U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY—BULLETIN NO. 35.
B. T. GALLOWAY, *Chief of Bureau.*

RECENT FOREIGN EXPLORATIONS,

AS BEARING ON THE AGRICULTURAL DEVELOPMENT OF THE SOUTHERN STATES.

BY

S. A. KNAPP, SPECIAL AGENT,
SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

ISSUED FEBRUARY, 14, 1903.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1903.

BUREAU OF PLANT INDUSTRY.

BEVERLY T. GALLOWAY, *Chief of Bureau.*

SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., September 18, 1902.

Sir: I have the honor to transmit herewith a report on "Recent Foreign Explorations, as Bearing on the Agricultural Development of the Southern States," by Dr. S. A. Knapp, Special Agent, Seed and Plant Introduction and Distribution, and recommend that it be published as Bulletin No. 35 of the series of this Bureau. This report has been submitted by the Botanist in Charge of Seed and Plant Introduction and Distribution with a view to publication.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

PREFACE.

The introduction of Kiushu rice by the Section of Seed and Plant Introduction of the United States Department of Agriculture in 1899 was the first step taken toward improving the conditions of rice growing in southern Louisiana and Texas, and the marked development of the rice industry since that time is in a large measure due to the value of this variety. There were still other problems connected with the rice industry, however, as well as those which concerned the improvement of extensive tracts of pine lands occurring in many of the Southern States, which remained unsolved. These problems could be best approached by first securing all the information available in foreign lands, and Dr. S. A. Knapp was commissioned to go to Asia to make a careful study of the rice industry and to secure such seeds as he might decide were valuable.

Dr. Knapp's report deals with the life of the peoples among whom he traveled, as well as with the methods and cost of rice production and the cultivation and production of certain other crops, and altogether it constitutes a unique contribution to our knowledge of the agriculture and the condition of the farming communities of these countries.

The report is submitted for publication as Bulletin No. 35 of the Bureau of Plant Industry.

A. J. PIETERS,
Botanist in Charge.

OFFICE OF SEED AND PLANT
INTRODUCTION AND DISTRIBUTION,
Washington, D. C., September 12, 1902.

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RECENT FOREIGN EXPLORATIONS, AS BEARING ON THE AGRICULTURAL DEVELOPMENT OF THE SOUTHERN STATES.

INTRODUCTION.

The rice belt of Louisiana and Texas comprises a section of prairie land bordering on the Gulf of Mexico and extending westward from the parish of St. Mary, along the coast of Louisiana, 140 miles to the Sabine River, and thence about 400 miles along the Texas coast to Brownsville, on the Rio Grande, with an average width of 60 miles and a mean elevation above the sea level of 6 to 40 feet.

Throughout the entire belt the surface has such a slight variation that for the purposes of irrigation it may be considered practically level. The soil is a rich, sandy loam, in some sections, underlaid with a tenacious clay at the depth of 2 to 3 feet. In the other sections the soil is a strong clay or clay loam, with subsoil conditions similar to that of sandy loam. Between these extremes the sand and the clay form many grades of loams, but all easily tilled and fertile. At a depth of 8 to 16 feet from the surface a stratum of water-bearing sand is generally struck, the water answering for house purposes. At a depth varying from 60 to 250 feet, veins of water providing a flow sufficiently strong for purposes of irrigation have been uniformly found.

This rice belt contains more acres of arable land than any one of a majority of the States in the Union. It is intersected by a large number of navigable rivers and minor streams, and has one of the most salubrious climates on this continent.

Until within a comparatively recent date (1884), however, it was regarded as almost valueless for agricultural purposes, due to its inaccessibility, its generally level surface, and its retentive soil. From an early period an occasional small field has been successfully planted in rice, but this was invariably handled by primitive methods. In 1884 the adaptation of wheat machinery to rice culture began, and with it the rapid expansion of this industry. For nearly ten years thereafter the rice crops mainly depended for success on rainfall, and the rice farmers met with many reverses, though irrigation by the construction of surface canals was undertaken as early as 1890.

By 1898 the canal and the deep-well system of irrigation had been satisfactorily tested and the rice industry was rapidly extending along safe lines. At this point it was found that too large a per cent of the machine-handled rice was liable to breakage in milling. The attention of the U. S. Department of Agriculture was called to this fact, and measures were immediately taken to remedy the defect and to overcome the difficulty by the introduction of new varieties. The Department work resulted in the introduction of a variety from Japan, known as Kiushu, which has given very satisfactory results.

In the evolution of this industry further difficulties became apparent. While rice could be successfully planted during a period of nearly four months—March, April, May, and June—it all ripened at nearly the same time, giving only about one month for harvest against four months for planting; that is, it was demonstrated that the harvest could not be prolonged in proportion to the period of planting, where only one variety of rice seed was used. The varieties planted developed this peculiar characteristic, that whether planted in March or June the crop would mature at about the same time, that planted later developing in every instance with increased rapidity. The harvest is the season of high wages, and the limited harvest period increased the expenses and prevented using the care necessary to properly cure, thrash, and store the crop, thus greatly augmenting the cost and reducing the quality of the rice. If the period of harvest could be materially lengthened, every grower could produce from 50 to 100 per cent more rice than at present. One farmer with a single helper and good teams can prepare the land and plant 200 to 300 acres of rice. It would be difficult to cut more than 100 to 150 acres with the same help, but if the harvest could be extended over three months' time, then the laborers who planted the crop could in the main harvest it. It became evident that this result could be attained only by planting early, medium, and late maturing varieties, and that these varieties must be rices of fixed characteristics and habits of growth. Such, with few exceptions, can be found only in Asiatic countries, where centuries of uniform conditions of climate and culture have established fixed habits of growth in certain varieties of rice.

A second and almost equally important reason for visiting foreign rice-producing countries was to observe methods of cultivation, harvesting, and storing, in so far as these affect the quality of the grain, and, if decidedly beneficial, then to suggest some way by which the same result could be obtained by the use of machinery. It had already been observed by American rice growers using imported Japanese seed rice that it had several points of superiority over the home-grown rice and it was desirable to find the reason for this superiority. (1) It had generally been noted that the vitality and germinating power of the imported seed were nearly 40 per cent greater than that of domestic

seed. (2) That imported seed averaged better in color and was freer from rust than much of the domestic. (3) That it was less liable to be chalky and break under the milling process.

Now, were these conditions due to soil, climate, and selection, or to more careful methods of harvesting and storing? If upon investigation it was decided that they resulted from the latter causes, then it was believed that the machinery used could be modified or added to till the rice grown upon the prairies of Louisiana and Texas would possess every excellence of the foreign article.

It should not be inferred that the rice lands of the United States are limited to the coast prairies of Louisiana and Texas; but in that section rice farming is carried on entirely with machinery, and the peculiar difficulties are more pronounced. The alluvial lands of the Lower Mississippi and of other rivers flowing into the Gulf of Mexico, as well as many tracts in the Carolinas, Georgia, and Florida, are admirably adapted to the cultivation of rice, and growers in these districts are deeply interested in anything that relates to improvements in rice production. Except where the density of population demands the use of all land to meet the food supply, there will be found many untilled tracts in the river bottoms of nearly all of the Southern States which can be profitably utilized for rice. Hence the best methods of producing rice are of general interest.

Other questions receiving the earnest attention of the U. S. Department of Agriculture relate to the vast tracts of land in the Gulf and South Atlantic States which are rapidly being denuded of their pine timber or on which the work of devastation has been completed. Except for some small value they possess as grazing lands they have been held in slight esteem from an agricultural standpoint. As a whole these lands possess a soil almost destitute of humus, with a stiff subsoil and a mechanical condition most unfavorable to the growth of plants. If valuable plants could be found that readily adapt themselves to such conditions, then the pine-land problem would largely be solved. The Department therefore decided to collect from Asiatic countries the most valuable of such plants and to conduct a series of experiments on the pine lands of the South to determine the best methods of making them profitable to agriculture.

JAPAN.

Such marked benefits had been secured by the importation of Kiushu rice that it was considered worth while to find other rices in the Flowery Empire that would ripen at different periods, suited to the requirements of our harvest. Two days spent at the Royal Agricultural College at Kamaba, Tokyo, and one day at Nishigahara Experiment Station gave a comprehensive view of the valuable work along practical and scientific lines for the advancement of agriculture going on

in Japan. Many tests had been made at these stations to determine the varieties of rice most profitable for general use among the farmers of Japan, and samples were exhibited of each variety tested. Fifteen of the best for general planting, including early, medium, and late varieties, were selected. In addition to the samples of seed exhibited, small plats of each variety were shown in the trial fields, from which, in connection with the notes that had been taken, the relative vigor and habit of growth of each variety were determined. Some deductions which the Japanese experimenters have made may be profitably noted here: (1) The great importance of selecting pure-bred seed of even quality and size of grain. (2) The removal of any light or imperfect grains. This is done in Japan by soaking the seed rice in water several days till it is about ready to sprout, when it is thrown into salt water of 1.3 specific gravity and allowed to remain two minutes, being gently stirred meanwhile. The light grains will float; the others are removed, washed in cold water, and planted. When a seed drill is to be used the damp seed is first dried by being rolled in the ashes of rice straw. (3) Even sprouting of the grains is very essential to even ripening of the crop. This is accomplished by previously soaking the seed as above stated.

The agricultural station experimenters found it profitable to use about 200 pounds of superphosphate per acre on rice. They also used with good effect soy-bean cake, horse manure, human excreta, and straw ashes. Too much straw plowed under caused fermentation and injured the roots of the plants. For their conditions the fertilizer should contain nitrogen, phosphoric acid, and potash in the ratio of 2, 1.5, and 1.2.

It is the observation of scientific and practical men in Japan and China that the best rice can not be produced on low, marshy ground. Such rice is relatively dark in color and inferior in quality. The best rice is produced on well-drained land. It is claimed that one advantage of planting a rice field to a winter wheat or barley crop is that the soil is dried and pulverized.

By the time the fields of growing rice had been carefully examined and the subject fully discussed with Japanese farmers, the 15 varieties originally selected were reduced to 10 by elimination of the less valuable ones. At Kobe some additions were made to the list on the advice of E. H. Hunter, the well-known rice miller, and the final number of varieties selected for importation was 15. This seed arrived in the United States in good condition and has been planted for trial. If it meets expectations the Department will be prepared to distribute seed which has been fully tested.

AGRICULTURAL SITUATION.

The following account of agriculture and rural life in Japan may be of interest: Rice forms the principal article of food of the Japanese,

and its cultivation presents many interesting problems. First, about 45,000,000 people must be sustained largely by the product of 7,000,000 acres of rice. This allows nearly 6½ persons to the acre and on the basis of the crop of 1896 furnishes 4 bushels of hulled rice, or about 240 pounds of milled rice, for each person. This indicates that Japan has attained a density of population which allows only a narrow margin between home consumption and possible production.

ACREAGE AND YIELD OF FOOD CROPS.

It must not, however, be inferred that rice is the sole food of the people. The daily ration includes a variety of foods of a highly nitrogenous character, which, with vegetables, supplement the rice. The following official report of the number of acres of food crops produced annually in Japan will correct to some extent the impression that the Japanese subsist almost solely on rice:

Food crops of Japan, as reported for 1896.[a]

Food crops.	Acres.	Total product.	Product per acre.
		Bushels.	*Bushels.*
Rice[b]	6,967,461	180,998,855	26
Wheat	1,104,200	17,763,945	16.09
Rye	1,681,267	14,608,117	8.7
Barley	1,626,260	39,246,425	24.1
Peas and beans	1,343,191	18,063,070	13.4
Millet, buckwheat, and rape	2,077,982	28,002,330	10.6
Irish potatoes	57,790	6,862,469	118.75
Sweet potatoes	195,251	68,402,579	350.33

[a] This does not include Formosa.
[b] The statement regarding rice refers to this product with hulls removed, and for comparison with paddy about 20 per cent should be added.

The acreage devoted to rice in Japan can not be very much increased. The islands are of volcanic formation, and in a general way it may be stated that a rather bold range of mountains traverses them from the southwest to the northeast, occupying seven-eighths of the territory. The remaining one-eighth consists of fertile valleys, widening toward the sea until they gradually expand into coastal deltas of considerable extent. The narrow valleys are terraced on each side; at the base of the mountains canals are made to receive the descending rivulets and convey the water to the various fields as required for irrigation.

Frequently the surplus water is used to turn an overshot wheel for milling rice or for manufacturing purposes in the native villages, or it may be allowed to flow into some creek or river, but as far as possible sufficient mountain water for irrigation is conducted by canals at a level somewhat higher than the rice field. (Pl. I, fig. 1.) The ingenuity displayed in devising the elaborate system of irrigating canals

and the amount of patient industry required to construct them are simply marvelous. The extent of the retaining walls constructed to prevent the washing of the terraces, or to arrest mountain slides, or as barriers against a river bent on destroying a field, is inconceivable. These are the works of a patient and industrious people throughout many generations.

Occasionally water for irrigation is elevated from a creek or river, but almost invariably by the simplest machinery, such as has been employed for hundreds of years. One of the simplest machines for elevating water in common use is a wooden wheel 6 to 8 feet in diameter and 12 inches wide, with buckets on the perimeter, or rim. The power that raises the water is the weight of a man traveling on the buckets on the side of the wheel opposite the buckets lifting the water. It is so adjusted that the weight of the man on one side of the wheel is a little more than the weight of the water raised by the buckets on the other side; hence the wheel revolves. When the water reaches the required elevation it is discharged into a spout.

METHODS OF RICE CULTURE.

Rice production in all oriental countries is conducted upon the same general plan, but the methods differ so materially from those employed in the United States that they should be carefully noted. The lands are divided by levees into small fields. These are of no regular form, and generally the inclosing levees are gracefully curved to represent some ideal of beauty in the mind of the planter. In the small valleys among the mountains these curved embankments were doubtless necessary to conform to the mountains and thus to inclose a larger area, but as the improvements encroached upon the lowlands curves continued to be used. The levees vary in width from 1 foot for field divisions and paths to 4 feet wide for main embankment roads. This system of levees and fields has precluded the use of domestic animals in the preparation of the soil and harvesting of the rice. The Japanese are fully aware of the disadvantages of having such small and irregular fields, and have made strenuous efforts to relieve the situation.

Many of the rice fields in Japan average scarcely more than 35 feet square, and the boundary levees have such wavy lines that they look as if made by hogs in a frolic. Under modern conditions the horse and the ox could be used in tillage, but there are no paths which such animals can traverse to these minute fields; and if there were, the tracts are too small for the use of plow or harrow, because there is not room to turn, much less to follow the angular boundary lines. If a farmer owns several tracts it is seldom that they are adjacent, and hence he is helpless to institute reform. Many progressive Japanese farmers have tried to institute reforms, but under the old law changes in land boundaries required the unanimous consent of the owners,

which it was practically impossible to secure. This was precisely the situation of the lands belonging to the yeomanry of England until about the commencement of the Nineteenth century. Three years since a law was passed by the Japanese Parliament that if two-thirds of the owners of a tract of land agreed to reform the boundaries the minority must concur. Still the farmers of Japan were conservative, and only two or three provinces have made any considerable progress.

The accompanying diagrams present a striking example of the land situation and the reform accomplished in one locality.

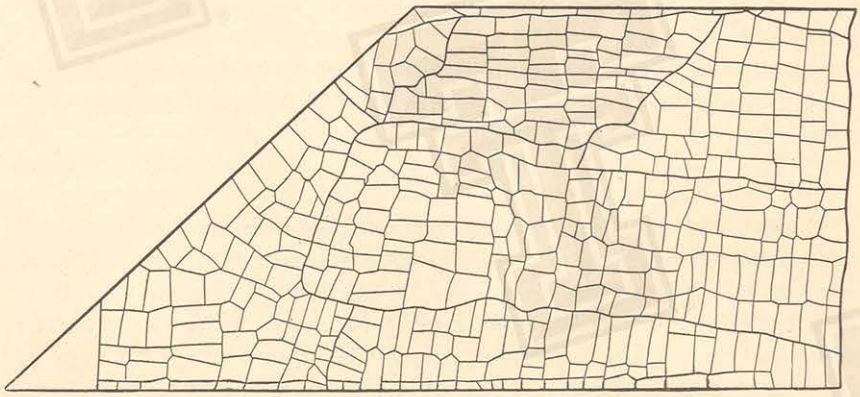

FIG. 1.—Tract of land at Masuda, containing 25 acres, divided into 409 irregular fields.

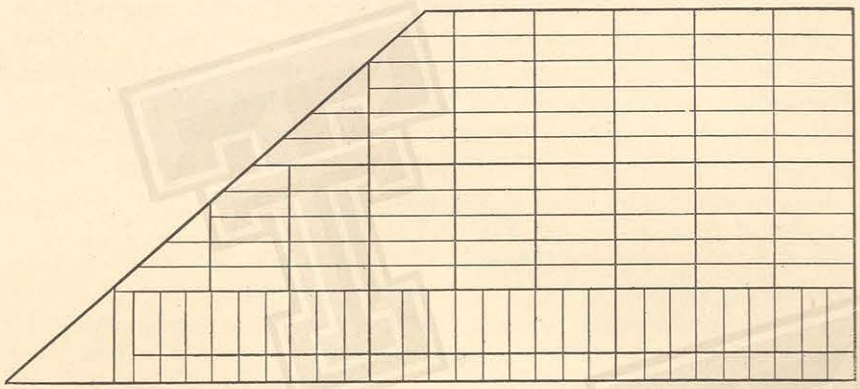

FIG. 2.—The same tract shown in fig. 1, redivided into 138 regular fields.

Fig. 1 is a plat of a tract of land at Masuda village, near Sendai, and shows the little fields as they have been for ages. Fig. 2 is of the same tract readjusted under the reform movement. Mr. J. H. De Forest, of Sendai, who furnished the maps from which these illustrations were made, states that this tract as platted contains only 25 acres and formerly had 409 irregular fields in it. (See fig. 1.) There are now (see fig. 2) only 138 regular fields, with perfectly straight water courses and roads wide enough for two loaded carts to pass. Even

thus enlarged these fields are small indeed as compared with those in the United States, but it is a great advance for Japan.

Such reform as this will greatly facilitate the use of cattle in plowing the wet fields and in carting out the crops. But, more than this, the area of arable land is greatly increased by breaking down the numerous grass ridges and throwing their space into productive soil. About one-tenth is thus gained, or 2 acres in the plat figured; and as 1 acre averages about $175 in value, the entire gain is over $350. But the whole expense of this reform was only $400, so that it almost paid for itself in the value of new space gained, to say nothing of the lessening of manual labor.

Japanese farmers are beginning to see that American methods must be more and more considered if they are to keep pace with agricultural advance all over the world.

FIELD WORK.

The fields of the Japanese farmers are generally well drained and thoroughly tilled, mostly with the spade or mattock. Both of these implements differ from those used in the United States. The mattock has a blade about 16 inches long and 5 inches wide, with a handle 4 or 5 feet long. The implement weighs 7 or 8 pounds. With a quick, powerful blow the blade is driven into the soil about 14 inches; then, using the handle as a lever, the soil is disintegrated and partially inverted. The spade is a wooden blade about 2 feet long with an ordinary handle; the lower end of the blade is cased with steel, and upon the back of the upper end is a block the width of the spade. The spade is thrust into the soil by the foot at an angle of about 30°, and, using the block for a fulcrum, the soil is rolled to one side, as in plowing, but it is more thoroughly disintegrated. All the trash, straw, or grass upon the field is turned under, together with such an amount of lime, ashes, fish manure, or human excreta as the farmer may be able to secure. Where a winter crop is raised the manure is generally applied in the fall. If the rice field remains fallow during the winter the manure is applied at the time of spring working, in March or April, according to conditions.

The seed bed is prepared as early as convenient in the spring, about April 1, thoroughly manured, and is given the care of a bed in the garden. It is spaded 8 inches deep and worked until the manure is thoroughly incorporated and all clods pulverized, after which it is surrounded by a low ridge and water is admitted to fill the soil until the spaded earth becomes consistent mud. The seed, which had been previously selected for purity, size of grain, and flinty character, is then soaked in pure water till well sprouted, which usually requires two days, and is then sown on the bed broadcast as thickly as admissible for strong plants. Prior to sowing the bed is covered with water

to the depth of 2½ inches. In five or six days the rice is well started. It is then left dry in the daytime and is flooded at night. Covering with water at night keeps it warm, and allowing the bed to become dry in the daytime admits air and prevents sun scalding, which frequently occurs when the rice is young and the covering of water is shallow.

Early in June, when the rice is 8 or 10 inches high, it is pulled up, tied in bundles of 6 to 10 plants, and transplanted into fields, which have been prepared and flooded to the depth of 1½ to 2 inches. (Pl. I, fig. 2.)

The rice plants are set in rows about 1 foot apart and at a distance of 10 to 12 inches in the row, on the richest lands, making 9 bunches to the yard. On poor lands double that number might be set. They are so set that the soil covers the root. Thereafter the flow of water is not continuous. After a few days it is drawn off, and if the farmer is able to make the investment an application of rape-seed oil cake or fish scraps is made to the surface. As soon as the fertilizer has had time to become incorporated with the soil, water is again applied and withdrawn to allow the crop to be hoed. Every weed is cut out, and in some cases the roots are slightly pruned. Each field is given the minute attention of a garden. When the growing period is well advanced the water is allowed to remain permanently upon the field, care being taken to renew it by gentle inflow and escape, till a slight change in color indicates that the period of ripening is approaching. It is then withdrawn. While the slight change of color is given as the guide, the time when the milk in the seed has become dough is more correct, for the Japanese cut their rice when the straw is scarcely turned. Both the straw and the rice are better when the harvest occurs before the grain is dead ripe.

CUTTING RICE.

The grain is cut close to the earth, with a small sickle-like knife set in a handle. Four hills or bunches are bound together with two straws, making a bundle 3 or 4 inches in diameter. These are generally laid crosswise in small piles, and are allowed to dry during the day. At evening they are hung with heads down on bamboo poles, which, by means of cross sticks, are made into a structure like a fence. The lower pole is high enough to allow a space of about a foot between the suspended bundles and the ground. The upper pole is 18 to 20 inches above this, the rice bundles on the upper pole overlapping the bundles below. After the bundles hang upon the poles long enough to become dry they are taken down by women and the grain removed by drawing the heads through a hatchel.

The grain is then placed upon mats and exposed to the sun till thoroughly dry. Before it is sent to market the hulls are removed by

passing the grain through a pair of burrs made of cement and bamboo and worked by hand. Winnowing is done by the open-air process, or by a simple fanning mill. (Pl. II, figs. 1, 2.)

After winnowing the milled product is placed in sacks deftly made of rice straw, each sack holding about 133⅓ pounds. In these the rice is transported to market and the sacks are afterwards sold for paper material.

MANURE.

The extent to which night soil is used for fertilizing is scarcely conceivable. Whether in city or country, it is practically all saved in earthen receptacles and removed once or twice daily, according to the weather. The night soil is carried in wooden buckets, balanced on a pole across the shoulder. In cities the collectors sell to fertilizer companies what a man can carry (about 8 gallons) for 10 cents in silver. The companies transport it on flatboats to the rural districts, where it is applied in liquid form. In one corner of almost every garden and field may be found a cistern for storing liquid manure.

FARM WAGES.

Common laborers on the farm in Japan receive on an average 6 cents (gold) per day for women and 10 cents for men, with board, except in harvest time, when they are paid about double these amounts. Harvesting is expensive, considering the price of labor. On one occasion while in Japan a field was passed where two men were cutting rice. They stated they were paid 2 yen ($1 gold) for cutting, binding, and hanging on poles the rice in a small field by the roadside. On measuring it there was found to be two-elevenths of an acre, the cost being at the rate of $5.50 (gold) per acre. Still, it is difficult to see how there could be any change in the methods of managing the rice industry in Japan. The present system of transplanting insures the best results and allows time to take off the winter crop. By the hand process the straw, which is quite valuable, is preserved, the grain is cut at the right time, even where there is a variation of maturity in the same field, and there is no loss from the cracking of kernels by the hatchel.

COST OF RAISING RICE.

A farmer near Tokyo furnished the following data in regard to the profits of rice farming, the estimate being for 1 acre of land:

CASE 1.—Where the owner of the land hires the work done:

Cost of seed, 16 sho, or nearly 36 pounds	$0.62
Cost of manure	10.00
Cost of labor, 120 days' work	18.00
Cost of repairing tools	1.20
Taxes, Government and local	8.00
Profits	16.18
Total	54.00

INCOME.

Hulled rice, 8 koku, or about 2,520 pounds, equivalent to 3,272 pounds of paddy or 20⅕ barrels	$48.00
Straw, 480 kwan, or about 2 tons	4.80
Chaff and broken rice	1.20
	54.00

CASE 2.—Where the land is rented to a tenant, supposing the crops to be the same, the account would stand as follows:

Seed for 1 acre	$0.62
Manure	10.00
Labor, 120 days, at 15 cents per day	18.00
Repairing tools	1.20
Rent, one-half the crop, or 1,260 pounds	24.00
Total expenses of tenant	53.82
Total profit	.18
	54.00

Total income, $54, as above.

The foregoing statement, taken from the account book of a practical Japanese farmer, is full of interest and throws some side lights on their agricultural system.

The small amount of seed used is due to transplanting. Considerable expense is incurred for manure, but a crop of 20⅕ barrels per acre is large for old land. One is chiefly impressed by the number of days' work, one hundred and twenty, expended on 1 acre, and the amount of the Government taxes, $8. Eight hundred dollars taxes on a hundred acres of rice would stagger the American farmer. Where the tenant does the farming it will be noted that one-half of the grain produced is allowed for the use of the land and that there is no real profit. He simply receives pay for his labor.

FARM LIFE.

How the Japanese farmers live can best be understood by giving a description of some particular farmhouse. While visiting the distinguished statesman, K. Mochizuki, at his country estate, a visit to the dwellings of some of his tenants was made. The following is a description of an average farmhouse on this estate:

In the rear of the house was a garden of about half an acre, planted to field crops, beans, barley, etc., and in front was a garden of about one-fourth of an acre, artistically laid out and planted to vegetables, with occasional flowers. The main building was one story high, about 24 by 48 feet in size, with the kitchen, 14 by 24 feet, across one end. Here was the usual clay stove, similar to those of Mexico, and a dirt floor, which by some process had been made as hard as cement. The remainder of the house was floored with mats. The family stores were packed in tubs, of which there were a dozen or more stacked at one side of the kitchen, all scoured to appear as if just brought from

the shop. The farmer's wife was cooking at the stove. On the left of the kitchen, in front of the house, was a room 10 by 12 feet, covered with the customary mats and used for a sitting room. Each mat was 3 by 6 feet in size and 2 inches thick. Back of the sitting room and opposite the stove was a room, 10 by 12 feet, used for a dining room. Beyond the sitting room, in the front of the house, was a private room, 12 by 16 feet, for lodging. From the dining room a hallway extended to and along the end of the house. The partitions of the rooms, which are generally removed during the day to give more ventilation, were made of light sash, with strong white paper instead of glass. On the right of the kitchen was an addition, 20 by 24 feet, for the servants' quarters and general storage. Each servant had a small sitting room and a lodging room, with mats on the floor. There was no furniture, as we use the term, in the house; no chairs, tables, bedsteads, or mirrors. The members of the household sit, eat, and sleep on the matted floor. How everything can be kept so perfectly clean, without soil or stains, belongs to the mysteries of Japanese housekeeping. In front of the servants' quarters a servant was cleaning grain and spreading it on the mats to dry in the sun. The tub and pounder for cleaning rice was in front of her. She did not like to be photographed in her ordinary garb, but was satisfied when told to turn her back and appear to be at work.

Adjoining the house on the left was a beautiful Japanese garden or tiny park, possibly 40 feet square, containing the usual landscape, trees, and statuary. In the center of this park and about 20 feet from the farm dwelling stood an artistic little one-story house, about 14 by 16 feet in size. It looked like a large playhouse for children, but we were informed that this was a special house for receiving guests and serving tea. The Japanese paper windows were slid back, revealing a beautiful little parlor about 10 feet square, with the usual seat or bench of honor on one side, and a tiny waiting room. The house was a frame building, cross lathed and plastered, with posts exposed, boarded up and down on the outside, and ceiled overhead. In the rear of the house was a barn, 18 by 20 feet.

The house here described is a typical Japanese farmhouse, one story, with thatched roof. The laborers' cottages are built upon the same plan, but are smaller. The residences of wealthy country gentlemen are somewhat larger and with more elaborate grounds, but they retain the same simple arrangements and general style of living. There is no arrogant caste in Japan. The rich and the poor, the landlord and the tenant, the employer and the employed, live on the most intimate and friendly terms.

Among the farmers of Japan, rice is considered quite a luxury and many can not afford to eat it regularly. Among the poorer farmers barley, millet, and sweet potatoes are substituted for rice. Among the

better nourished Japanese the following constitutes the ordinary bill of fare: Boiled rice, boiled rape and daikon (half radish and half turnip), bean soup, and barley tea for breakfast and dinner. Lunch at noon is the same without the bean soup. A little salt fish is added occasionally.

GENERAL REMARKS.

Japan has an area of 147,655 square miles, exclusive of Formosa, about one-tenth of which, or 15,000 square miles, is tillable. The population is now not far from 45,000,000, which gives a ratio of 3,000 persons to the square mile of arable land. At this ratio the State of Iowa could sustain 156,000,000 people and Texas more than 600,000,000. This statement is sufficient to refute the claim that Japanese agricultural products may at some future time compete with America in our home markets. Japan is rapidly becoming a great manufacturing and commercial nation, for which she is, by virtue of the genius of her people, exceedingly well adapted. The trend of events indicates that when that time arrives Japan will be a large consumer of American food and fiber products.

CEYLON.

The island of Ceylon, a British dependency, in latitude 6° north, contains 25,365 square miles and has a population of 3,391,443, composed of about two-thirds Cingalese and one-third Tamils, with a few Moormen and Malays. The Cingalese are the primitive inhabitants and occupy mainly the southwestern portion of the island. They are medium sized, well formed, rather light colored, intelligent, and dignified. They are inclined to play the gentleman even in the roughest work, but are honest and make good clerks. The Tamils have been imported from the mainland, presidency of Madras, and bear a striking resemblance to the American negro. They do a large part of the farm work and furnish most of the servants. There is not, however, much general farming done in the island, the central portion of which is occupied by mountain ranges, though the valleys are fertile. Only about 4,400 square miles are under cultivation of any kind. The thin sandy soil of the coast does not appear to be adapted to any crops except the cocoanut palm, which grows with amazing luxuriance, and the nuts constituting an important article of export. In the higher lands and on the mountain sides are large plantations of tea and coffee, with occasional groves of cinnamon and other spices.

AGRICULTURE.

Rice is the main crop, but not enough of this is produced for home consumption, large quantities being imported from Penang, Singapore, India, and Burma. When preparing the ground for rice, a kind of

wooden drill, shod with iron and drawn by oxen or water buffaloes, is used. Two crops are produced, of which the principal or maha crop is sown in July, just in time to catch the late summer rains, and is harvested in December or January. The small or yala crop is planted in February and harvested in June. About 15 bushels per acre is considered a fair crop on the west coast, but in Anuradapura Province 30 to 50 bushels per acre are frequently obtained, depending on conditions. The Ceylon rice is rather inferior in quality.

IMPORTS.

The imports of cleaned rice at Colombo, Ceylon, from January 1 to November 10, 1900, were 486,652,390 pounds; from January 1 to November 1, 1901, 459,229,540 pounds. This shows that Ceylon, with a population of about 3,500,000, imports more rice than the entire product and annual imports of the United States.

FARMHOUSES.

The farmhouses are one story generally, with about three rooms, and are commonly built of brick or sun-dried clay, with mud-plastered walls. Some houses are built of poles, lathed with bamboo or bamboo matting, and are plastered with clay outside and inside. The floors are of tile or clay, and the roof is covered with grass, palm leaf, or tile. The usual cost of a house is $50 gold. Farm laborers receive about 8 cents (gold) per day, without board, but generally prefer to work for a share of the crop. One-half is given to the laborer. (Pl. III, figs. 1, 2.)

INDIA.

India (including Burma) has an area of 1,800,258 square miles and a population a little short of 300,000,000. This population is not uniformly distributed. It is very dense in the valleys of the Ganges, the Brahmaputra, and the Indus and its tributaries. Bengal, with an area of 151,543 square miles (less than three-fifths of Texas), has a population of about 75,000,000.

TIMBER.

The absence of timber in India strongly impresses the traveler. No fences, rarely woodlands, and no barns in a country almost exclusively devoted to agriculture indicate a peculiar people. In the government reports considerable forest lands are mentioned. They are, however, in remote sections and quite inaccessible as a source of supply of wood and timber for the centers of a dense population. The price of wood for fuel is from $16 to $40 per cord and not very good wood at that; hence the masses must live without fire, except the little that is used for cooking.

EXTENT OF ARABLE LAND.

The large proportion of the whole country that is arable is one of the first and most noteworthy observations of the traveler in India. In Japan one-tenth of the entire area can be tilled, and in China a large part of the country can never be subjected to the plow, although China as a whole ranks high in fertile lands; but in India, out of the 544,993,122 acres of surveyed land in 1899, seven-elevenths were available for cultivation and 196,487,658 acres were actually sown with crops.

FERTILITY OF THE SOIL.

One of the most suggestive items to be noted is the fertility of the soil, after a tillage of so many thousand years, with little manure of any kind. With few exceptions all the dung of animals is used for fuel, and as far as observed those exceptions were limited to the government farms. Many good farmers are said to use some cattle excreta on the land, but in all the small villages visited dung, made into patties and dried in the sun, was almost the only fuel. In the vicinity of cities the preparation and sale of cattle dung for fuel is quite an industry, and as far as observed it is all used in this way.

GREEN MANURES.

Inquiry at all the government agricultural stations visited and observations throughout India failed to develop a single case where green manures had been used to fertilize the soil. A further evidence that it is not used is found in the fact that the plows used simply stir the soil, but can not turn anything under.

COMMERCIAL FERTILIZERS.

It is difficult to use commercial fertilizers among Hindu farmers, for they suspect that all such preparations contain bone, blood, or some refuse of dead or slaughtered animals, and they declare it will defile them to handle it. An English gentleman in Calcutta told me that he had purchased some commercial fertilizer for his garden and his Hindu gardener refused to put it on the land. He employed a low-caste man to apply it to the vegetables, and after it was applied the gardener made no objection to working the soil on which it had been scattered.

CROP ROTATION.

Rotation of crops is well understood and practiced. This gives a partial relief in case of continuous cropping. To some extent summer fallowing has been employed as a renovating method. On the whole the present fertility of the soil is marvelous.

PUBLIC ROADS.

The main highways are models of excellence, broad, well graded, and bordered with lovely shade trees, such as the banyan, the tamarind, and the sacred neem. At suitable distances wells have been made, and near them are located rest houses for weary travelers. Generally the rest houses are unfurnished and without any resident care-takers, but all day and all night they are occupied by weary travelers for a shorter or longer rest, as the case may be. Here and there may be seen a single man or woman; but generally the people travel in families or small groups, carrying their more cumbersome bundles upon their heads and their wealth upon the ankles of their women in the form of silver bangles.

Mingled with the country people are numerous pack oxen and donkeys, with immense loads of all kinds of products. The oxen are noted for their docility and the donkeys for their diminutive size, being not more than 30 inches tall; but they are sturdy little animals and for their size they carry enormous loads.

CONVEYANCES.

In addition to the native families and village groups traversing the principal highways, there may be seen numerous carts drawn by oxen with a peculiar hump on their shoulders, the straight yoke resting on their necks and tied firmly to their horns. The carts are crude affairs. In some cases the wheels are merely two thicknesses of 2-inch plank, crossing each other at right angles, while in other cases the wheel consists of a large hub through which spokes are mortised to support a wooden felly 5 or 6 inches deep and 5 inches wide.

The carts invariably have large wooden axles, which soon wear the hubs and allow the wheels to stand at considerable angles. Occasionally a native official or the family of some village headman rides in an ekka or a tonga drawn by a trotting ox.

DRESS.

The clothing of the country people is exceedingly simple. In warm weather the men wear a turban and a single loin cloth so wrapped as to form a sort of breeches, extending to the knee; generally they have neither shoes nor sandals. In cold weather the cotton loin cloth is supplemented by a thick cotton bedquilt worn like an Indian's blanket. The women wear short skirts and a thin cotton waist without sleeves, and in addition a long shawl or wrap of thin cotton stuff is thrown over the head and twined about the shoulders or allowed to hang loose.

COUNTRY HOUSES.

There are no country houses, in an English sense, in India. The ryots (farmers) live in a collection of dwellings called a village for

want of a better term. These houses are of one story, having a single room, or occasionally two. In the mountain regions the walls are of stone, while on the plains they are made of brick or dried mud. There is usually a small yard in the rear of the house. There are openings, but no windows, and the doorway, if closed at all, simply has a bamboo-mat curtain. The roofs are made of tile and the floors of clay hardened by repeated washings with cow dung.

VILLAGES.

Between the houses in the small villages are narrow, tortuous alleys, but rarely regular streets. The village is surrounded by a high wall of stone, brick, or adobe, which answers for a fence against depredators, the cattle being brought within this inclosure at night. Each village has its customs and unwritten laws, and it and not the individual is the political and social unit. It has its blacksmith and carpenter, its doctor, and its headman or chief, and generally its banker.

The government taxes for the village are paid by the headman, who assesses them among the inhabitants in proportion to their property or income. Local matters are settled by the village, though in important cases there lies an appeal to the British courts. The village doctor, the carpenter, and the blacksmith are paid in rice at the harvest, not for specific work done, but as a sort of annual salary.

PLOWS AND SCRAPERS.

The plows used in different provinces vary somewhat, but have a general resemblance in that there is no moldboard and the instrument is simply one for stirring the soil. It consists of three pieces—the standard, the tongue, and the steel drill at the tip of a wood support or shoe. (Pl. IV, fig. 2.)

The standard is usually 3 by 4 inches and about 5 feet long, into which, about 12 inches from the lower end, the tongue is mortised at an angle. The standard stands a little less inclined than ordinary plow handles. Near the upper end is a single pin used for a handle. A steel bar about 1 inch square at one end and brought to a point at the other passes through the lower end of the standard and is supported by a V-shaped shoe. This steel bar stands at such an angle that the sharp point penetrates the soil 3 or 4 inches or more, as may be required. It amounts to nothing more than a sharp-tooth drill, and costs 60 cents complete. This plow is drawn by two oxen. (Pl. IV, fig. 1.) In use, the steel tooth cuts from the land a cloddy strip from 4 to 6 inches wide, and this is then broken up by the wedge-shaped wooden shoe. Afterwards men and women pass over the fields and smash the lumps with their mauls. Some ryots use a crude clod crusher made of wood and drawn by oxen. The harrow is much like ours, but crude. After the harrow has been used the routine of labor depends upon the crop to be planted.

In some cases where the farmers were planting wheat they used a wood scraper to prepare wide, flat furrows for the seed. This scraper consists of a board 1 by 6 inches and 3 feet long, with a handle 4 feet long attached to one edge at the center. The lower edge of the board is sharpened. It requires two men to operate it—one holding it on the ground by means of the handle and the second standing about 8 feet in front and pulling it from the holder by means of a rope. In this slow way a shallow furrow is formed for the water of irrigation. (Pl. V, fig. 1.) It must not be inferred from the inferior implements used that Indian lands are not well tilled; the farmers make up for the defects of tools by additional labor.

SEEDING AND HARVESTING.

Seeding is done in a variety of ways, one method being for the dropper to follow the plow and drop the seed into the drill-like furrow through a tube behind the plow, the next furrow covering it. Or the seed may be sown broadcast and harrowed. Or, in case of rice, the plants may be set into the flooded field from a seed bed previously prepared. The grain is all hand cut, and when dry, thrashed by tramping with oxen.

RICE FARMING.

The experience of the practical and scientific farmers of India has shown that rice does best on a deep clay or clay-loam soil, but the subsoil should not be so stiff as to prevent all natural drainage and cause stagnation of water, since rice is more luxuriant where fresh water is constantly added. Sandy-loam soils, if manured, produce an excellent quality of rice; the more manure the better the rice. More seed per acre should be used on sandy-loam soils than on clay loams.

Rice sown late in the spring when the weather is hot requires more seed than if sown in the early spring. If sown in a seed bed and transplanted the least seed is required—about 35 pounds per acre. Drilled rice requires about double this quantity, and if broadcasted 15 to 20 pounds more per acre are needed than when drilled.

While there are many hundred varieties of rice, for practical purposes only three general classes need be recognized, i. e., early, medium, and late ripening.

TREATMENT OF THE SEED BED AND MANURING.

The site for the seed bed is usually selected on land more or less elevated to insure drainage. If water is allowed to stand on the field between crops it produces a ferment which is unfavorable to the future production of the plants.

The use of green stable manure on rice fields just before planting is not recommended. It is of little value, due to the fact that where ordinary manure is kept very wet it undergoes no chemical changes by

which useful plant food is liberated. Therefore manure should be well rotted and applied long enough before planting to have some effect; better still, in case of a winter crop on the same field the manure should be applied to the winter crops. It is a common practice after plowing to burn trash on all seed beds from which rice plants are to be transplanted. Coarse grass, dead leaves, brush, rice husks, straw tramped under the feet of the oxen, dust piles, and occasionally some cattle dung are piled on the plowed land, and on top of this a thin layer of soil is spread to prevent rapid burning. The trash is then fired. The effect of this on the seed bed is the production of an ash for the support of the young plants and the destruction of weed seeds and injurious roots near the surface. The action of the heat on the surface soil also tends to liberate potash and phosphoric acid and to make the soil more porous.

PLOWING AND FERTILIZING.

Plowing and other heavy field work are generally done by bullocks, water buffaloes, or camels. Great emphasis is placed on repeated plowing. In India most of the rice lands receive no manure and have not received any for centuries, yet they continue productive, and when well tilled yield fair crops. One writer states: "All that is necessary to produce a bumper crop is timely and abundant rain." Some writers seem to think that the fertility of the rice lands of Bengal is due to the overflowing of the Ganges and Brahmaputra rivers. But these streams do not overflow and deposit silt to the same extent that this is done by the Nile. Moreover, this would not explain the fertility of the terraced rice land. The continuous fertility can not be due to the use of manure, for practically no commercial fertilizers are used, and almost all the droppings of cattle are used for fuel. It is mainly due to great natural strength of soil, good tillage, and rotation of crops.

METHODS OF CULTIVATION.

In December the old straw and trash are raked into pil and burned on the land. The field is then plowed, and at intervals it is given two more plowings, after which it is left until the latter part of March or early part of April, when the clods are crushed, and advantage is taken of the first rains to plow it twice more. The field is harrowed after each of the later plowings. Harrowing is done with a ladder having pins on the under side. The cultivator rides on the ladder, which also serves in a measure to break the clods. When the rice is up a few inches it is raked. This stirs the soil and to some extent thins the plants. The average product of a field sown and cultivated in this way is 6½ barrels per acre.

Where rice is sown in a bed or nursery and transplanted into the field, the field is first plowed three or four times in water, thoroughly

mixing the soil into thin mud. After the mud has settled the ground remains covered by about 2 inches of water. Where the fields depend on rainfall for moisture the plants are transplanted during a shower. The plants are set in hills 6 inches apart each way, two or three plants being set in each hill. In this way about 28,000 plants are set per acre. Transplanting for the main or aman crop is done in May, and for the spring or boro crop in December and January. It is possible in some parts of India to raise five crops of rice in one year. The first crop is called aus and is the summer harvest from July to August; the second crop, or kaida, from September to October; the third, chatan aman, from October to November; the fourth, called boran aman, from December to January, and the fifth or boro crop from April to May.

In the sub-Himalayan districts labor is very cheap, and it is customary to dig over the fields for rice with the mattock to the depth of 6 inches. This costs 80 cents per acre.

PRODUCT PER ACRE.

It is difficult to arrive at any correct estimate of the yield per acre from direct statements by native farmers. By dividing the total product in a given season by the total number of acres planted it has been ascertained that the average yield of rice per acre for all India is 823 pounds for the principal crop and 558 pounds for the spring or boro crop, making 1,381 pounds, or about 8½ barrels, for the year, as only two crops in one year are generally raised. This is not a large showing for two crops, and it is quite evident that if one crop should be raised and the land devoted to green-manuring crops the remainder of the season, the one rice crop for the year would exceed the amount at present secured from two crops.

HARVESTING.

Rice is cut with a small sickle or hook knife and bound at first in bundles about 3 inches in diameter. After it has cured a while, the small bundles are made into larger ones and drawn to the thrashing place, where they are placed in hollow stacks, one tier of straw deep, with the heads on the inside. Twenty women can on an average harvest 1 acre in a day. One binder, four horses, and two men in the United States daily do the work of two hundred women in India.

THRASHING.

The usual mode of thrashing is to clear and level a small space of ground, wash it with cow dung until hard, and to pile on this circular form the rice to be thrashed. Five bullocks are tied to a rope tandem, and driven around on this pile of unthrashed grain. Sometimes, to expedite the work, a second line of bullocks is used. Two men drive the two lines of bullocks and two men sift the straw with forks. In this way four men and ten bullocks will thrash the grain from an acre

in six hours. When the straw is to be kept whole the rice is thrashed by beating the heads over the edge of a plank.

During the harvest and thrashing time the farmer has to be constantly on the watch to see that the paddy is not stolen by dishonest laborers. He frequently builds a straw hut close to the thrashing floor in which he can sit and sleep. It is a regular custom to surround the pile of paddy with a ring of ashes so that it can not be approached without evidence.

WAGES.

Money wages are not usually paid. In some cases the reaper gets 1 load out of every 21 he cuts. In other cases he gets 10 or 12 pounds of paddy for a day's work. Usually he receives 6 pounds of paddy and half a pound of cleaned rice. Laborers are generally employed by the year, and the wages paid are much less than the above, averaging about 2 cents per day. The ordinary plan upon which crops are raised is to form a farmers' club. For this purpose five to ten farmers, each the owner of a pair of bullocks and a plow, form a club to help each other plow their lands.

COST OF CULTIVATION.

The ryot never keeps any account of his expenses, and hence it is difficult to estimate the cost of cultivating an acre of rice; but allowing customary wages and estimating the time required for the work performed, the following is an approximation of the cost on an acre of land where rice is sown broadcast:

Plowing 4 times, 12 days' work for 1 man and a pair of bullocks, at 3 cents per day	$0.36
Carrying and spreading manure, 4 men 1 day	.08
82⅔ pounds seed paddy	.32
One plowing and harrowing after seeding, 3 teams 1 day	.08½
One weeding, 20 women 1 day, at 2 cents	.40
Repairing levees, 16 men 1 day, at 2 cents	.32
Reaping, 16 women 1 day	.32
Carrying the bundles of paddy to the thrashing place or floor	.04
Thrashing, 4 men and 10 bullocks 1 day, at 2 cents for each man and 1 cent for each bullock	.18
Cleaning and winnowing, 3 men 1 day	.06
Rent of first-class land per acre	.96
Additional charges per acre	.12
	3.24½
Yield of first-class land, 1,010 pounds of paddy, valued at	3.84
Profit per acre	.59½

The foregoing estimate, obtained from the most reliable authority, is impressive because it shows the low condition of agriculture in this Himalayan district. The wages of a man one day—2 cents—and the charges for the use of an ox one day—1 cent—are prices below our conception of values of labor.

It is noted that no account is made of manure and straw. Very little manure is generally used, and in many districts none. In the interior, where the above estimates were received, the straw and manure have no commercial value. While wages are low the price of rice is also low, only 32 cents for 82⅔ pounds of paddy, or 61½ cents per barrel of 162 pounds. When the rice crop is handled in the usual way—the plants grown in a seed bed and transplanted to the field—there is an additional cost of 6½ cents for preparing the seed bed; and the cost of pulling plants and transplanting into the field, which requires five men and twenty-eight women one day, is 66 cents. There is, however, a saving of 40 cents for weeding and also a saving in spreading manure and other small items, which reduces the total cost of an acre of transplanted rice to 30 cents more than that of broadcast, leaving a net profit of 29½ cents per acre on the crop.

In the above estimates no account is made of the Government assessments on rice, which are considerable. These are sufficient at least to wipe out all profits in this class of farming.

The following estimates of the cost of raising rice under high-class conditions are furnished by Hon. James Mollison, inspector-general of agriculture for India:

Preparing and tilling seed bed		$0.64
Manure used on seed bed, 6 loads; on an acre, 20 loads		4.16
Cost of seed, 80 pounds		.80
Plowing, puddling, and leveling		1.52
Transplanting		.80
Weeding seed bed		.48
Top dressing with castor cake, 200 pounds per acre		.96
Cutting, thrashing, and winnowing		1.44
Tying and stacking bundles of straw		.24
Cost of irrigation		1.28
		12.32
Add Government tax per acre		4.80
Total cost per acre		17.12
Probable crop, 3,000 pounds, valued at	$24.00	
Value of straw	1.60	
		25.60
Net profits per acre		8.48

The above estimates are based on wages in the Surat district, which are higher than in the Himalayan, but still very low.

Under good cultivation the cost per acre is equal to that in the United States.

NORTHERN LIMIT OF CULTURE.

The question is frequently asked how far north rice can be produced profitably. Hon. C. L. Dundas, director of agriculture for the Punjab, stated that he could not tell, but assuredly as far north as his administration extended, 34° 15′ north latitude.

CONSUMPTION OF RICE AS FOOD.

The people in India do not keep account of farm products, except as they are compelled to by law; hence it is impossible to arrive at any exact data except through Government sources. In some provinces of India rice is the principal food; in others, less rice is produced and it constitutes only a portion of the food supply. In Bengal the 75,000,000 people on an average consume 1 pound of rice per capita each day, or 365 pounds per year, as determined by the Government reports. This would appear to be large, but in the way this amount is obtained it covers all losses, wastage, etc. The following table gives a comprehensive statement of the food crops produced in India and the relative proportion of rice to other grains:

TABLE 1.—*Area (in acres) under crop of principal products in each province of British India, 1897–1900.*

[Native States not included.]

Province.	Rice.	Wheat.	Barley.	Millet.	Corn.	Peas, beans, pulses, etc.
Upper Burma	1,818,962	15,813	120	804,950	76,300	195,523
Lower Burma	6,277,678	14	.....	748	11,492	45,010
Assam	3,653,533	223	59	.....	2,823	86,283
Bengal	39,656,800	1,541,400	1,448,200	183,500	1,802,200	5,141,200
Northwest Provinces	4,592,603	4,601,392	3,154,323	3,395,313	1,143,430	3,943,905
Oudh	2,899,792	1,619,583	1,020,830	547,575	462,575	2,224,635
Ajmer-Merwara	296	1,838	27,214	91,109	62,438	14,240
Parganá Mánpur	167	1,292	.....	2,504	1,101	509
Punjab	482,795	5,488,598	898,443	1,243,605	1,239,723	1,047,568
Sind	898,853	347,445	8,910	1,014,678	1,400	165,678
Bombay	1,251,143	811,590	44,328	11,035,141	184,854	1,861,980
Central Provinces	4,708,624	1,633,777	6,005	80,887	104,201	2,921,603
Berár	44,138	21,192	234	60,102	7,701	236,661
Madras	6,429,045	20,636	3,318	4,155,425	95,234	5,453,883
Coorg	94,523	.....	.....	18,219	.....	80
Total	[a]72,808,952	[b]16,104,793	6,611,984	22,633,756	5,195,472	23,338,758

Province.	Sugar cane.	Cotton.	Jute.	Total acres in crops.	Total population.
Upper Burma	2,236	153,734	.....	2,976,850	3,167,791
Lower Burma	9,330	9,068	.....	6,335,406	4,603,103
Assam	28,315	3,399	100,168	3,743,608	5,433,668
Bengal	873,000	144,000	1,970,500	51,733,900	70,414,425
Northwest Provinces	1,023,851	968,302	.....	24,144,439	33,801,894
Oudh	235,326	28,780	.....	10,176,896	12,650,831
Ajmer-Merwara	199	35,453	5	199,478	543,258
Parganá Mánpur	16	4	.....	6,165	.....
Punjab	360,978	735,125	.....	11,074,831	20,861,061
Sind	2,615	91,091	.....	2,488,277	2,871,774
Bombay	70,515	2,050,251	.....	15,964,219	15,135,827
Central Provinces	25,583	712,836	.....	12,129,278	10,784,294
Berár	2,471	2,061,082	.....	3,097,782	2,897,040
Madras	58,638	1,382,716	.....	20,694,679	35,630,440
Coorg	.....	.....	.....	112,981	.....
Total	2,693,023	[c]8,375,841	2,070,673	164,878,789	.....

[a] Total yield, 618,966,312 barrels of 162 pounds each. [b] Total yield, 266,250,560 bushels.
[c] Total yield, 2,110,562 bales of 400 pounds each.

In the more populous provinces the area planted to food crops is so small in proportion to the population that even the slightest failure results in disaster.

Nearly all the tilling of the soil is done with the plow, and oxen, buffaloes, and sometimes cows furnish the motive power. The small number of carts (wagons are not used on the farms) is explained by the fact that a large part of the transportation of produce is done on the backs of oxen or donkeys.

TABLE 2.—*Area (in acres) irrigated in British India, 1899–1900.*

Province.	Irrigated from—		Tanks.	Wells.	Other sources.	Total irrigated.	Net area cropped during year.	Area cropped more than once.
	Government canals.	Private canals.						
Upper Burma	252,161	307,198	129,864	7,211	102,587	799,021	3,695,206	260,036
Lower Burma	310	1,325	.....	.....	3,434	5,069	6,857,898	846
Assam	.....	.....	.....	.....	.....	.....	4,552,210	565,146
Bengal	754,557	.....	.....	.....	.....	754,557	53,253,600	10,618,100
Northwest Provinces	1,981,373	5,692	1,215,683	4,478,507	553,595	8,234,850	24,402,658	4,461,342
Oudh	.....	.....	976,394	1,643,178	80,453	2,700,025	8,624,254	2,427,975
Ajmer-Merwara	.....	.....	7,228	43,776	116	51,120	230,773	17,400
Parganá Mánpur	.....	.....	.....	324	.....	324	6,786	136
Punjab	4,243,524	823,729	20,049	4,154,598	134,083	9,375,983	23,275,728	2,017,570
Sind	2,352,433	140,595	.....	41,005	110,414	2,644,447	2,781,014	215,474
Bombay	99,829	5,013	30,413	667,789	78,149	871,223	19,278,203	320,293
Central Provinces	.....	810	176,187	64,118	14,079	255,264	14,762,603	164,340
Berár	.....	72	.....	66,838	107	67,017	5,403,758	1,495
Madras	2,648,160	26,289	1,832,527	1,129,804	146,986	5,783,766	23,122,215	2,674,229
Coorg	1,370	.....	.....	.....	.....	1,370	200,117	701
Total	12,333,717	1,310,723	4,388,345	12,297,148	1,224,003	31,544,036	190,447,023	23,745,083

Table 2 shows the number of acres irrigated as in Table 1, native states not being included. Of course lands subjected to natural overflow or on which there is a heavy rainfall are not included in this table. The irrigated lands are principally planted to wheat and food crops other than rice, although in some provinces the rice crop depends entirely on artificial irrigation. In the best rice districts, however, the rainfall is very heavy, amounting to over 200 inches in a year in Lower Burma, which with the annual deposits from the overflow of the Irawadi River makes it ideal rice land.

Table 3 shows the number of head of live stock and number of farm implements in the same area as that covered by Table 1.

TABLE 3.—*Live stock and farm implements in British India.*

Province.	Bulls and bullocks.	Cows.	Buffaloes.		Sheep.	Goats.
			Bulls.	Cows.		
Upper Burma	687,823	697,939	109,953	98,581	5,113	25,013
Lower Burma	578,821	397,338	276,620	231,588	2,374	12,374
Assam	1,102,938	1,006,305	91,136	122,548	.....	11,497
Bengal	1,195,736	880,754	105,597	326,042	137,903	478,551
Northwest Provinces	7,045,630	4,567,777	565,835	2,413,369	1,819,487	3,123,899
Oudh	3,148,842	2,065,569	219,357	866,232	554,948	1,495,322
Ajmer-Merwara	64,390	60,233	2,731	21,142	161,305	118,906
Parganá Mánpur	1,996	2,009	27	727	.....	994
Punjab	4,631,729	2,566,047	592,137	1,903,070	4,759,122	5,142,771
Sind	528,744	515,559	5,502	190,093	320,378	831,937
Bombay	2,295,836	1,139,843	197,780	669,469	1,439,216	1,670,436
Central Provinces	2,831,655	2,524,616	354,531	511,467	279,998	681,091
Berár	697,791	623,370	37,909	211,774	217,502	283,464
Madras	4,411,350	3,853,408	846,679	1,560,104	8,234,262	5,181,639
Coorg	34,629	26,674	11,931	7,690	629	1,755
Total	29,257,910	20,927,441	3,417,725	9,133,896	17,932,237	19,059,649

Province.	Horses and ponies.	Mules and donkeys.	Plows.	Carts.	Young stock and buffalo calves.
Upper Burma	23,197	2,692	415,630	239,101	638,724
Lower Burma	12,112	.....	478,388	199,181	594,034
Assam	9,908	133	821,570	11,883	1,390,361
Bengal	35,913	12,722	458,211	60,337	246,227
Northwest Provinces	434,426	262,777	3,162,668	486,136	6,408,351
Oudh	181,084	50,213	1,464,406	100,702	2,427,824
Ajmer-Merwara	2,436	5,029	33,069	9,407	21,040
Parganá Mánpur	83	23	865	315	1,411
Punjab	312,746	612,387	2,229,768	242,648	3,712,614
Sind	76,799	84,442	243,042	35,125	352,797
Bombay	90,367	51,207	891,451	468,958	1,550,194
Central Provinces	94,542	17,628	1,295,953	417,521	1,886,250
Berár	29,627	20,488	136,041	129,779	249,549
Madras	40,239	120,086	2,749,701	524,041	4,383,639
Coorg	401	274	26,979	715	19,096
Total	1,343,880	1,240,101	14,407,742	2,925,849	23,882,111

WELLS.

The wells are open, 5 to 7 feet in diameter, and 30 to 60 feet deep. On one side of the well an embankment is made about 5 feet high. This slopes at an angle of 20° from the well and frequently terminates in a pit a few feet deep. This embankment forms a descending road for the oxen to travel when hoisting the water. A bullock's hide is used for a bucket; the corners are attached to a rope, which passes over a single pulley at the top of the well and is tied to the yoke of the oxen. Each hoist carries about one barrel. (Pl. V, fig. 2.) Two yoke of oxen are required, as one yoke can be used only six hours consecutively, and there must be one man to drive the oxen, one to

manipulate the bucket, and one in the field to distribute the water. Three men and four oxen will water 10 acres of wheat during the cropping season.

RICE PRODUCED.

In 1900 there were in the provinces of Bengal, Burma, and Madras 49,915,913 acres in rice, which produced 435,822,000 barrels. If we place the product of the remaining 22,893,039 acres in rice at 183,144,312 barrels, the total for India would be 618,966,312 barrels of rough rice, or about 177 times more than the entire rice product of the United States.

AGRICULTURE IN THE PUNJAB.

Hon. C. L. Dundas, director of land records and agriculture for the Punjab, stated, in reply to inquiries, that—

Unirrigated rice can only be grown in the submontane tracts, where there is heavy rainfall. The average yield is about 550 pounds per acre. On irrigated lands the average yield is about 900 pounds. A good crop would be 1,200 pounds, and 1,500 can be obtained by careful cultivation. In the Punjab this is produced almost invariably by owners with small holdings. If the holding is large, part is cultivated by the tenant on the share plan, the tenant paying one-fourth to one-half the gross product. Hired labor is employed sometimes in transplanting and generally in harvesting. This is paid for in kind.

Throughout the Punjab, women of the agricultural class are employed in the lighter kinds of outdoor field labor, such as harvesting, picking cotton, etc. The women of certain tribes of high social or religious character never work in the field, but generally women work on the lands of their male relatives. Compensation consists in their food and a small present in kind at the close of the harvest, practically subsistence and nothing more, but differing from the starvation wages of civilized countries by the patriarchal customs of India, which forbid a man from filling his own stomach while leaving his employee hungry. Hence harvest wages depend entirely on the harvest. If this is good, the laborer, male or female, may get enough grain to keep him or her two or three months. Unless forced by famine, women will not work in the field except for their male relatives. In the Himalayas the women do all the farm work, including plowing.

Windmills being unknown and water mills impossible on the plains, all the grain used as food in India is ground on handmills (small stone burrs) by women. Spinning is universal, and much of the coarse cloth used for clothing is manufactured at home.

The cost of labor necessary to produce a crop of rice is about 45 per cent of the total product grown, including the straw. To give a definite cash estimate of cost is practically impossible. A landlord would, in a typical case, pay some 8 per cent customary dues and divide the balance with his tenant, paying one-half his own share in water rates and land revenue to the Government. The revenue or tax to the Government varies from $1.50 to $3 per acre. As a rule, the landlord works his own farm.

The highly flavored rices are regarded as choice, but the people prefer to plant the coarser varieties, as giving less trouble. There is apparently great obscurity in the scientific names of rices, and it is difficult to distinguish varieties.

Wheats, millets, and gram (peas) form the staple crops, wheat being the chief article of export. Considerable cotton is produced. About 110 pounds of lint cotton is an average crop for an acre. It sells at about 5 cents per pound.

The practice of plowing under renovating crops I believe is unknown in the Punjab.

Cattle for plowing or lifting irrigating water range in value from $15 to $25 per head. Buffaloes are worth from $20 to $35 per head and camels about $15 each. The price of cattle for work varies with the provinces. At Poona a good buffalo for field work is worth $6.50; an ox $16 to $17. At Delhi a buffalo is worth $8 to $10; an ox $16 to $26, according to size. Native plows generally sell for 60 cents each.

COST OF LIVING.

Among the ryots no cash estimate of the cost of living could be obtained. The following statement made by an educated Hindu may be assumed to be correct as regards cost of living in the city: A laborer needs 1 pound of rice, worth 2 cents; one-half pound of dahl (split peas), 0.75 cent; one-half pound of barley, 0.875 cent; condiments, 0.17 cent; fuel, 0.5 cent; making a total of 4 cents for a day's living. Better living for laborers earning higher wages costs about 6 cents per day, divided as follows: Rice, 1 pound; mutton, one-half pound; barley, one-half pound; vegetables, condiments, oil or butter, and fuel. The retail price of rice, low grade, is here given at 2 cents per pound. The wholesale price in India for this grade is about 1 cent per pound and in Burma 90 cents per hundred.

RICE FARMING IN LOWER BURMA.

Rice farming in Lower Burma varies somewhat from that in Bengal. The lands are richer, and the rains are more abundant. The cultivator commences to plow about the 1st of June and continues to work the soil till he secures an even surface of mud, which is kept soft by the heavy rains. In July women transplant the rice from the seed bed and receive for this work at the harvest a certain number of bundles per hundred plants set. The harvest commences in November, and cutting, curing, thrashing, and winnowing are done in much the same manner as in Bengal. Rice cultivation in Lower Burma comes nearer being on a commercial basis than in India. Wages are regulated by each village and are frequently paid in money. Laborers who are imported from Madras in harvest time usually receive 23 cents per barrel of product for cutting and binding. A large portion of the crop is cultivated on the tenant system, the landlord furnishing land and seed every other year and receiving one-third to one-half the product. He furnishes no house nor other buildings and does not fence the land. A yoke of cattle will work about 10 acres of land.

RICE MILLING.

Very little rice milling, as the term is commonly understood, is done in India proper, except for resident Europeans. In the rural districts, where the rice is wanted for local consumption or for export, the hulls are removed by pounding, using a pounder worked by the foot. Pounding and winnowing in the open air or by a fanning mill

complete the milling process. There is no charge for milling, the hulls and bran being considered by the natives full compensation. As late as 1891 there were only two modern power mills in India. Most of the rice exported to Europe from Bengal is cargo rice, four-fifths husked and one-fifth paddy. It is claimed by shippers that cargo rice is not as liable to heat on shipboard as that completely milled. In Burma the grower markets all his rice in the paddy and in bulk, except such as goes by rail, which must be sacked. The larger part is delivered by boat, and is carried to the mills in baskets by coolies. It is weighed and delivery actually takes place in the mills. At first the mills were merely husking mills to prepare the large crop of paddy for export, but gradually other processes were added until complete modern milling plants were equipped. The hulling stones in the best mills are made of emery. Some of the machines are cruder than similar machines in the United States, but they appear to do the work satisfactorily. Permission was freely granted to inspect the Kemendine mill in Rangoon, which has a daily milling capacity of 500 tons of rice for native use or 300 tons for Europeans. A larger mill has just been completed for the same company. The Kemendine does no custom milling. The paddy is bought and the milled product sold on the market. There are over fifty mills in Rangoon, and many of them do custom work. The usual price for custom milling ranges from 2¼ to 3¾ cents per bushel, or an average of 11 cents per barrel, giving the farmers all the by-product. The breakage in milling for native use amounts to 6¼ pounds per hundred. For European use or for export rice milling the charges are 18 cents per barrel. The laborers employed are mostly Tamils from Madras, who are paid from 24 to 32 cents per day. Women employed in the rice mills are paid 12 to 16 cents per day. Most of the mills use the hulls for fuel. Over 24,000,000 barrels of paddy rice were milled last season at Rangoon for foreign account. This furnished a large amount of bran and polish, which the thrifty Chinese in Burma and the Straits Settlements buy and feed to pigs and cattle. Many mills are owned by Chinese. Last year Burma furnished about 2,000,000 tons of cleaned rice for export.

RICE FOR FOREIGN MARKETS.

India and Burma rice is not generally raised on a commercial basis. Each farmer or tenant produces enough for home consumption, and the surplus is sold for whatever it will bring. If the price falls ever so low just the same amounts are produced and placed on the market. It is true that if rice is abundant and cheap in India home consumption is increased. Rice is raised in those countries commercially very much as eggs are generally produced in the United States. No account is kept of the expenses, and it is sold regardless of cost. Where no cash wages are paid it is impossible to determine the cost of production.

American supremacy in the rice industry depends upon more economical production. This may be accomplished by diversified farming and by an increased efficiency in machinery. Improved machinery in the rice field is of recent introduction, and it will undoubtedly be made more efficient and the rice farmers will handle it with greater economy.

SELECTION OF SEEDS.

No rices were seen in India that appeared to be an improvement on those grown in the United States, except possibly some very early varieties. In Bengal there are varieties that mature in sixty days. While it must not be expected that they will mature as quickly in America, they are nevertheless worthy of trial on account of their rapid maturing qualities.

India produces some good wheats and shows a large and profitable yield in the latitudes corresponding to our Southern States. Out of 150 varieties 5 were selected as worthy of trial. A few good soil-renovating plants were found. The sunn hemp (*Crotalaria juncea*) is highly recommended by the Poona State Farm for its luxuriant and rapid growth. If planted immediately after the rice harvest, it will make a growth of 2 feet before frost. Some valuable sorghums and vetches for the semiarid portions of the United States were found.

CHINA.

In scholarship, energy, and business qualities the Chinese take very high rank among the nations of the earth. They are bright, apt, of indefatigable perseverance, and instinctively grasp the financial bearings of business transactions. They soon become the merchants and bankers of every country in which they settle. They have such marvelous tact along business lines that Europeans doing business in China uniformly employ Chinese agents or compradors in all dealings with the Chinese.

AGRICULTURAL CONDITIONS.

It is difficult to deal with the agricultural conditions in China in a comprehensive way, because there are no reliable statistics published, and the traveler is limited to his observations and the very meager information to be obtained from Chinese farmers. The farmer, too, is not disposed to give information to a stranger, thinking that some advantage will be taken of it. In traveling through the rural districts of China the large areas of unused lands were observed with surprise. Along the Yangtze in particular the cultivation of the highlands has been largely abandoned and tillage has been limited to the fertile alluvial lands. Even in the vicinity of Nankin, the old capital of the Ming Dynasty, there are thousands of acres of land, evidently fertile if properly tilled, which lie neglected as commons. The rainfall is

somewhat uncertain on the highlands and it is necessary to resort to irrigation, but apparently an abundance of water for most food crops can be obtained from wells. These highlands bear evidence of having been cropped in former ages.

Few nations are in advance of the Chinese in economic production and in crop results along well-established lines of agriculture, but they seem to be entirely ignorant of modern methods of renovating worn-out soils. Thousands of acres of land in the vicinity of large cities, it was said, could be obtained of the Government either free or at a nominal cost for renovation and cultivation.

The almost entire absence of timber or woodlands in eastern China was noted with surprise. The highlands and the mountains are completely denuded, with the usual result of alternate periods of great drought and excessive rainfall. Grass and reeds are used for fuel. During September thousands of men and women were cutting grass from the sides of the mountains, coarse grasses in the untilled places in the valleys, and the tall reeds on the Yangtze bottoms. These were bound into bundles and sold for fuel. In cooking with this trashy material one person is needed to feed the fire. In cities a common fuel is coal dust, mixed with equal quantities of clay, made into balls about 3 inches in diameter and dried. The Government does not appear to be making any effort to restore the forests.

An impressive feature of Chinese rural life is the apparent insecurity of person and property. Every farmer has a compound, or high-walled inclosure, into which stock is driven at night and in which are stored the farm crops. Farmhouses of the better class are about 42 feet square, and without windows in the outside walls. In the center of each house is an open court, generally about 14 feet square, called the "heavenly well," which admits air and light to the rooms. The houses of the coolies or peasants are rarely more than 16 by 24 feet in size and contain one room only, having no compound. Pigs and chickens are driven into this room at night. The houses are one-story structures with adobe, brick, or stone walls, according to the cost of material, with thatched or tiled roofs and clay or tile floors. There are no fences; consequently the farm animals are herded.

TILLAGE OF THE SOIL.

In some provinces there is considerable hand tillage after the manner of the Japanese, but generally oxen, cows, or buffaloes are used for plowing. The plows are much like those used in India. They operate like a single-tooth harrow slightly depressed from the horizontal, and simply stir up the ground. No inversion of the soil is possible. On the alluvial lands water buffaloes are generally used for plowing rice fields, because they are plowed with water standing on them and worked until a field of mud is secured. After the first plowing, high

lands, especially such as are used for gardens, are worked over with a claw hoe, the tines of which are 8 to 10 inches long. This is forced into the ground by a quick, smart stroke, and the tool is then pulled toward the cultivator. Steel-toothed harrows are also used to pulverize the soil.

Plowing for rice is done in May. Seed beds are prepared and planted in April, and about the 1st of June the young rice plants are transplanted from the seed bed to the field. To prevent breaking the roots a spade is run under the plants some 2 inches below the surface before pulling commences. The plants are set in rows which are 8 inches apart, the space between the plants in the rows being about the same distance. After the plants are set out the field is kept flooded with water about 2 inches deep till the heads begin to fill. Further irrigation is then left to the rainfall unless it is unusually dry.

IRRIGATION.

One of the common ways of irrigating gardens is from open wells, using the balance pole and bucket to raise the water. For raising water only a few feet a narrow vertical wheel is used and operated by the weight of one or two men opposite the water to be elevated and sufficient to balance it. For higher lifts a large wheel is commonly used, with wooden or earthen buckets on the rim. Oxen turn a horizontal wheel, which imparts power to the vertical wheel by means of cogs in the rim.

CULTIVATING, HARVESTING, AND THRASHING RICE.

The Chinese are good cultivators. They go through the rice fields pulling all the weeds and stirring the soil with their fingers or with a small rake. When the rice is ripe it is cut with a small reap hook, bound into bundles, and set up in small shocks. Thrashing is done by whipping the heads over the edge of a box some 6 feet square. The rice is then spread on mats in the sun to dry.

HULLING RICE.

Before the rice is sent to the market it is generally hulled by pounding, using the foot-power pounder so universal in the Orient. If complete milling is required, the pounding is continued longer. Occasionally the hulls are removed by placing the grain in a small circular stone trench, in which a broad-rimmed wheel is rolled by ox power. A long axle passes through the wheel, one end of which is attached to a pivot in the center of the space surrounded by the stone trench, and the other extends some 6 feet beyond the wheel and trench; to this end the oxen are attached and are driven around till the rice is hulled.

PRODUCTION AND COST OF MILLING RICE.

The average yield of rice is from twenty to thirty fold. This probably denotes a crop of 1,200 to 2,000 pounds of paddy. The cost of milling is 7½ cents (gold) per barrel (162 pounds), of which 6 cents is paid for pounding and 1½ cents for winnowing. The entire cost of milling is met by the value of the bran and hulls. The red rice and lower grades are all consumed locally. The local price of rice is from 1 to 2 cents per pound, according to quality. It is difficult to secure accurate data, because in the different provinces weights of the same name vary materially in the amount they represent and coins of the same denomination differ in value.

COST OF BUILDING, ETC.

Hard brick sell for $2.10 per thousand and it costs about $1.50 per thousand to lay them in a wall. The wall is the principal expense incurred in building in the country. Lumber for building is generally imported from the United States and is expensive, costing on the coast from $40 to $80 per thousand. Country carpenters and masons usually receive 10 cents per day and board. Farm laborers are paid $5 per year and board. Board for a day consists of 1¼ pounds of rice, costing 2 cents, and pork and vegetables costing 1 cent. Allowing 10 cents per month for the labor of cooking the food, the total cost of board is about $1 per month.

EXPORTATION OF AGRICULTURAL PRODUCTS.

There is no probability of the overproduction of staple foods in China and their large exportation for the following reasons:

(1) At present China produces only about sufficient food for her own consumption; any large increase of the area planted would involve a system of levees to protect river bottoms, and deep wells to irrigate the highlands.

(2) Before rice and other grains can be produced in large quantities for export, the Chinese must feel that they are safe in the enjoyment of their property, and the duties between different provinces and the petty exactions imposed on internal commerce must be abolished. The conservative type of Chinese character prevents radical and sudden changes. The increasing consumption will keep pace with the increase of production.

THE PHILIPPINE ISLANDS.

A visit to the Philippine Islands in October, 1901, confirmed the opinion formed during a visit in 1898, that from an agricultural standpoint these islands are among the most valuable territories of all Asia.

This does not mean that the soil is richer than portions of Japan, China, India, or Siam, but richness of soil is not the only element that determines productive capacity; rainfall and temperature, with good drainage, are even more essential conditions than natural richness of soil. In possessing a uniform temperature suited to the best conditions of tropical plant growth, the Philippines enjoy a great advantage. The distance of the islands from China and Siam is sufficient to allow the intervening water to neutralize any chill winds from the northwest, while the great warm current of the Pacific touches them upon their eastern shores, producing a most enjoyable climate. The rainfall, from 80 to 100 inches per annum, is sufficient to meet the requirements of tropical plants; but what is still more important, it falls during the months—May to December—best suited to the growth of plants. This is followed by a comparatively dry period—December to May 15—in which the plants mature and are harvested.

The report of the observatory at Manila shows the following average number of days in each month on which rain fell:

Rainfall in the Philippine Islands.

Month.	Number of days on which rain fell.	Rainfall.[a]	Month.	Number of days on which rain fell.	Rainfall.[a]
		Inches.			*Inches.*
January	4.3	1.15	August	10.8	13.08
February	2.2	.47	September	20.7	15.02
March	3.4	.65	October	14.4	7.47
April	3.5	1.11	November	11.3	4.92
May	9.2	4.2	December	8.4	3.09
June	15.4	9.68	Total	125.7	75.56
July	22.1	14.72			

[a] The rainfall is the average from 1865 to 1896, inclusive.

The following table, compiled from the report of the observatory at Manila, shows the mean temperature of each month for seventeen years ended 1897:

Temperature of the Philippine Islands.

Month.	Temperature.	Month.	Temperature.
	° *F.*		° *F.*
January	77.0	August	80.9
February	77.9	September	80.6
March	80.6	October	80.4
April	82.9	November	79.0
May	83.8	December	77.3
June	82.4	Average	80.3
July	80.9		

The valleys are broad and well drained, while the mountains are approached by a gradual elevation and frequently by table-lands, and are generally fertile to the top. Neither on the coast nor in the lowest valleys of the interior is the heat at any time oppressive, and within a short distance from any point on the islands it is possible to reach an altitude where the climate is perfectly delightful, even in the warmest season of the year.

RANGE OF PRODUCTS.

Taking all the islands and the fertile mountains into consideration, there is possible a very wide range of products, from the most delicate spices to the hardy cereals. The chief commercial products have been rice, sugar, tobacco, coffee, and fiber plants, but the islands can produce cattle, wheat, corn, oats, the legumes, and the grasses.

STOCK AND PASTURE LANDS.

Like Porto Rico, the Philippines furnish admirable conditions for stock raising. The mountain sides have frequent streams of pure water and produce an abundance of grasses, somewhat coarse and lacking in flavor, but which if cropped closely are relished by domestic animals. Softer and sweeter grasses can readily be introduced. Bermuda grass and several of the Paspala and some clovers do well. Stock raising has been profitably carried on for many years by natives, often on quite a large scale. The native horses are small, but are hardy and of immense energy, showing their descent from Andalusian stock. There is a good demand for dairy products, and few lines of husbandry would be found more profitable.

FODDER PLANTS.

The soil and climate of the Philippines are especially adapted to the production of a great variety of fodder plants. Among the many may be mentioned alfalfa, esparcet, serradella, vetch, lupine, pea, soy bean, *Lespedeza bicolor*, *Pueraria thunbergiana*, *Astragalus latoides*, cow peas, *Panicum colonum*, guinea grass, and *Panicum maximum*. During the rainy season it would be necessary to use these plants for soiling, as the almost daily showers prevent curing. From December 1 to May hay could be made in most parts of the islands.

SUGAR CANE.

Conditions are very favorable for raising sugar cane. The heavy rainfall during the growing period, followed by the dry months of December, January, February, March, and April, are ideal conditions, so far as climate is concerned. This gives a full year for growth and five months for manufacturing the sugar. The sugar mills are very

crude, except some in Negros, Panay, and Cebu. In Luzon the sugar factories are mainly of the open-kettle sort, and with machinery cruder than is generally used in farm sorghum manufacture in America. Some stone rollers for crushing the cane are used, and many factories have only large wooden tubs with iron bottoms for boiling the cane juice. In Panay and Cebu the mills are of a higher type, although crude as compared with American up-to-date milling plants. (Pl. VI, fig. 2.)

RICE FARMING.

The method of raising rice in the Philippines is practically the same as in India, except that the plowing is almost exclusively done with water buffaloes, and a larger proportion of the land is sown broadcast. Rice planting is usually done in June, and harvesting in November and December. Only one crop is raised each year. With artificial irrigation two crops could be produced annually, one in the summer and one in the winter and early spring. The area devoted to rice could be considerably enlarged, but it is doubtful whether in the evolution of the islands under American conditions such will be the result, as a number of other farm products are more profitable and are cultivated with less labor. The natives much prefer to plant and work manila hemp (*Musa textilis*), as when once planted it produces a crop for several years with slight attention. Coffee and some of the spices are favorite products in certain sections. Plowing the land and setting rice plants in the mud is a disagreeable task, even to Filipinos; consequently the general trend of agricultural industries in case of expansion will be away from rice and toward crops more easily handled and more profitable.

FRUITS.

Nearly every known variety of fruit can be produced on these islands, from such as require extreme tropical conditions to the hardy fruits of the temperate zone, like the apple and the cherry, for the islands possess a great range of climate. There are valleys where the temperature never falls below 70° and there are table-lands where it drops nearly to the frost line in the winter. These extremes are found on the same island. At Manila 65° F. above zero would be extraordinary weather. A hundred and thirty miles north, in the province of Benguet, the grains and fruits of northern New York can be produced.

TIMBER.

It is estimated that only about one-fifteenth of the land has been brought under cultivation. A large portion of the remainder is timber land, and nearly all of it belongs to the Government. Many very

valuable varieties are found, among which is mahogany. Except the teak forests of Upper Burma, now under complete Government control, these are the most valuable timber lands in eastern Asia, and if cutting is properly regulated they will remain a source of profit for many years. At present the only method of obtaining this wood is to cut and hew it into square timbers, which are then dragged down the mountains by oxen. By this method fully one-third is wasted and many valuable young trees are destroyed.

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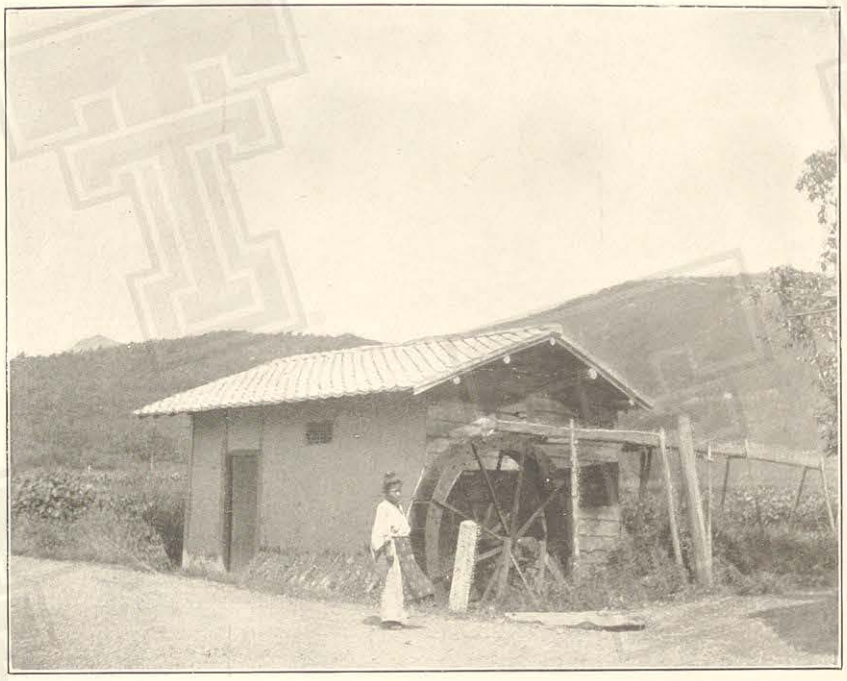

FIG. 1.—RICE MILL AMONG THE MOUNTAINS, JAPAN.

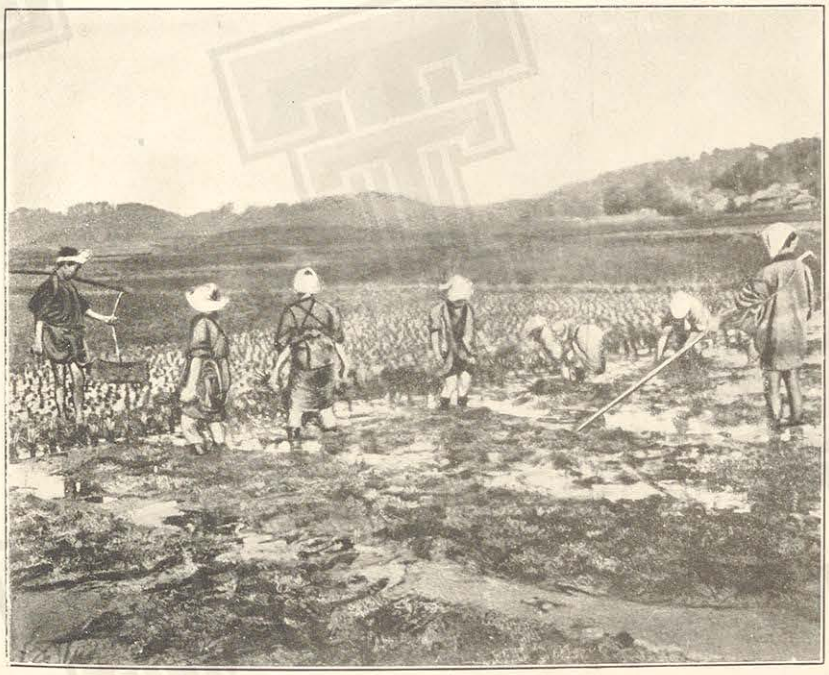

FIG. 2.—PLANTING RICE, JAPAN.

FIG. 1.—CLEANING RICE, JAPAN.

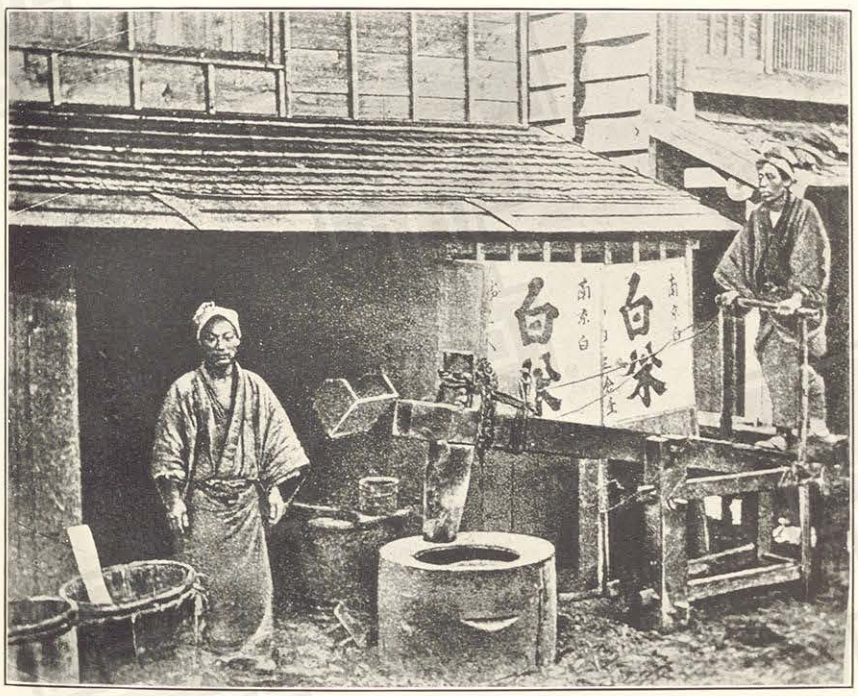

FIG. 2.—POUNDING RICE, JAPAN.

FIG. 1.—TAMIL GIRLS PICKING TEA, CEYLON.

FIG. 2.—CARTS WITH BAMBOO COVERS, CEYLON.

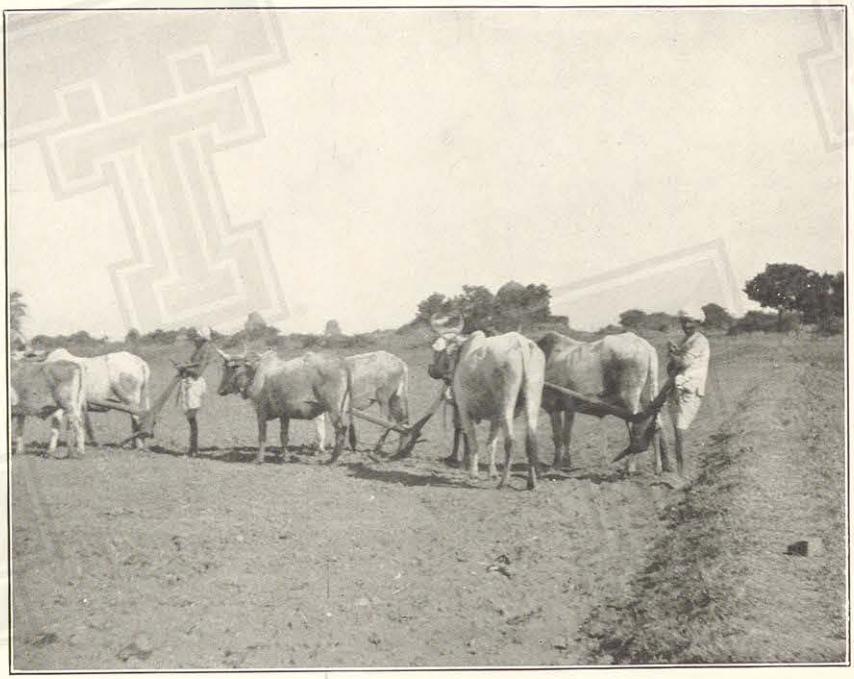

FIG. 1.—PLOWING IN INDIA.

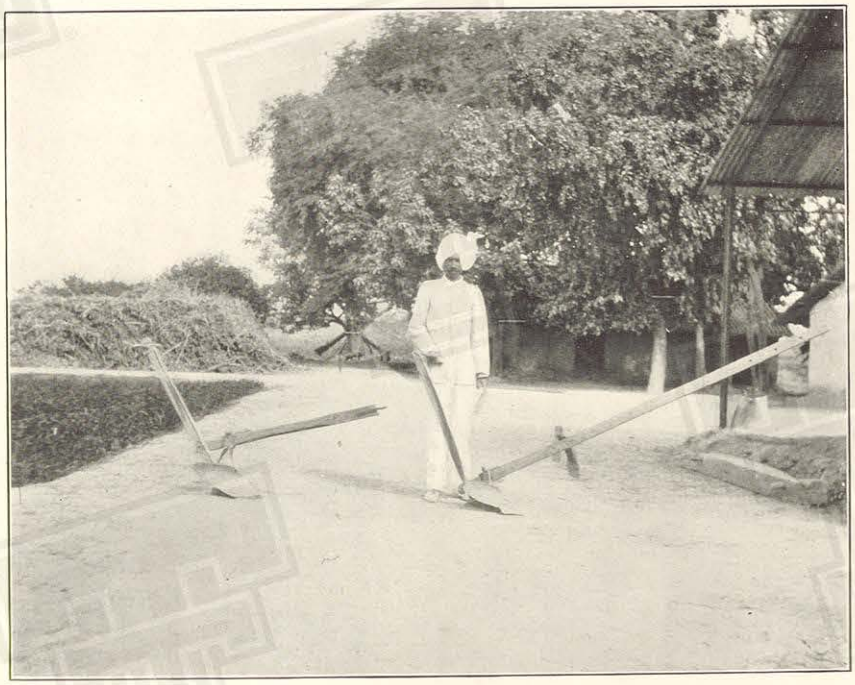

FIG. 2.—ENGLISH PLOW AND INDIAN PLOW.

FIG. 1.—WOODEN SCRAPERS USED IN PREPARING FOR IRRIGATION, INDIA.

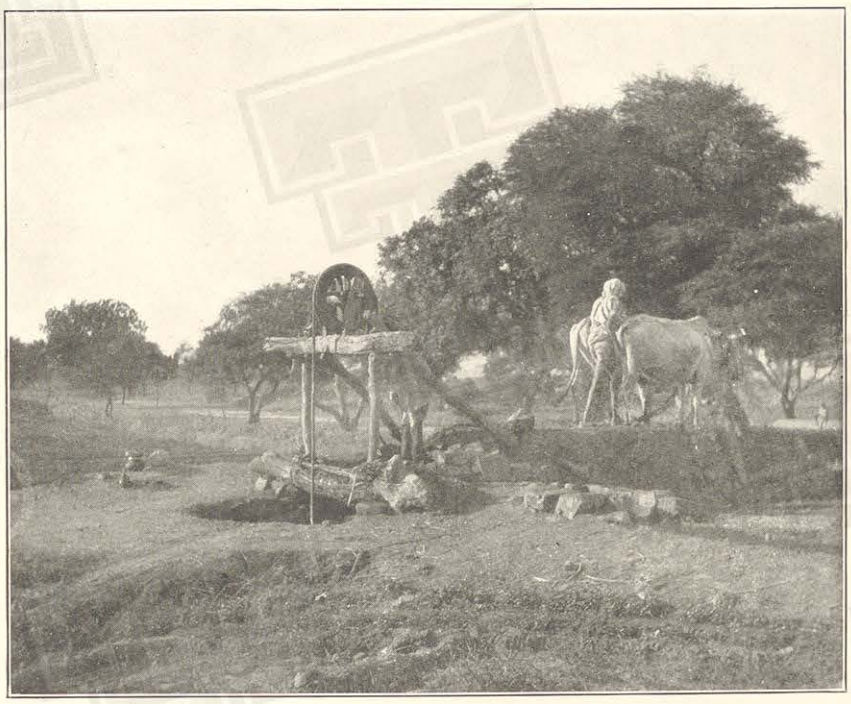

FIG. 2.—WELL USED FOR IRRIGATION, INDIA.

FIG. 1.—WASHING RICE, CHINA.

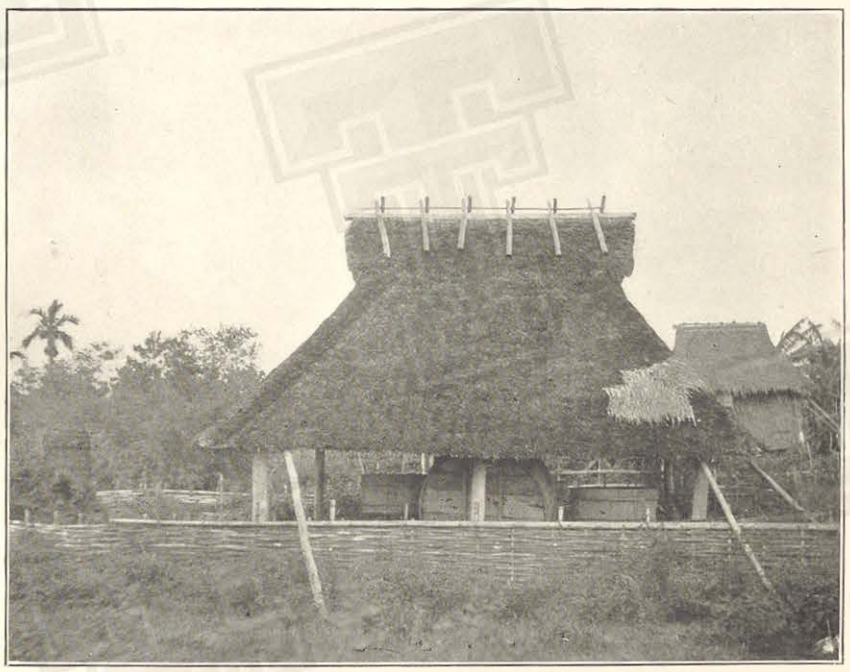

FIG. 2.—SUGAR-BOILING HOUSE, LUZON.

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