is at a higher level than the surrounding country.

It is feared that this class of soil often receives a greater quantity of water than is necessary, as, on account of the difficulty of percolation, it becomes more or less stagnant and sours the land. There is also insufficient care given to the question of cultivating the land when in the right condition. It is often plowed when more or less wet, the result being that it dries up into a brick-like condition, quite unsuited for a seed bed.

A second class of soil is also clayey to the depth of a few feet, but is underlaid by soil of a more or less light nature. This soil is more free to work than that already mentioned. A third class of soil may be described as a sandy loam, while in some districts there are soils which may be described as almost pure sand.

As regards the chemical nature of the ordinary clay soil of the Nile Valley, it would be rash to reproduce any figures which could be taken as representing in any way their general composition. No systematic attempt has been made to analyze representative samples of every province, only the results of a few isolated analyses being available. It may be stated, however, that the soil is more deficient in nitrogen than in any other ingredient, and nitrogenous manures are found to exercise a most marked effect upon growth.

The manures in common use in the country, in addition to barnyard manure and pigeon manure, are what is known as "coufri," or the remains of ancient villages and ruins, and the nitrate-bearing clay found in Upper Egypt, to which reference has already been made. These latter two fertilizers are valuable chiefly on account of the soluble nitrogen they contain. The soils are almost invariably rich in potash, while in phosphoric acid they are neither poor nor exceptionally rich. For some crops, such as cotton and sugar cane, the use of phosphatic manures is attended with great benefit, while other crops do not, as a rule, repay the cost of the fertilizer.

LABOR.

In Egypt there is a plentiful supply of cheap labor. The labor, from a European point of view, would be described as inefficient, but with the crude systems of cultivation in force it meets all requirements. Owing to its cheapness, a great deal of the labor which would be performed in Europe and in the United States by one or other of the various farm implements is in Egypt done by hand. Practically the only large implements used in the cultivation of the land are the primitive native plows, kassabiehs, or scoops for leveling the land, and planks of wood which, when drawn over the land, serve as harrows. The fass, or hoe, is the essential hand tool, and is the fellah's stock in trade.

The land was formerly held by large proprietors, and though this is true to-day a division into smaller farms is gradually taking place. This subdivision of land is reducing the supply of labor available on large farms, and at certain times of the year it is somewhat difficult to find sufficient labor. The commercial developments of Egypt and the numberless improvements which are being effected attract a considerable amount of labor which would otherwise be employed in agriculture, and a rise in the price of labor has taken place during recent years which is likely to continue in the future. As, however, labor is obtainable for 15 cents a day, it will be seen that there is no cause for complaint—at least from a western standpoint.

The fellah is an extremely clever cultivator and a hard worker. He works sometimes for a daily wage, but in the majority of cases is engaged under one of many bases of contract, receiving a certain area of land for the whole year in lieu of a part of his wages, or it may be a certain area for the growth of corn. In other cases he receives a share of certain crops, etc.; in fact, it would be impossible in a short treatise to deal with the almost innumerable arrangements which are made between employers and employed.

VALUE OF LAND.

Land has increased enormously in value during recent years and to attempt to estimate the increase would be a difficult matter. The best land in the Delta can not be purchased for less than $500 to $600 an acre, while there are many cases where as much as $800 have been paid for land possessing no value, present or prospective, except from an agricultural point of view. Good average land costs from $300 to to $400 per acre, while it would be difficult to find any land under a state of cultivation which could be purchased for less than $150 per acre. Even at these prices land well cultivated will return 6 or 7 per cent on the capital invested, the sheet-anchor of the cultivator being his cotton crop.

ANIMAL LABOR.

Practically the whole of the animal labor on the farm is done by bullocks, a race whose history is somewhat doubtful. The cattle of Upper Egypt are somewhat smaller than those of Lower Egypt, of which the accompanying illustrations (Pl. I, figs. 1 and 2) may be taken as good types.

A certain number of mules and donkeys (see Pl. II, figs. 1 and 2) for transport work are kept on the farm, and from eight to ten bullocks are considered necessary to work 100 acres, generally the smaller number.

The value of these animals has very considerably increased during recent years, and at the present time $100 would have to be paid for a good average working bullock, while anything above the ordinary costs up to $135. During the winter, spring, and early summer months—say, from December to June—they are fed on clover, chiefly grazed in the field, the animals being tethered. About three-fourths of an acre are allowed for each animal. From June to early December they are fed on beans and chopped straw, about 12 or 13 pounds of the former and 22 pounds of the latter being a common ration.

The fellahs are the cattle raisers of Egypt, and large cultivators supply their needs by purchasing from them; in consequence, the small cultivator, raising cattle as he does and keeping buffaloes for the supply of milk for his family and for sale, has a much greater quantity of manure in proportion at his disposal than has the large proprietor.

It may be mentioned incidentally that sheep in Egypt are of a very poor standard. There are several breeds or divisions of breeds known by local names, but the accompanying illustration (Pl. III, fig. 1) will give an idea of the type of animal found in the country. The sheep live on anything they can procure, and are allowed to run over the clover after the cattle have been tethered on it. A fair sheep weighs about 100 pounds live weight, though the better class fed by some cultivators weigh more.

SEASONS.

Agriculturally three seasons are, as already mentioned, recognized in Egypt, viz, winter, summer, and Nili. During the former, extending from November or December to March, wheat, barley, beans, clover, etc., are sown in Lower Egypt, and also flax, lentils, onions, vetches, etc., in Upper Egypt. The summer crops are cotton, sugar cane (chiefly in Upper Egypt), rice, and summer sorghum (Upper Egypt), while during the Nili season corn and rice, together with flood sorghum in Upper Egypt, are the principal crops.

COTTON.

Of all crops cotton is preeminently the most important; it, in fact, in great part constitutes the agricultural wealth of Egypt. Its cultivation commenced about the year 1820, being simultaneous with the introduction of perennial irrigation in the Delta of the Nile. From this time the areas under cotton gradually increased, a great stimulus having been given to its cultivation at the time of the civil war in the United States and the consequent cotton famine throughout the world. When more or less normal conditions were reestablished Egypt did not, like many other countries, cease to show an increase in its cotton area, but on the other hand continued to progress. Recent developments and improvements in the system of irrigation, as well as the expenditure of large sums of money on drainage, have given still greater facilities for cotton cultivation, until there seems to be a growing tendency on the part of cultivators to place too great a reliance on the "one crop," such as existed formerly and is still often found in many cotton districts of the United States.

The cotton area seems to increase annually, though in the absence of a statistical bureau it is impossible to state what the area actually is or what increase takes place yearly. It has been generally accepted by the irrigation department that one-third of the land of the Delta was occupied by cotton, though there can be no doubt whatever that it is more correct now to assume that one-half of the land is planted to this crop. The present area under cotton in Egypt amounts probably to between 1,500,000 and 1,750,000 acres, though the finance department of the Egyptian Government gives as the area under cotton in the year 1901–2, 1,275,676 acres, of which 1,169,106 acres were

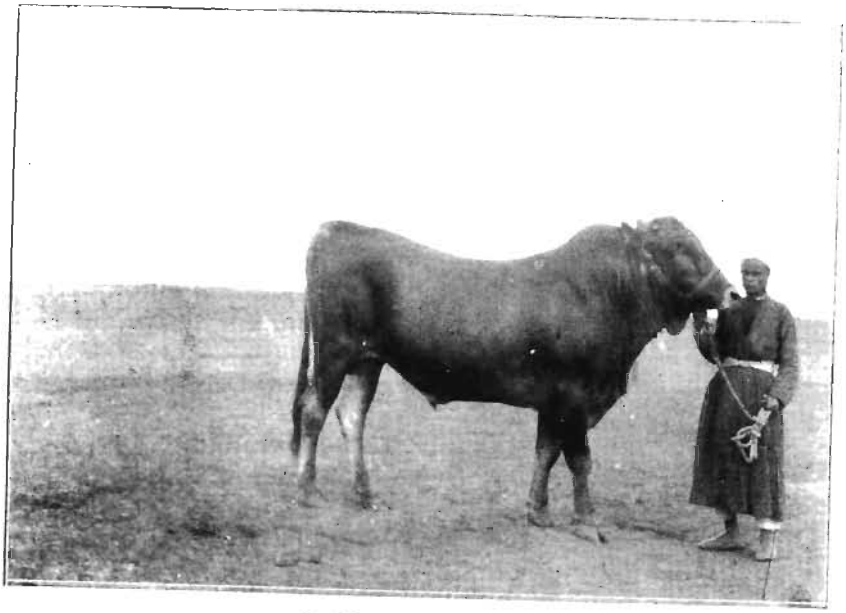


FIG. 1.—TYPE OF EGYPTIAN BULL.

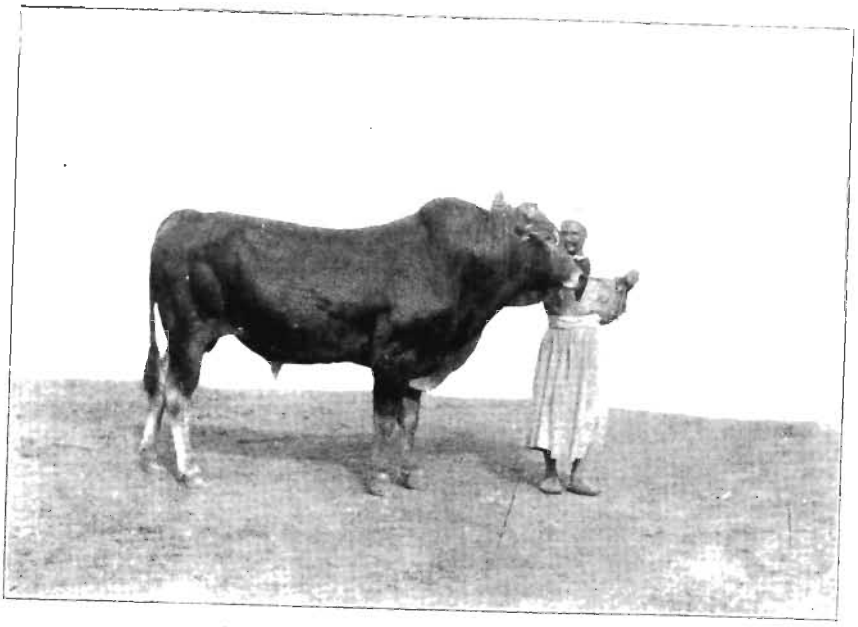


FIG. 2.—ANOTHER TYPE OF EGYPTIAN BULL.

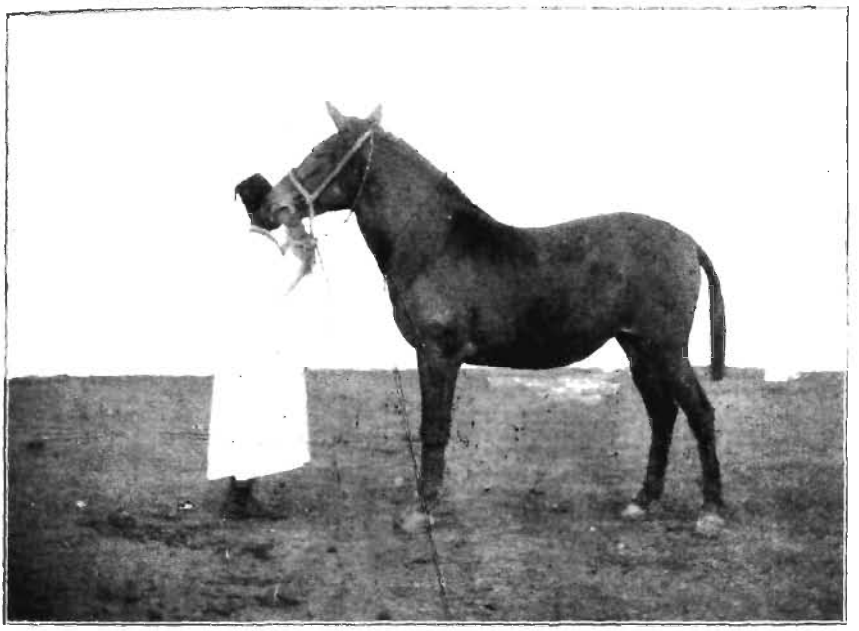


FIG. 1.—TYPE OF MULE USED IN EGYPT.

FIG. 2.—ANOTHER TYPE OF MULE USED IN EGYPT.

FIG. 1.—A MERAISE SHEEP, THE BEST EGYPTIAN BREED.

the Delta and 106,570 in Upper Egypt. In any case we may state at 90 per cent of the total cotton of Egypt is grown in the Delta oper, and for the purposes of this bulletin, when dealing with the ,rious branches of cotton culture, the writer's observations will refer this region.

Theoretically a three-year rotation of crops is practiced, though is is in a great majority of cases reduced to a two-year course. ·iginally on good land the rotation was as follows:

Three-year rotation of crops formerly practiced in Egypt.

Year.	Winter.	Summer.	Nili.
First year	Clover	Cotton	
Second year	Beans or clover		Corn.
Third year	Wheat		Corn.

At present, however, it is more common to find the following system:

Two-year rotation of crops at present practiced in Egypt.

Year.	Winter	Summer.	Nili.
First year	Clover	Cotton	
Second year	Beans or wheat		Corn or fallow.

On poor land clover is grown more frequently and rice is introduced instead of corn, or the land may be fallowed. The cotton crop then generally follows clover or maize or a fallow. If it follows maize, the land is left fallow from the time of cutting the maize in October or November until cotton planting in March; or again, in some cases, the land may be fallowed from the time of the removal of the cereal crop in June until the following spring. If the land is to be fallowed after the cereal crop, a heavy flooding is given with the red water of the Nile, and when sufficiently dry it is plowed and left exposed to the action of the sun and other atmospheric agencies until the winter months, when the preparation of the land for cotton is continued. If it follows maize, the land is plowed as soon as possible after the crop is removed from the ground, while if after clover, the land is generally left until about a fortnight before cotton planting begins, when the soil is broken up and hurriedly prepared.

Small cultivators who can not afford to leave their land fallow occupy the land every moment, as it were. They scatter the clover seeds among their standing maize before it is cut, and thus obtain two crops of clover previous to cotton sowing. Owners of large estates, however, adopt the fallow system—either a long fallow after a cereal crop, a short fallow after a maize crop, or both. It would be impossible for them to prepare a large area of land in time for cotton

after berseem, while again they would be unable to dispose of such a quantity of clover were it grown. The small cultivator is, as already mentioned, the raiser of cattle, and can always dispose of his clover crop to advantage.

Large administrations in Egypt are now using steam plows, and by means of them the land is thoroughly plowed for cotton during the autumn months to a depth of 12 inches. With this exception, however, the cotton area of Egypt is prepared by means of the ordinary native plow drawn by two bullocks. (See fig. 1.) As a general rule, four plowings are given in preparation for cotton, each being at right angles to the previous one.

The plow is somewhat comparable to the "scooter" employed in the United States for laying off the cotton rows. The beam, which is

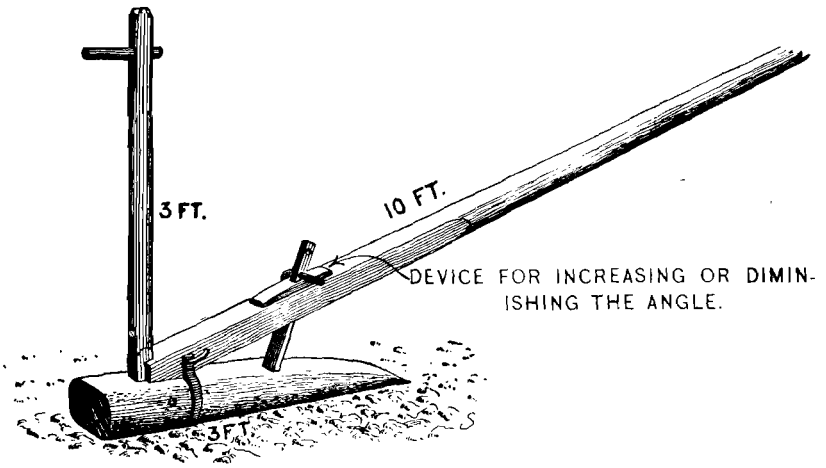


FIG. 1.—Ordinary native plow.

made of wood, is about 10 feet long, while the part which projects from it at an angle of about 25° is also made of wood, but shod with iron, the weight of the whole being about 60 pounds or more. This is the plow in almost universal use in Egypt, though on some areas cultivated by Europeans a few modern plows, provided with moldboards which turn a furrow, are used. The nature of the plow does not admit of the soil being inverted, but merely stirs it. The angle between the draft pole and the sole of the plow can be increased or diminished by adjustment.

It is laid down as an axiom by the best cotton growers that cotton land should be plowed early and left exposed for some time. In a practically rainless climate there is nothing to fear from the leaching effects of rain, while it is universally accepted that cotton sown on such land germinates better and grows more regularly. Growers are fully alive to the necessity of deep and thorough cultivation, and some careful farmers plow their land even more than four times. It must

be confessed, on the other hand, that many are less enlightened; but this often arises from the fact that when the cotton follows clover the latter crop occupies the land until the last moment, so that the greatest amount may be obtained from it. Whether this is good practice or not will be dealt with subsequently.

The land, having been thoroughly plowed, is made into ridges (Pl. IV.), and this is done by cheap labor, in a primitive, though effective manner. The angle of the ordinary plow is filled with dried leaves, sacking, or some other material, so that when drawn through the soil it throws the earth to the right and left; this being repeated during the return journey of the plow, a ridge is made. When the land has been thrown into rough ridges at the required distance apart, they are shaped by men working with a fass (hoe), who at the same time break down any large clods of soil. The land is then ready for sowing. Each plow with a pair of bullocks will ridge in this manner about $2\frac{1}{2}$ acres per day, while three men per day are required for completing the ridges on an acre.

The cost of preparing the land for cotton may be estimated thus: It is generally accepted that the labor of a man and a pair of bullocks per day amounts to about $1, making allowance for depreciation in the value of the bullocks, mortality, idle days, etc. The amount of work that can be accomplished per day varies according to the condition of the land. If breaking up clover land less than half an acre may be allowed, while subsequent plowings may result in nearly an acre being accomplished per day on free-working soils, though less on stiff clays. It is approximately correct, therefore, to say that on an average each plowing will cost about $1.25, or the four plowings a total of $5 or $6. The making of the ridges will cost about 40 or 50 cents for animal labor and about 50 cents for manual labor, or approximately $1, making thus a total of about $6 or $7 per acre.

The best cultivators are now, however, adopting an even more intensive preparation of the land and follow the ordinary plowing by another native plow working in the furrow left by the former and thus acting as a subsoil stirrer. The cost of preparing the land in this case is proportionately increased.

Such, then, is the general system adopted, but the depth of plowing usually attained is not sufficient to give the best results. The native plow, as a rule, does not stir to a greater depth than about 6 inches, unless followed, as described above, by a second plow. For cotton, with its deep taproot, this is not sufficient, and there is ample evidence in Egypt of the benefits to be derived by a deeper stirring of the soil. The deeper the stirring the better are the plants enabled to resist periods of drought, provided the surface soil is kept continually broken up, and the deeper can the roots descend in search of nourishment. In the United States the bulk of the work of preparing the soil for cotton seems to be put into the ridges or beds, as it were, and

but little or none into the general field. In Egypt it is quite the reverse, and the ridges are not, generally speaking, as well made as they should be. When cotton follows a fallow of greater or less duration, and the land is consequently plowed early, a suitable tilth can be obtained, but when following clover, and a more or less hurried preparation of the soil results, the tilth leaves a great deal to be desired. In such case the cotton is sown in very lumpy ridges, and germination is consequently often very uneven and irregular.

That the well-known Egyptian clover has been the mainstay of Egyptian agriculture there can be no doubt, and without it the fertility of the Delta could not have been kept up except at an enormous expenditure for manure. Both in theory and in practice a crop of clover is an excellent preparation for a cotton crop; but on rich land, when the soil is plowed up just before cotton planting, the unfavorable seed bed obtained seems to more than counterbalance the effects of the decomposing vegetable matter; hence a better crop of cotton is obtained by leaving the land fallow. On the other hand, on poorer land the effects of the clover growth are marked, and a better crop is obtained after the clover than when following a fallow. The sprouting of the cotton is, as a rule, more regular after a fallow, and the greatest amount of replanting is necessary when following a clover crop. If clover immediately precedes cotton it is necessary, in order to obtain the best results, that the soil be broken up some time before planting; the roots then have time to undergo a certain amount of decay and the soil to become dry. To sow cotton in a soil which is plowed up more or less wet, as is the clover land in Egypt, is not conducive to the preparation of a good seed bed and regular germination. The soil should be quite dry when cotton is planted, though a watering is given immediately afterwards.

DISTANCE BETWEEN THE COTTON BEDS.

As Egyptian cotton is raised by means of irrigation, the beds have to be arranged in such a manner as to facilitate watering. (Pl. IV.) The land is divided into sections by ridges running at right angles to the ordinary beds, and the beds are thus not more than about 36 feet long. In some cases where the land is very level they are made longer than this, while small cultivators, whose land is as a rule very uneven, make them of less length. The land is thus divided into sections and from six to seven furrows are irrigated at a time. The arrangement will be made perfectly clear by the accompanying diagram (fig. 2).

The distance at which the furrows are made, as well as the distance allowed between the plants, is at the present time receiving considerable attention in Egypt. The writer, who recently visited the American cotton-growing districts, was particularly struck with the great difference in this respect between the United States and Egypt. It is

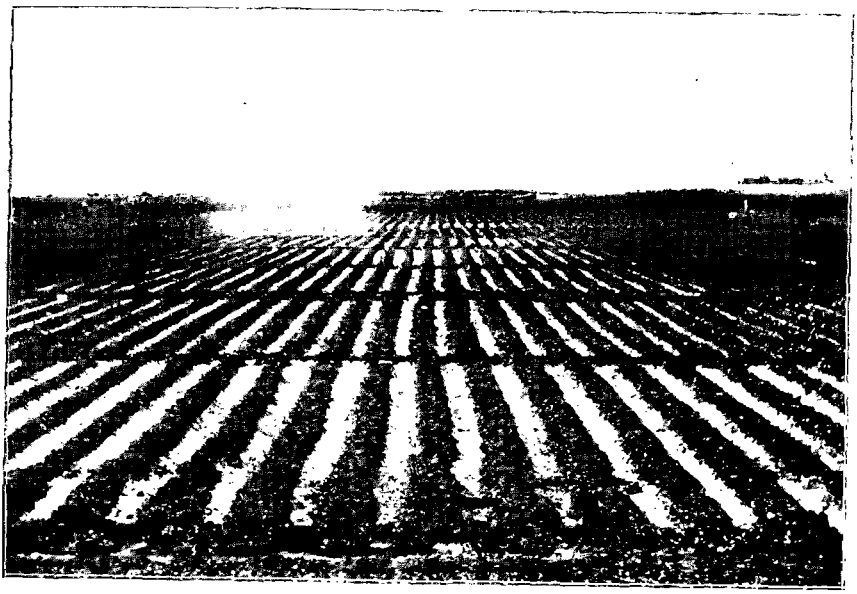


FIG. 1.—FIELD OF COTTON RECEIVING FIRST WATERING IN APRIL, ABOUT THIRTY-FIVE DAYS AFTER PLANTING.

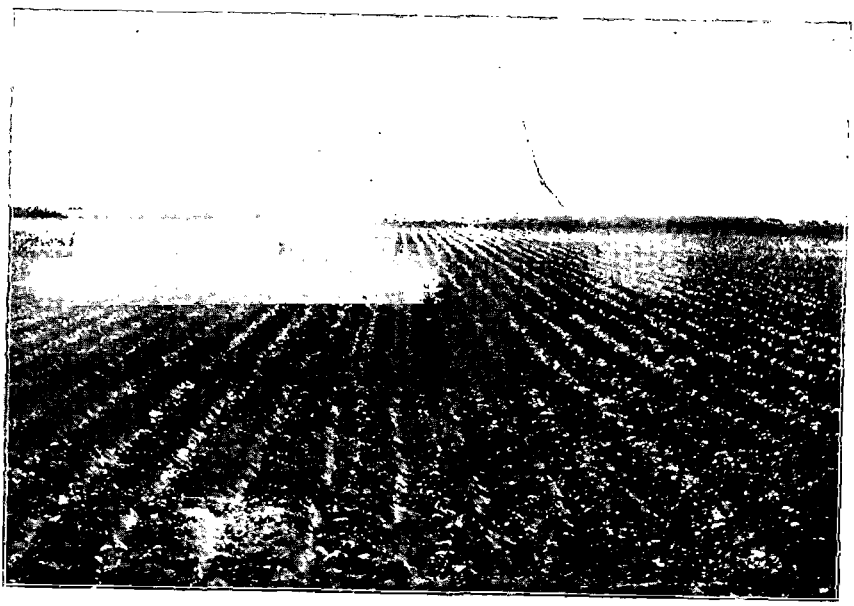


FIG. 2. FIELD OF COTTON SHOWN IN FIG. 1, HAVING BEEN HOED AFTER FIRST WATERING.

very rare in Egypt to find even as great a distance as 35 inches between the beds, while on average land, producing a bale of cotton (500 pounds) or even a bale and a half, about 30 inches or even less may be looked upon as an average. On land which produces less than a bale of cotton, less than 30 inches are left between the rows. This in comparison with the 4 feet in common use in America, together with the fact that Egyptian cotton produces a larger growth, constitutes a sufficiently striking difference in practice. Though there is a tendency among the most enlightened Egyptian planters to increase somewhat the distance between the beds, yet it is quite certain that they will never reach the distances employed in America. There can be no doubt that on certain areas of land in Egypt, where the plants grow particularly large, ridges could with advantage be made 40

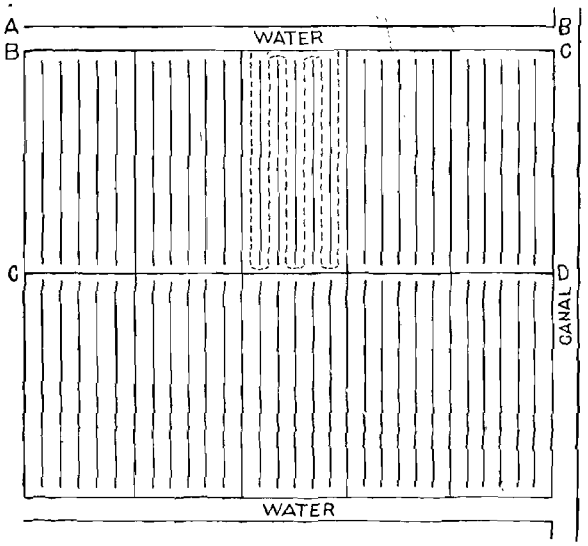


FIG. 2.—Arrangement of ridges for irrigating cotton.

inches apart, but it is at least doubtful whether it would be profitable to extend them farther. That, generally speaking, throughout Egypt cotton is planted too closely there can be no doubt whatever.

The whole of the cultivation subsequent to planting is accomplished by hand labor in Egypt, and it may be that the employment of animal labor in the United States necessitates a greater width between the rows. Whatever the reason, it can be said with safety that practically no cotton is grown in Egypt in beds as far apart as 40 inches, while from 30 to 32 inches may be given as an average on good medium soils and less on poor lands.

As regards the distance between the plants in the row, it is rare to find even on the best lands as much as 19 or 20 inches; the average is about 15 or 16 inches. It must not be forgotten, also, that 2 plants

are always left standing together. On an average there are about 13,000 holes, as it were, per acre, each with 2 plants, making thus a total of 26,000 plants, while there are often many more on poorer lands. General experience seems to indicate that if too wide planting is adopted there is a reduction in yield, and it would be impossible to find an Egyptian planter who on any class of soil whatever would bed his land more than 34 or 35 inches, and extremely few at that. It is again very rare to find plants as far apart as 19 or 20 inches in the row. The Egyptian cultivator is a believer in close planting, but there is every reason to think that many have gone too far in this direction.

Beds, then, are much closer than is common in the United States, while on an average the plants are a little farther apart in the row, eliminating the fact that in Egypt 2 plants are left together. The excessive shade and dampness induced by too close planting militates against the production of the finest quality of fiber and encourages at the same time various fungous and insect attacks. Yet it appears to the writer that to adopt such wide distances between the beds as are common in the United States would by loss of plants mean probably a diminished yield.

It is true that the complete control which the Egyptian cultivator has of his water supply enables him to regulate to a certain extent the development of his plants, but in only too many cases this advantage is not employed to the greatest extent, as will be shown subsequently.

DATE OF PLANTING COTTON.

Planting commences as early as the second half of February, though March is essentially the month of cotton planting. In the northern part of the Delta it is delayed until April. There are in Egypt no late killing frosts to contend with, but merely short periods of cold and windy weather in early spring, which do considerable harm to the very young cotton plant. There has been, during recent years, a distinct tendency toward early planting, it being contended that during a series of years the largest yields, as well as the best qualities, are produced by early planters.

Early planted cotton grows more regularly and evenly and does not tend to produce such coarse growth (weed) as that planted late. It also branches better from the bottom. In view of the rainfall to which the American cotton crop is subjected, it is interesting to notice the ill effects of rain in the case of Egyptian cotton. Though it may be said that the crop is grown without rainfall, yet during the very early stages of growth, and especially in the case of early sown cotton, a shower of rain occasionally falls which does considerable harm to the newly sown cotton, especially if the plants have just appeared above the surface of the ground. If they are well established the

damage is slight, but in the very young stage a shower generally necessitates a considerable amount of replanting.

SOWING COTTON.

The seed is not planted on the top of the bed, but two-thirds of the distance up the slope of the bed—that is to say, two-thirds of the distance up from the bottom of the furrow to the top of the bed. The quantity of seed used is about 1¼ bushels per acre. Holes are made, generally by boys, by means of a stick or a small wooden scoop, at the required distance apart and at the height mentioned, and from eight to ten seeds are deposited in each hole at a depth of 2 or 3 inches. A watering is then given, the water entering between the beds as already described (Pl. IV). In about ten or twelve days the seeds germinate, though this may be a little more or less, depending on the time of sowing and the weather prevailing.

It is soon seen that some seeds fail to germinate and blanks are evident. In some seasons this is much more than in others, but in any case resowing is at once done. Seeds are soaked in water over night and the next day sown in the blank places in a similar manner to the general sowing. The soil has now become somewhat dry, and the object of soaking the seed is to aid germination. If replanting is general and forms a very large proportion of the total, it may be necessary to water the land. In this case the seed is sown dry; the young plants existing suffer, however.

WATERING COTTON.

As soon as the plants are fairly well established a hoeing is given to destroy weeds and break up the surface. (Pl. IV, fig. 2.) This is practiced by all good cultivators, though neglected by others. Three or four men are necessary to hoe an acre per day, stirring not only the soil between the plants, but disturbing also the tops of the beds. Occasionally a second hoeing is given before the first watering, which takes place some thirty-five days after planting. This period is a variable one, depending on the nature of the soil and the prevailing weather conditions. On a clay soil, well hoed, it may be longer, while on a sandy soil it may be less. Before this watering is given the crop should be thinned, the two strongest plants being left standing, while the others are removed. This early thinning is advisable, and to water the crop before thinning is not considered good practice, if it can be avoided.

It is generally accepted that as long an interval as is consistent with the health of the plant should elapse before the first watering is given; otherwise the plant is not encouraged to root well, but tends to grow too rapidly. Too frequent waterings during the early growing period prevent the proper branching of the plants from the bottom. They grow up rapidly, producing their forms at the top rather

than from the bottom, and are spindling. After the first watering, which should be a light one, the water not reaching up to the plants, but being allowed to ascend a little by capillarity to reach them, the land is allowed to dry, and when sufficiently dried, another hoeing is given. Some do not thin their cotton until after this hoeing. There are cases (when the first watering is given at a short interval after planting) where this may be advisable, but, generally speaking, it is considered better practice, as already mentioned, to thin before the first watering.

The second watering is given about twenty-five or thirty days after the first, and when the land is sufficiently dry another hoeing (this being generally the third) is given. At each hoeing the soil is removed from the top on the opposite bed and drawn up to the plants. As the plants are planted on the side of the bed, the crest of the ridge is above them. This crest is gradually brought over by the hoe to the opposite bed, so that after the third hoeing the plants will be practically on the tops of the beds. (Pl. V.)

The third watering is given about twenty days after the second—the end of May or beginning of June. This may be followed by another hoeing, and generally speaking on good land the cotton, if sown early, is now sufficiently far advanced to make any further intercultural operations difficult.

Waterings are now given more frequently, if possible, and during the months of June, July, and August the crop requires approximately two waterings during each month, but especially in the two latter months. During the summer months of low Nile supply, however, there exist what are known in Egypt as rotations of canals—that is to say, a restriction is placed by the irrigation department on the frequency of watering; otherwise the quantity of water available would not be sufficient for the whole of the cotton crop. The watering of fallow land is also prohibited by governmental decree until the Nile has again risen sufficiently high to place the safety of the cotton crop beyond question, and in some years of low supply the cultivation of summer rice has also been prohibited.

In the simplest form the rotation is as follows: A canal is divided into three divisions, A, B, and C—A being the first section at the canal head, B the middle section, while C is the section at the tail of the canal. Each section was, for example, in the year 1901, allowed a week's supply when it had first claim on the water. If, however, there was any excess passing section A during its week of supply, when it entered section B the latter was allowed to make use of it during the last three days of A's period, but it must be understood that B had no claim or right to the water. The same arrangement holds good for sections B and C during B's week, and for C and A during C's week. No difficulty can be experienced by this arrangement during A's week and B's week, but great caution has to be exercised in giving section A permission to pump during C's week, as A,

FIG. 1.—FIELD OF COTTON SHOWN IN PLATE IV ON MAY 6.

FIG. 2.—FIELD OF V ON MAY 20.

being higher up the canal, has first pull on the water. When water becomes scarce, however, at the end of June, there is no surplus, and no section will get more than its seven days' supply. In bad years there may not be sufficient water to permit the whole of the cotton in any section, even during the seven days of its supply, to be watered, but any unirrigated areas are, if possible, watered during the following section's week.

Under such an arrangement as that described the cotton obtains a watering every twenty-one days. During the season of 1903 the rotation was reduced to one of eighteen days, the completion of the Assuan Dam permitting the quantity of water during low Nile to be supplemented by the opening of the dam and the addition thus of a certain quantity of water to the natural supply. From the middle of June to the middle of July the difficulties in the distribution of water are very great, and as the cotton is then in flower and the temperature high the plants are greatly in need of water. It is seen, therefore, that though cotton may be benefited by a watering every fifteen days during the summer months of June and July, this is not possible owing to the rotations in force. During July, August, and September the cotton crop requires no labor, with the exception of that involved in watering, and in the southern part of the Delta cotton picking begins in the first half of September, and in Upper Egypt earlier.

The actual number of waterings which the cotton crop should receive from the time of planting to the first picking is about nine or ten. There can be no doubt that a great tendency exists toward the too free use of water, and though rotations are not in favor with cultivators, yet, provided they are not severe, it is very questionable whether it is not to their interest to have some kind of control in this way over the water supply. Some crops do not show the ill effects of excessive waterings to the extent that cotton does, but very heavy waterings given to the latter cause considerable damage. It is not only that there is a tendency to apply water too frequently, but too heavy applications are given, and it is extremely likely that a flooding does more harm than lighter applications even at more frequent intervals. When severe rotations were at first put in force great alarm was felt for the safety of the crop, but results showed that cotton was enabled to resist longer periods of drought than had been previously imagined. Land which had been well prepared and kept thoroughly hoed suffered least, and early sown cotton less than that planted later.

It may be interesting to state the quantity of water required to raise a cotton crop. Each watering is supposed to be equivalent to about 350 tons of water per acre, and, as already mentioned, some nine or ten applications of water are given up to the first picking, or a total of from 3,150 to 3,500 tons of water. This is approximately equivalent to a rainfall of from 31 to 35 inches. The "duty" of water in the Delta is annually calculated by the irrigation department, the period chosen being from the date when the rotations are applied to the date

of their removal—that is, when the Nile has risen sufficiently high to warrant this step being taken.

This period extends approximately from May to the middle of July, and as the result of observations it is accepted that each acre of cotton consumes about 25 tons of water per day. It is assumed that in the months of May, June, and July a cotton crop can be successfully raised on this basis. The actual "duty" of course varies from year to year, according to the state of the summer supply of the Nile. In a year of good summer discharge the "duty" of water is always low, while in a bad year when severe rotations are employed the "duty" is high. In May and June a canal discharging 25 tons of water per day for each acre of cotton to be irrigated is generally, therefore, accepted as sufficient, though cultivators would use more were it available.

MANURING COTTON.

The question of manures and manuring is assuming greater importance in Egypt than formerly. When the Delta was under a basin system of irrigation and receiving annually the life-giving deposit of the Nile, and when consequently the cultivation of a summer crop, such as cotton, was impossible, there was not that need for manure which exists to-day. The introduction of perennial irrigation and the more intensive cultivation which follows in its train have, however, brought about a great change, and the idea that the soils of the Nile Valley are inexhaustible is a myth which is being rapidly dispelled. True, in the basin lands of Upper Egypt the ancient conditions still prevail, but this section is in a state of transition; and that system which has been typical of the country for so many thousands of years is now giving place to perennial irrigation and the consequent abolition of the one-crop system in favor of a more intensive culture.

The interdependence of water and manure has already been referred to, and whenever land is artificially irrigated the need for manure at once arises. The two questions of water and manure are really intimately connected, and the supply of one should always be considered with reference to that of the other. Where land is artificially irrigated in Upper Egypt the demand for manure, as already mentioned, is very great, and even in the basins themselves, when watering by means of wells is practiced, manure is employed.

In the Delta the supply of manure is considered especially in its relation to the cotton and corn crops, but at present we shall confine ourselves to the question of cotton. It is generally laid down that from 8 to 10 working bullocks per 100 acres are required in Egypt, and in addition there are mules for transport, as well as cows, buffaloes, etc., kept both for milk purposes and for breeding. If it is assumed that about one-half of the area of each farm is under cotton, so far as work animals themselves are concerned there are from

to 10, say, to every 50 acres of cotton, and in addition to this manure as to be provided for other crops. It is seen, therefore, that in comarison with the conditions prevailing in the cotton-growing States of merica there is a much greater quantity of natural fertilizer at the isposal of the cultivators, though, unfortunately, far from sufficient. Earth is in universal use as litter, and the heaps of manure which one sees surrounding every village are evidence of the great value which even small cultivators attach to the fertilizer question.

It is accepted as beyond question by every Egyptian cultivator that cotton requires manuring, and in many cases the cotton area has been governed by the amount of manure available. Manure and water, in fact, tend to control the area under cotton. At one time it was thought that maximum crops could be raised by ordinary stable manure alone, but during the past five years a great change of opinion has made itself felt. The introduction of chemical fertilizers has not only resulted in increased returns, but has made possible the manuring of a greater area. Instead of applying stable manure, as previously, to a portion of the cotton area and leaving of necessity a part unmanured, it is now accepted that the best practice consists in spreading the stable manure over the whole area and supplementing it by chemical fertilizers.

The question of cotton manuring is not an easy one where not only has the yield to be considered, but (and especially is this the case in Egypt) also the quality. It is unnecessary to state that as a cotton-growing country Egypt is noted for the quantity of its product, and consequently, while endeavoring to obtain the greatest product possible from a given area, the question of quality is one which is ever brought home to the cultivator.

It may be laid down as an axiom that the basis of cotton manuring in Egypt must be organic manures. These must form, as it were, the foundation on which to build up the system of manuring. Unfortunately, in Egypt, as in India, organic matter is at a premium. The absence of wood as fuel necessitates the poorer classes employing every form of organic matter for this purpose, and were it not for the growth of clover it is certain that the soils would speedily become deficient in humus. It is true that by means of chemical manures alone full crops of cotton may be obtained, but in this case if a cereal crop follows the cotton the result is not so satisfactory as when the cotton receives stable manure, while the cost of raising the cotton is increased.

Stable manure is almost invariably spread broadcast over the land before the last plowing is given in the preparation of the land. The amount applied varies from 10 or 15 tons per acre to as much as 30 tons. It is not, however, possible on a farm of any extent to find a sufficient quantity of manure to treat the whole cotton area as liberally as 30 tons or even 20 tons per acre. In fact, it is rarely that

large growers can find sufficient manure to apply as much as 15 tons per acre, especially so as a greater proportion of the land is now under cotton. It may be assumed, however, that under the ordinary circumstances of successful agriculture 15 tons per acre are employed.

The manure is certainly not covered as deeply as in America, the use of the native plow after its distribution over the land resulting in its being buried to a trifling depth only. The irrigation water employed tends to wash the valuable ingredients of the manure down into the soil; furthermore, in Egypt great importance is attached to the feeding of the cotton plant during the early stages of growth, and opinion would be rather opposed to burying the manure as deeply as is practiced in the cotton States of America. It is again laid down as a rule that the manure should be old; that is, should have been in the heap for some time. The use of fresh stable manure causes rank growth, late maturity, and an inferior fiber.

Though great importance is attached to the use of stable manure, the best results are not, as a rule, obtained when large quantities are used without the application of chemical manures. The basis of the mixture of chemical manures employed is superphosphate. About 400 pounds per acre of this substance are applied, the quality in common use being that which contains 16 to 18 per cent of soluble phosphoric acid. It is found that this substance exercises a most beneficial effect on the crop. It checks the tendency to coarse growth, and thus encourages ripening, while it greatly improves the quality of the fiber. It is generally considered that the best results are obtained when this manure is applied previous to the sowing of the crop. The use of basic slag as a substitute for superphosphate has not been attended with satisfactory results, the more soluble forms of phosphoric acid being preferred.

While phosphoric acid is the basis of the mixture of manure employed, it is universally conceded that the application of soluble nitrogenous manures during the early stages of growth is most beneficial. It is found that the cotton plants require pushing when young, and that though there may be theoretically quite sufficient nitrogen in the stable manure applied, it does not act as early as is advisable; in fact, when large quantities are applied it causes growth at too late a period, and consequent harm. Some few years since, when the idea gained ground that the question of the manuring of cotton merited more attention than had been given to it in the past, some excellent cultivators, by the addition of large quantities of organic manures produced cotton of poorer quality than they had grown previously with a less liberal application.

The question whether nitrate of soda or sulphate of ammonia is the most suitable substance to employ as the basis of nitrogenous manuring, or whether a mixture of the two is advisable, has been made the subject of many experiments. There were those who

maintained that the former would be almost entirely washed away by the irrigation water employed. The results which have been obtained indicate that when barnyard manure is applied there is little need for any nitrogenous fertilizers which do not supply nitrogen in the very early stages of growth. When considerable quantities of sulphate of ammonia are applied, there is a tendency to cause excessive growth late in the season, and on account of a failure to ripen there is often a considerable diminution in the yield. On the other hand, when nitrate of soda predominates, the plant receives a supply of nitrogen just when it is wanted at the early stages, and this gives the plant that good start which is so essential in cotton culture. That there is a loss of a part of the nitrogen is probable, but the effects of its application are always most pronounced and profitable. The benefit derived from the part which is not lost is more than sufficient on ordinary soils to pay for its cost.

It is generally considered that in addition to an application of 10 or 15 tons of stable manure it is profitable to employ as much as 150 or 200 pounds of soluble nitrogenous manure, and two-thirds nitrate of soda and one-third sulphate of ammonia give excellent results. Experiments have clearly proved that better results are obtained when the amount of nitrate of soda predominates than when the greater part consists of sulphate of ammonia, assuming that an organic manure has been applied, which should always be the case when possible.

The employment of cotton seed or cotton-seed meal is out of the question in Egypt, the seed being considered too expensive. It is more costly than in the United States, and practically the whole of it is exported. The economy of the use of cotton seed and cotton-seed meal as such as sources of nitrogen for the cotton crop seems to the writer to be very questionable. In passing through the body of an animal comparatively little of the valuable fertilizing ingredients of the meal are retained, but are found in the resulting manure. It seems, therefore, more practical to employ stable manure or green manures as the basis of manuring in Egypt and to supplement these by the use of such substances as superphosphate, nitrate of soda, and potash manures to supply the deficiency.

Soluble nitrogen gives size to the plant, and up to a certain point a larger and more vigorous plant means an increased yield. It is often argued that the production of large plants reduces the yield, and this may be true to a certain extent; but this arises generally from the plant being stimulated too late. Excessive growth is produced by manures containing nitrogen which act too late in the season. This objection is not felt in the case of manures which supply their nitrogen early, but with those which continue to push the plant too late.

The employment of potash manures in Egypt has not, generally speaking, been attended with satisfactory results except in the case

of light soils. The alluvial soils of Egypt are as a rule very rich in potash, and, though potash manures may have a beneficial effect on the quality of the fiber, as far as yield is concerned they exercise practically no effect. Sulphate of potash is the substance generally employed.

As a general rule a mixture of 400 pounds of superphospate, 125 pounds of nitrate of soda, 50 pounds of sulphate of ammonia, and, provided it is thought necessary, about 80 or 90 pounds of sulphate of potash, gives the best results. This mixture is employed in addition to stable manure. Discretion must be exercised as to the quantity of soluble nitrogenous manures to employ. On many soils which naturally produce very strong growth the amounts given may be excessive, but even with the relatively large growth of Egyptian plants there are very few soils where nitrogenous manures may not be used with advantage.

Stable manure contains on an average about 0.25 per cent nitrogen, 0.2 per cent phosphoric acid, and 1.25 per cent potash, so that each ton contains about 5½ pounds of nitrogen, nearly 5 pounds of phosphoric acid, and about 28 pounds of potash. If it is assumed that over the cotton area 10 or 15 tons on an average are applied per acre, it is equivalent to at least 55 pounds of nitrogen, 50 pounds of phosphoric acid, and 280 pounds of potash. A great part of these ingredients is derived from the soil itself, which was used as litter, and the availability of the various elements must be very low. It is generally thought that in addition to this about 30 pounds of nitrogen and 60 pounds of phosphoric acid in available forms are necessary to produce a good crop on land which grows from a bale to a bale and a quarter of cotton per acre. Numerous experiments have shown that these quantities can be applied with advantage to the great bulk of the cotton area.

As already mentioned, the barnyard manure is applied broadcast before the last plowing, and the phosphoric acid is also generally applied before sowing. The nitrate of soda and the sulphate of ammonia, however, are mixed together and applied after the cotton has received its first watering. The plants, generally speaking, are thinned before this watering, and after the second hoeing has been given the nitrogenous manure, mixed with a little earth, is applied at the base of the plants, hoed in, and the second watering given. This occurs in the month of April, and the effects of the manure are seen almost immediately after the watering. Spells of fresh weather often somewhat retard growth during the early months, and the advantages to be obtained by tiding the plant over this period and keeping it steadily growing are very marked.

It may be of interest to give some of the results of experiments which have been made in Egypt during the past three or four years on the subject of cotton manuring. This question was first systematically investigated by the Khedivial Agricultural Society, and as the

results of experiments which have been conducted on their experimental farms the matter has assumed great importance, since it is being recognized to a greater extent year by year that by the employment of suitable mixtures of manures profitable increases in yield, as well as an improvement in quality, can be obtained. During the seasons of 1901 and 1902 experiments conducted on somewhat poor land at the society's farm at Mit el Diba showed that when, in addition to stable manure, a suitable mixture of commercial fertilizers consisting of 400 pounds of superphosphate, 125 pounds of nitrate of soda, 50 pounds of sulphate of ammonia, and 80 pounds of sulphate of potash was employed the yield of seed cotton was increased from 880 pounds on unmanured land to 1,595 pounds. The yield obtained by the use of stable manure alone was 1,135 pounds, or 460 pounds less than when commercial fertilizers were employed in conjunction with it. By the use of mineral manures alone, in addition to stable manure, the yield obtained was 1,340 pounds of seed cotton, whereas an increase of 260 pounds, or a total of 1,600 pounds of seed cotton, was obtained when supplemented by nitrate of soda.

As already mentioned, the use of potash salts is attended with practically no increase in yield on the ordinary alluvial soil of the Delta, though when the soils are light the case may be different. This fact has been brought out in many experiments, though whether the use of these salts exercises any effect on the length, strength, or fineness of the staple is a matter for further determination.

The influence of the growth of Egyptian clover preceding cotton is most marked on poor land. On the Khedivial Agricultural Society's farm, in the province of Gharbieh, an experiment was conducted during the season of 1902 on land of similar quality. In one case, series of fertilizer trials were conducted on land where the cotton crop had been preceded by wheat and in the other case by clover. The results obtained in pounds of seed cotton per acre are given below in a tabulated form:

Effect of chemical fertilizers on cotton in Egypt.

Kind of fertilizer.	After wheat.	After clover.
	Pounds.	*Pounds.*
Without manure	800	880
With stable manure only	1,032	1,135
With superphosphate and potash salts	1,005	1,340
With superphosphate, potash salts, and soluble nitrogenous manure	1,105	1,595

It will be seen that the greatest difference is brought out when a mixture of fertilizers is employed and is least when the crop is grown without manure. It may be stated conclusively, therefore, that the use of chemical fertilizers in conjunction with stable manures exercises a very beneficial effect and gives a profitable return. The proportion of nitrogen employed is greater than seems to be the case usually in the United States, and a dressing of soluble nitrogenous fertilizer can

be applied in Egypt with advantage, even though barnyard manure is employed, or when following a crop of clover, except on the very best land. The extent of land which is not benefited is very limited, even in Egypt. It may be that, theoretically speaking, sufficient total nitrogen is found in either of the two (i. e., barnyard manure and clover), but they push the plant a little too late in the season and do not enable it to grow so rapidly in the younger stages as is the case under the influence of a more quickly acting source of nitrogen.

The use of soluble nitrogenous manures must not be carried beyond a certain point or there is a great tendency to late maturity. The influence of phosphoric acid in hastening maturity is most marked, and when employed in sufficient quantities in conjunction with soluble nitrogenous manure it checks any tendency of the latter to prolong growth. The use of phosphoric acid without soluble nitrogen gives an earlier crop, but a diminished yield in comparison with that obtained by a combination of the two. Again, soluble nitrogen without phosphoric acid gives also a diminished yield and a late crop. A mixture of the two gives an increased yield and intermediate conditions as regards ripening. This will be made clear from the following table, obtained in an experiment where these manures were employed, the figures referring to pounds of seed cotton per acre on poor land:

Effect of a mixture of phosphoric acid and soluble nitrogen on cotton in Egypt.

Manuring.	First picking.	Second picking.	Third picking.	Total.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Phosphoric acid only	835	420	400	1,655
Soluble nitrogen only	138	455	900	1,493
Phosphoric acid, together with soluble nitrogen	435	935	870	2,240

There can be no doubt that organic manures must form the foundation of the Egyptian system of manuring, but it is rare, unfortunately, that a sufficient supply can be obtained by the farmer, and this is more especially the case in view of the tendency to put an increased area under cotton. In Egypt there is no substitute for barnyard manure in any quantity to fall back upon, though poudrette and similar substances give excellent results when so employed.

As regards quality, samples of soil from experimental areas have been repeatedly submitted to experts, and when a suitable mixture of chemical fertilizers has been employed there has always been an improvement in comparison with the employment of large quantities of barnyard manure only.

SUMMARY.

Summarizing, the following statements may be made:

(1) The cotton crop is almost invariably manured and responds freely to the application of manures.

(2) Barnyard manure or some manure of a similar nature should form the basis of manuring in Egypt.

(3) Leguminous forage crops form an excellent preparation for a good cotton crop, but to obtain the best results the soil should be plowed up some time before cotton planting takes place.

(4) The fullest advantage of the use of these manures, as well as of any chemical fertilizer that may be employed, can only be obtained when the soil is well prepared, deeply cultivated, and the crop judiciously watered during growth. Frequent hoeings also keep the crop in a gradually progressive condition.

(5) In addition to the use of barnyard manure at the rate of 10 or 15 tons per acre, applications of chemical fertilizers are attended with profit.

(6) Phosphoric acid at the rate of 400 pounds per acre applied in the form of soluble phosphate gives excellent results. It tends to check excessive growth, increases the yield, improves the staple, and hastens maturity.

(7) A subsequent dressing of soluble nitrogenous manure is attended with excellent results. A good mixture in Egypt consists of about 125 pounds of nitrate of soda and about 50 pounds of sulphate of ammonia. Where larger quantities of barnyard manure are employed it may be advisable to omit the latter. The soluble nitrogenous manure is best employed in two applications.

(8) Potash manures in Egypt have not given any increase in yield, and their value is problematical. Their effect on the quality of the fiber has not been accurately determined.

VARIETIES OF COTTON GROWN IN EGYPT.

The origin of Egyptian varieties of cotton is lost in obscurity. Previous to the year 1820 an indigenous cotton existed in Egypt, but, as already stated, its cultivation was practically unknown. In that year a variety of ordinary white cotton was brought to Egypt by a Frenchman, M. Jumel, and even its origin is somewhat uncertain. It was, however, probably brought from the upper Nile regions. In the growth of this cotton the Khedive took a great interest, and he compelled cultivators to grow it in several districts. At that time the irrigation of Lower Egypt was greatly modified by the making of deep canals capable of carrying the low summer water of the Nile, and the cultivation of cotton began to assume greater importance. From the year 1825 to 1839 it is said that Sea Island cotton was grown regularly in Egypt; and though it is unknown now, old natives occasionally speak of a variety whose name certainly appears to be a corruption of the words "sea island." Again, it is stated by some that Peruvian cotton was introduced and grown.

All that can be asserted with safety is that out of the varieties existing in the country "Ashmouni" cotton was evolved, and of the varieties at present cultivated in Egypt this is the oldest.

ASHMOUNI.

Ashmouni cotton, although at first discovered in the Delta, where its cultivation was at one time general, is now practically confined to Upper Egypt, in the provinces of Beni-Suef, Fayum, and Minieh, being watered by the Ibrahimia Canal. The area exceeds 100,000 acres, though, as already stated, the absence of a statistical department renders any figures somewhat approximate.

The production in the year 1901–2 was 432,000 cantars, made up as follows: Beni-Suef, 174,000 cantars; Minieh, 128,000 cantars; Fayum, 130,000 cantars; total, 432,000 cantars.

The Egyptian bale is equivalent to about 750 pounds of cotton. Expressed in American bales of 500 pounds, the production of Ashmouni cotton would be thus 86,400 bales. Assuming the acreage given to be correct, the average yield is about 1,300 pounds of seed cotton per acre.

This variety is now replaced in Lower Egypt by "Afifi." Practically the whole of the Ashmouni cotton is ginned at various establishments in Upper Egypt, and the fiber is sent to Alexandria for sale and shipment. A small proportion is ginned in Lower Egypt, chiefly at Kafr Zayat. Ashmouni plants are smaller in habit of growth than Afifi and ripen early, owing to the hotter climate of Upper Egypt. When grown under the same climatic conditions Ashmouni does not ripen appreciably earlier than Afifi. The fiber of Ashmouni is brown, though less so than Afifi, and is shorter, being about 1⅛ to 1¼ inches in length. In strength it is fair, but it is neither so lustrous nor so fine as lower Egypt cottons. Though inferior to Afifi, it seems to do better in Upper Egypt than the latter. Afifi not only gives a smaller yield, but soon deteriorates. There seems to be no reason, however, why the latter should not be acclimatized there or a successful cross obtained between the two varieties.

The yield of Ashmouni in ginning is unsatisfactory, being until quite recently only about 95 pounds of fiber per cantar, or about 30 per cent. During the past few years the output has reached 98 to 104 pounds, probably owing to mixture with Afifi. Its value is about 81 per cantar less than that of Afifi for classes up to "good." Ashmouni gives no fine or extra-fine qualities like Afifi. The seed differs from other Egyptian varieties in being "clean"—that is, possessing no adhering fiber. It is very much mixed at the present time, but for the season of 1903 it seemed a little cleaner than usual. The seed is sold early in the season for the same price as Lower Egypt varieties.

The general cultivation of this variety in Upper Egypt has not received as much attention as the Lower Egypt cottons, and as a rule it is not so well cultivated. The fiber is exported chiefly to the Continent of Europe and to Russia, though quantities are sent to England and the United States.

LOWER EGYPT COTTONS.

MIT AFIFI.

Undoubtedly the chief variety of cotton in Egypt is Mit Afifi (Pls. III, fig. 2, and VI, fig. 1), so called from a village in Galiubieh Province, where it was first grown about 1883. It constitutes a very high percentage of the total production of the country, and the price at which its fiber is sold forms a basis for that of other varieties. The plant is normal in size and not so large, generally speaking, as Jannovitch. It is average as regards the time at which it ripens. Ashmouni, grown in upper Egypt, comes into the market first. Abbasi is probably a little earlier, and Jannovitch a little later than Afifi. As regards sowing, quantity of seed used, watering, picking, etc., the particulars given in another part of this bulletin refer to this variety. The fiber of Mit Afifi is brown in color, long, lustrous, generally very strong, and fine to the touch. It attains an average length of 1⅜ to 1½ inches. There is a great demand for it; in fact, it leads the market. The total production per acre is good, being on an average higher than that of any other variety. It is true that in certain favored districts Abbasi may rival and even surpass it in this respect, but no other variety appears under all circumstances to yield 500 or 600 pounds per acre of lint on good average soil. The bolls are pointed and rather small, but the cotton is easily picked. Ginning is easy, and from 105 to 109 pounds of fiber are obtained per cantar, i. e., from 33 to 35 per cent. Afifi cotton does not show great differences in quality in late pickings as do the other Lower Egypt cottons; that is to say, the difference between the first and second pickings is less marked than with others.

The origin of Afifi cotton is very doubtful. Some years ago there existed in Egypt a considerable number of varieties which were short lived, such as Hamouli, Gallini, Hindi, etc. Pure white cotton also existed, but its cultivation was abandoned after the appearance of Afifi. A variety known as "Bahmia" was also somewhat extensively grown for several years and gave good results on good quality land. It was also replaced by Afifi. A variety known as "Hariri" was first cultivated in the Goddaba district (Garbieh province). This was finer even than the variety known as "Jannovitch" which is cultivated at the present time. The output in ginning, however, was very poor (60 to 70 pounds of fiber per 315 pounds of raw cotton), and its cultivation was abandoned because growers found it unprofitable. Gallini was also first known in the Goddaba district when this region was badly drained and the land consequently salty. Since that time, however, the quality has greatly deteriorated, and as the output in ginning was poor it also was replaced by Afifi. It was commonly reported that this variety, which was itself said to be of Sea Island

origin, gave rise to our present Afifi. Each cantar of Gallini cotton (315 pounds) gave only from 85 to 88 pounds of lint.

What is known as "Hindi" cotton is really the old native variety and is now unfortunately found in almost every quality of cotton to a greater or less extent. This, of course, causes deterioration in the staple and also reduces the output in ginning.

The silky nature of Egyptian cottons and the fact that they possess a brown color probably indicate that they are really of Sea Island origin, but there is no evidence to show whence their deeper coloration than Sea Island arose unless it was by means of a cross with some highly colored variety, such as Peruvian. It has often been suggested in the United States that the peculiar soil conditions of Egypt, the Nile mud, etc., may account for this; but there exists in Egypt a pure white variety (Abbasi), which has now been grown for many years, and there has been no tendency whatever toward the development of any brown coloration, which seems to preclude this idea. Again, previous to the appearance of Afifi, the common white cotton was grown. This possessed a short staple and when in quantity sold for less than Ashmouni. It is doubtful also whether a cross with highly colored Peruvian cotton would have resulted in such good quality as Egyptian cottons possess.

The majority of the varieties are probably "sports." When a new variety has appeared, its origin has always been kept a profound secret owing to the very high prices asked at the commencement for seed, and any inquiries made always led to widely differing replies.

The seeds of the different varieties of Lower Egypt cottons can not readily be distinguished from each other. They are black, with small tufts of green fiber at the ends. Their market values are the same.

ABBASI.

This is the only white cotton now grown in Egypt. It made its appearance about 1891–92. At first it was grown only on large estates, but it gradually increased in favor, though at the present time its cultivation is diminishing. Afifi is the general cultivators' cotton, as it were; it is more suited to all conditions, requires less care in picking, and the market is always certain. All other varieties may be called "special," requiring more careful treatment, and the demand for them is not so universal. Abbasi, owing to its color, requires more care in picking. It is said to be more hardy than Afifi, resisting periods of drought and adverse climatic changes more successfully. In the late summer and early autumn, fogs which do a great deal of harm are experienced in Egypt, and it is said that Abbasi cotton suffers less than any other variety, and is also less affected by cold spells. It produces in certain districts a heavier crop than Afifi, and is perhaps a little earlier. In general management and cultivation it resembles the latter.

The first picking of Abbasi is very superior and sells well; the later gatherings deteriorate, and there is small demand for them. The fiber of the first picking is as fine as Afifi and a little longer. As a general rule the second picking is much weaker than the first, and the lower qualities sell for less in proportion than lower grade Afifi. Abbasi is rather more difficult to gin, having a tendency to break the knives. The fiber clings to the roller and often comes to the knives again. Care must be taken not to injure the long fiber; therefore the gins are run at a slower speed. The longer stapled cottons, such as Abbasi, Gallini, and Jannovitch, require a little different regulation of the gins in order to avoid damaging the staple. The output of seed per cantar of Abbasi is about the same as Afifi; there is more "scarto," however. The price of the best qualities ranges from $1 to $1.50 per cantar of 315 pounds more than Afifi.

Abbasi was first put on the market by a Greek planter near Birket-el-Sab in the Garbieh province, and it is almost needless to state that the name given to it is derived from that of the present Khedive. The best qualities are exported to England, and the poorer qualities to all parts of the Continent—a little to Russia.

JANNOVITCH.

This variety, which has been cultivated for about seven years, is the most silky and fine of all Egyptian cottons. It possesses good length—1½ to 1⅝ inches—is very fine, and stronger than the best qualities of Afifi. As a rule its cultivation is in the hands of large growers, the fellah confining himself chiefly to Afifi.

The plant is of somewhat coarser growth than the other Egyptian varieties, and is a little later in coming to maturity. The best qualities are grown in the northern part of the Delta, near the sea, and where the land generally contains a certain amount of salt. The output in ginning is inferior to both Afifi and Abbasi, the average being about 97 to 100 pounds per cantar, but in some districts it gives 100 to 102 pounds of lint per cantar, or 315 pounds, of seed cotton. It is chiefly exported to England, but also to America, the north of France, and Switzerland; other countries take very little. The price is generally $2 to $2.50 per cantar above Afifi, and this in spite of the fact that the yield in ginning is from 5 to 8 pounds of lint per cantar less.

It is suposed that this variety originated from a cross of good quality Gallini (of which very little existed at the time in the district) and Afifi. Gallini gave in ginning only from 80 to 88 pounds of fiber per cantar, while Jannovitch when it was subsequently grown gave from 97 to 100 pounds, and Afifi similarly yielded from 106 to 108 pounds. In this respect, therefore, the new variety was intermediate between its parents. At first the originator of this variety planted a few seeds in a garden, but in February, 1898, about 8 or 10 ardebs of seed were bought at $40 per ardeb (5.4 bushels), while subsequently as much as

$100 per ardeb was paid for about 11 ardebs. The following year seed was sold for from $20 to $30 per ardeb.

It may be mentioned that Sea Island cotton when grown in Egypt produces good quality the first year. The staple is longer even than that grown, on an average, in America, but is more irregular in length and not so strong. During the second and third years there is a general deterioration. It ripens late and being in consequence exposed to cold weather and fogs, both yield and quality suffer. The yield in any case is inferior to native Egyptian varieties. The output is only from 70 to 80 pounds of fiber per cantar, according to the quality of the lands. The best qualities are grown on salty lands. On rich soils the quality deteriorates.

SEED SELECTION.

The question of the selection of seed for sowing is occupying considerable attention in Egypt, as Afifi cotton, which is the mainstay of the crop, is greatly deteriorating. Owing to the great similarity not only of the plants of the different varieties grown in the country but also of their seeds, the matter is a somewhat difficult one. At the present time the question of seed is entirely in the hands of the cotton merchants. When the best qualities of cotton of the first picking are being ginned, the factory owner places on one side the resulting seed for disposal to his clients the following season. This is excellent as far as it goes, but where two or three varieties are being dealt with in a factory, even though the proprietor may clean his gins, his riddles, etc., after each ginning a certain admixture must take place. The seedsman class is quite wanting in Egypt, and until recently most of the cultivators were not sufficiently alive to the question of good seed. At the present time, however, the Khedivial Agricultural Society is paying special attention to this most important subject, while individual cultivators appreciate more the necessity of employing good and pure seed.

Small cultivators in the past obtained their seed to a great extent through the village money lender, who supplied them with ordinary commercial seed quite unsuited for sowing purposes. The Khedivial Agricultural Society now distributes seed of first-picking cotton to small growers at cost price. The value of the seed, plus a moderate rate of interest, is collected by the Government agents when the ordinary taxes are collected. The seed is not paid for until the resulting cotton crop is picked. The benefits are two-fold—not only is the fellah provided with better seed than he would obtain elsewhere, but he is to a certain extent kept out of the hands of the usurer.

Afifi seed at present is mixed and contains Hindi seed. This, as already stated, is the old white variety, and its presence greatly detracts from the value of any sample. There are also a great many seeds present in samples which, while differing in shape from good,

true Afifi seed are yet Afifi, but seem to be in a state of deterioration. The question of the establishment of seed areas is now under consideration.

PICKING COTTON.

The picking of cotton commences in Upper Egypt, where Ashmouni is grown, during the latter part of August, but in the Delta, generally speaking, toward the middle of September. Cotton is usually picked by small children, who are paid a sum of 18 or 20 cents per hundred pounds of seed cotton (Pl. VI, fig. 2). The previous watering of the crop is so arranged that the land is dry when picking commences to avoid poaching of the land. The operation of picking is more difficult than that of ordinary Upland cotton, though not as much so as that of Sea Island. The average quantity picked per day is about 30 or 40 pounds. After the first gathering the land is watered, and during the month of October a second picking takes place. These two pickings give the best quality of fiber. They are never mixed with each other nor with the third, or last, picking. The latter is taken in November, and as it is small in amount compared with the others a superior sum is generally paid for picking it, generally 25 or 30 cents per hundred pounds.

After picking, the cotton is generally placed in large stores and subsequently put into sacks which hold about 420 pounds, or it may be put directly into sacks.

MARKETING COTTON.

Cotton is almost invariably sold at the farm. There are distributed throughout the country a number of large ginning establishments (as well as a number of minor ones) owned by large exporting houses. Agents are sent into the country to buy cotton, and the grower can obtain many offers from competing houses. The cotton is sold as seed cotton, weighed at the store in the presence of the buyer's agent and the seller, and is then taken charge of by the former for removal to the nearest railway station or is delivered by the seller, according to agreement. In the case of large lots of cotton the grower, provided with samples, sometimes visits the factories,[a] and after a considerable amount of competition and bargaining disposes of his crop.

Cotton is quoted on the bourse at Alexandria per cantar of 100 pounds of lint for "fully good fair" cotton. To this amount the value of the seed is added and a certain sum per cantar (of 315 pounds of seed cotton) is offered to cultivators, depending on the quality of the cotton in question. Ginning is carried on, as already mentioned, at various centers, and the resulting fiber and seed are forwarded to Alexandria for shipment. The factories are generally situated so that

transportation is easy both by rail and by water. The season is from September to May, and during its height the factories work *night* and day.

The gin almost invariably used in Egypt is that known as Macarthy's patent self-feeding single action. It is particularly suited to long-stapled cotton, and separates the seeds without crushing, while the fiber is as a rule uninjured. The 40-inch gin so commonly used costs, when complete with roller, shafting, etc., about $150. The gin alone costs $90. It is said to require only 1½ indicated horsepower to drive it, but in practice from 3 to 4 horsepower are allowed. The quantity of cotton turned out per hour varies according to the speed at which the gin runs. It is supposed to give a hundredweight of clean cotton per hour, but from 90 to 100 pounds is considered a good average. Running at 900 or 1,000 revolutions per minute, 100 pounds of fiber per hour will be ginned, or, say from 900 to 1,100 pounds per day of ten hours. The driving pulleys being now provided with balance weights, the gin can run at an increased speed with but little increase in vibration. The gin is not large, the floor space it occupies being less than 17 square feet, while the net weight is less than 700 pounds. In Egyptian factories from 50 to 100 of such machines are generally found.

Regarding the cost of working, it may be taken as a general average that 30 cents will gin a cantar of cotton, i. e., 315 pounds of the seed and fiber, giving approximately 100 pounds of clean cotton. According to the reports of the State Domains the net cost of ginning is 26½ cents per cantar, and thus an acre of good cotton yielding 6 cantars would cost a little over $1.50 for ginning (actual cost).

The gins are generally arranged in two rows, with a trolley line down the middle for the removal of the cotton. The latter is taken to the press room, which is situated at the end of the ginning room. Both hydraulic and steam presses are used. In the small factories, the former only are found and the bales are steam pressed at Alexandria. In the large factories the good qualities are pressed twice. After removal from the gins the fiber is spread out and sprinkled with water by means of a fine syringe and then put into hydraulic bales. After remaining a day the cotton is steam pressed, and the three bands which are used in the former case are replaced by eleven in the steam bale. The seed after removal from the gin is elevated to riddles, which allow those possessing no adhering lint to pass through, while the rest is carried on to the "scarto" gin, which removes short fiber.

One or two of such gins, each requiring 5 horsepower, are sufficient for 100 ordinary gins and turn out about 4 bales of "scarto" cotton per day. The seed is subsequently put into bags containing an ardeb (5.4 bushels), the weight being about 270 pounds, and is sent to Alex-

FIG. 1.—FIELD OF MIT AFIFI COTTON BEFORE GATHERING.

FIG. 2.—EGYPTIAN METHOD OF PICKING AND CARRYING COTTON.

andria for export. Sometimes cotton is ginned for clients at about 30 cents per cantar, the owner selling the resulting seed to the factory, while the cotton is sent in hydraulic bales for his account to Alexandria. If steam pressed, a charge of 15 cents per cantar (100 pounds) of lint is made, plus the cost of bagging required for the bales. The sacking used for bales in Egypt consists of old cotton sacks. The latter after being used two seasons for packing cotton are cut up for this purpose.

The first, second, and third pickings of cotton are always ginned separately. That of the third picking is generally put in hydraulic bales only and forwarded as such to Alexandria.

During the past few years two cotton mills have been erected, one at Alexandria and one at Cairo. The local consumption of cotton, however, is not great. A certain amount is consumed in the villages by being woven into coarse goods, but this is generally the very last cotton gathered from the plants and is of very low quality. The consumption during the past season by local mills amounted to 27,000 cantars, or an equivalent of 5,400 American bales.

Practically the whole of the Egyptian cotton seed is exported. A certain amount is, however, consumed by soap and oil mills in the country. This latter consumption amounts to 420,000 ardebs, or an equivalent of 2,320,000 bushels. The seed is rich in oil, the average content being about 25 per cent. The cotton cake resulting is exported to England, and, as is well known, is "undecorticated cotton cake," the seed not being decorticated.

The following table shows the production of seed cotton in Egypt from the year 1864 to 1903, the season being from September 1 to August 31:

Total crops of seed cotton (interior gross weight).

Season.	Cantars.	Season.	Cantars.	Season.	Cantars.
1864–65	2,139,716	1877–78	2,593,670	1890–91	4,072,500
1865–66	864,581	1878–79	1,683,749	1891–92	4,672,520
1866–67	1,127,895	1879–80	3,198,800	1892–93	5,118,150
1867–68	1,207,402	1880–81	2,776,400	1893–94	4,933,666
1868–69	1,303,156	1881–82	2,912,073	1894–95	4,615,270
1869–70	1,362,514	1882–83	2,284,250	1895–96	5,275,383
1870–71	1,970,717	1883–84	2,694,000	1896–97	5,879,750
1871–72	2,044,254	1884–85	3,615,750	1897–98	6,543,128
1872–73	2,298,942	1885–86	2,923,450	1898–99	5,589,314
1873–74	2,538,351	1886–87	2,931,691	1899–1900	6,510,050
1874–75	2,106,699	1887–88	2,937,000	1900–1901	5,427,338
1875–76	2,928,498	1888–89	2,723,000	1901–2	6,371,643
1876–77	2,773,258	1889–90	3,183,000	1902–3	5,838,090

It is impossible, owing to the absence of a statistical bureau, to state the exact average yield of cotton per acre in Egypt, but it is probably about 1,300 pounds of seed cotton. Very good land gives 2,500 pounds, and in exceptional cases more.

COTTON AND COTTON-SEED EXPORTS.

The statistics of cotton and cotton-seed exports furnished by the customs administration are calculated from January 1 to December 31. In the year 1901 cotton constituted 75.2 per cent of the total exports of Egypt and in 1902 similarly 78.8 per cent.

Distribution of cotton and cotton seed for the years 1902 and 1903.

Countries to which exported.	1902.	1903
Exports from Alexandria to –	*Bales.*	*Bales.*
Germany	19,126	19,422
England	322,514	351,745
Belgium	9,604	12,650
Spain	31,781	24,910
United States	106,565	84,819
France	78,875	70,608
India	2,443	836
Italy	63,068	60,728
Japan	11,322	9,498
Russia	121,343	55,121
Austria	92,249	75,989
The Netherlands	327	
Greece, Turkey, and other countries	3,753	1,798
Exported from Port Said and Suez	700	65,445
	863,670	775,892
Total in cantars	6,526,407	5,860,023

[a] Estimate.

COTTON SEED (IN ARDEBS OF 5.4 BUSHELS).

To England	3,146,660	2,732,366
To Marseille	182,925	137,018
To various Continental ports	153,585	104,290
Total	3,483,170	2,973,735
Local consumption	310,978	420,000

SUGAR CANE.

Sugar cane is grown in Upper Egypt. The climate of the Delta proper is unsuited to it and results in a low content of sugar. Cane is characteristic of the tract watered by the Ibrahimia Canal already referred to, but it is also grown farther south, being watered by pumps direct from the river. The area varies from year to year, an increase in the cotton area being practically equivalent to a diminution in that devoted to sugar cane. Generally speaking, during the past few years there has been a tendency toward a diminution.

In the year 1902 the area under cane in Upper Egypt amounted to 84,664 acres, of which 58,765 were on the Ibrahimia Canal, while the remainder was grown farther south. Cane occupies the land for nearly a year, and requires water during the whole period, while for the production of maximum crops the soil has to be in a high state of fertility.

to individual cultivators, owned until quite recently the greater part of the sugar-growing lands and possessed several factories. The land under this administration was cultivated chiefly through tenants.

Considerable areas were leased to large cultivators who grew cane under an agreement to sell the produce to the administration at a fixed price (generally about 15 cents per hundred pounds of canes). The leases for cane cultivation were for three years and bound the tenant to one year's fallow, during which it was plowed by the administration at a fixed rate. This was followed by cane for two years. This again was followed by a three years' lease for minor crop cultivation, after which cane was grown again. The growth of summer crops was prohibited during the intermediate years, but corn was cultivated during the flood season, this being heavily manured. The growth of clover was practiced during the winter, and thus the land was brought into condition for cane again. Small owner proprietors, however, crop their land more intensively. They manure their cane heavily (while this was prohibited on the Daira lands) and only take one cane crop; that is to say, they do not take a rattoon crop. This is followed by two or three years' ordinary cropping with grain crops and clover, when cane is grown again. Though a large yield per acre is obtained in this way, yet by applying heavy quantities of manure the sugar content is considerably reduced.

The factories of the Daira Sanieh have been sold to a private company, and the sugar industry of Egypt is now practically a monopoly in the hands of a French company known as the Société Générale des Sucreries et de la Raffinerie d'Egypte. This company owns the majority of the factories and may be said to crush practically the whole of the crop, except that employed for the manufacture of molasses in small mills owned by natives and Syrians.

The rotation employed is either one of four or five years. In the former case cane is grown for two years, followed the next year by a flood and a winter crop, and this again during the fourth year by a fallow in preparation for the next year's cane crop. Since the introduction of the growing of beets into Egypt a modification in the rotation has been introduced in some places by growing a crop of beets before the fallow, thus making the rotation a five years' course.

Steam plows and cultivators, which do most effective work, are employed by the company; but on ordinary plantations the native plow is used, and four plowings and even more are given with this implement in preparation for the sowing of the crop. The land is thrown into ridges or beds about 40 inches apart; but native cultivators allow a less distance than this, generally about 30 inches. The ridges are made north and south and should have a depth of 15 inches measured from the top of the ridge to the bottom of the furrow. The soil at the bottom of the furrow should be well pulverized, and this

is accomplished by attaching a sort of rake to the ridging machine where this is employed. Native cultivators make their ridges in the manner described in the chapter on cotton.

Planting takes place early in spring, in February, though experiments which have been conducted recently seem to indicate an advantage in sowing as early as October. Too little care is given to the question of the choice of canes for planting instead of employing only the best. Generally speaking, the whole of the cane is used. The company to which reference has been made adopted the following plan: If planting takes place before the factories are at work, the whole of the cane is employed, while if the factories are crushing, the top third only (which gives the best results) is kept for planting, the remainder being sent to the factory. No greater quantity is cut and stripped per day than is necessary for that day's planting. The canes are laid along the furrows, covered lightly with earth, and then watered, the same day preferably.

The cultivation of this crop is comparatively simple, and from twelve to fifteen waterings are given. Several hoeings are necessary, and these are performed with the hoe as described under cotton.

It is very doubtful whether Egypt can be regarded as a very suitable country for the production of sugar cane, for neither in yield nor in richness in sugar can it compare with many other countries. The average yield of cane for the first year may be taken as about 26 tons, though in some cases more than 30 tons are obtained. During the second year the yield on an average does not exceed 50 per cent of that obtained during the first.

The average sugar content does not exceed 14 per cent; indeed this would be considered an extremely good result. During the season of 1902, 11,148,491 cantars (of 100 pounds each) of cane were crushed in Upper Egypt, yielding 1,028,105 cantars of sugar of first quality, equivalent to 9.2 per cent of No. 1 sugar.

Only one refinery exists in Egypt. A great portion of the sugar produced is consumed locally or exported to India and other countries without being refined.

The following tables show the quantities of cane crushed during the past five years, together with the yield of No. 1 sugar:

Quantity of cane crushed and yield of sugar during the past five years.

[Cantars of 100 pounds.]

Season.	Cane crushed.	No. 1 sugar produced.	
			Per cent.
1898–1899	13,680,944	1,253,525	9.2
1899–1900	14,515,565	1,369,953	9.4
1900–1901	11,850,485	1,161,471	9.0
1901–1902	12,442,452	1,240,843	10.01
1902–1903	11,148,491	1,028,105	9.2

The following table indicates the export trade in Egyptian pounds:[a]

Country to which exported.	1900.	1901.	1902.
England	33,049	32,747	22,235
English possessions in the Mediterranean		67	70
English possessions in the extreme East	21,029	46,042	34,611
Germany			449
United States	462,454	410,031	257,404
France and Algeria	4,381	1,061	1,270
Italy	1,698	1,211	699
Turkey	39,766	41,593	37,378
Other countries	13,132	9,493	7,777
Total	575,509	542,245	361,973

From these figures it will be seen that the United States is by far the best customer for Egyptian sugar. Of the total production of sugar, 63½ per cent is refined. Of the unrefined sugar 35 per cent is consumed locally and 1½ per cent exported. Of the refined product 84½ per cent is consumed locally and 15 per cent exported.

The crop is heavily manured by natives. Ordinary stable manure is employed, and large quantities of the material known as "coufri," which has already been referred to, are used. Experiments which have been made clearly indicate that an employment of superphosphate with soluble nitrogenous manures gives excellent results for cane.

In an extensive series of experiments made by Mr. Tieman, details of which are given in a recent work, entitled "The Sugar Cane in Egypt," the author recommends the employment of nitrate of soda in preference to any other form of available nitrogen for sugar cane, while as a phosphoric manure the use of basic slag is advocated. The manuring of cane has not, however, received as much attention as has been given to cotton.

Three varieties of cane are cultivated in Egypt: Red, yellow, and striped. The last named seems to give a slightly heavier yield, though in richness of sugar no difference is perceptible.

BEETS.

Though a very minor crop, it may be advisable to refer to beets in close proximity to sugar cane. Some few years since a first attempt was made to cultivate this crop, but up to the present it has not been very successful. The land of Egypt, as is well known, is of good quality, and, generally speaking, such crops as beets, which have a wide range of cultivation, can not be grown in competition with European countries which possess a poorer soil.

Again, the rich soils of the Nile Valley do not give comparatively heavy yields of roots, and 15 tons per acre may be considered a full

[a] An Egyptian pound equals about £1 0s. 6d., which is equivalent to about $4.94.

average. Perhaps, however, the one fact which has militated against the success of the crop has been the severe attacks to which it has been subjected by worms. The most favorable time for the planting is in summer, and attacks by worms are at that time very common; in fact, the beet crop has never escaped. Moreover, summer crops in Egypt exhaust the land, and especially those which require much irrigation. In spite of the fact that the green leaves are turned under after the removal of the crop, and that the land is in good condition after the numerous hoeings, etc., received, a crop of cotton following beets (in the Delta) always suffers and gives a poor yield. This has been repeatedly brought out in experiments which have been made in Lower Egypt.

All the beets grown at present in Egypt are grown by the sugar company in the upper division of the country and amount to about 1,200 acres. The crop occupies the land about six months and is practically always manured with nitrate of soda, which greatly increases the yield. The sugar content is high.

BERSEEM, OR EGYPTIAN CLOVER.

Berseem is the great leguminous forage crop of Egypt, and for luxuriance and rapidity of growth is probably unequaled and certainly not surpassed by any crop in the world. What Egypt would have been or would be without this crop is difficult to conjecture. It is certainly impossible to overestimate its importance. The growth of such heavy crops of cotton, for example, with, comparatively speaking (and especially so until recently), small quantities of manure, has only been possible through the renovating influences of berseem. It has, in fact, only been by the extensive growth of this crop that the maintenance of the fertility of Egyptian soils has been possible. To state the area of land under berseem is extremely difficult, as it not only takes its place in the ordinary rotation, but is also used as a catch crop, one cutting, or it may be two, being taken before the sowing of cotton in the spring.

Berseem constitutes the sole food of working animals, cows and buffaloes; in fact all farm animals during the months of its growth, that is to say, from a period extending from December to early in June. During the rest of the year, as already mentioned, there is almost a complete absence of green fodder and a dry ration, composed of chopped straw, beans, barley, etc., has to be resorted to. The want of a summer forage crop which will grow without repeated applications of water is very much felt in the country. During the winter months no other forage crop is grown; indeed, it is difficult to see how any crop could compete with it in universal use in the country.

There are three recognized varieties grown in the country, viz, the Muscowi, Fachl, and Saidi. The former is that grown on the perennially irrigated lands of Lower Egypt, and the following remarks apply to this variety.

Berseem is generally sown in the months of October and November, following, as a rule, the corn or cotton crop, the date of sowing consequently being dependent on the removal of these crops. As the weather is now daily becoming cooler, the earlier the berseem is sown the shorter the period which elapses before the first cutting or grazing is obtained, and the earlier this is obtained the better, as it diminishes the period during which animals have to be fed on dry food. The first grazing when early can be sold for a considerable sum, as much as $15 per acre in favored districts. When sown after a corn or a cotton crop, the seed is often sown among the standing crop eight or ten days before the corn crop is removed. A heavy watering is given and the seed is then broadcasted immediately. It may be sown in a similar manner among the standing cotton plants. By these means there is a gain of several days and the young clover will be established before the grain or fiber crop is removed. It is becoming more common now, however, to plow the land after the removal of the corn or cotton crop. The cotton ridges or beds are split down the middle with one passage of the plow, the land heavily watered, and the berseem seed broadcasted immediately. The soil is not allowed to become dry, but the seed is scattered over the surface while the water is still on the land, when, owing to its weight, it at once sinks. The amount of seed used varies from 70 to 80 pounds per acre. Germination takes place in two or three days, and if the weather is warm the plants make rapid growth.

Three waterings are generally given previous to the first cutting or grazing, which is obtained from fifty to seventy-five days after sowing, depending to a great extent on the date of the latter. The number and frequency of waterings depend on soil and climate to a certain extent, but two waterings are given between the first two cuttings, and generally two between the second and third and the third and fourth—a total of eight or nine or even ten waterings. On an average three good cuttings or grazings are obtained, while a fourth may or may not be obtained, depending on the date of sowing. In any case it is little in comparison with previous ones. The fourth cutting is generally the one left for seed. Of the latter, 6 or 7 bushels are obtained on good average land. The first and second crops will yield about 8 tons of green fodder; subsequent ones, less. If sown late in October, the first crop will be ready at the end of December, the second early in March, the third from the middle to end of April, and a light fourth crop, either for feeding or for seed, at the end of May or early in June. Hay is frequently made from berseem, about 5 tons of the latter giving 1 ton.

Berseem is fed by tethering animals on the ground by the fore feet, the pegs being moved on as they have eaten those plants within their immediate reach. The luxuriance is sometimes so great that the long lines of bullocks seem to be feeding against a solid wall of forage which reaches almost up to their briskets. A few days are allowed to elapse

after grazing before the land is watered again, and the new crop then makes rapid growth. The forage is very succulent, containing as much as 85 or 86 per cent of water in the earlier grazings, and a little care has to be exercised in feeding it to animals in the early morning during the winter when dew is on it to prevent "tympanitis." Animals in Egypt are never in as good condition as when fed on berseem, and during this period no other food is allowed them, though the pressure of work is very severe at cotton planting. From the moment of planting, the crop requires no labor except that involved in watering. No manure of any kind is ever applied.

The root system of berseem is not an extensive one, but it is most abundantly supplied with nodules. In the latter connection and as exemplifying its renovating effect on the soil it may be interesting to quote the results of analyses made last year by Doctor Mackenzie, director of the School of Agriculture. Berseem was sown in October on two adjacent areas, A and B. On B the crop was allowed to *remain for two grazings* and then plowed up in March in preparation for a cotton crop, while on area A the crop was allowed to remain for its full period of growth until June, and four crops were taken. Previous to the experiment the nitrogen content of each area was determined and also after each crop was grazed. The results were as follows:

	Area A.	Area B.
	Per cent.	*Per cent.*
Nitrogen before sowing	0.099	0.101
Nitrogen after first crop	.110	.116
Nitrogen after second crop	.113	.111
Nitrogen after third crop	.105	.....
Nitrogen after fourth crop	.099	.....

On area B, after removing two crops, each containing 100 pounds of nitrogen, the soil was enriched to the extent of practically *300* pounds of nitrogen, or, in other words, the percentage of nitrogen was increased *from 0.101 to 0.110 per cent.*

When, however, as on area A, the crop is allowed to run the whole course of its existence there is no increase in the total soil nitrogen or it is so minute as to show no difference in the percentage of soil nitrogen present. During the latter stages of growth, therefore, it is clear that the nitrogen contained in the nodules must be drawn upon by the plant for its growth. By comparing the amount of nitrogen added to the soil by the growing of two cuttings of berseem, viz, 300 pounds, with that accepted as the increase in Europe by the growth of an ordinary clover crop, viz, 60 or 70 pounds, it is seen how valuable this forage crop is in this respect.

The rôle played by berseem in the reclamation of salt land in Egypt is worthy of mention. The fact as to whether a stand of this crop can be obtained or not is regarded as an indication of the ability of

the soil to grow other crops. There can be no doubt that it will grow on soils so salt that the majority of ordinary crops would fail. Its shallow-rooted habit and the fact that the frequent waterings which it receives tend to keep the salt down no doubt account for this rather than its power to withstand salt. As soon as sufficient salt has been removed by washing, in the process of reclamation, to enable a crop of berseem to be sown, this is done, and is repeated until a successful crop is obtained, when ordinary culture may be followed with the exercise of that discretion necessary for the management of such lands.

In addition to the variety of berseem known as "Muscowi," grown in Lower Egypt, a kind known as "Fachl" is largely grown on basin lands. The seed is broadcasted on the mud as the water recedes, and as this variety is grown without irrigation one main crop only is obtained, which is usually a heavy one. It is less watery than the ordinary Muscowi sort and is generally used in making hay.

The variety known as "Saidi" is less luxuriant than Fachl. It is somewhat of a trailing nature, and is sometimes mixed with the latter sort. It requires but little water, and is generally cut twice, though sometimes a third time. It is grown chiefly on basin lands, and is smaller in growth and less succulent than the Muscowi variety.

LUCERN (ALFALFA).

Lucern is not grown to any extent in Egypt, as during the winter and spring months it can not compete with berseem in luxuriance. It yields very frequent grazings or cuttings during summer, but requires frequent waterings in order to give the best results, and, as already explained, there are too many demands on the supply of summer water to permit this. During these months it becomes, unfortunately, the home of myriads of worms, which are attracted by it and spread to adjoining crops, often doing considerable damage. The scarcity of summer water already mentioned is also a great impediment to its cultivation. Again, land is usually too valuable to make it profitable to leave it under a forage crop for three or four years. The limited area grown is generally cultivated to supply a little green forage to sick animals, or to a few milch cows or horses.

CORN.

The corn crop is of great importance, as it forms the staple food of the lower classes. It is the characteristic Nili crop. The summer season ends about the last of July, when this, the great flood crop, is sown. As already mentioned, during the summer months a system of rotation of canals is adopted to insure a sufficient supply of water for the cotton crop, and during this period the watering of fallow lands is severely prohibited. The cereal crops, wheat and barley, as

well as beans, berseem, etc., are all off the land by June, and it is on these lands that the corn crop is sown. The latter, however, can not of course be planted without water, and every cultivator awaits the removal of the decree which has prohibited the flooding of such lands.

As soon after the first week in July as water can be obtained, the irrigation of the land for corn sowing begins. If the Nili is a favorable and early one, this may be permitted as early as July 10, while if the reverse be true it is only toward the end of the month that this is possible. The earlier the corn crop is sown the better, and there is consequently a great rush for water, as not only has the corn area to be watered, but cotton, rice, and sugar cane also require water, while the land to be left fallow is also flooded. The water for flood irrigation is obtained from separate flood canals, in addition to the ordinary perennial canals, and during this period is "flush." The flood canals run from the month of August to November.

It will be seen that for flood irrigation, the earlier the Nile rises the better it is for the farmer. The earlier the corn is sown the better, and an early removal of this crop enables the berseem, which often follows it, to be sown in good time.

As already mentioned, it may be assumed that about 50 per cent of the area of Lower Egypt is under summer crops (chiefly cotton), while the flood crops occupy about 30 per cent. The area of land in Lower Egypt under corn during the year 1902 was 1,128,254 acres, while in Upper Egypt also a certain area is grown.

It is seen, therefore, that during flood the whole of the country requires water and the demand is unlimited; thus, the more the canals can carry the better. The watering given in preparation for the corn crop is a very heavy one, and if water is flush at this period may amount to as much as 600 tons per acre, but less if pumped. This, the first watering of the land to be put under flood irrigation, is thus a very heavy one, but as soon as the land is put under crop the subsequent waterings are about the same as the ordinary summer waterings, viz, about 350 tons.

The land after being watered is allowed to remain some days until it is sufficiently dry to admit the plow. As the latter is drawn through the soil by the usual pair of bullocks, its effect, as already explained, being somewhat similar to the scooter or a one-tined scarifier, it is followed by a boy who deposits seed behind it, which will be covered by the plow on its return journey. The land is subsequently harrowed by drawing a plank of wood over it. No attempt is made to deposit the seed in any regular manner in rows, such as is practiced in the United States, and, as would be imagined, the plants are very thickly crowded together. The number of plants found in an acre of corn varies from 13,000 to as many as 20,000, or even more. This, it will be seen, is strikingly different from American practice. The quantity of seed sown per acre is about 1½ bushels. The cultivation is simple, the crop being merely hoed three times during growth and watered

six or seven times. The plants are thinned twice, once when very small and once subsequently. Those removed are given to cattle. The time the crop occupies the land varies according to the sort sown. The so-called native varieties may be cut from seventy to ninety days after sowing. They are small in habit of growth and possess small cobs. The large varieties (often known as *Americani*), which grow to a greater height and produce large cobs, occupy the land from one hundred and ten to one hundred and twenty days. Varieties which take a long time to grow are not in favor because they make the succeeding berseem crop late, while, again, owing to their larger habit of growth, they exhaust the soil more.

The corn crop is universally manured; in fact, it is the heaviest *manured* of all Egyptian crops. Both barnyard manure and coufri are used, the latter to the greater extent. The former, as a rule, does not give such good results for the corn crop itself, but exercises an effect on wheat, cotton, etc., if *following* the corn. Coufri (which contains soluble nitrogen) is quicker in its action, and heavy crops of corn are grown by means of it.

Neither phosphoric acid nor potash is used for this crop, but top dressings of nitrate of soda, as well as applications of sulphate of ammonia, give excellent results. Nitrate of soda is practically the only chemical fertilizer employed in Egypt for this crop.

It may be said that only nitrogenous manures seem to exercise any great effect on the corn crop in Egypt. It is true that no very extensive series of experiments have been made as regards phosphoric acid, but up to the present no appreciable benefit has resulted.

After clover the crop does not require such large quantities of manure as when following a cereal, but in any case it is always manured and a sum of at least $5 or $6 an acre is expended. The heavy watering which the land receives before sowing, and especially the fact that water is given during summer when nitrification is active, no doubt partly explains the pronounced effect of purely nitrogenous manures of rapid action.

The average yield of corn on ordinary land is about 30 or 35 bushels; on good land, well manured, 50 or 55 bushels are obtained, while on poor soil 20 to 25 bushels an acre are produced. The price at which it is sold is about 60 to 65 cents per bushel.

WHEAT AND BARLEY.

Wheat and barley are grown over the whole of Egypt, being sown in the basins of Upper Egypt as well as on the perennially irrigated lands of Lower Egypt. On the latter they are sown in the month of November after cotton or, as is very frequently the case, after a crop of corn which may have been grown during the Nili season and heavily manured, or after a fallow. In Upper Egypt the grain crops are sown earlier, after the water of the Nile recedes, by simply broadcasting the seed on the mud. In the Delta also the cultivation is of

the simplest description. The land is plowed, then harrowed by drawing a plank of wood over it, the seed is broadcasted and covered by means of the native plow and harrow, and the land is immediately watered.

In other cases the land is watered some days before planting, and when sufficiently dry for plowing the seed is sown and plowed in, no water being given after planting. The use of implements, such as European harrows, for covering the seed instead of the native plow is very restricted. The quantity of seed employed is about 2½ bushels per acre. When the crop has attained a height of about 8 or 9 inches (in January or early in February) it is watered, and no further watering need be given, though it is more usual to irrigate the crop a second time, viz, when the plants are forming into ears (March or early April). This completes the cultivation of the crop.

Cereals are harvested in Upper Egypt in the month of April, and in Lower Egypt in May and June. The crop is either pulled by hand, in the case of barley, or cut by means of small sickles. About five men are sufficient per acre, and this work is often done by contract for about $1 per acre. Harvesting machinery is not employed, as the small ridges made to facilitate watering prevent the successful working of a reaper, the knives of which run into these small ridges and are broken.

Some years since thrashing machines were introduced into Egypt, these being provided with revolving drums for crushing and bruising the straw into what is known as "tibn." The grain is delivered from them similar to the ordinary thrasher, while the bruised straw is blown out at the end of the machine. These are found on some large estates, though the bulk of the grain is still separated by means of the primative "norag," consisting of a number of circular disks on an axle, which revolve as the whole is drawn by two bullocks.

The produce is arranged in a circle and the tread of the bullocks and the cutting and bruising action of the disks chop the straw and knock out the grain. When this is completed the whole is thrown into a heap for the subsequent separation of the grain from the tibn. This is accomplished by throwing it into the air, when the grain, being the heavier, falls directly to the ground, while the tibn is blown by the wind to one side. It will at once be understood that this system is most laborious. Barley is more easy to thrash than wheat, the straw being more brittle. Hand siftings are necessary to clean the grain, though grain-cleaning machines worked by hand are now finding a use in the country.

As regards the employment of manures, barley is practically never manured, though it is grown on poorer lands than wheat; in fact, it is one of the earliest crops cultivated on newly reclaimed salty lands, as it succeeds where wheat would fail.

Stable manure is sometimes used on wheat, though it is very questionable whether this is economical. It is now thought better to reserve the whole of this manure for the cotton crop. Coufri is also extensively used. During recent years the practice of top dressing wheat with nitrate of soda has become common, and most striking results are obtained. The yield both of grain and straw is increased, and a net profit of fully $5 an acre is obtained by its use.

It may be interesting to note that Egypt is practically free from "rust." The native varieties grow so rapidly that they seem to outstrip it. On the other hand, foreign varieties, when grown, are occasionally entirely destroyed by it, as happened, for example, with American seed introduced by the writer some years since.

The weight of wheat per bushel is about 60 pounds. The standard measure is the ardeb of 5.4 bushels, which weighs about 325 pounds, and is sold on an average for about $4.75 to $5. There are no well-defined varieties grown, different names being given to the same variety in different provinces.

As regards yield, on very good lands from 40 to 45 bushels of grain and 1½ tons of straw are obtained per acre. The average of the country, however, is about 20 to 22 bushels.

Egyptian wheats are poor, being very mixed and deficient in gluten. It is quite exceptional to find a good sample, either white or red, and for the making of bread by Europeans an admixture of foreign flour is almost invariably employed. The wheats in Lower Egypt are almost invariably called white, while in Upper Egypt a greater portion of so-called red wheat is found. For making bread natives prefer the wheat grown in the basin lands of Upper Egypt to that grown on irrigated land.

Egypt, instead of being an exporter of wheat, as is often thought, actually imports a considerable quantity of flour from France and Russia, though that from the former country is largely of Russian origin, having been ground at Marseille. The following table shows the importation of flour during the past three years, the bulk being wheat flour, though a small portion is that of maize. The figures refer to Egyptian pounds, equivalent to about $4.94 in American money:

Country to which exported.	1900.	1901.	1902.	Country to which exported.	1900.	1901.	1902.
England	42,641	34,094	67,628	Belgium	323	307	1,403
English possessions in the Mediterranean	58	5	.....	France and Algeria	234,035	294,045	310,799
English possessions in the extreme East	54	.....	91	Greece	60	213	71
Germany	305	204	2,842	Italy	9,506	4,663	5,659
United States	1,549	5,025	6,096	Russia	104,700	112,863	119,153
Austria-Hungary	3,364	1,165	2,612	Turkey	811	1,017	5,767
				Other countries	254	2,257	776
				Total	397,660	455,858	552,897

During the same period the import of wheat (as grain) was as follows:

	Egyptian pounds.
1900	72,669
1901	110,374
1902	67,620

The bulk of this grain is of Turkish and Russian origin.

From a European point of view, the barley is poor, being long and thin. Attempts have been made to grow European barleys for malting purposes, and while a good quality can be produced the yield is slight compared with that obtained from native varieties. Practically the whole of the crop is consumed by horses, mules, etc. A superior class of barley (Mariout barley) is grown in the desert in the neighborhood of Alexandria and is dependent on rainfall. As this latter is a very varying amount, the crop fluctuates greatly from year to year. Even in the case of barley the imports exceed the exports in value, as will be seen from the following table:

Year.	Imports.	Exports.
	Egyptian pounds.	*Egyptian pounds.*
1900	70,820	8,000
1901	57,635	11,200
1902	48,939	33,652

The barleys of Egypt are light and generally weigh less than 50 pounds per bushel. The yields obtained on favorable soils are heavy, amounting to as much as 100 bushels per acre in exceptional cases. The average is from 30 to 35 bushels, and the price at which it is sold may be taken as $2.50 to $2.75 per ardeb of 5.4 bushels. The cultivation of barley is similar to that of wheat.

BEANS.

The bean crop of Egypt is a most important one, as it supplies the staple food of working animals during a great part of the year, while a considerable quantity is exported. It is grown in the basin lands, as well as in Lower Egypt, though the bulk of the crop is raised in Upper Egypt. According to the latest returns there were 471,530 acres of beans in the latter division of the country and 162,306 in Lower Egypt during the year 1902, a total of 633,836 acres.

The cultivation of the crop is simple. On the basin lands seed is sown after the emptying of the basins, and the crop is simply allowed to remain until harvest in the spring.

The crop is luxuriant and yields on an average from 30 to 35 bushels per acre on good land. From 3 to 4 bushels of seed are required per acre in Upper Egypt. In Lower Egypt the crop is sown about the same time as ordinary cereal crops, the grain being deposited in the

furrow left by the ordinary native plow, a boy following the latter and depositing the seeds by hand. They are then covered on the return journey of the plow, and the land is subsequently harrowed. The quantity of seed employed is about $2\frac{3}{4}$ or 3 bushels per acre. The crop may be sown "wet" or "dry," as explained in the chapter on wheat—that is, whether a watering has been given previously or not. It is sometimes raised without any water, though one irrigation is generally given in spring.

The harvesting of the crop is similar to that of an ordinary cereal and takes place in April. It may be thrashed by machine or by the norag. The chopped straw is given to camels, goats, sheep, etc., and it is also used for making bricks, etc. The crop is never manured, and yields from 20 bushels on poor land to as much as 35 or 40 bushels on rich soils.

The value of beans as food for dairy and other cattle is well known in Europe and there is a considerable exportation from Smyrna, Egypt, etc., to Europe. The export from Egypt is not increasing, there being a greater home consumption, as will be seen from the following figures, showing total exports:

Year.	Quantity.	Value.
	Bushels.	*Egyptian pounds.*
1889–1893 (average)	5,614,669	669,377
1894–1898 (average)	4,244,157	457,264
1901 (average)	1,886,071	200,508
1902 (average)	1,346,702	190,526

As already mentioned, about 13 pounds of crushed beans are fed per day to working bullocks during the season of scarcity of green forage and a proportional amount to cows, etc. The animals, of course, do not keep up their condition on this food (mixed with chopped straw) as well as they do on green, succulent food, but the work they accomplish during the hot weather when on this diet is remarkable.

Beans form an article of diet of nearly all classes. They are prepared in several ways. They may be soaked throughout the night in water, which is kept at a high temperature, and eaten in the morning, with liberal quantities of clarified butter, or they may be soaked in cold water until they begin to burst previous to germination, and are then boiled and eaten. Upper Egypt beans are preferred to those of Lower Egypt for human consumption.

RICE.

Rice is grown in Egypt both as a summer and a Nili crop, and largely so as a means of reclaiming land. Thus it is sown both in summer and during flood, the difficulty in connection with the former being the large quantities of water required at a time when the cotton area

makes such heavy demands on the available supply. For this reason in seasons of a very low Nile the growth of summer rice has been prohibited by governmental decree. As regards actual quality, summer rice (Sultani) is superior to that grown during flood (Sabeini).

It is almost needless to state that this crop will grow on land heavily impregnated with salt. The large amount of water required and the shallow-rooted nature of the crop tend to make this possible. The salt is washed down into the lower reaches of the soil, where the roots do not penetrate.

Summer rice, of which several varieties are grown, is sown in May and early June and occupies the land for varying periods, according to the variety grown, some remaining in the ground for as long as seven months. Sabeini, or flood rice, is sown as soon as the flood arrives, generally early in August to the first week in September, and occupies the land for about ninety days, according to the date of planting. It is thus harvested about the same time as summer rice. During flood, rice lands get flush irrigation and receive every ton of water that the drains can carry. For summer rice it is generally accepted that at least 40 cubic meters of water per acre per day must be allowed, while during the flood season the land practically receives as much water as the drains can carry off.

The first and most important essential in reclamation and rice cultivation is to make the land perfectly level. Unless this is done disappointment will result. The land is divided into squares equal in size, and around these divisions small dikes are made to retain the irrigation water. After leveling is completed sowing takes place. The seed is soaked in water for about six days. It is then spread out under sheds in the shade for two or three days to sprout. Water to a depth of $3\frac{1}{2}$ or 4 inches is put on the land and the seed is sown broadcast. Three days after sowing the water is removed and the land allowed to dry for twenty-four hours. During fifteen days this operation is twice repeated. Subsequently the water is changed from time to time. When about 7 or 8 inches high thinning is done and seedlings of dineba (barnyard grass) and of weeds which would interferfere with the development of the plants are removed. When ripe the crop is cut by hooks and placed in small bundles and is thrashed either by machine or by the norag. For summer rice from 1 to $1\frac{3}{8}$ bushels of seed are sown. For the flood crop more is employed.

Rice is grown in Lower Egypt on low-lying lands and those undergoing reclamation, chiefly in the three provinces of Gharbieh, Dakahlieh, and Behera. During the year 1902, 59,634 acres of summer rice and 56,134 acres during flood were grown in Lower Egypt. In Upper Egypt flood rice is grown in the Fayum, the area last year being 24,963 acres. The accompanying diagram (fig. 3) will give an idea of the arrangement of a crop of flood rice which is found successful in the northern part of Gharbieh.

The plan shows a plat of land 500 meters long by 300 meters in width, or a little over 35 acres. The land is cut up into divisions ("gattas"), each being 150 meters by 100 meters, or a little more than 3½ acres. The main drains are 27 inches deep and the smaller drains, similarly, 23 inches. The drainage, according to these data, requires 1,865 cubic meters of earthwork per acre, which, at the rate paid in Egypt, is equal to an expenditure of $2.15. It is generally conceded that it is preferable for a landowner to let land to tenants for the growth of flood rice rather than to cultivate it himself. The small banks and water channels are made by the tenant. The former are very necessary, as they prevent the disturbing of the young plants during the first fortnight of growth by the heavy winds which often prevail. The small channels are also necessary; otherwise the plats marked "C" will

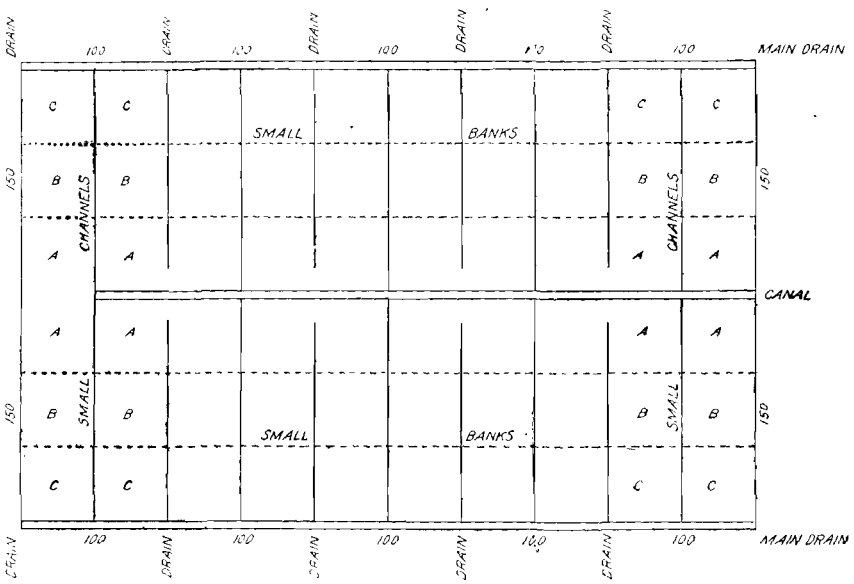


FIG. 3.—Arrangement of a crop of flood rice.

not get fresh water and will be more backward than those marked "A." Fellaheen pay from $4 to $5 per acre as rent to grow a crop of flood rice on fairly sweet land. If the land is salt, the tenant gets half the crop for his labor and the owner the other half as rent. The seed is provided by the owner, half of which is returned at harvest.

As soon as the Nile water arrives, the little divisions are filled with water, and the land is again leveled by drawing a plank over it. If the land is not very salt, the seed may be sown after leveling; but if salt, the water must be run off once or twice before sowing. More seed than usual is required on salt lands. The critical period of the crop is the first ten or fifteen days, and if the land has not been properly leveled the high patches die for want of water, or, on the other hand, the low-lying patches are flooded out. On fairly sweet land

the water may not be run off for the first six or seven days, and it may be necessary to water every day at the rate of 100 cubic meters per acre under a good system of drainage. After eight or ten days tenants will employ all the water they can get, but this is not necessary and is done at the sacrifice of good drainage.

On salt land more water is necessary than if the soil is fairly sweet, and at first it is necessary to irrigate and run off the water almost daily, which means as much as 150 cubic meters per acre each twenty-four hours. If sown later than the end of August, rice does not grow so well, and any land remaining at that time may be sown with dineba.

To obtain the greatest benefit from the growing of rice it should be followed by berseem. When the heads of the rice begin to curl up, the berseem may be sown; and if rice is sown as late as September, the sowing of the clover is greatly delayed.

The success of the berseem after rice is an indication as to the extent of the removal of salt; and if the clover grows well, it will not be necessary to sow rice again. If otherwise, it may be necessary to resort to rice again. This system of reclamation without summer water is that adopted by a very capable rice grower, to whom the author is indebted for the information.

As regards the yield of rice in Egypt, 40 to 60 bushels per acre may be taken as an average of the summer crop on good land, while of flood rice the product varies from 25 bushels on poor land to 50 or 60 bushels on more forward lands.

ONIONS.

Onions are grown to a considerable extent in Upper Egypt (not less than 15,000 acres), largely on the islands which appear after the fall of the Nile and on the banks of the river. They are also grown on ordinary soils under perennial irrigation. Although two or three varieties are recognized, that known as the Saidi forms the bulk of the export trade. The crop grows to the greatest advantage on deep, loamy soils, inclining to sandy, and possessing a considerable amount of humus.

Seed is sown in a manured seed bed in September. About one-ninth of a bushel of seed sown on 350 square yards of land provides sufficient plants for 1 acre.

The land for onions should be well prepared by two or three plowings, reduced to a friable condition, and made into ridges about 2 feet apart. The seedlings are pushed in the sides of the ridges (both sides) by the fingers and are left about 6 inches apart.

On the islands and river banks the land is not plowed at all, but the seedlings are sown on the flat, either singly in rows about 14 inches apart or in bunches in rows 20 inches apart. In this case the crop is not watered during growth.

The operation of transplanting is done in November and December

on the islands and river banks, but later on ordinary lands even up to January and February.

The crop requires careful cultivation to prevent the growth of weeds, and a small hoe is employed to keep the land well stirred. During the first month after transplanting, the crop must be hoed and weeded, and this must be repeated during the second month.

Onions respond to liberal manuring. Barnyard manure is employed, and on the alluvial deposits this is put under the plants at the time of transplanting, but on other land it is applied from one to one and one-half months after transplanting and as a rule before any water is applied. Small quantities of coufri are sometimes used, though barnyard manure is in greatest favor.

On ordinary perennially irrigated lands six or seven waterings are given during the growth of the crop. These should be light and not sufficient in amount to soak the soil.

About five months after transplanting, the bulbs have attained full size and the leaves become yellow. The crop is now ready to lift, and no water should be applied for nearly a month before harvesting; otherwise a second growth commences.

The bulbs are removed and exposed to the sun for two days, the tops being then removed, and another day allowed for drying.

Early in April the onion crop arrives at Alexandria for export, the first arrivals realizing the highest price. The product per acre amounts to 5 or 6 tons, on an average, on good soil. Care has to be taken in storing. If not thoroughly dried many of the onions will sprout, and those which have been injured or bruised will decay. The average price is from £2 to £3 per ton.

The following figures indicate the export trade:

Year.	Quantity.	Value.
	Tons.	*Egyptian pounds.*
1899	76,568	229,382
1900	76,034	152,873
1901	64,935	129,926
1902	49,933	100,697

The bulk of the crop is sent to England and the rest chiefly to Austria.

MILLETS AND SORGHUMS.

Several varieties of millet possessing either white, yellow, or red grain are grown in Upper Egypt. It is sown both as a summer and as a flood crop, as has previously been mentioned when referring to crops grown in the basins.

Summer sorghum in the basins is sown from about the middle of March to the middle of April, or a little later, the crop being harvested in August. The water for its growth is lifted by hand or animal labor,

and it is irrigated on an average about every ten days. It is a very profitable crop, and the area grown in the basins is between 90,000 and 100,000 acres, while it is also sown along the Ibrahimia Canal tract to the extent of between 20,000 and 25,000 acres.

Flood sorghum is sown both in the perennially irrigated tract of Upper Egypt and in the basins. Sowing begins early in August and ends early in September, the crop being harvested in the latter part of November or in December.

Millet is sown either by depositing a few seeds in holes about 14 inches apart, or the seed may be dropped behind the plow similar to corn. It delights in a rich soil and requires large quantities of manure, both coufri and the nitrate-bearing clay being extensively used. The crop is thinned during growth and when grown in holes two plants are left standing together.

The production varies greatly and some very heavy yields are obtained. From good soils 50 to 60 bushels per acre may be taken.

Millet forms the staple food in Upper Egypt, taking to a great extent the place of corn in Lower Egypt. In making bread fenugreek seeds are often mixed with it.

MINOR CROPS.

In a short bulletin such as this it is quite impossible either to treat in detail the most important crops or to deal with those of secondary importance. Of the latter there are many grown in the country, such as lentils, peanuts, chick-peas, lupins, fenugreek, etc. A mere note concerning them will be given.

LENTILS.

Lentils are sown in basin lands as well as those perennially irrigated. On the latter the seed is broadcasted at the rate of about $1\frac{3}{4}$ bushels per acre. The crop is not manured and requires very little water. From five to six months after sowing, the crop is pulled and thrashed, the yield being about 20 to 25 bushels of seed. The plants are somewhat straggling in habit and grow about 2 feet in height. The seeds possess a high nutritive value and are largely consumed locally. The straw also possesses considerable value. During the year 1902 about 110,000 bushels of seed were exported, valued at approximately 17,000 Egyptian pounds.

EARTH NUTS, OR PEANUTS.

Earth nuts, or peanuts, are grown on light sandy soils in Lower Egypt, being sown in late spring and requiring considerable quantities of water. Their cultivation is similar to that practiced in the United States and calls for no special comment. They occupy the land for about eight months and yield about 55 bushels per acre. They are not generally manured. During the year 1902, peanuts to the value

of between 17,000 and 18,000 Egyptian pounds were exported, chiefly to Turkey.

CHICK-PEAS.

Chick-peas are grown to a limited extent both in Upper and Lower Egypt for local consumption. The seeds are eaten either green or roasted, and are also employed in native confectionery. The crop is sown in October and November and harvested from five to six months later, yielding about 23 to 30 bushels of seed per acre. No manure is applied and very little water. During the year 1902 the exports amounted to 7,827 bushels, valued at 1,709 Egyptian pounds.

LUPINES.

Lupines are grown on sandy situations, and, generally speaking, in places where it would be difficult to grow other crops successfully. They are sown in October and November in holes about 15 or 16 inches apart, four or five seeds being dropped in, or the seed may be deposited behind the plow. Lupines are grown either as a green manure crop or for the sake of the seeds, of which about 20 bushels are obtained per acre. The crop is harvested in April. It requires no care, is not manured, receives but little water, and sometimes none at all.

FENUGREEK.

Fenugreek is sown in October or November, the seed at the rate of $1\frac{3}{4}$ bushels per acre being broadcasted after a heavy watering. If grown as a green crop it is cut about sixty or seventy days after sowing and fed, in conjunction with berseem, to camels chiefly and also to cattle. It is not fed alone, as it is too laxative. It is eaten green by natives.

If for grain, the crop is cut about four and one-half to five months after sowing. About 20 to 25 bushels of seed are obtained per acre. The seed is mixed with corn and millet in bread making, and when germinated it is also eaten by natives as a purgative. The seeds are largely used in Europe for the preparation of condiments.

FLAX.

Flax is not so extensively grown as formerly. Seed is sown broadcast from the end of October to the end of November at the rate of $2\frac{1}{3}$ to $2\frac{3}{4}$ bushels per acre. The crop is grown both for fiber and seed. The harvest is in March. The fiber obtained is inferior and calls for no mention. The seed is crushed in native mills and the cake is used for feeding.