X.

IN THE SHANTUNG PROVINCE.

On May 15th we left Shanghai by one of the coastwise steamers for Tsingtao, some three hundred miles farther north, in the Shantung Province, our object being to keep in touch with methods of tillage and fertilization, corresponding phases of which would occur later in the season there.

The Shantung province is in the latitude of North Carolina and Kentucky, or lies between that of San Francisco and Los Angeles. It has an area of nearly 56,000 square miles, about that of Wisconsin. Less than one-half of this area is cultivated land yet it is at the present time supporting a population exceeding 38,000,000 of people. New York state has today less than ten millions and more than half of these are in New York city.

It was in this province that Confucius was born 2461 years ago, and that Mencius, his disciple, lived. Here, too, seventeen hundred years before Confucius' time, after one of the great floods of the Yellow river, 2297 B.C., and more than 4100 years ago, the Great Yu was appointed "Superintendent of Public Works" and entrusted with draining off the flood waters and canalizing the rivers.

Here also was the beginning of the Boxer uprising. Tsingtao sits at the entrance of Kiaochow Bay. Following the war of Japan with China this was seized by Germany, November 14, 1897, nominally to indemnify for the murder of two German missionaries which had occurred in Shantung, and March 6th, 1898, this bay, to the high water
line, its islands and a "Sphere of Influence" extending thirty miles in all directions from the boundary, together with Tsingtao, was leased to Germany for ninety-nine years. Russia demanded and secured a lease of Port Arthur at the same time. Great Britain obtained a similar lease of Weihaiwei in Shantung, while to France Kwang-chow-wan in southern China, was leased. But the "encroachments" of European powers did not stop with these leases and during the latter part of 1898 the "Policy of Spheres of Influence" culminated in the international rivalry for railway concessions and mining. These greatly alarmed China and uprisings broke out very naturally first in Shantung, among the people nearest of kin to the founders of the Empire. As might have been expected of a patriotic, even though naturally peaceful people, they determined to defend their country against such encroachments and the Boxer troubles followed.

Tsingtao has a deep, commodious harbor always free from ice and Germany is constructing here very extensive and substantial harbor improvements which will be of lasting benefit to the province and the Empire. A pier four miles in length encloses the inner wharf, and a second wharf is nearing completion. Germany is also maintaining a meteorological observatory here and has established a large, comprehensive Forest Garden, under excellent management, which is showing remarkable developments for so short a time.

Our steamer entered the harbor during the night and, on going ashore, we soon found that only Chinese and German were generally spoken; but through the kind assistance of Rev. W. H. Scott, of the American Presbyterian Mission, an interpreter promised to call at my hotel in the evening, although he failed to appear. The afternoon was spent at the Forest Garden and on the reforestation tract, which are under the supervision of Mr. Haas. The Forest Garden covers two hundred and seventy acres and the reforestation tract three thousand acres more. In the garden a great variety of forest and fruit trees and small
fruits are being tried out with high promise of the most valuable results.

It was in the steep hills about Tsingtao that we first saw at close range serious soil erosion in China; and the returning of forest growth on hills nearly devoid of soil was here remarkable, in view of the long dry seasons which prevail from November to June, and Fig. 118 shows how destitute of soil the crests of granite hills may become and yet how the coming back of the forest growth may hasten as soon as it is no longer cut away. The rock going into decay, where this view was taken, is an extremely coarse crystalline granite, as may be seen in contrast with the watch, and it is falling into decay at a marvelous rate.

Fig. 118.—Granite hill destitute of soil, rapidly falling into decay. Reforestation area, Tsingtao, Shantung.
Fig. 119.—Almost soil-free granite surface on which young forest growth, largely pine, is developing. Reforestation tract, Tsingtao, Shantung.
Disintegration has penetrated the rock far below the surface and the large crystals are held together with but little more tenacity than prevails in a bed of gravel. Moisture and even roots penetrate it deeply and readily and the crystals fall apart with thrusts of the knife blade, the rock crumbling with the greatest freedom. Roadways have been extensively carved along the sides of the hills with the aid of only pick and shovel. Close examination of the rock shows that layers of sediment exist between the crystal faces, either washed down by percolating rain or formed through decomposition of the crystals in place. The next illustration, Fig. 119, shows how large the growth on such soils may be, and in Fig. 120 the vegetation and forest growth are seen coming back, closely covering just such soil surfaces and rock structure as are indicated in Figs. 118 and 119.

These views are taken on the reforestation tract at Tsingtao but most of the growth is volunteer, standing now protected by the German government in their effort to see what may be possible under careful supervision.
The loads of pine bough fuel represented in Fig. 80 were gathered from such hills and from such forest growth as are here represented, but on lands more distant from the city. But Tsingtao, with its forty thousand Chinese, and Kiaochow across the bay, with its one hundred and twenty thousand more, and other villages dotting the narrow plains, maintain a very great demand for such growth on the hill lands. The wonder is that forest growth has persisted at all and has contributed so much in the way of fuel.

Growing in the Forest Garden was a most beautiful wild yellow rose, native to Shantung, being used for landscape effect in the parking, and it ought to be widely introduced into other countries wherever it will thrive. It was growing as heavy borders and massive clumps six to eight feet high, giving a most wonderful effect, with its brilliant, dense cloud of the richest yellow bloom. The blossoms are single, fully as large as the Rosa rugosa, with the tips of the petals shading into the most dainty light straw yellow.
In the Shantung Province.

while the center is a deep orange, the contrast being sufficient to show in the photograph from which Fig. 121 was prepared. Another beautiful and striking feature of this rose is the clustering of the blossoms in one-sided wreath-like sprays, sometimes twelve to eighteen inches long, the flowers standing close enough to even overlap.

The interpreter engaged for us failed to appear as per agreement so the next morning we took the early train for Tsinan to obtain a general view of the country and to note the places most favorable as points for field study. We had resolved also to make an effort to secure an interpreter through the American Presbyterian College at Tsinan. Leaving Tsingtao, the train skirts around the Kiaochow bay for a distance of nearly fifty miles, where we pass the city of the same name with its population of 120,000, which had an import and export trade in 1905 valued at over $24,000,000. At Sochen we passed through a coal mining district where coal was being brought to the cars in baskets carried by men. The coal on the loaded open cars was sprinkled with whitewash, serving as a seal to safe-guard against stealing during transit, making it so that none could be removed without the fact being revealed by breaking the seal. This practice is general in China and is applied to many commodities handled in bulk. We saw baskets of milled rice carried by coolies sealed with a pattern laid over the surface by sprinkling some colored powder upon it. Cut stone, corded for the market, was whitewashed in the same manner as the coal.

As we were approaching Weihsien, another city of 100,000 people, we identified one of the deeply depressed, centuries-old roadways, worn eight to ten feet deep, by chancing to see half a dozen teams passing along it as the train crossed. We had passed several and were puzzling to account for such peculiar erosion. The teams gave the explanation and thus connected our earlier reading with the concrete. Along these deep-cut roadways caravans may pass, winding through the fields, entirely unobserved unless one chances to be close along the line or the movement is
discovered by clouds of dust, one of the methods that has produced them, and we would not be surprised if gathering manure from them has played a large part also.

Weihsien is near one of the great commercial highways of China and in the center of one of the coal mining regions of the province. Still further along towards Tsinan we passed Tsingchowfu, another of the large cities of the province, with 150,000 population. All day we rode through fields of wheat, always planted in rows, and in hills in the row east of Kaumi, but in single or double continuous drills westward from here to Tsinan. Thousands of wells used for irrigation, of the type seen in Fig. 123, were passed during the day, many of them recently dug to supply water for the barley suffering from the severe drought which was threatening the crop at the time.

It was 6:30 P.M. before our train pulled into the station at Tsinan; 7:30 when we had finished supper and engaged a ricksha to take us to the American Presbyterian College in quest of an interpreter. We could not speak Chinese, the ricksha boy could neither speak nor understand a word of English, but the hotel proprietor had instructed him where to go. We plunged into the narrow streets of a great Chinese city, the boy running wherever he could, walking where he must on account of the density of the crowds or the roughness of the stone paving. We had turned many corners, crossed bridges and passed through tunneled archways in sections of the massive city walls, until it was getting dusk and the ricksha man purchased and lighted a lantern. We were to reach the college in thirty minutes but had been out a full hour. A little later the boy drew up to and held conference with a policeman. The curious of the street gathered about and it dawned upon us that we were lost in the night in the narrow streets of a Chinese city of a hundred thousand people. To go further would be useless for the gates of the mission compound would be locked. We could only indicate by motions our desire to return but these were not understood. On the train a thoughtful, kindly old
German had recognized a stranger in a foreign land and volunteered useful information, cutting from his daily paper an advertisement describing a good hotel. This gave the name of the hotel in German, English and in Chinese characters. We handed this to the policeman, pointing to the name of the hotel, indicating by motions the desire to return, but apparently he was unable to read in either language and seemed to think we were assuming to direct the way to the college. A man and boy in the crowd apparently volunteered to act as escort for us. The throng parted and we left them, turned more corners into more unlighted narrow alleyways, one of which was too difficult to permit us to ride. The escorts, if such they were, finally left us, but the dark alley led on until it terminated at the blank face, probably of some other portion of the massive city wall we had thrice threaded through lighted tunnels. Here the ricksha boy stopped and turned about but the light from his lantern was too feeble to permit reading the workings of his mind through his face, and our tongues were both utterly useless in this emergency, so we motioned for him to turn back and by some route we reached the hotel at 11 P. M.

We abandoned the effort to visit the college, for the purpose of securing an interpreter, and took the early train back to Tsingtao, reaching there in time to secure the very satisfactory service of Mr. Chu Wei Yung, through the further kind offices of Mr. Scott. We had been twice over the road between the two cities, obtaining a general idea of the country and of the crops and field operations at this season. The next morning we took an early train to Tsangkau and were ready to walk through the fields and to talk with the last generations of more than forty unbroken centuries of farmers who, with brain and brawn, have successfully and continuously sustained large families on small areas without impoverishing their soil. The next illustration is from a photograph taken in one of these fields. We astonished the old farmer by asking the privilege of holding his plow through one round in his little
field, but he granted the privilege readily. Our furrow was not as well turned as his, nor as well as we could have done with a two-handled Oliver or John Deere, but it was better than the old man had expected and won his respect.

This plow had a good steel point, as a separate, blunt, V-shaped piece, and a moldboard of cast steel with a good twist which turned the soil well. The standard and sole were of wood and at the end of the beam was a block for gauging the depth of furrow. The cost of this plow, to

![Fig. 122.—A Shantung plow, simple but effective.](image)

the farmer, was $2.15, gold, and when the day’s work is done it is taken home on the shoulders, even though the distance may be a mile or more, and carefully housed. Chinese history states that the plow was invented by Shennung, who lived 2737–2697 B. C. and “taught the art of agriculture and the medical use of herbs”. He is honored as the “God of Agriculture and Medicine.”

Through my interpreter we learned that there were twelve in this man’s family, which he maintained on fifteen mow of land, or 2.5 acres, together with his team, consisting of a cow and small donkey, besides feeding two pigs.
This is at the rate of 192 people, 16 cows, 16 donkeys and 32 pigs on a forty-acre farm; and of a population density equivalent to 3072 people, 256 cows, 256 donkeys and 512 swine per square mile of cultivated field.

On another small holding we talked with the farmer standing at the well in Fig. 27, where he was irrigating a little piece of barley 30 feet wide and 138 feet long. He owned and was cultivating but one and two-thirds acres of land and yet there were ten in his family and he kept one donkey and usually one pig. Here is a maintenance capacity at the rate of 240 people, 24 donkeys and 24 pigs on a forty-acre farm; and a population density of 3840 people, 384 donkeys and 384 pigs per square mile. His usual annual sales in good seasons were equivalent in value to $73, gold.

In both of these cases the crops grown were wheat, barley, large and small millet, sweet potatoes and soy beans or peanuts. Much straw braid is manufactured in the province by the women and children in their homes, and the cargo of the steamer on which we returned to Shanghai consisted almost entirely of shelled peanuts in gunny sacks and huge bales of straw braid destined for the manufacture of hats in Europe and America.

Shantung has only moderate rainfall, little more than 24 inches annually, and this fact has played an important part in determining the agricultural practices of these very old people. In Fig. 123 is a closer view than Fig. 27 of the farmer watering his little field of barley. The well had just been dug over eight feet deep, expressly and solely to water this one piece of grain once, after which it would be filled and the ground planted.

The season had been unusually dry, as had been the one before, and the people were fearing famine. Only 2.44 inches of rain had fallen at Tsingtao between the end of the preceding October and our visit, May 21st, and hundreds of such temporary wells had been or were being dug all along both sides of the two hundred and fifty miles of railway, and nearly all to be filled when the crop on
Fig. 123.—Temporary well and portable irrigation outfit, Shantung, China.
In the Shantung Province.

the ground was irrigated, to release the land for one to follow. The homes are in villages a mile or more apart and often the holdings or rentals are scattered, separated by considerable distances, hence easy portability is the key-note in the construction of this irrigating outfit. The bucket is very light, simply a woven basket waterproofed with a paste of bean flour. The windlass turns like a long spool on a single pin and the standard is a tripod with removable legs. Some wells we saw were sixteen or twenty feet deep and in these the water was raised by a cow walking straight away at the end of a rope.

The amount and distribution of rainfall in this province, as indicated by the mean of ten years' records at Tsingtao, obtained at the German Meteorological Observatory through the courtesy of Dr. B. Meyermanns, are given in the table in which the rainfall of Madison, Wisconsin, is inserted for comparison.

<table>
<thead>
<tr>
<th></th>
<th>Mean monthly rainfall</th>
<th>Mean rainfall in 10 days.</th>
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<tbody>
<tr>
<td></td>
<td>Tsingtao, Inches.</td>
<td>Madison, Inches.</td>
</tr>
<tr>
<td>January</td>
<td>.394</td>
<td>.131</td>
</tr>
<tr>
<td>February</td>
<td>.240</td>
<td>.090</td>
</tr>
<tr>
<td>March</td>
<td>.882</td>
<td>.297</td>
</tr>
<tr>
<td>April</td>
<td>1.240</td>
<td>.413</td>
</tr>
<tr>
<td>May</td>
<td>1.636</td>
<td>.545</td>
</tr>
<tr>
<td>June</td>
<td>2.702</td>
<td>.901</td>
</tr>
<tr>
<td>July</td>
<td>6.637</td>
<td>2.212</td>
</tr>
<tr>
<td>August</td>
<td>5.157</td>
<td>1.719</td>
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<tr>
<td>September</td>
<td>2.448</td>
<td>.816</td>
</tr>
<tr>
<td>October</td>
<td>2.258</td>
<td>.733</td>
</tr>
<tr>
<td>November</td>
<td>.896</td>
<td>.382</td>
</tr>
<tr>
<td>December</td>
<td>.682</td>
<td>.227</td>
</tr>
<tr>
<td>Total</td>
<td>24.682</td>
<td>31.65</td>
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</tbody>
</table>

While Shantung receives less than 25 inches of rain during the year, against Wisconsin's more than 31 inches, the rainfall during June, July and August in Shantung is nearly 14.5 inches, while Wisconsin receives but 11.2 inches. This greater summer rainfall, with persistent fertilization and intense management, in a warm latitude, are some of the elements permitting Shantung today to feed 38,247,900 people from an area equal to that upon which Wisconsin is yet feeding but 2,333,860. Must American agriculture ultimately feed sixteen people where it is now
feeding but one? If so, correspondingly more intense and effective practices must follow, and we can neither know too well nor too early what these Old World people have been driven to do; how they have succeeded, and how we and they may improve upon their practices and lighten the human burdens by more fully utilizing physical forces and mechanical appliances.

As we passed on to other fields we found a mother and daughter transplanting sweet potatoes on carefully fitted ridges of nearly air-dry soil in a little field, the remnant of a table on a deeply eroded hillside, Fig. 124. The husband was bringing water for moistening the soil from a deep ravine a quarter of a mile distant, carrying it on his shoulder in two buckets, Fig. 125, across an intervening gulch. He had excavated four holes at intervals up the gulch and from these, with a broken gourd dipper mended with stitches, he filled his pails, bailing in succession from one to the other in regular rotation.

The daughter was transplanting. Holding the slip with its tip between thumb and fingers, a strong forward stroke plowed a furrow in the mellow, dry soil; then, with a
backward movement and a downward thrust, planted the slip, firmed the soil about it, leaving a depression in which the mother poured about a pint of water from another gourd dipper. After this water had soaked away, dry earth was drawn about the slip and firmed and looser earth drawn over this, the only tools being the naked hands and dipper.

The father and mother were dressed in coarse garb but the daughter was neatly clad, with delicate hands decorated with rings and a bracelet. Neither of the women had bound feet. There were ten in his family; and on adjacent similar areas they had small patches of wheat nearly ready for the harvest, all planted in hills, hoed, and in astonishingly vigorous condition considering the extreme drought which prevailed. The potatoes were being planted under these extreme conditions in anticipation of the rainy season which then was fully due. The summer before had been one of unusual drought, and famine was threatened. The government had recently issued an edict that no sheep should be sold from the province, fearing they might be needed for food. An old woman in one of the villages came out,
as we walked through, and inquired of my interpreter if we had come to make it rain. Such was the stress under which we found these people.

One of the large farmers, owning ten acres, stated that his usual yield of wheat in good season was 160 catty per
mow, equivalent to 21.3 bushels per acre. He was expecting the current season not more than one-half this amount. As a fertilizer he used a prepared earth compost which we shall describe later, mixing it with the grain and sowing in the hills with the seed, applying about 5333 pounds per acre, which he valued, in our currency, at $8.60, or $3.22 per ton. A pile of such prepared compost is seen in Fig. 126, ready to be transferred to the field. The views show with what cleanliness the yard is kept and with what care all animal waste is saved. The cow and donkey are the work team, such as was being used by the plowman referred to in Fig. 122. The mounds in the background of the lower view are graves; the fence behind the animals is made from the stems of the large millet, kaoliang, while that at the right of the donkey is made of earth, both indicative of the scarcity of lumber. The buildings, too, are thatched and their walls are of earth plastered with an earthen mortar worked up with chaff.

In another field a man plowing and fertilizing for sweet potatoes had brought to the field and laid down in piles the finely pulverized dry compost. The father was plowing; his son of sixteen years was following and scattering, from a basket, the pulverized dry compost in the bottom of the furrow. The next furrow covered the fertilizer, four turned together forming a ridge upon which the potatoes were to be planted after a second and older son had smoothed and fitted the crest with a heavy hand rake. The fertilizer was thus applied directly beneath the row, at the rate of 7400 pounds per acre, valued at $7.15, our currency, or $1.93 per ton.

We were astonished at the moist condition of the soil turned, which was such as to pack in the hand notwithstanding the extreme drought prevailing and the fact that standing water in the ground was more than eight feet below the surface. The field had been without crop and cultivated.

To the question, "What yield of sweet potatoes do you expect from this piece of land?" he replied, "About 4000
Density of Population.

The usual market price was stated to be $1.00, Mexican, per one hundred catty, making the gross value of the crop $79.49, gold, per acre. His land was valued at $60, Mexican, per mow, or $154.80 per acre, gold.

My interpreter informed me that the average well-to-do farmers in this part of Shantung own from fifteen to twenty mow of land and this amount is quite ample to provide for eight people. Such farmers usually keep two cows, two donkeys and eight or ten pigs. The less well-to-do or small farmers own two to five mow and act as superintendents for the larger farmers. Taking the largest holding, of twenty mow per family of eight people, as a basis, the density per square mile would be 1536 people, and an area of farm land equal to the state of Wisconsin would have 86,000,000 people; 21,500,000 cows; 21,500,000 donkeys and 86,000,000 swine. These observations apply to one of the most productive sections of the province, but very large areas of land in the province are not cultivable and the last census showed the total population nearly one-half of this amount. It is clear, therefore, that either very effective agricultural methods are practiced or else extreme economy is exercised. Both are true.

On this day in the fields our interpreter procured his dinner at a farm house, bringing us four boiled eggs, for which he paid at the rate of 8.3 cents of our money, but his dinner was probably included in the price. The next table gives the prices for some articles obtained by inquiry at the Tsingtao market, May 23rd, 1909, reduced to our currency.

<table>
<thead>
<tr>
<th>Item</th>
<th>Price (Cents)</th>
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</thead>
<tbody>
<tr>
<td>Old potatoes, per lb</td>
<td>2.15</td>
</tr>
<tr>
<td>New potatoes, per lb</td>
<td>2.87</td>
</tr>
<tr>
<td>Salted turnip, per lb</td>
<td>.86</td>
</tr>
<tr>
<td>Onions, per lb</td>
<td>4.10</td>
</tr>
<tr>
<td>Radishes, bunch of 10</td>
<td>1.29</td>
</tr>
<tr>
<td>String beans, per lb</td>
<td>11.46</td>
</tr>
<tr>
<td>Cucumbers, per lb</td>
<td>5.73</td>
</tr>
<tr>
<td>Pears, per lb</td>
<td>.57</td>
</tr>
<tr>
<td>Apricots, per lb</td>
<td>8.20</td>
</tr>
<tr>
<td>Pork, fresh, per lb</td>
<td>10.33</td>
</tr>
<tr>
<td>Fish, per lb</td>
<td>5.73</td>
</tr>
<tr>
<td>Eggs, per dozen</td>
<td>5.16</td>
</tr>
</tbody>
</table>
The only items which are low compared with our own prices are salted turnips, radishes and eggs. Most of the articles listed were out of season for the locality and were imported for the foreigners, turnips, radishes, pork, fish and eggs being the exceptions. Prof. Ross informs us that he found eggs selling in Shensi at four for one cent of our money.

Our interpreter asked a compensation of one dollar, Mexican, or 43 cents, U. S. currency, per day, he furnishing his own meals. The usual wage for farm labor here was $8.60, per year, with board and lodging. We have referred to the wages paid by missionaries for domestic service. As servants the Chinese are considered efficient, faithful and trustworthy. It was the custom of Mr. and Mrs. League to intrust them with the purse for marketing, feeling that they could be depended upon for the closest bargaining. Commonly, when instructed to procure a certain article, if they found the price one or two cash higher than usual they would select a cheaper substitute. If questioned as to why instructions were not followed the reply would be "Too high, no can afford."

Mrs. League recited her experience with her cook regarding his use of our kitchen appliances. After fitting the kitchen with a modern range and cooking utensils, and working with him to familiarize him with their use, she was surprised, on going into the kitchen a few days later, to find that the old Chinese stove had been set on the range and the cooking being done with the usual Chinese furniture. When asked why he was not using the stove his reply was "Take too much fire." Nothing jars on the nerves of these people more than incurring of needless expense, extravagance in any form, or poor judgment in making purchases.

Daily we became more and more impressed by the evidence of the intense and incessant stress imposed by the dense populations of centuries, and how, under it, the laws of heredity have wrought upon the people, affecting constitution, habits and character. Even the cattle and sheep
have not escaped its irresistible power. Many times in this province we saw men herding flocks of twenty to thirty sheep along the narrow unfenced pathways winding through the fields, and on the grave lands. The prevailing drought had left very little green to be had from these places and yet sheep were literally brushing their sides against fresh green wheat and barley, never molesting them. Time and again the flocks were stampeded into the grain by an approaching train, but immediately they returned to their places without taking a nibble. The voice of the shepherd and an occasional well aimed lump of earth only being required to bring them back to their uninviting pastures.

In Kiangsu and Chekiang provinces a line of half a dozen white goats were often seen feeding single file along the pathways, held by a cord like a string of beads, sometimes led by a child. Here, too, one of the most common sights was the water buffalo grazing unattended among the fields along the paths and canal banks, with crops all about. One of the most memorable shocks came to us in Chekiang, China, when we had fallen into a revery while gazing at the shifting landscape from the doorway of our low-down Chinese houseboat. Something in the sky and the vegetation along the canal bank had recalled the scenes of boyhood days and it seemed, as we looked aslant up the bank with its fringe of grass, that we were gliding along White-water creek through familiar meadows and that standing up would bring the old home in sight. That instant there glided into view, framed in the doorway and projected high against the tinted sky above the setting sun, a giant water buffalo standing motionless as a statue on the summit of a huge grave mound, lifted fully ten feet above the field. But in a flash this was replaced by a companion scene, and with all its beautiful setting, which had been as suddenly fixed on the memory fourteen years before in the far away Trossachs when our coach, hurriedly rounding a sharp turn in the hills, suddenly exposed a wild ox of Scotland similarly thrust against the sky from a small but isolated
rocky summit, and then, outspeeding the wireless, recollection crossed two oceans and an intervening continent, bringing us back to China before a speed of five miles per hour could move the first picture across the narrow doorway.

It was through the fields about Tsangkow that the stalwart freighters referred to, Fig. 32, passed us on one of the paths leading from Kiaochow through unnumbered country villages, already eleven miles on their way with their wheelbarrows loaded with matches made in Japan. Many of the wheelbarrow men seen in Shanghai and other cities are from Shantung families, away for employment, expecting to return. During the harvest season, too, many of these people go west and north into Manchuria seeking employment, returning to their homes in winter.

Alexander Hosie, in his book on Manchuria, states that from Chefoo alone more than 20,000 Chinese laborers cross to Newchwang every spring by steamer, others finding their way there by junks or other means, so that after the harvest season 8,000 more return by steamer to Chefoo than left that way in the spring, from which he concludes that Shantung annually supplies Manchuria with agricultural labor to the extent of 30,000 men.

About the average condition of wheat in Shantung during this dry season, and nearing maturity, is seen in Fig. 127, standing rather more than three feet high, as indicated by our umbrella between the rows. Beyond the wheat and to the right, grave mounds serrate the sky line, no hills being in sight, for we were in the broad plain built up from the sea between the two mountain islands forming the highlands of Shantung.

On May 22nd we were in the fields north of Kiaochow, some sixty miles by rail west from Tsingtao, but within the neutral zone extending thirty miles back from the high water line of the bay of the same name. Here the Germans had built a broad macadam road after the best European type but over it were passing the vehicles of forty centuries seen in Figs. 128 and 129. It is doubtful if the
resistance to travel experienced by these men on the better road was enough less than that on the old paths they had left to convince them that the cost of construction and maintenance would be worth while until vehicles and the price of labor change. It may appear strange that with a nation of so many millions and with so long a history, roads have persisted as little more than beaten foot-paths; but modern methods of transportation have remained physical impossibilities to every people until the science of the last century opened the way. Throughout their history the burdens of these people have been carried largely on foot, mostly on the feet of men, and of single men wherever the load could be advantageously divided. Animals have been supplemental burden bearers but, as with the men, they have carried the load directly on their own feet, the mode least disturbed by inequalities of road surface.

For adaptability to the worst road conditions no vehicle equals the wheelbarrow, progressing by one wheel and two feet. No vehicle is used more in China, if the carrying
Figs. 128 and 129.—The vehicles of forty centuries on a modern road of German construction, Kiaochow, Shantung, China.
pole is excepted, and no wheelbarrow in the world permits
so high an efficiency of human power as the Chinese, as
must be clear from Figs. 32 and 61, where nearly the
whole load is balanced on the axle of a high, massive wheel
with broad tire. A shoulder band from the handles of
the barrow relieves the strain on the hands and, when the
load or the road is heavy, men or animals may aid in
drawing, or even, when the wind is favorable, it is not
unusual to hoist a sail to gain propelling power. It is
only in northern China, and then in the more level por-
tions, where there are few or no canals, that carts have
been extensively used, but are more difficult to manage on
bad roads. Most of the heavy carts, especially those in
Manchuria, seen in Fig. 203, have the wheels framed
rigidly to the axle which revolves with them, the bearing
being in the bed of the cart. But new carts of modern
type are being introduced.

In the extent of development and utilization of inland
waterways no people have approached the Chinese. In the
matter of land transportation they have clearly followed
the line of least resistance for individual initiative, so
characteristic of industrial China.

There are Government courier or postal roads which
connect Peking with the most distant parts of the Empire,
some twenty-one being usually enumerated. These, as far
as practicable, take the shortest course, are often cut into
the mountain sides and even pass through tunnels. In the
plains regions these roads may be sixty to seventy-five feet
wide, paved and occasionally bordered by rows of trees.
In some cases, too, signal towers are erected at intervals of
three miles and there are inns along the way, relay posts
and stations for soldiers.

We have spoken of planting grain in rows and in hills
in the row. In Fig. 130 is a field with the rows planted in
pairs, the members being 16 inches apart, and together oc-
cupying 30 inches. The space between each pair is also 30
inches, making five feet in all. This makes frequent hoeing
practicable, which is begun early in the spring and is
repeated after every rain. It also makes it possible to feed the plants when they can utilize food to the best advantage and to repeat the feeding if desirable. Besides, the ground in the wider space may be fitted, fertilized and another crop planted before the first is removed. The hills alternate in the rows and are 24 to 26 inches from center to center.

The planting may be done by hand or with a drill such as that in Fig. 131, ingenious in the simple mechanism which permits planting in hills. The husbandman had just returned from the field with the drill on his shoulder when we met at the door of his village home, where he explained to us the construction and operation of the drill and permitted the photograph to be taken, but turning his face aside, not wishing to represent a specific character, in the view. In the drill there was a heavy leaden weight swinging free from a point above the space between the openings leading to the respective drill feet. When planting, the operator rocks the drill from side to side, causing

Fig. 130.—Wheat planted in hills and in rows, the pairs of rows being 30 inches apart and the rows 16 inches, covering 5 feet.
the weight to hang first over one and then over the other opening, thus securing alternation of hills in each pair of rows.

Counting the heads of wheat in the hill in a number of fields showed them ranging between 20 and 100, the distance between the rows and between the hills as stated above. There were always a larger number of stalks per hill where the water capacity of the soil was large, where the ground water was near the surface, and where the soil was evidently of good quality. This may have been partly the result of stooling but we have little doubt that judgment was exercised in planting, sowing less seed on the lighter soils where less moisture was available. In the piece just referred to, in the illustration, an average hill contained 46 stalks and the number of kernels in a head varied between 20 and 30. Taking Richardson’s estimate of 12,000 kernels of wheat to the pound, this field would yield about twelve bushels of wheat per acre this unusually dry season. Our interpreter, whose parents lived near Kaomi, four stations further west, stated that in 1901,
one of their best seasons, farmers there secured yields as high as 875 catty per legal mow, which is at the rate of 116 bushels per acre. Such a yield on small areas highly fertilized and carefully tilled, when the rainfall is ample or where irrigation is practiced, is quite possible and in the Kiangsu province we observed individual small fields which would certainly approach close to this figure.

Further along in our journey of the day we came upon a field where three, one of them a boy of fourteen years, were hoeing and thinning millet and maize. In China, during the hot weather, the only garment worn by the men in the field, was their trousers, and the boy had found these unnecessary, although he slipped into them while we were talking with his father. The usual yield of maize was set at 420 to 480 catty per mow, and that of millet at 600 catty, or 60 to 68.5 bushels of maize and 96 bushels of millet, of fifty pounds, per acre, and the usual price would make the gross earnings $23.48 to $26.83 per acre for the maize, and $30.96, gold, for the millet.

It was evident when walking through these fields that the fall-sowed grain was standing the drought far better than the barley planted in the spring, quite likely because of the deeper and stronger development of root system made possible by the longer period of growth, and partly because the wheat had made much of its growth utilizing water that had fallen before the barley was planted and which would have been lost from the soil through percolation and surface evaporation. Farmers here are very particular to hoe their grain, beginning in the early spring, and always after rains, thoroughly appreciating the efficiency of earth mulches. Their hoe, seen in Fig. 132, is peculiarly well adapted to its purpose, the broad blade being so hung that it draws nearly parallel with the surface, cutting shallow and permitting the soil to drop practically upon the place from which it was loosened. These hoes are made in three parts; a wooden handle, a long, strong and heavy iron socket shank, and a blade of steel. The blade is detachable and different forms and sizes of blades may be
used on the same shank. The mulch-producing blades may have a cutting edge thirteen inches long and a width of nine inches.

At short intervals on either hand, along the two hundred and fifty miles of railway between Tsingtao and Tsinan, were observed many piles of earth compost distributed in the fields. One of these piles is seen in Fig. 133. They were sometimes on unplanted fields, in other cases they occurred among the growing crops soon to be harvested, or where another crop was to be planted between the rows of one already on the ground. Some of these piles were six feet high. All were built in cubical form with flat top and carefully plastered with a layer of earth

Fig. 132.—Method of using the broad, heavy hoe in producing surface mulch, as seen in Shantung, China.
mortar which sometimes cracked on drying, as seen in the illustration. The purpose of this careful shaping and plastering we did not learn although our interpreter stated it was to prevent the compost from being appropriated for use on adjacent fields. Such a finish would have the effect of a seal, showing if the pile had been disturbed, but we suspect other advantages are sought by the treatment, which involves so large an amount of labor.

The amount of this earth compost prepared and used annually in Shantung is large, as indicated by the cases cited, where more than five thousand pounds, in one instance, and seven thousand pounds in another, were applied per acre for one crop. When two or more crops are grown the same year on the same ground, each is fertilized, hence from three to six or more tons may be applied to each cultivated acre. The methods of preparing compost and of fertilizing in Kiangsu, Chekiang and Kwangtung provinces have been described. In this part of Shantung, in Chihli and north in Manchuria as far as Mukden, the methods are materially different and if possible even more laborious, but clearly rational and

Fig. 133.—Carefully plastered earth compost stacked in the field awaiting distribution, Shantung, China.
effective. Here nearly if not all fertilizer compost is prepared in the villages and carried to the fields, however distant these may be.

Rev. T. J. League very kindly accompanied us to Chengyang on the railway, from which we walked some two miles back to a prosperous rural village to see their methods of preparing this compost fertilizer. It was toward the close of the afternoon before we reached the village, and from all directions husbandmen were returning from the fields, some with hoes, some with plows, some with drills over their shoulders and others leading donkeys or cattle, and similar customs obtain in Japan, as seen in Fig. 134. These were mostly the younger men. When we reached the village streets the older men, all bareheaded, as were those returning from the fields, and usually with their queues tied about the crown, were visiting, enjoying their pipes of tobacco.

Opium is no longer used openly in China, unless it be permitted to some well along in years with the habit confirmed, and the growing of the poppy is prohibited. The penalties for violating the law are heavy and enforcement is said to be rigid and effective. For the first violation a fine is imposed. If convicted of a second violation the fine is heavier with imprisonment added to help the victim acquire self control, and a third conviction may bring the death penalty. The eradication of the opium scourge must prove a great blessing to China. But with the passing of this most formidable evil, for whose infliction upon China England was largely responsible, it is a great misfortune that through the pitiless efforts of the British-American Tobacco Company her people are rapidly becoming addicted to the western tobacco habit, selfish beyond excuse, filthy beyond measure, and unsanitary in its polluting and oxygen-destroying effect upon the air all are compelled to breathe. It has already become a greater and more inexcusable burden upon mankind than opium ever was.

China, with her already overtaxed fields, can ill afford
to give over an acre to the cultivation of this crop and she should prohibit the growing of tobacco as she has that of the poppy. Let her take the wise step now when she readily may, for all civilized nations will ultimately be compelled to adopt such a measure. The United States in 1902 had more than a million acres growing tobacco, and harvested 821,000,000 pounds of leaf. This leaf depleted those soils to the extent of more than twenty-eight million pounds of nitrogen, twenty-nine million pounds of potassium and nearly two and a half million pounds of phosphorus, all so irrecoverably lost that even China, with her remarkable skill in saving and her infinite patience with little things, could not recover them for her soils. On a like area of field might as readily be grown twenty million bushels of wheat and if the twelve hundred million pounds of grain were all exported it would deplete the soil less than the tobacco crop in everything but phosphorus, and in this about the same. Used at
home, China would return it all to one or another field.

The home consumption of tobacco in the United States averaged seven pounds per capita in 1902. A like consumption for China's four hundred millions would call for 2800 million pounds of leaf. If she grew it on her fields two million acres would not suffice. Her soils would be proportionately depleted and she would be short forty million bushels of wheat; but if China continues to import her tobacco the vast sum expended can neither fertilize her fields nor feed, clothe or educate her people, yet a like sum expended in the importation of wheat would feed her hungry and enrich her soils.

In the matter of conservation of national resources here is one of the greatest opportunities open to all civilized nations. What might not be done in the United States with a fund of $57,000,000 annually, the market price of the raw tobacco leaf, and the land, the labor and the capital expended in getting the product to the men who puff, breathe and perspire the noxious product into the air everyone must breathe, and who bespatter the streets, sidewalks, the floor of every public place and conveyance, and befoul the million spittoons, smoking rooms and smoking cars, all unnecessary and should be uncalled for, but whose installation and up-keep the non-user as well as the user is forced to pay, and this in a country of, for and by the people. This costly, filthy, selfish tobacco habit should be outgrown. Let it begin in every new home, where the mother helps the father in refusing to set the example, and let its indulgence be absolutely prohibited to everyone while in public school and to all in educational institutions.

Mr. League had been given a letter of introduction to one of the leading farmers of the village and it chanced that as we reached the entranceway to his home we were met by his son, just returning from the fields with his drill on his shoulder, and it is he standing in the illustration, Fig. 131, holding the letter of introduction in his hand. After we had taken this photograph and another
one looking down the narrow street from the same point, we were led to the small open court of the home, perhaps forty by eighty feet, upon which all doors of the one-storied structures opened. It was dry and bare of everything green, but a row of very tall handsome trees, close relatives of our cottonwood, with trunks thirty feet to the limbs, looked down into the court over the roofs of the low thatched houses. Here we met the father and grandfather of the man with the drill, so that, with the boy carrying the baby in his arms, who had met his father in the street gateway, there were four generations of males at our conference. There were women and girls in the household but custom requires them to remain in retirement on such occasions.

A low narrow four-legged bench, not unlike our carpenter's saw-horse, five feet long, was brought into the court as a seat, which our host and we occupied in common. We had been similarly received at the home of Mrs. Wu in Chekiang province. On our right was the open doorway to the kitchen in which stood, erect and straight, the tall spare figure of the patriarch of the household, his eyes still shining black but with hair and long thin straggling beard a uniform dull ashen gray. No Chinese hair, it seems, ever becomes white with age. He seemed to have assumed the duties of cook for while we were there he lighted the fire in the kitchen and was busy, but was always the final oracle on any matter of difference of opinion between the younger men regarding answers to questions. Two sleeping apartments adjoining the kitchen, through whose wide kang beds the waste heat from the cooking was conveyed, as described on page 142, completed this side of the court. On our left was the main street completely shut off by a solid earth wall as high as the eaves of the house, while in front of us, adjoining the street, was the manure midden, a compost pit six feet deep and some eight feet square. A low opening in the street wall permitted the pit to be emptied and to receive earth and stubble or refuse from the fields for composting.
Fig. 135.—Farm village street with stacks of earth and piles of compost for use as fertilizer, Shantung, China.
Against the pit and without partition, but cut off from the court, was the home of the pigs, both under a common roof continuous with a closed structure joining with the sleeping apartments, while behind us and along the alleyway by which we had entered were other dwelling and storage compartments. Thus was the large family of four generations provided with a peculiarly private open court where they could work and come out for sun and air, both, from our standards, too meagerly provided in the houses.

We had come to learn more of the methods of fertilizing practiced by these people. The manure midden was before us and the piles of earth brought in from the fields, for use in the process, were stacked in the street, where we had photographed them at the entrance, as seen in Fig. 135. There a father, with his pipe, and two boys stand at the extreme left; beyond them is a large pile of earth brought into the village and carefully stacked in the narrow street; on the other side of the street, at the corner of the first building, is a pile of partly fermented compost thrown from a pit behind the walls. Further along in the street, on the same side, is a second large stack of soil where two boys are standing at either end and another little boy was in a near-by doorway. In front of the tree, on the left side of the street, stands a third boy, near him a small donkey and still another boy. Beyond this boy stands a third large stack of soil, while still beyond and across the way is another pile partly composted. Notwithstanding the cattle in the preceding illustration, the donkey, the men, the boys, the three long high stacks of soil and the two piles of compost, the ten rods of narrow street possessed a width of available travelway and a cleanliness which would appear impossible. Each farmer’s household had its stack of soil in the street, and in walking through the village we passed dozens of men turning and mixing the soil and compost, preparing it for the field.

The compost pit in front of where we sat was two-thirds
Composts.

filled. In it had been placed all of the manure and waste of the household and street, all stubble and waste roughage from the field, all ashes not to be applied directly and some of the soil stacked in the street. Sufficient water was added at intervals to keep the contents completely saturated and nearly submerged, the object being to control the character of fermentation taking place.

The capacity of these compost pits is determined by the amount of land served, and the period of composting is made as long as possible, the aim being to have the fiber of all organic material completely broken down, the result being a product of the consistency of mortar.

When it is near the time for applying the compost to the field, or of feeding it to the crop, the fermented product is removed in waterproof carrying baskets to the floor of the court, to the yard, such as seen in Fig. 126, or to the street, where it is spread to dry, to be mixed with fresh soil, more ashes, and repeatedly turned and stirred to bring about complete aeration and to hasten the processes of nitrification. During all of these treatments, whether in the compost pit or on the nitrification floor, the fermenting organic matter in contact with the soil is converting plant food elements into soluble plant food substances in the form of potassium, calcium and magnesium nitrates and soluble phosphates of one or another form, perhaps of the same bases and possibly others of organic type. If there is time and favorable temperature and moisture conditions for these fermentations to take place in the soil of the field before the crop will need it, the compost may be carried direct from the pit to the field and spread broadcast, to be plowed under. Otherwise the material is worked and reworked, with more water added if necessary, until it becomes a rich complete fertilizer; allowed to become dry and then finely pulverized, sometimes using stone rollers drawn over it by cattle, the donkey or by hand. The large numbers of stacks of compost seen in the fields between Tsingtao and Tsinan were of this type and thus laboriously prepared in the villages.
and then transported to the fields, stacked and plastered, to be ready for use at next planting.

In the early days of European history, before modern chemistry had provided the cheaper and more expeditious method of producing potassium nitrate for the manufacture of gunpowder and fireworks, much land and effort were devoted to niter-farming which was no other than a specific application of this most ancient Chinese practice and probably imported from China. While it was not until 1877 to 1879 that men of science came to know that the processes of nitrification, so indispensable to agriculture, are due to germ life, in simple justice to the plain farmers of the world, to those who through all the ages from Adam down, living close to Nature and working through her and with her, have fed the world, it should be recognized that there have been those among them who have grasped such essential, vital truths and have kept them alive in the practices of their day. And so we find it recorded in history as far back as 1686 that Judge Samuel Lewell copied upon the cover of his journal a practical man's recipe for making saltpeter beds, in which it was directed, among other things, that there should be added to it "mother of petre", meaning, in Judge Lewell's understanding, simply soil from an old niter bed, but in the mind of the man who applied the maternity prefix,—mother,—it must have meant a vital germ contained in the soil, carried with it, capable of reproducing its kind and of perpetuating its characteristic work, belonging to the same category with the old, familiar, homely germ, "mother" of vinegar. So, too, with the old cheesemaker who grasped the conception which led to the long time practice of washing the walls of a new cheese factory with water from an old factory of the same type, he must have been led by analogies of experience with things seen to realize that he was here dealing with a vital factor. Hundreds, of course, have practiced empirically, but some one preceded with the essential thought and we feel it is small credit to men of our time who, after ten or twenty
years of technical training, having their attention directed to a something to be seen, and armed with compound microscopes which permit them to see with the physical eye the "mother of petre", arrogate to themselves the discovery of a great truth. Much more modest would it be and much more in the spirit of giving credit where credit is due to admit that, after long doubting the existence of such an entity, we have succeeded in confirming in fullness the truth of a great discovery which belongs to an unnamed genius of the past, or perhaps to a hundred of them who, working with life's processes and familiar with them through long intimate association, saw in these invisible processes analogies that revealed to them the essential truth in such fullness as to enable them to build upon it an unfailing practice.

There is another practice followed by the Chinese, connected with the formation of nitrates in soils, which again emphasizes the national trait of saving and turning to use any and every thing worth while. Our attention was called to this practice by Rev. A. E. Evans of Shunking, Szechwan province. It rests upon the tendency of the earth floors of dwellings to become heavily charged with calcium nitrate through the natural processes of nitrification. Calcium nitrate being deliquescent absorbs moisture sufficiently to dissolve and make the floor wet and sticky. Dr. Evans' attention was drawn to the wet floor in his own house, which he at first ascribed to insufficient ventilation, but which he was unable to remedy by improving that. The father of one of his assistants, whose business consisted in purchasing the soil of such floors for producing potassium nitrate, used so much in China in the manufacture of fireworks and gunpowder, explained his difficulty and suggested the remedy.

This man goes from house to house through the village, purchasing the soil of floors which have thus become overcharged. He procures a sample, tests it and announces what he will pay for the surface two, three or four inches, the price sometimes being as high as fifty cents for the
privilege of removing the top layer of the floor, which the proprietors must replace. He leaches the soil removed, to recover the calcium nitrate, and then pours the leachings through plant ashes containing potassium carbonate, for the purpose of transforming the calcium nitrate into the potassium nitrate or saltpeter. Dr. Evans learned that during the four months preceding our interview this man had produced sufficient potassium nitrate to bring his sales up to $80, Mexican. It was necessary for him to make a two-days journey to market his product. In addition he paid a license fee of 80 cents per month. He must purchase his fuel ashes and hire the services of two men.

When the nitrates which accumulate in the floors of dwellings are not collected for this purpose the soil goes to the fields to be used directly as a fertilizer, or it may be worked into compost. In the course of time the earth used in the village walls and even in the construction of the houses may disintegrate so as to require removal, but in all such cases, as with the earth brick used in the kangs, the value of the soil has improved for composting and is generally so used. This improvement of the soil will not appear strange when it is stated that such materials are usually from the subsoil, whose physical condition would improve when exposed to the weather, converting it in fact into an uncropped virgin soil.

We were unable to secure definite data as to the chemical composition of these composts and cannot say what amounts of available plant food the Shantung farmers are annually returning to their fields. There can be little doubt, however, that the amounts are quite equal to those removed by the crops. The soils appeared well supplied with organic matter and the color of the foliage and the general aspect of crops indicated good feeding.

The family with whom we talked in the village place their usual yields of wheat at 420 catty of grain and 1000 catty of straw per mow,* the grain being worth 35 strings

*Their mow was four-thirds of the legal standard mow.
accumulate it from the atmosphere, through the instrumentality of their soy bean crop or some other legume. It has already been stated that they do add more than 5000 to 7000 pounds of dry compost, which, repeated for a second crop, would make an annual application of five to seven tons of dry compost per acre annually. They do use, in addition to this compost, large amounts of bean and peanut cake, which carry all of the plant food elements derived from the soil which are contained in the beans and the peanuts. If the vines are fed, or if the stems of the beans are burned for fuel, most of the plant food elements in these will be returned to the field, and they have doubtless learned how to completely restore the plant food elements removed by their crops, and persistently do so.

The roads made by the Germans in the vicinity of Tsingtao enabled us to travel by ricksha into the adjoining country, and on one such trip we visited a village mill for grinding soy beans and peanuts in the manufacture of oil, and Fig. 136 shows the stone roller, four feet in diameter and two feet thick, which is revolved about a vertical
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axis on a circular stone plate, drawn by a donkey, crushing the kernels partly by its weight and partly by a twisting motion, for the arm upon which the roller revolves is very short. After the meal had been ground the oil was expressed in essentially the same way as that described for the cotton seed, but the bean and peanut cakes are made much larger than the cotton seed cakes, about eighteen inches in diameter and three to four inches thick. Two of these cakes are seen in Fig. 137, standing on edge outside

![Fig. 137.—Two large peanut cakes and a paper demijohn for containing the oil, outside the village mill, Shantung, China.](image)

the mill in an orderly clean court. It is in this form that bean cake is exported in large quantities to different parts of China, and to Japan in recent years, for use as fertilizer, and very recently it is being shipped to Europe for both stock food and fertilizer.

Nowhere in this province, nor further north, did we see the large terra cotta receptacles so extensively used in the south for storing human excreta. In these dryer climates some method of desiccation is practiced and we found the gardeners in the vicinity of Tsingtao with quantities of the fertilizer stacked under matting shelters in
the desiccated condition, this being finely pulverized in one or another way before it was applied. The next illustration, Fig. 138, shows one of these piles being fitted for the garden, its thatched shelter standing behind the grandfather of a household. His grandson was carrying the prepared fertilizer to the garden area seen in Fig. 139, where the father was working it into the soil. The greatest pains is taken, both in reducing the product to a fine powder and in spreading and incorporating it with the soil, for one of their maxims of soil management is to make each square foot of field or garden the equal of every other in its power to produce. In this manner each little holding is made to yield the highest returns possible under the conditions the husbandman is able to control.

From one portion of the area being fitted, a crop of artemisia had been harvested, giving a gross return at the rate of $73.19 per acre, and from another leeks had been taken, bringing a gross return of $43.86 per acre. Chinese celery was the crop for which the ground was being fitted.

The application of soil as a fertilizer to the fields of
China, whether derived from the subsoil or from the silts and organic matter of canals and rivers, must have played an important part in the permanency of agriculture in the Far East, for all such additions have been positive accretions to the effective soil, increasing its depth and carrying to it all plant food elements. If not more than one-half of the weight of compost applied to the fields of Shantung is highly fertilized soil, the rates of application observed would, in a thousand years, add more than two million pounds per acre, and this represents about the volume of soil we turn with the plow in our ordinary tillage operations, and this amount of good soil may carry more than 6000 pounds of nitrogen, 2000 pounds of phosphorus and more than 60,000 pounds of potassium.
When we left our hotel by ricksha for the steamer, returning to Shanghai, we soon observed a boy of thirteen or fourteen years apparently following, sometimes a little ahead, sometimes behind, usually keeping the sidewalk but slackening his pace whenever the ricksha man came to a walk. It was a full mile to the wharf. The boy evidently knew the sailing schedule and judged by the valise in front, that we were to take the out-going steamer and that he might possibly earn two cents, Mexican, the usual fee for taking a valise aboard the steamer. Twenty men at the wharf might be waiting for the job, but he was taking the chance with the mile down and back thrown in, and all for less than one cent in our currency, equivalent at the time to about twenty "cash". As we neared the steamer the lad closed up behind but strong and eager men were watching. Twice he was roughly thrust aside and before the ricksha stopped a man of stalwart frame seized the valise and, had we not observed the boy thus unobtrusively entering the competition, he would have had only his trouble for his pains. Thus intense was the struggle here for existence and thus did a mere lad put himself effectively into it. True to breeding and example he had spared no labor to win and was surprised but grateful to receive more than he had expected.
XI.

ORIENTALS CROWD BOTH TIME AND SPACE.

Time is a function of every life process, as it is of every physical, chemical and mental reaction, and the husbandman is compelled to shape his operations so as to conform with the time requirements of his crops. The oriental farmer is a time economizer beyond any other. He utilizes the first and last minute and all that are between. The foreigner accuses the Chinaman of being always "long on time", never in a fret, never in a hurry. And why should he be when he leads time by the forelock, and uses all there is?

The customs and practices of these Farthest East people regarding their manufacture of fertilizers in the form of earth composts for their fields, and their use of altered subsoils which have served in their kangs, village walls and dwellings, are all instances where they profoundly shorten the time required in the field to affect the necessary chemical, physical and biological reactions which produce from them plant food substances. Not only do they thus increase their time assets, but they add, in effect, to their land area by producing these changes outside their fields, at the same time giving their crops the immediately active soil products.

Their compost practices have been of the greatest consequence to them, both in their extremely wet, rice-culture methods, and in their "dry-farming" practices, where the soil moisture is too scanty during long periods to permit
rapid fermentation under field conditions. Western agriculturalists have not sufficiently appreciated the fact that the most rapid growth of plant food substances in the soil cannot occur at the same time and place with the most rapid crop increase, because both processes draw upon the available soil moisture, soil air and soluble potassium, calcium, phosphorus and nitrogen compounds. Whether this fundamental principle of practical agriculture is written in their literature or not it is most indelibly fixed in their practice. If we and they can perpetuate the essentials of this practice at a large saving of human effort, or perpetually secure the final result in some more expeditious and less laborious way, most important progress will have been made.

Fig. 140.—Looking across reservoir and four-man foot-power pump, used to lift water to a nursery rice bed, at fields of grain sowed broadcast in narrow beds.

When we went north to the Shantung province the Kiangsu and Chekiang farmers were engaged in another of their time saving practices, also involving a large amount of human labor. This was the planting of cotton in wheat fields before the wheat was quite ready to
harvest. In the sections of these two provinces which we visited most of the wheat and barley were sowed broadcast on narrow raised lands, some five feet wide, with furrows between, after the manner seen in Fig. 140, showing a reservoir in the immediate foreground, on whose bank is installed one of the four-man foot-power irrigation pumps in use to flood the nursery rice bed close by on the right. The narrow lands of broadcasted wheat extend back from the reservoir toward the farmsteads which dot the landscape, and on the left stands one of the pump shelters near the canal bank.

To save time, or lengthen the growing season of the cotton which was to follow, this seed was sown broadcast among the grain on the surface, some ten to fifteen days before the wheat would be harvested. To cover the seed the soil in the furrows between the beds had been spaded loose to a depth of four or five inches, finely pulverized, and then with a spade was evenly scattered over the bed, letting it sift down among the grain, covering the
seed. This loose earth, so applied, acts as a mulch to conserve the capillary moisture, permitting the soil to become sufficiently damp to germinate the seed before the wheat is harvested. The next illustration, Fig. 141, is a closer view with our interpreter standing in another field of wheat in which cotton was being sowed April 22nd in the manner described, and yet the stand of grain was

![Fig. 142.—View of same field as Fig. 141, after the grain had been cut, removed and the cotton sowed in it was up.](image)

very close and shoulder high, making it not an easy task either to sow the seed or to scatter sufficient soil to cover it.

When we had returned from Shantung this piece of grain had been harvested, giving a yield of 95.6 bushels of wheat and 3.5 tons of straw per acre, computed from the statement of the owner that 400 catty of grain and 500 catty of straw had been taken from the beds measuring 4050 square feet. On the morning of May 29th the photograph for Fig. 142 was taken, showing the same
area after the wheat had been harvested and the cotton was up, the young plants showing slightly through the short stubble. These beds had already been once treated with liquid fertilizer. A little later the plants would be hoed and thinned to a stand of about one plant per each square foot of surface. There were thirty-seven days between the taking of the two photographs, and certainly thirty days had been added to the cotton crop by this method of planting, over what would have been available if the grain had been first harvested and the field fitted before planting. It will be observed that the cotton follows

Fig. 143.—Multiple crops, wheat, windsor beans and cotton. Wheat ready to harvest, beans two-thirds grown, cotton just planted. Upper view looking between wheat rows, lower, looking between bean rows now covering ground.
the wheat without plowing, but the soil was deep, naturally open, and a layer of nearly two inches of loose earth had been placed over the seed at the time of planting. Besides, the ground would be deeply worked with the two or four tined hoe, at the time of thinning.

Starting cotton in the wheat in the manner described is but a special case of a general practice widely in vogue. The growing of multiple crops is the rule throughout these countries wherever the climate permits. Sometimes as many as three crops occupy the same field in recurrent rows, but of different dates of planting and in different stages of maturity. Reference has been made to the overlapping and alternation of cucumbers with greens. The general practice of planting nearly all crops in rows lends itself readily to systems of multiple cropping, and these to the fullest possible utilization of every minute of the growing season and of the time of the family in caring for the crops. In the field, Fig. 143, a crop of winter wheat was nearing maturity, a crop of windsor beans was about two-thirds grown, and cotton had just been planted, April 22nd. This field had been thrown into ridges some five feet wide with a twelve inch furrow between them. Two rows of wheat eight inches wide, planted two feet between centers occupied the crest of the ridge, leaving a
Other Multiple Cropping.

strip sixteen inches wide, seen in the upper section, (1) for tillage, (2) then fertilization and (3) finally the row of cotton planted just before the wheat was harvested. Against the furrow on each side was a row of windsor beans, seen in the lower view, hiding the furrow, which was matured some time after the wheat was harvested and before the cotton was very large. A late fall crop sometimes follows the windsor beans after a period of tillage and fertilization, making four in one year. With such a succession fertilization for each crop, and an abundance of soil moisture are required to give the largest returns from the soil.

In another plan winter wheat or barley may grow side by side with a green crop, such as the 'Chinese clover' (Medicago denticulata, Willd.) for soil fertilizer, as was the case in Fig. 144, to be turned under and fertilize for a crop of cotton planted in rows on either side of a crop of barley. After the barley had been harvested the ground it occupied would be tilled and further fertilized, and when the cotton was nearing maturity a crop...
of rape might be grown, from which "salted cabbage" would be prepared for winter use.

Multiple crops are grown as far north in Chihli as Tientsin and Peking, these being oftenest wheat, maize, large and small millet and soy beans, and this, too, where the soil is less fertile and where the annual rainfall is only about twenty-five inches, the rainy season beginning in late June or early July, and Fig. 145 shows one of these fields as it appeared June 14th, where two rows of wheat and two of large millet were planted in alternating pairs, the rows being about twenty-eight inches apart. The wheat was ready to harvest but the straw was unusually short because growing on a light sandy loam in a season of exceptional drought, but little more than two inches of rain having fallen after January 1st of that year.

The piles of pulverized dry-earth compost seen between the rows had been brought for use on the ground occupied
by the wheat when that was removed. The wheat would be pulled, tied in bundles, taken to the village and the roots cut off, for making compost, as in Fig. 146, which shows the family engaged in cutting the roots from the small bundles of wheat, using a long straight knife blade, fixed at one end, and thrust downward upon the bundle with lever pressure. These roots, if not used as fuel, would be transferred to the compost pit in the enclosure seen in Fig. 147, whose walls were built of earth brick. Here, with any other waste litter, manure or ashes, they would be permitted to decay under water until the fiber had been destroyed, thus permitting it to be incorporated with soil and applied to the fields, rich in soluble plant food and in a condition which would not interfere with the capillary movement of soil moisture, the work going on outside the field where the changes could occur unimpeded and without interfering with the growth of crops on the ground.

In this system of combined intertillage and multiple cropping the oriental farmer thus takes advantage of whatever good may result from rotation or succession of crops, whether these be physical, vito-chemical or biological. If
plants are mutually helpful through close association of their root systems in the soil, as some believe may be the case, this growing of different species in close juxtaposition would seem to provide the opportunity, but the other advantages which have been pointed out are so evident and so important that they, rather than this, have doubtless led to the practice of growing different crops in close recurrent rows.
The basal food crop of the people of China, Korea and Japan is rice, and the mean consumption in Japan, for the five years ending 1906, per capita and per annum, was 302 pounds. Of Japan's 175,428 square miles she devoted, in 1906, 12,856 to the rice crop. Her average yield of water rice on 12,534 square miles exceeded 33 bushels per acre, and the dry land rice averaged 18 bushels per acre on 321 square miles. In the Hokkaido, as far north as northern Illinois, Japan harvested 1,780,000 bushels of water rice from 53,000 acres.

In Szechwan province, China, Consul-General Hosie places the yield of water rice on the plains land at 44 bushels per acre, and that of the dry land rice at 22 bushels. Data given us in China show an average yield of 42 bushels of water rice per acre, while the average yield of wheat was 25 bushels per acre, the normal yield in Japan being about 17 bushels.

If the rice eaten per capita in China proper and Korea is equal to that in Japan the annual consumption for the three nations, using the round number 300 pounds per capita per annum, would be:

<table>
<thead>
<tr>
<th></th>
<th>Population</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>410,600,000</td>
<td>61,500,000 tons</td>
</tr>
<tr>
<td>Korea</td>
<td>12,000,000</td>
<td>1,800,000 tons</td>
</tr>
<tr>
<td>Japan</td>
<td>53,000,000</td>
<td>7,950,000 tons</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>475,000,000</strong></td>
<td><strong>71,250,000 tons</strong></td>
</tr>
</tbody>
</table>

If the ratio of irrigated to dry land rice in Korea and China proper is the same as that in Japan, and if the
mean yield of rice per acre in these countries were forty bushels for the water rice and twenty bushels for the dry land rice, the acreage required to give this production would be:

<table>
<thead>
<tr>
<th>Area</th>
<th>Water rice, sq. miles</th>
<th>Dry land rice, sq. miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>In China</td>
<td>78,078</td>
<td>4,004</td>
</tr>
<tr>
<td>In Korea</td>
<td>2,285</td>
<td>117</td>
</tr>
<tr>
<td>In Japan</td>
<td>12,584</td>
<td>321</td>
</tr>
<tr>
<td>Sum</td>
<td>92,892</td>
<td>4,442</td>
</tr>
<tr>
<td>Total</td>
<td>97,334</td>
<td>4,442</td>
</tr>
</tbody>
</table>

Our observations along the four hundred miles of railway in Korea between Antung, Seoul and Fusan, suggest that the land under rice in this country must be more rather than less than that computed, and the square miles of canalized land in China, as indicated on pages 97 to 102, would indicate an acreage of rice for her quite as large as estimated.

In the three main islands of Japan more than fifty per cent of the cultivated land produces a crop of water rice each year and 7.96 per cent of the entire land area of the Empire, omitting far-north Karafuto. In Formosa and in southern China large areas produce two crops each year. At the large mean yield used in the computation the estimated acreage of rice in China proper amounts to 5.93 per cent of her total area and this is 7433 square miles greater than the acreage of wheat in the United States in 1907. Our yield of wheat, however, was but 19,000,000 tons, while China's output of rice was certainly double and probably three times this amount from nearly the same acreage of land; and notwithstanding this large production per acre, more than fifty per cent, possibly as high as seventy-five per cent, of the same land matures at least one other crop the same year, and much of this may be wheat or barley, both chiefly consumed as human food.

Had the Mongolian races spread to and developed in North America instead of, or as well as, in eastern Asia,
there might have been a Grand Canal, something as suggested in Fig. 148, from the Rio Grande to the mouth of the Ohio river and from the Mississippi to Chesapeake Bay, constituting more than two thousand miles of inland water-way, serving commerce, holding up and redistributing both the run-off water and the wasting fertility of soil erosion, spreading them over 200,000 square miles of thoroughly canalized coastal plains, so many of which are now impoverished lands, made so by the intolerable waste of a vaunted civilization. And who shall venture to enumerate the increase in the tonnage of sugar, bales of cotton, sacks of rice, boxes of oranges, baskets of peaches, and in the trainloads of cabbage, tomatoes and celery such husbanding would make possible through all time; or number the increased millions these could feed and clothe? We may prohibit the exportation of our phosphorus, grind our limestone, and apply them to our fields, but this alone is only temporizing with the future. The more we produce, the more numerous our millions, the faster must present
Fig. 149.—Recently transplanted rice fields in Japan.
Fig. 149.—Recently transplanted rice fields in Japan.
for composting; and in the almost religious fidelity with which they have returned to their fields every form of waste which can replace plant food removed by the crops, these nations have demonstrated a grasp of essentials and of fundamental principles which may well cause western nations to pause and reflect.

While this country need not and could not now adopt their laborious methods of rice culture, and while, let us hope, those who come after us may never be compelled to do so, it is nevertheless quite worth while to study, for the sake of the principles involved, the practices they have been led to adopt.

Great as is the acreage of land in rice in these countries, but little, relatively, is of the dry land type, and the fields upon which most of the rice grows have all been graded to a water level and surrounded by low, narrow raised rims, such as may be seen in Fig. 149 and in Fig. 150, where three men are at work on their foot-power
pump, flooding fields preparatory to transplanting the rice. If the country was not level then the slopes have been graded into horizontal terraces varying in size according to the steepness of the areas in which they were cut. We saw these often no larger than the floor of a small room, and Professor Ross informed me that he walked past those in the interior of China no larger than a dining table and that he saw one bearing its crop of rice, surrounded by its rim and holding water, yet barely larger than a good napkin. The average area of the paddy field in Japan is officially reported at 1.14 se, or an area of but 31 by 40 feet. Excluding Hokkaido, Formosa and Karafuto, fifty-three per cent of the irrigated rice lands in Japan are in allotments smaller than one-eighth of an acre, and seventy-four per cent of other cultivated lands are held in areas less than one-fourth of an acre, and each of these may be further subdivided. The next two illustrations, Figs. 151 and 152, give a good idea both of the small size of the rice fields and of the terracing which has been done to secure the water level basins. The house standing near the center of Fig. 151 is a good scale for judging both the size of the paddies and the slope of the valley. The distance between the rows of rice is scarcely one foot, hence counting these in the foreground may serve as another measure. There are more than twenty little fields shown in this engraving in front of the house and reaching but half way to it, and the house was less than five hundred feet from the camera.

There are more than eleven thousand square miles of fields thus graded in the three main islands of Japan, each provided with rims, with water supply and drainage channels, all carefully kept in the best of repair. The more level areas, too, in each of the three countries, have been similarly thrown into water level basins, comparatively few of which cover large areas, because nearly always the holdings are small. All of the earth excavated from the canals and drainage channels has been leveled over the fields unless needed for levees or dikes, so that
Fig. 151.—Terraced valley with small terraces flooded and transplanted to rice, Japan.
the original labor of construction, added to that of maintenance, makes a total far beyond our comprehension and nearly all of it is the product of human effort.

The laying out and shaping of so many fields into these level basins brings to the three nations an enormous aggregate annual asset, a large proportion of which western nations are not yet utilizing. The greatest gain comes from the unfailing higher yields made possible by providing an abundance of water through which more plant food can be utilized, thus providing higher average yields. The waters used, coming as they do largely from the uncultivated hills and mountain lands, carrying both dissolved and suspended matters, make positive annual additions of dissolved limestone and plant food elements to the fields which in the aggregate have been very

Fig. 152.—Looking down a steep, narrow Japanese valley at small, flooded and transplanted rice paddies.
large, through the persistent repetitions which have prevailed for centuries. If the yearly application of such water to the rice fields is but sixteen inches, and this has the average composition quoted by Merrill for rivers of North America, taking into account neither suspended matter nor the absorption of potassium and phosphorus by it, each ten thousand square miles would receive, dissolved in the water, substances containing some 1,400 tons of phosphorus; 23,000 tons of potassium; 27,000 tons of nitrogen; and 48,000 tons of sulphur. In addition, there are brought to the fields some 216,000 tons of dissolved organic matter and a still larger weight of dissolved limestone, so necessary in neutralizing the acidity of soils, amounting to 1,221,000 tons; and such savings have been maintained in China, Korea and Japan on more than five, and possibly more than nine, times the ten thousand square miles, through centuries. The phosphorus thus turned upon ninety thousand square miles would aggregate nearly thirteen million tons in a thousand years, which is less than the time the practice has been maintained, and is more phosphorus than would be carried in the entire rock phosphate thus far mined in the United States, were it all seventy-five per cent pure.

The canalization of fifty thousand square miles of our Gulf and Atlantic coastal plain, and the utilization on the fields of the silts and organic matter, together with the water, would mean turning to account a vast tonnage of plant food which is now wasting into the sea, and a correspondingly great increase of crop yield. There ought, and it would seem there must some time be provided a way for sending to the sandy plains of Florida, and to the sandy lands between there and the Mississippi, large volumes of the rich silt and organic matter from this and other rivers, aside from that which should be applied systematically to building above flood plain the lands of the delta which are subject to overflow or are too low to permit adequate drainage.
Provisions Against Leaching.

It may appear to some that the application of such large volumes of water to fields, especially in countries of heavy rainfall, must result in great loss of plant food through leaching and surface drainage. But under the remarkable practices of these three nations this is certainly not the case and it is highly important that our people should understand and appreciate the principles which underlie the practices they have almost uniformly adopted on the areas devoted to rice irrigation. In the first place, their paddy fields are under-drained so that most of the water either leaves the soil through the crop, by surface evaporation, or it percolates through the subsoil into shallow drains. When water is passed directly from one rice paddy to another it is usually permitted some time after fertilization, when both soil and crop have had time to appropriate or fix the soluble plant food substances. Besides this, water is not turned upon the fields until the

Fig. 153.—Egg plants growing in the midst of rice fields with soil continually saturated and water standing in surface drain within 14 inches of the surface, Japan.
time for transplanting the rice, when the plants are already provided with a strong root system and are capable of at once appropriating any soluble plant food which may develop about their roots or be carried downward over them.

Although the drains are of the surface type and but eighteen inches to three feet in depth, they are sufficiently numerous and close so that, although the soil is continuously nearly filled with water, there is a steady percola-

Fig. 154.—Watermelons, with the ground heavily mulched with straw, growing on low beds under conditions similar to those of Fig. 153.

tion of the fresh, fully aerated water carrying an abundance of oxygen into the soil to meet the needs of the roots, so that watermelons, egg plants, musk melons and taro are grown in the rotations on the small paddies among the irrigated rice after the manner seen in the illustrations. In Fig. 153 each double row of egg plants is separated from the next by a narrow shallow trench which connects with a head drain and in which water was standing within fourteen inches of the surface. The same was true in the case of the watermelons seen in Fig. 154, where the vines are growing on a thick layer of
straw mulch which holds them from the moist soil and acts to conserve water by diminishing evaporation and through decay from the summer rains and leaching, serves as fertilizer for the crop. In Fig. 155 the view is along a pathway separating two head ditches between areas in watermelons and taro, carrying the drainage waters from the several furrows into the main ditches. Although the soil appeared wet the plants were vigorous and healthy, seeming in no way to suffer from insufficient drainage.

These people have, therefore, given effective attention to the matter of drainage as well as irrigation and are looking after possible losses of plant food, as well as ways of supplying it. It is not alone where rice is grown that cultural methods are made to conserve soluble plant food and to reduce its loss from the field, for very often, where flooding is not practiced, small fields and beds, made quite level, are surrounded by low raised borders which
permit not only the whole of any rain to be retained upon the field when so desired, but it is completely distributed over it, thus causing the whole soil to be uniformly charged with moisture and preventing washing from one portion of the field to another. Such provisions are shown in Figs. 133 and 138.

Extensive as is the acreage of irrigated rice in China, Korea and Japan, nearly every spear is transplanted; the largest and best crop possible, rather than the least labor and trouble, as is so often the case with us, determining their methods and practices. We first saw the fitting of

the rice nursery beds at Canton and again near Kashing in Chekiang province on the farm of Mrs. Wu, whose homestead is seen in Fig. 156. She had come with her husband from Ningpo after the ravages of the Taiping rebellion had swept from two provinces alone twenty millions of people and settled on a small area of then vacated land. As they prospered they added to their holding by purchase until about twenty-five acres were acquired, an area about ten times that possessed by the usual prosperous family in China. The widow was managing her place, one of her sons, although married, being still in school, the daughter-in-law living with her mother-in-law and helping in the home. Her field help during the summer consisted of seven laborers and she kept four cows for the plowing and pumping of water for irrigation. The

Fig. 156.—Residence compound and farm buildings of Mrs. Wu, Kashing, China.
wages of the men were at the rate of $24, Mexican, for five summer months, together with their meals which were four each day. The cash outlay for the seven men was thus $14.45 of our currency per month. Ten years before, such labor had been $30 per year, as compared with $50 at the time of our visit, or $12.90 and $21.50 of our currency, respectively.

Her usual yields of rice were two piculs per mow, or twenty-six and two-thirds bushels per acre, and a wheat crop

yielding half this amount, or some other, was taken from part of the land the same season, one fertilization answering for the two crops. She stated that her annual expense for fertilizers purchased was usually about $60, or $25.80 of our currency. The homestead of Mrs. Wu, Fig. 156, consists of a compound in the form of a large quadrangle surrounding a court closed on the south by a solid wall eight feet high. The structure is of earth brick with the roof thatched with rice straw.

Our first visit here was April 19th. The nursery rice beds had been planted four days, sowing seed at the rate
of twenty bushels per acre. The soil had been very carefully prepared and highly fertilized, the last treatment being a dressing of plant ashes so incompletely burned as to leave the surface coal black. The seed, scattered directly upon the surface, almost completely covered it and had been gently beaten barely into the dressing of ashes, using a wide, flat-bottom basket for the purpose. Each evening, if the night was likely to be cool, water was pumped over the bed, to be withdrawn the next day,

if warm and sunny, permitting the warmth to be absorbed by the black surface, and a fresh supply of air to be drawn into the soil.

Nearly a month later, May 14th, a second visit was made to this farm and one of the nursery beds of rice, as it then appeared, is seen in Fig. 159, the plants being about eight inches high and nearing the stage for transplanting. The field beyond the bed had already been partly flooded and plowed, turning under "Chinese clover" to ferment as green manure, preparatory for the rice transplanting. On the opposite side of the bed and
Fig. 159.—Nursery bed of rice 29 days planted, showing irrigation furrows; field beyond flooded, partly plowed, and the rice nearly ready for transplanting.
in front of the residence, Fig. 156, flooding was in progress in the furrows between the ridges formed after the previous crop of rice was harvested and upon which the crop of clover for green manure was grown. Immediately at one end of the two series of nursery beds, one of which is seen in Fig. 159, was the pumping plant seen in Fig. 157, under a thatched shelter, with its two pumps installed at the end of a water channel leading from the canal. One of these wooden pump powers, with the blind-

Fig. 160.—Plowed field nearly fitted for rice, and the smoothing, pulverizing harrow used for the purpose, Chekiang province, China.

folded cow attached, is reproduced in Fig. 158 and just beyond the animal's head may be seen the long handle dipper to which reference has been made, used for collecting excreta.

More than a month is saved for maturing and harvesting winter and early spring crops, or in fitting the fields for rice, by this planting in nursery beds. The irrigation period for most of the land is cut short a like amount, saving in both water and time. It is cheaper and easier to highly fertilize and prepare a small area for the nursery, while at the same time much stronger and more uniform plants are secured than would be possible by sowing in the field. The labor of weeding and caring for the plants in
the nursery is far less than would be required in the field. It would be practically impossible to fit the entire rice areas as early in the season as the nursery beds are fitted, for the green manure is not yet grown and time is required for composting or for decaying, if plowed under directly. The rice plants in the nursery are carried to a stage when they are strong feeders and when set into the

![Image](https://via.placeholder.com/150)

**Fig. 161.**—Form of revolving wooden harrow for fitting flooded rice fields preparatory to transplanting.

newly prepared, fertilized, clean soil of the field they are ready to feed strongly under these most favorable conditions. Both time and strength of plant are thus gained and these people are following what would appear to be the best possible practices under their condition of small holdings and dense population.

With our broad fields, our machinery and few people, their system appears to us crude and impossible, but cut our holdings to the size of theirs and the same stroke makes our machinery, even our plows, still more im-
possible, and so the more one studies the environment of these people, thus far unavoidable, their numbers, what they have done and are doing, against what odds they have succeeded, the more difficult it becomes to see what course might have been better.

How full with work is the month which precedes the transplanting of rice has been pointed out,—the making of the compost fertilizer; harvesting the wheat, rape and beans; distributing the compost over the fields, and their flooding and plowing. In Fig. 160 one of these fields is seen plowed, smoothed and nearly ready for the plants. The turned soil had been thoroughly pulverized, leveled and worked to the consistency of mortar, on the larger fields with one or another sort of harrow, as seen in Figs. 160 and 161. This thorough puddling of the soil permits the plants to be quickly set and provides conditions which ensure immediate perfect contact for the roots.

When the fields are ready women repair to the nurseries with their low four-legged bamboo stools, to pull the rice plants, carefully rinsing the soil from the roots, and then tie them into bundles of a size easily handled in transplanting, which are then distributed in the fields.
Fig. 163.—Transplanting rice in China. Four views taken from the same point at intervals of fifteen minutes, showing the progress made during forty-five minutes.
The work of transplanting may be done by groups of families changing work, a considerable number of them laboring together after the manner seen in Fig. 163, made from four snap shots taken from the same point at intervals of fifteen minutes. Long cords were stretched in the rice field six feet apart and each of the seven men was setting six rows of rice one foot apart, six to eight plants in a hill, and the hills eight or nine inches apart in the row. The bundle was held in one hand and deftly, with the other, the desired number of plants were selected with the fingers at the roots, separated from the rest and, with a single thrust, set in place in the row. There was no packing of earth about the roots, each hill being set with a single motion, which followed one another in quick succession, completing one cross row of six hills after another. The men move backward across the field, completing one entire section, tossing the unused plants into the unset field. Then reset the lines to cover another section. We were told that the usual day’s work of transplanting, for a man under these conditions, after the field is fitted and the plants are brought to him, is two mow or one-third of an acre. The seven men in this group would thus set two and a third acres per day and, at the wage Mrs. Wu was paying, the cash outlay, if the help was hired, would be nearly 21 cents per acre. This is more cheaply than we are able to set cabbage and tobacco plants with our best machine methods. In Japan, as seen in Figs. 164 and 165, the women participate in the work of setting the plants more than in China.

After the rice has been transplanted its care, unlike that of our wheat crop, does not cease. It must be hoed, fertilized and watered. To facilitate the watering all fields have been leveled, canals, ditches and drains provided, and to aid in fertilizing and hoeing, the setting has been in rows and in hills in the row.

The first working of the rice fields after the transplanting, as we saw it in Japan, consisted in spading between the hills with a four-tined hoe, apparently more for loosen-
ing the soil and aeration than for killing weeds. After this treatment the field was gone over again in the manner seen in Fig. 166, where the man is using his bare hands to smooth and level the stirred soil, taking care to eradicate every weed, burying them beneath the mud, and to straighten each hill of rice as it is passed. Sometimes the fingers are armed with bamboo claws to facilitate the weeding. Machinery in the form of revolving hand cultivators is recently coming into use in Japan, and two men using these are seen in Fig. 14. In these cultivators the teeth are mounted on an axle so as to revolve as the cultivator is pushed along the row.

Fertilization for the rice crop receives the greatest attention everywhere by these three nations and in no direction more than in maintaining the store of organic matter in the soil. The pink clover, to which reference has been made, Figs. 99 and 100, is extensively sowed after a crop of rice is harvested in the fall and comes into full bloom, ready to cut for compost or to turn under directly when the rice fields are plowed. Eighteen to twenty tons of this green clover are produced per acre, and in Japan this is usually applied to about three acres, the stubble...
Fig. 165.—Japanese young women transplanting rice, under broad sunshade hats.
and roots serving for the field producing the clover, thus giving a dressing of six to seven tons of green manure per acre, carrying not less than 37 pounds of potassium; 5 pounds of phosphorus, and 58 pounds of nitrogen.

Where the families are large and the holdings small, so they cannot spare room to grow the green manure crop, it is gathered on the mountain, weed and hill lands, or it may be cut in the canals. On our boat trip west from Soochow the last of May, many boats were passed carrying tons of the long green ribbon-like grass, cut and gathered from the bottom of the canal. To cut this grass men were working to their armpits in the water of the canal, using a crescent-shaped knife mounted like an anchor from the end of a 16-foot bamboo handle. This was shoved forward along the bottom of the canal and then drawn backward, cutting the grass, which rose to the surface where it was gathered upon the boats. Or material for green manure may be cut on grave, mountain or hill lands, as described under Fig. 115.
The straw of rice and other grain and the stems of any plant not usable as fuel may also be worked into the mud of rice fields, as may the chaff which is often scattered upon the water after the rice is transplanted, as in Fig. 168.

Reference has been made to the utilization of waste of various kinds in these countries to maintain the productive power of their soils, but it is worth while, in the interests of western nations, as helping them to realize the ultimate necessity of such economies, to state again, in more explicit terms, what Japan is doing. Dr. Kawaguchi, of the National Department of Agriculture and Commerce, taking his data from their records, informed me that Japan produced, in 1908, and applied to her fields, 23,850,295 tons of human manure; 22,812,787 tons of compost; and she imported 753,074 tons of commercial fertilizers, 7000 of which were phosphates in one form or another. In addition to these she must have applied not less than 1,404,000 tons of fuel ashes and 10,185,500 tons of green manure products grown on her hill and weed lands, and all of these applied to less than 14,000,000
working a similar pump are seen in Fig. 150, a closer view of three men working the foot-power may be seen in Fig. 42 and still another stands adjacent to a series of flooded fields in Fig. 172. Where this view was taken the old farmer informed us that two men, with this pump, lifting water three feet, were able to cover two mow of land with three inches of water in two hours. This is at the rate of 2.5 acre-inches of water per ten hours per man, and for 12 to 15 cents, our currency, thus making sixteen acre-inches, or the season’s supply of water, cost 77 to 96 cents, where coolie labor is hired and fed. Such is the efficiency of human power applied to the Chinese pump, measured in American currency.

This pump is simply an open box trough in which travels a wooden chain carrying a series of loosely fitting boards which raise the water from the canal, discharging
working a similar pump are seen in Fig. 150, a closer view of three men working the foot-power may be seen in Fig. 42 and still another stands adjacent to a series of flooded fields in Fig. 172. Where this view was taken the old farmer informed us that two men, with this pump, lifting water three feet, were able to cover two mow of land with three inches of water in two hours. This is at the rate of 2.5 acre-inches of water per ten hours per man, and for 12 to 15 cents, our currency, thus making sixteen acre-inches, or the season’s supply of water, cost 77 to 96 cents, where coolie labor is hired and fed. Such is the efficiency of human power applied to the Chinese pump, measured in American currency.

This pump is simply an open box trough in which travels a wooden chain carrying a series of loosely fitting boards which raise the water from the canal, discharging
it into the field. The size of the trough and of the buckets are varied to suit the power applied and the amount of water to be lifted. Crude as it appears there is nothing in western manufacture that can compete with it in first cost, maintenance or efficiency for Chinese conditions and nothing is more characteristic of all these people than their efficient, simple appliances of all kinds, which they have reduced to the lowest terms in every feature of construction and cost. The greatest results are accomplished

![Fig. 170.—Well sweep and quadrangular, conical water bucket used for irrigation in Chihli.](image)

by the simplest means. If a canal must be bridged and it is too wide to be covered by a single span, the Chinese engineer may erect it at some convenient place and turn the canal under it when completed. This we saw in the case of a new railroad bridge near Sungkiang. The bridge was completed and the water had just been turned under it and was being compelled to make its own excavation. Great expense had been saved while traffic on the canal had not been obstructed.

In the foot-power wheel of Japan all gearing is eliminated and the man walks the paddles themselves, as seen
in Fig. 173. Some of these wheels are ten feet in diameter, depending upon the height the water must be lifted.

Irrigation by animal power is extensively practiced in each of the three countries, employing mostly the type of power wheel shown in Fig. 158. The next illustration, Fig. 174, shows the most common type of shelter seen in Chekiang and Kiangsu provinces, which are there very numer-

![Fig. 171.—Three-man Chinese foot-power and wooden chain pump extensively used for irrigation in various parts of China.](image)

ous. We counted as many as forty such shelters in a semicircle of half a mile radius. They provide comfort for the animals during both sunshine and rain, for under no conditions must the water be permitted to run low on the rice fields, and everywhere their domestic animals receive kind, thoughtful treatment.

In the less level sections, where streams have sufficient fall, current wheels are in common use, carrying buckets near their circumference arranged so as to fill when passing
through the water, and to empty after reaching the highest level into a receptacle provided with a conduit which leads the water to the field. In Szechwan province some of these current wheels are so large and gracefully constructed as to strongly suggest Ferris wheels. A view of one of these we are permitted to present in Fig. 175, through the kindness of Rollin T. Chamberlin who took

![Image of rice fields]

**Fig. 172.**—Fields recently flooded with the Chinese foot-power chain pump preparatory to plowing for rice.

the photograph from which the engraving was prepared. This wheel which was some forty feet in diameter, was working when the snap shot was taken, raising the water and pouring it into the horizontal trough seen near the top of the wheel, carried at the summit of a pair of heavy poles standing on the far side of the wheel. From this trough, leading away to the left above the skyline, is the long pipe, consisting of bamboo stems joined together, for conveying the water to the fields.
When the harvest time has come, notwithstanding the large acreage of grain, yielding hundreds of millions of bushels, the small, widely scattered holdings and the surface of the fields render all of our machine methods quite impossible. Even our grain cradle, which preceded the reaper, would not do, and the great task is still met with the old time sickle, as seen in Fig. 176, cutting the rice hill by hill, as it was transplanted.

![Fig. 173.—Japanese irrigation foot-wheel.](image)

Previous to the time for cutting, after the seed is well matured, the water is drawn off and the land permitted to dry and harden. The rainy season is not yet over and much care must be exercised in curing the crop. The bundles may be shocked in rows along the margins of the paddies, as seen in Fig. 176, or they may be suspended, heads down, from bamboo poles as seen in Fig. 177.

The threshing is accomplished by drawing the heads of the rice through the teeth of a metal comb mounted as seen at the right in Fig. 178, near the lower corner, be-
Fig. 174.—Power-wheel shelter on bank of canal, in Kiangsu province, China.

Fig. 175.—Large current water-wheel in use in Szechwan province, China.
Photograph by Rollin T. Chamberlin.
hind the basket, where a man and woman are occupied in winnowing the dust and chaff from the grain by means of a large double fan. Fanning mills built on the principle of those used by our farmers and closely resembling them have long been used in both China and Japan. After the rice is threshed the grain must be hulled before it can serve as food, and the oldest and simplest method of polishing used by the Japanese is seen in Fig. 179, where the

Fig. 176.—Japanese farmers harvesting rice with the old-time sickle.

friction of the grain upon itself does the polishing. A quantity of rice is poured into the receptacle when, with heavy blows, the long-headed plunger is driven into the mass of rice, thus forcing the kernels to slide over one another until, by their abrasion, the desired result is secured. The same method of polishing, on a larger scale, is accomplished where the plungers are worked by the weight of the body, a series of men stepping upon lever handles of weighted plungers, raising them and allowing them to fall under the force of the weight attached. Re-
cently, however, mills worked by gasoline engines are in operation for both hulling and polishing, in Japan.

The many uses to which rice straw is put in the economies of these people make it almost as important as the rice itself. As food and bedding for cattle and horses; as thatching material for dwellings and other shelters; as fuel; as a mulch; as a source of organic matter in the soil, and as a fertilizer, it represents a money value which

![Fig. 177.—Suspending rice bundles from bamboo frames set up in the fields for curing the grain, preparatory to threshing, Japan.](image)

is very large. Besides these ultimate uses the rice straw is extensively employed in the manufacture of articles used in enormous quantities. It is estimated that not less than 188,700,000 bags such as are seen in Figs. 180 and 181, worth $3,110,000 are made annually from the rice straw in Japan, for handling 346,150,000 bushels of cereals and 28,190,000 bushels of beans; and besides these, great numbers of bags are employed in transporting fish and other prepared manures.

In the prefecture of Hyogo, with 596 square miles of
farm land, as compared with Rhode Island's 712 square miles, Hyogo farmers produced in 1906, on 265,040 acres, 10,584,000 bushels of rice worth $16,191,400, securing an average yield of almost forty bushels per acre and a gross return of $61 for the grain alone. In addition to this, these farmers grew on the same land, the same season, at

least one other crop. Where this was barley the average yield exceeded twenty-six bushels per acre, worth $17.

In connection with their farm duties these Japanese families manufactured, from a portion of their rice straw, at night and during the leisure hours of winter, 8,980,000 pieces of matting and netting of different kinds having a market value of $262,000; 4,838,000 bags worth $185,000;
8,742,000 slippers worth $34,000; 6,254,000 sandals worth $30,000; and miscellaneous articles worth $64,000. This is a gross earning of more than $21,000,000 from eleven and a half townships of farm land and the labor of the

farmers’ families, an average earning of $80 per acre on nearly three-fourths of the farm land of this prefecture. At this rate three of the four forties of our 160-acre farms should bring a gross annual income of $9,600 and the fourth forty should pay the expenses.

At the Nara Experiment Station we were informed that
Fig. 180.—Sacking rice in bags made from the rice straw, Japan.

Fig. 181.—Loading, for shipment, rice put up in bags made from the rice straw, Japan.
the money value of a good crop of rice in that prefecture should be placed at ninety dollars per acre for the grain and eight dollars for the unmanufactured straw; thirty-six dollars per acre for the crop of naked barley and two dollars per acre for the straw. The farmers here practice a rotation of rice and barley covering four or five years, followed by a summer crop of melons, worth $320 per acre and some other vegetable instead of the rice on the fifth or sixth year, worth eighty yen per tan, or $160 per acre. To secure green manure for fertilizing, soy beans are planted each year in the space between the rows of barley, the barley being planted in November. One week after the barley is harvested the soy beans, which produce a yield of 160 kan per tan, or 5290 pounds per acre, are turned under and the ground fitted for rice. At these rates the Nara farmers are producing on four-fifths or five-sixths of their rice lands a gross earning of $136 per acre annually, and on the other fifth or sixth, an earning of $480 per acre, not counting the annual crop of soy beans.
used in maintaining the nitrogen and organic matter in their soils, and not counting their earnings from home manufactures. Can the farmers of our south Atlantic and Gulf Coast states, which are in the same latitude, sometime attain to this standard? We see no reason why they should not, but only with the best of irrigation, fertilization and proper rotation, with multiple cropping.
SILK CULTURE.

Another of the great and in some ways one of the most remarkable industries of the Orient is that of silk production, and its manufacture into the most exquisite and beautiful fabrics in the world. Remarkable for its magnitude; for having had its birthplace apparently in oldest China, at least 2600 years B.C.; for having been founded on the domestication of a wild insect of the woods; and for having lived through more than four thousand years, expanding until a $1,000,000 cargo of the product has been laid down on our western coast at one time and rushed by special fast express to New York City for the Christmas trade.

Japan produced in 1907 26,072,000 pounds of raw silk from 17,154,000 bushels of cocoons, feeding the silkworms from mulberry leaves grown on 957,560 acres. At the export selling price of this silk in Japan the crop represents a money value of $124,000,000, or more than two dollars per capita for the entire population of the Empire; and engaged in the care of the silkworms, as seen in Figs. 184, 185, 186 and 187, there were, in 1906, 1,407,766 families or some 7,000,000 people.

Richard's geography of the Chinese Empire places the total export of raw silk to all countries, from China, in 1905, at 30,413,200 pounds, and this, at the Japanese export price, represents a value of $145,000,000. Richard also states that the value of the annual Chinese export of silk to France amounts to 10,000,000 pounds sterling and
that this is but twelve per cent of the total, from which it appears that her total export alone reaches a value near $400,000,000.

The use of silk in wearing apparel is more general among the Chinese than among the Japanese, and with China's eightfold greater population, the home consumption of silk must be large indeed and her annual production must much exceed that of Japan. Hosie places the output of raw silk in Szechwan at 5,439,500 pounds, which is nearly a quarter of the total output of Japan, and silk is extensively grown in eight other provinces, which together have an area nearly fivefold that of Japan. It would appear, therefore, that a low estimate of China's annual production of raw silk must be some 120,000,000 pounds, and this, with the output of Japan and Korea, would make a product for the three countries probably exceeding 150,000,000 pounds annually, representing a total value of perhaps $700,000,000; quite equalling in value the wheat
of two and a half pounds of green leaf to one pound of growth.

According to Paton, the cocoons from the 700,000 worms would weigh between 1400 and 2100 pounds and these, according to the observations of Hosie in the province of Szechwan, would yield about one-twelfth their weight of raw silk. On this basis the one pound of worms hatched from the eggs would yield between 116 and 175 pounds of raw silk, worth, at the Japanese export price for 1907, between $550 and $832, and 164 pounds of green mulberry leaves would be required to produce a pound of silk.

A Chinese banker in Chekiang province, with whom we talked, stated that the young worms which would hatch from the eggs spread on a sheet of paper twelve by eighteen inches would consume, in coming to maturity, 2660 pounds of mulberry leaves and would spin 21.6 pounds of silk. This is at the rate of 123 pounds of leaves to one pound of silk. The Japanese crop for 1907, 26,072,000 pounds, produced on 957,560 acres, is a mean yield of

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Fig. 186.—Providing places for silkworms to spin their cocoons.
of two and a half pounds of green leaf to one pound of growth.

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Yields of Mulberries.

27.23 pounds of raw silk per acre of mulberries, and this would require a mean yield of 4465 pounds of green mulberry leaves per acre, at the rate of 164 pounds per pound of silk.

Ordinary silk in these countries is produced largely from three varieties of mulberries, and from them there may be three pickings of leaves for the rearing of a spring, summer and autumn crop of silk. We learned at the Nagoya Experiment Station, Japan, that there good spring yields of mulberry leaves are at the rate of 400 kan, the second crop, 150 kan, and the third crop, 250 kan per tan, making a total yield of over thirteen tons of green leaves per acre. This, however, seems to be materially higher than the average for the Empire.

In Fig. 188 is a near view of a mulberry orchard in Chekiang province, which has been very heavily fertilized with canal mud, and which was at the stage for cutting the leaves to feed the first crop of silkworms. A bundle of cut limbs is in the crotch of the front tree in the view.
Those who raise mulberry leaves are not usually the feeders of the silkworms and the leaves from this orchard were being sold at one dollar, Mexican, per picul, or 32.25 cents per one hundred pounds. The same price was being paid a week later in the vicinity of Nanking, Kiangsu province.

The mulberry trees, as they appear before coming into leaf in the early spring, may be seen in Fig. 189. The long limbs are the shoots of the last year's growth, from which at least one crop of leaves had been picked, and in healthy orchards they may have a length of two to three feet. An orchard from a portion of which the limbs had just been cut, presented the appearance seen in Fig. 190. These trees were twelve to fifteen years old and the enlargements on the ends of the limbs resulted from the frequent pruning, year after year, at nearly the same place. The ground under these trees was thickly covered with a growth of pink clover just coming into bloom, which would be spaded into the soil, providing nitrogen and organic matter, whose decay would liberate potash, phosphorus and other mineral plant food elements for the crop.

In Fig. 191 three rows of mulberry trees, planted four
Fig. 189.—Near view of mulberry tree many years old, showing limbs of the last year’s growth which will be cut close to the old wood when in full leaf.

feet apart, stand on a narrow embankment raised four feet, partly through adjusting the surrounding fields for rice, and partly by additions of canal mud used as a fertilizer. On either side of the mulberries is a crop of wind-
Fig. 190.—Mulberry orchard recently pruned for the first crop of leaves, with unpruned trees along the right.
Cultivating Mulberries.

sor beans, and on the left a crop of rape, both of which would be harvested in early June, the ground where they stand flooded, plowed and transplanted to rice. This and the other mulberry views were taken in the extensively canalized portion of China represented in Fig. 52. The farmer owning this orchard had just finished cutting two large bundles of limbs for the sale of the leaves in the village. He stated that his first crop ordinarily yields from three to as many as twenty piculs per mow, but that the second crop seldom exceeded two to three piculs. The first and second crop of leaves, if yielding together twenty-three piculs per mow, would amount to 9.2 tons per acre, worth, at the price named, $59.34. Mulberry leaves must be delivered fresh as soon as gathered and must be fed the same day, the limbs, when stripped of their leaves, at the place where these are sold, are tied into bundles and reserved for use as fuel.

In the south of China the mulberry is grown from low cuttings rooted by layering. We have before spoken of our five hours ride in the Canton delta region, on the steamer Nanning, through extensive fields of low mulberry then in full leaf, which were first mistaken for cotton nearing the blossom stage. This form of mulberry is seen in Fig. 43, and the same method of pruning is practiced in southern Japan. In middle Japan high pruning, as in Chekiang and Kiangsu provinces, is followed, but in northern Japan the leaves are picked directly, as is the case with the last crop of leaves everywhere, pruning not being practiced in the more northern latitudes.

Not all silk produced in these northern countries is from the domesticated Bombyx mori, large amounts being obtained from the spinnings of wild silkworms feeding upon the leaves of species of oak growing on the mountain and hill lands in various parts of China, Korea and Japan. In China the collections in largest amount are reeled from the cocoons of the tussur worm (Antheraea pernyi) gathered in Shantung, Honan, Kweichow and Szechwan provinces. In the hilly parts of Manchuria also this industry
Fig. 191.—Three rows of mulberry trees occupying a long, narrow embankment which will be surrounded later by flooded rice fields.
Wild Silkworms.

is attaining large proportions, the cocoons being sent to Chefoo in the Shantung province, to be woven into pongee silk.

M. Randot has estimated the annual crop of wild silk cocoons in Szechwan at 10,180,000 pounds, although in the opinion of Alexander Hosie much of this may come from Kweichow. Richard places the export of raw wild silk from the whole of China proper, in 1904, at 4,400,000 pounds. This would mean not less than 75,300,000 pounds of wild cocoons and may be less than half the home consumption.

From data collected by Alexander Hosie it appears that in 1899 the export of raw tussur silk from Manchuria, through the port of Newchwang by steamer alone, was 1,862,448 pounds, valued at $1,721,200, and the production is increasing rapidly. The export from the same port the previous year, by steamer, was 1,046,704 pounds. This all comes from the hilly and mountain lands south of Mukden, lying between the Liao plain on the west and the Yalu river on the east, covering some five thousand square miles, which we crossed on the Antung-Mukden railway.

There are two broods of these wild silkworms each season, between early May and early October. Cocoons of the fall brood are kept through the winter and when the moths come forth they are caused to lay their eggs on pieces of cloth and when the worms are hatched they are fed until the first moult upon the succulent new oak leaves gathered from the hills, after which the worms are taken to the low oak growth on the hills where they feed themselves and spin their cocoons under the cover of leaves drawn about them.

The moths reserved from the first brood, after becoming fertile, are tied by means of threads to the oak bushes where they deposit the eggs which produce the second crop of tussur silk. To maintain an abundance of succulent leaves within reach the oaks are periodically cut back.

Thus these plain people, patient, frugal, unshrinking
from toil, the basic units of three of the oldest nations, go to the uncultivated hill lands and from the wild oak and the millions of insects which they help to feed upon it, not only create a valuable export trade but procure material for clothing, fuel, fertilizer and food, for the large chrysalides, cooked in the reeling of the silk, may be eaten at once or are seasoned with sauce to be used later. Besides this, the last unreelable portion of each cocoon is laid aside to be manufactured into silk wadding and into soft mattresses for caskets upon which the wealthy lay their dead.
XIV.

THE TEA INDUSTRY.

The cultivation of tea in China and Japan is another of the great industries of these nations, taking rank with that of sericulture, if not above it, in the important part it plays in the welfare of the people. There is little reason to doubt that the industry has its foundation in the need of something to render boiled water palatable for drinking purposes. The drinking of boiled water has been universally adopted in these countries as an individually available, thoroughly efficient and safe guard against that class of deadly disease germs which it has been almost impossible to exclude from the drinking water of any densely peopled country.

So far as may be judged from the success of the most thorough sanitary measures thus far instituted, and taking into consideration the inherent difficulties which must increase enormously with increasing populations, it appears inevitable that modern methods must ultimately fail in sanitary efficiency and that absolute safety must be secured in some manner having the equivalent effect of boiling water, long ago adopted by the Mongolian races, and which destroys active disease germs at the latest moment before using. And it must not be overlooked that the boiling of drinking water in China and Japan has been demanded quite as much because of congested rural populations as to guard against such dangers in large cities, while as yet our sanitary engineers have dealt only with the urban phases of this most vital problem and chiefly,
too, thus far, only where it has been possible to procure the water supply in comparatively unpopulated hill lands. But such opportunities cannot remain available indefinitely, any more than they did in China and Japan, and already typhoid epidemics break out in our large cities and citizens are advised to boil their drinking water.

If tea drinking in the family is to remain general in most portions of the world, and especially if it shall increase in proportion to population, there is great industrial

Fig. 192.—Near view of tea garden with ground heavily mulched with straw, adjoining a Japanese farm village.

and commercial promise for China, Korea and Japan in their tea industry if they will develop tea culture still further over the extensive and still unused flanks of the hill lands; improve their cultural methods; their manufacture; and develop their export trade. They have the best of climatic and soil conditions and people sufficiently capable of enormously expanding the industry. Both improvement and expansion of methods along all essential lines, are needed, enabling them to put upon the market pure teas of thoroughly uniform grades of guaranteed quality, and with these the maintenance of an international
code of rigid ethics which shall secure to all concerned a square deal and a fair division of the profits.

The production of rice, silk and tea are three industries which these nations are preeminently circumstanced and qualified to economically develop and maintain. Other nations may better specialize along other lines which fitness determines, and the time is coming when maximum production at minimum cost as the result of clean robust living that in every way is worth while, will determine lines of social progress and of international relations. With the vital awakening to the possibility of and necessity for world peace, it must be recognized that this can be nothing less than universal, industrial, commercial, intellectual and religious, in addition to making impossible forever the bloody carnage that has ravaged the world through all the centuries.

With the extension of rapid transportation and more rapid communication throughout the world, we are fast entering the state of social development which will treat the whole world as a mutually helpful, harmonious industrial unit. It must be recognized that in certain regions, because of peculiar fitness of soil, climate and people, needful products can be produced there better and enough more cheaply than elsewhere to pay the cost of transportation. If China, Korea and Japan, with parts of India, can and will produce the best and cheapest silks, teas or rice, it must be for the greatest good to seek a mutually helpful exchange, and the erection of impassable tariff barriers is a declaration of war and cannot make for world peace and world progress.

The date of the introduction of tea culture into China appears unknown. It was before the beginning of the Christian era and tradition would place it more than 2700 years earlier. The Japanese definitely date its introduction into their islands as in the year 805 A. D., and state its coming to them from China. However and whenever tea growing originated in these countries, it long ago attained and now maintains large proportions. In 1907
Japan had 124,482 acres of land occupied by tea gardens and tea plantations. These produced 60,877,975 pounds of cured tea, giving a mean yield of 489 pounds per acre. Of the more than sixty million pounds of tea produced annually on nearly two hundred square miles in Japan, less than twenty-two million pounds are consumed at home, the balance being exported at a cash value, in 1907, of $6,309,122, or a mean of sixteen cents per pound.

Fig. 193.—Looking across a tea plantation located on the flanks of wooded hill lands rising in the background, Japan.

In China the volume of tea produced annually is much larger than in Japan. Hosie places the annual export from Szechwan into Tibet alone at 40,000,000 pounds and this is produced largely in the mountainous portion of the province west of the Min river. Richard places her direct export to foreign countries, in 1905, at 176,027,255 pounds; and in 1906 at 180,271,000 pounds, so that the annual export must exceed 200,000,000 pounds, and her total product of cured tea must be more than 400,000,000.
The general appearance of tea bushes as they are grown in Japan is indicated in Fig. 192. The form of the bushes, the shape and size of the leaves and the dense green, shiny foliage quite suggests our box, so much used in borders and hedges. When the bushes are young, not covering the ground, other crops are grown between the rows, but as the bushes attain their full size, standing after trimming, waist to breast high, the ground between is usually thickly covered with straw, leaves or grass and weeds from the hill lands, which serve as a mulch, as a fertilizer, as a means of preventing washing on the hillsides, and to force the rain to enter the soil uniformly where it falls.

Quite a large per cent of the tea bushes are grown on small, scattering, irregular areas about dwellings, on land
not readily tilled, but there are also many tea plantations of considerable size, presenting the appearance seen in Fig. 193. After each picking of the leaves the bushes are trimmed back with pruning shears, giving the rows the appearance of carefully trimmed hedges.

![Image of tea pickers weighing leaves](image)

Fig. 195.—Weighing the freshly picked tea leaves in Japan.

The tea leaves are hand picked, generally by women and girls, after the manner seen in Fig. 194, where they are gathering the tender, newly-formed leaves into baskets to be weighed fresh, as seen in Fig. 195.

Three crops of leaves are usually gathered each season, the first yielding in Japan one hundred kan per tan, the
Tea Curing.

second fifty kan and the third eighty kan per tan. This is at the rate of 3307 pounds, 1653 pounds, and 2645 pounds per acre, making a total of 7605 pounds for the season, from which the grower realizes from a little more than 2.2 to a little more than 3 cents per pound of the green leaves, or a gross earning of $167 to $209.50 per acre.

We were informed that the usual cost for fertilizers for the tea orchards was 15 to 20 yen per tan, or $30 to $40 per acre per annum, the fertilizer being applied in the fall, in the early spring and again after the first picking of the leaves. While the tea plants are yet small one winter crop and one summer crop of vegetables, beans or barley are grown between the rows, these giving a return of some forty dollars per acre. Where the plantations are given good care and ample fertilization the life of a plantation may be prolonged continuously, it is said, through one hundred or more years.

During our walk from Joji to Kowata, along a country road in one of the tea districts, we passed a tea-curing house. This was a long rectangular, one-story building with twenty furnaces arranged, each under an open window, around the sides. In front of each heated furnace with its tray of leaves, a Japanese man, wearing only a breech cloth, and in a state of profuse perspiration, was busy rolling the tea leaves between the palms of his hands.

At another place we witnessed the making of the low grade dust tea, which is prepared from the leaves of bushes which must be removed or from those of the prunings. In this case the dried bushes with their leaves were being beaten with flails on a threshing floor. The dust tea thus produced is consumed by the poorer people.
On the 6th of June we left central China for Tientsin and further north, sailing by coastwise steamer from Shanghai, again plowing through the turbid waters which give literal exactness to the name Yellow Sea. Our steamer touched at Tsingtao, taking on board a body of German troops, and again at Chefoo, and it was only between these two points that the sea was not strongly turbid. Nor was this all. From early morning of the 10th until we anchored at Tientsin, 2:30 P. M., our course up the winding Pei ho was against a strong dust-laden wind which left those who had kept to the deck as grey as though they had ridden by automobile through the Colorado desert; so the soils of high interior Asia are still spreading eastward by flood and by wind into the valleys and far over the coastal plains. Over large areas between Tientsin and Peking and at other points northward toward Mukden trees and shrubs have been systematically planted in rectangular hedgerow lines, to check the force of the winds and reduce the drifting of soils, planted fields occupying the spaces between.

It was on this trip that we met Dr. Evans of Sungking, Szechwan province. His wife is a physician practicing among the Chinese women, and in discussing the probable rate of increase of population among the Chinese, it was stated that she had learned through her practice that very many mothers had borne seven to eleven children and yet but one, two or at most three, were living. It was said
there are many customs and practices which determine this high mortality among children, one of which is that of feeding them meat before they have teeth, the mother masticating for the children, with the result that often fatal convulsions follow. A Scotch physician of long experience in Shantung, who took the steamer at Tsingtao, replied to my question as to the usual size of families in his circuit, "I do not know. It depends on the crops. In good years the number is large; in times of famine the girls especially are disposed of, often permitted to die when very young for lack of care. Many are sold at such times to go into other provinces." Such statements, however, should doubtless be taken with much allowance. If all the details were known regarding the cases which have served as foundations for such reports, the matter might appear in quite a different light from that suggested by such cold recitals.

Although land taxes are high in China Dr. Evans informed me that it is not infrequent for the same tax to be levied twice and even three times in one year. Inquiries regarding the land taxes among farmers in different parts of China showed rates running from three cents to a dollar and a half, Mexican, per mow; or from about eight cents to $3.87 gold, per acre. At these rates a forty acre farm would pay from $3.20 to $154.80, and a quarter section four times these amounts. Data collected by Consul-General E. T. Williams of Tientsin indicate that in Shantung the land tax is about one dollar per acre, and in Chihli, twenty cents. In Kiangsi province the rate is 200 to 300 cash per mow, and in Kiangsu, from 500 to 600 cash per mow, or, according to the rate of exchange given on page 76, from 60 to 80 cents, or 90 cents to $1.20 per acre in Kiangsi; and $1.50 to $2.00 or $1.80 to $2.40 in Kiangsu province. The lowest of these rates would make the land tax on 160 acres, $96, and the highest would place it at $384, gold.

In Japan the taxes are paid quarterly and the combined amount of the national, prefectural and village assessments
usually aggregates about ten per cent of the government valuation placed on the land. The mean valuation placed on the irrigated fields, excluding Formosa and Karafuto, was in 1907, 35.35 yen per tan; that of the upland fields, 9.40 yen, and the ge nya and pasture lands were given a valuation of .22 yen per tan. These are valuations of $70.70, $18.80 and $.44, gold, per acre, respectively, and the taxes on forty acres of paddy field would be $282.80; $75.20 on forty acres of upland field, and $1.76, gold, on the same area of the ge nya and weed lands.

In the villages, where work of one or another kind is done for pay, Dr. Evans stated that a woman’s wage might not exceed $8, Mexican, or $3.44, gold, per year, and when we asked how it could be worth a woman’s while to work a whole year for so small a sum, his reply was, “If she did not do this she would earn nothing, and this would keep her in clothes and a little more.” A cotton spinner in his church would procure a pound of cotton and on returning the yarn would receive one and a quarter pounds of cotton in exchange, the quarter pound being her compensation.

Dr. Evans also described a method of rooting slips from trees, practiced in various parts of China. The under side of a branch is cut, bent upward and split for a short distance; about this is packed a ball of moistened earth wrapped in straw to retain the soil and to provide for future watering; the whole may then be bound with strips of bamboo for greater stability. In this way slips for new mulberry orchards are procured.

At eight o’clock in the morning we entered the mouth of the Pei ho and wound westward through a vast, nearly sea-level, desert plain and in both directions, far toward the horizon, huge white stacks of salt dotted the surface of the Taku Government salt fields, and revolving in the wind were great numbers of horizontal sail windmills, pumping sea water into an enormous acreage of evaporation basins. In Fig. 196 may be seen five of the large-
Salt Works.

Salt stacks and six of the windmills, together with many smaller piles of salt. Fig. 197 is a closer view of the evaporation basins with piles of salt scraped from the surface after the mother liquor had been drained away. The windmills, which were working one, sometimes two, of the large wooden chain pumps, were some thirty feet in diameter and lifted the brine from tide-water basins into those of a second and third higher level where the second and final concentration occurred. These windmills, crude as they appear in Fig. 198, are nevertheless efficient, cheaply constructed and easily controlled. The eight sails, each six by ten feet, were so hung as to take the wind through the entire revolution, tilting automatically to receive the wind on the opposite face the moment the edge passed the critical point. Some 480 feet of sail surface were thus spread to the wind, working on a radius of fifteen feet. The horizontal drive wheel had a diameter of ten feet, carried eighty-eight wooden cogs which engaged a pinion with fifteen leaves, and there were nine arms on the reel at the other end of the shaft which drove the chain. The boards or buckets of the chain pump were six by twelve inches, placed nine inches apart, and with a fair breeze the pump ran full.
Enormous quantities of salt are thus cheaply manufactured through wind, tide and sun power directed by the cheapest human labor. Before reaching Tientsin we passed the Government storage yards and counted two hundred stacks of salt piled in the open, and more than a third of the yard had been passed before beginning the count. The average content of each stack must have exceeded 3000 cubic feet of salt, and more than 40,000,000 pounds must have been stored in the yards. Armed guards in military uniform patrolled the alleyways day and night. Long strips of matting laid over the stacks were the only shelter against rain.

Throughout the length of China's seacoast, from as far north as beyond Shanhaikwan, south to Canton, salt is manufactured from sea water in suitable places. In Szechwan province, we learn from the report of Consul-General Hosie, that not less than 300,000 tons of salt are
annually manufactured there, largely from brine raised by animal power from wells seven hundred to more than two thousand feet deep.

Hosie describes the operations at a well more than two thousand feet deep, at Tzeliutsing. In the basement of a power-house which sheltered forty water buffaloes, a huge bamboo drum twelve feet high, sixty feet in circumference, was so set as to revolve on a vertical axis propelled by four cattle drawing from its circumference. A hemp rope was wound about this drum, six feet from the ground, passing out and under a pulley at the well, then up and around a wheel mounted sixty feet above and descended to the bucket made from bamboo stems four inches in diameter and nearly sixty feet long, which dropped with
great speed to the bottom of the well as the rope unwound. When the bucket reached the bottom four attendants, each with a buffalo in readiness, hitched to the drum and drove at a running pace, during fifteen minutes, or until the bucket was raised from the well. The buffalo were then unhitched and, while the bucket was being emptied and again dropped to the bottom of the well, a fresh relay were brought to the drum. In this way the work continued night and day.

The brine, after being raised from the well, was emptied into distributing reservoirs, flowing thence through bamboo pipes to the evaporating sheds where round-bottomed, shallow iron kettles four feet across were set in brick arches in which jets of natural gas were burning.

Within an area some sixty miles square there are more than a thousand brine and twenty fire wells from which fuel gas is taken. The mouths of the fire wells are closed with masonry, out from which bamboo conduits coated with lime lead to the various furnaces, terminating with iron burners beneath the kettles. Remarkable is the fact that in the city of Tzeliutsing, both these brine and the fire wells have been operated in the manufacture of salt since before Christ was born.

The forty water buffalo are worth $30 to $40 per head and their food fifteen to twenty cents per day. The cost of manufacturing this salt is placed at thirteen to fourteen cash per catty, to which the Government adds a tax of nine cash more, making the cost at the factory from 82 cents to $1.15, gold, per hundred pounds. Salt manufacture is a Government monopoly and the product must be sold either to Government officials or to merchants who have bought the exclusive right to supply certain districts. The importation of salt is prohibited by treaties. For the salt tax collection China is divided into eleven circuits each having its own source of supply and transfer of salt from one circuit to another is forbidden.

The usual cost of salt is said to vary between one and a half and four cash per catty. The retail price of salt
ranges from three-fourths to three cents per pound, fully twelve to fifteen times the cost of manufacture. The annual production of salt in the Empire is some 1,860,000 tons, and in 1901 salt paid a tax close to ten million dollars.

Beyond the salt fields, toward Tientsin, the banks of the river were dotted at short intervals with groups of low, almost windowless houses, Fig. 199, built of earth brick plastered with clay on sides and roof, made more resistant to rain by an admixture of chaff and cut straw, and there was a remarkable freshness of look about them which we learned was the result of recent preparations made for the rainy season about to open. Beyond the first of these villages came a stretch of plain dotted thickly and far with innumerable grave mounds, to which reference has been made. For nearly an hour we had traveled up the river before there was any material vegetation, the soil being too saline apparently to permit growth, but beyond this, crops in the fields and gardens, with some fruit and other trees, formed a fringe of varying width

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Fig. 199.—Chinese village on the bank of the Pei ho, Province of Chihli.
along the banks. Small fields of transplanted rice on both banks were frequent and often the land was laid out in beds of two levels, carefully graded, the rice occupying the lower areas, and wooden chain pumps were being worked by hand, foot and animal power, irrigating both rice and garden crops.

In the villages were many stacks of earth compost, of the Shantung type; manure middens were common and donkeys drawing heavy stone rollers followed by men with large wooden mallets, were going round and round, pulverizing and mixing the dry earth compost and the large earthen brick from dismantled kangs, preparing fertilizer for the new series of crops about to be planted, following the harvest of wheat and barley. Large boat-loads of these prepared fertilizers were moving on the river and up the canals to the fields.

Toward the coast from Tientsin, especially in the country traversed by the railroad, there was little produced except a short grass, this being grazed at the time of our visit and, in places, cut for a very meagre crop of hay. The productive cultivated lands lie chiefly along the rivers and canals or other water courses, where there is better drainage as well as water for irrigation. The extensive, close canalization that characterizes parts of Kiangsu and Chekiang provinces is lacking here and for this reason, in part, the soil is not so productive. The fuller canalization, the securing of adequate drainage and the gaining of complete control of the flood waters which flow through this vast plain during the rainy season constitute one of China's most important industrial problems which, when properly solved, must vastly increase her resources. During our drive over the old Peking-Taku road saline deposits were frequently observed which had been brought to the surface during the dry season, and the city engineer of Tientsin stated that in their efforts at parking portions of the foreign concessions they had found the trees dying after a few years when their roots began to penetrate the
more saline subsoil, but that since they had opened canals, improving the drainage, trees were no longer dying. There is little doubt that proper drainage by means of canals, and the irrigation which would go with it, would make all of these lands, now more or less saline, highly productive, as are now those contiguous to the existing water courses.

![China's method of shallow cultivation](image)

*Fig. 200.—* China's method of shallow cultivation, producing an earth mulch to conserve soil moisture.

It had rained two days before our drive over the Taku road and when we applied for a conveyance the proprietor doubted whether the roads were passible, as he had been compelled to send out an extra team to assist in the return of one which had been stalled during the previous night. It was finally arranged to send an extra horse with us. The rainy season had just begun but the deep trenching of the roads concentrates the water in them and greatly intensifies the trouble. In one of the little hamlets through which we passed the roadway was trenched to a depth of three to four feet in the middle of the narrow street, leaving only five feet for passing in front of the dwellings
on either side, and in this trench our carriage moved through mud and water nearly to the hubs.

Between Tientsin and Peking, in the early morning after a rain of the night before, we saw many farmers working their fields with the broad hoes, developing an earth mulch at the first possible moment to conserve their much needed moisture. Men were at work, as seen in Figs. 200 and 201, using long handled hoes, with blades

![Hoe used for shallow cultivation in developing an earth mulch. The blade is 13 inches long and 9 inches wide.](image)

nine by thirteen inches, hung so as to draw just under the surface, doing very effective work, permitting them to cover the ground rapidly.

Walking further, we came upon six women in a field of wheat, gleaning the single heads which had prematurely ripened and broken over upon the ground between the rows soon to be harvested. Whether they were doing this as a privilege or as a task we do not know; they were strong, cheerful, reasonably dressed, hardly past middle life and it was nearly noon, yet not one of them had col-
lected more straws than she could readily grasp in one hand. The season in Chihli as in Shantung, had been one of unusual drought, making the crop short and perhaps unusual frugality was being practiced; but it is in saving that these people excel perhaps more than in producing. These heads of wheat, if left upon the ground, would be wasted and if the women were privileged gleaners in the fields their returns were certainly much greater than were those of the very old women we have seen in France gathering heads of wheat from the already harvested fields.

In the fields between Tientsin and Peking all wheat was being pulled, the earth shaken from the roots, tied in small bundles and taken to the dwellings, sometimes on the heavy cart drawn by a team consisting of a small donkey and cow hitched tandem, as seen in Fig. 202. Millet had been planted between the rows of wheat in this field and was already up. When the wheat was removed the ground would be fertilized and planted to soy beans. Because of the dry season this farmer estimated his yield would be but eight to nine bushels per acre. He was ex-
pecting to harvest thirteen to fourteen bushels of millet and from ten to twelve bushels of soy beans per acre from the same field. This would give him an earning, based on the local prices, of $10.36, gold, for the wheat; $6.00 for the beans, and $5.48 per acre for the millet. This land was owned by the family of the Emperor and was rented at $1.55, gold, per acre. The soil was a rather light sandy loam, not inherently fertile, and fertilizers to the value of $3.61 gold, per acre, had been applied, leaving the earning $16.71 per acre.

Another farmer with whom we talked, pulling his crop of wheat, would follow this with millet and soy beans in alternate rows. His yield of wheat was expected to be eleven to twelve bushels per acre, his beans twenty-one bushels and his millet twenty-five bushels which, at the local prices for grain and straw, would bring a gross earning of $35, gold, per acre.

Before reaching the end of our walk through the fields toward the next station we came across another of the many instances of the labor these people are willing to perform for only a small possible increase in crop. The field was adjacent to one of the windbreak hedges and the trees had spread their roots far afield and were threatening his crop through the consumption of moisture and plant food. To check this depletion the farmer had dug a trench twenty inches deep the length of his field, and some twenty feet from the line of trees, thereby cutting all of the surface roots to stop their draft on the soil. The trench was left open and an interesting feature observed was that nearly every cut root on the field side of the trench had thrown up one or more shoots bearing leaves, while the ends still connected with the trees showed no signs of leaf growth.

In Chihli as elsewhere the Chinese are skilled gardeners, using water for irrigation whenever it is advantageous. One gardener was growing a crop of early cabbage, followed by one of melons, and these with radish the same
Yields.

season. He was paying a rent of $6.45, gold, per acre; was applying fertilizer at a cost of nearly $8 per acre for each of the three crops, making his cash outlay $29.67 per acre. His crop of cabbage sold for $103, gold; his melons for $77, and his radish for something more than $51, making a total of $232.20 per acre, leaving him a net value of $202.53.

A second gardener, growing potatoes, obtained a yield, when sold new, of 8,000 pounds per acre; and of 16,000 pounds when the crop was permitted to mature. The new potatoes were sold so as to bring $51.60 and the mature potatoes $185.76 per acre, making the earning for the two crops the same season a total of $237.36, gold. By planting the first crop very early these gardeners secure two crops the same season, as far north as Columbus, Ohio, and Springfield, Illinois, the first crop being harvested when the tubers are about the size of walnuts. The rental and fertilizers in this case amounted to $30.96 per acre.

Still another gardener growing winter wheat followed by onions, and these by cabbage, both transplanted, realized from the three crops a gross earning of $176.73, gold, per acre, and incurred an expense of $31.73 per acre for fertilizer and rent, leaving him a net earning of $145 per acre.

These old people have acquired the skill and practice of storing and preserving such perishable fruits as pears and grapes so as to enable them to keep them on the markets almost continuously. Pears were very common in the latter part of June, and Consul-General Williams informed me that grapes are regularly carried into July. In talking with my interpreter as to the methods employed I could only learn that the growers depend simply upon dry earth cellars which can be maintained at a very uniform temperature, the separate fruits being wrapped in paper. No foreigner with whom we talked knew their methods.

Vegetables are carried through the winter in such earth cellars as are seen in Fig. 88, page 161, these being covered after they are filled.
As to the price of labor in this part of China, we learned through Consul-General Williams that a master mechanic may receive 50 cents, Mexican, per day, and a journeyman 18 cents, or at a rate of 21.5 cents and 7.75 cents, gold. Farm laborers receive from $20 to $30, Mexican, or $8.60 to $12.90, gold, per year, with food, fuel and presents which make a total of $17.20 to $21.50. This is less for the year than we pay for a month of probably less efficient labor. There is relatively little child labor in China and this perhaps should be expected when adult labor is so abundant and so cheap.
The 39th parallel of latitude lies just south of Tientsin; followed westward, it crosses the toe of Italy's boot, leads past Lisbon in Portugal, near Washington and St. Louis and to the north of Sacramento on the Pacific. We were leaving a country with a mean July temperature of 80° F., and of 21° in January, but where two feet of ice may form; a country where the eighteen year mean maximum temperature is 103.5° and the mean minimum 4.5°; where twice in this period the thermometer recorded 113° above zero, and twice 7° below, and yet near the coast and in the latitude of Washington; a country where the mean annual rainfall is 19.72 inches and all but 3.37 inches falls in June, July, August and September. We had taken the 5:40 A. M. Imperial North-China train, June 17th, to go as far northward as Chicago,—to Mukden in Manchuria, a distance by rail of some four hundred miles, but all of the way still across the northward extension of the great Chinese coastal plain. Southward, out from the coldest quarter of the globe, where the mean January temperature is more than 40° below zero, sweep northerly winds, which bring to Mukden a mean January temperature only 3° above zero, and yet there the July temperature averages as high as 77° and there is a mean annual rainfall of but 18.5 inches, coming mostly in the summer, as at Tientsin.

Although the rainfall of the northern extension of China's coastal plain is small, its efficiency is relatively
high because of its most favorable distribution and the high summer temperatures. In the period of early growth, April, May and June, there are 4.18 inches; but in the period of maximum growth, July and August, the rainfall is 11.4 inches; and in the ripening period, September and October, it is 3.08 inches, while during the rest of the year but 1.06 inch falls. Thus most of the rain comes at the time when the crops require the greatest daily consumption and it is least in mid-winter, during the period of little growth.

As our train left Tientsin we traveled for a long distance through a country agriculturally poor and little tilled, with surface flat, the soil apparently saline, and the land greatly in need of drainage. Wherever there were canals the crops were best, apparently occupying more or less continuous areas along either bank. The day was hot and sultry but laborers were busy with their large hoes, often with all garments laid aside except a short shirt or a pair of roomy trousers.

In the salt district about the village of Tangku there were huge stacks of salt and smaller piles not yet brought together, with numerous windmills, constituting most striking features in the landscape, but there was almost no agricultural or other vegetation. Beyond Pehtang there are other salt works and a canal leads westward to Tientsin, on which the salt is probably taken thither, and still other salt stacks and windmills continued visible until near Hanku, where another canal leads toward Peking. Here the coast recedes eastward from the railway and beyond the city limits many grave mounds dot the surrounding plains where herds of sheep were grazing.

As we hurried toward the delta region of the Lwan ho, and before reaching Tangshan, a more productive country was traversed. Thrifty trees made the landscape green, and fields of millet, kaoliang and wheat stretched for miles together along the track and back over the flat plain beyond the limit of vision. Then came fields planted with
two rows of maize alternating with one row of soy beans, but not over twenty-eight inches apart, one stalk of corn in a place every sixteen to eighteen inches, all carefully hoed, weedless andblanketed with an excellent earth mulch; but still the leaves were curling in the intense heat of the sun. Tangshan is a large city, apparently of recent growth on the railroad in a country where isolated conical hills rise one hundred or two hundred feet out of the flat plains. Cart loads of finely pulverized earth compost were here moving to the fields in large numbers, being laid in single piles of five hundred to eight hundred pounds, forty to sixty feet apart. At Kaiping the country grows a little rolling and we passed through the first railway cuts, six to eight feet deep, and the water in the streams is running ten to twelve feet below the surface of the fields. On the right and beyond Kuyeh there are low hills, and here we passed enormous quantities of dry, finely powdered earth compost, distributed on narrow unplanted area over the fields. What crop, if indeed any, had occupied these areas this season, we could not judge. The fertilization here is even more extensive and more general than we found it in the Shantung province, and in places water was being carried in pails to the fields for use either in planting or in transplanting, to ensure the readiness of the new crops to utilize the first rainfall when it comes.

Then the bed of a nearly dry stream some three hundred feet wide was crossed and beyond it a sandy plain was planted in long narrow fields between windbreak hedges. The crops were small but evidently improved by the influence of the shelter. The sand in places had drifted into the hedges to a height of three feet. At a number of other places along the way before Mukden was reached such protected areas were passed and oftenest on the north side of wide, now nearly dry, stream channels.

As we passed on toward Shankaikwan we were carried over broad plains even more nearly level and unobstructed
than any to be found in the corn belt of the middle west, and these too planted with corn, kaoliang, wheat and beans, and with the low houses hidden in distant scattered clusters of trees dotting the wide plain on either side, with not a fence, and nothing to suggest a road anywhere in sight. We seemed to be moving through one vast field dotted with hundreds of busy men, a plowman here, and there a great cart hopelessly lost in the field so far as one could see any sign of road to guide their course.

Fig. 203.—Exportation of soy beans from Manchuria. Lwanchow, Chihli.

Some early crop appeared to have been harvested from areas alternating with those on the ground, and these were dotted with piles of the soil and manure compost, aggregating hundreds of tons, distributed over the fields but no doubt during the next three or four days these thousands of piles would have been worked into the soil and vanished from sight, to reappear after another crop and another year.

It was at Lwanchoh that we met the out-going tide of soy beans destined for Japan and Europe, pouring in from the surrounding country in gunny sacks brought on heavy carts drawn by large mules, as seen in Fig. 203, and enormous quantities had been stacked in the open
along the tracks, with no shelter whatever, awaiting the arrival of trains to move them to export harbors.

The planting here, as elsewhere, is in rows, but not of one kind of grain. Most frequently two rows of maize, kaoliang or millet alternated with the soy beans and usually not more than twenty-eight inches apart, sharp high ridge cultivation being the general practice. Such planting secures the requisite sunshine with a larger number of plants on the field; it secures a continuous general distribution of the roots of the nitrogen-fixing soy beans in the soil of all the field every season, and permits the soil to be more continuously and more completely laid under tribute by the root systems. In places where the stand of corn or millet was too open the gaps were filled with the soy beans. Such a system of planting possibly permits a more immediate utilization of the nitrogen gathered from the soil air in the root nodules, as these die and undergo nitrification during the same season, while the crops are yet on the ground, and so far as phosphorus and potassium compounds are liberated by this decay, they too would become available to the crops.

The end of the day's journey was at Shanhaikwan on the boundary between Chihli and Manchuria, the train stopping at 6:20 P. M. for the night. Stepping upon the veranda from our room on the second floor of a Japanese inn in the early morning, there stood before us, sullen and grey, the eastern terminus of the Great Wall, winding fifteen hundred miles westward across twenty degrees of longitude, having endured through twenty-one centuries, the most stupendous piece of construction ever conceived by man and executed by a nation. More than twenty feet thick at the base and than twelve feet on the top; rising fifteen to thirty feet above the ground with parapets along both faces and towers every two hundred yards rising twenty feet higher, it must have been, for its time and the methods of warfare then practiced, when defended by their thousands, the boldest and most efficient national
defense ever constructed. Nor in the economy of construction and maintenance has it ever been equalled.

Even if it be true that 20,000 masons toiled through ten years in its building, defended by 400,000 soldiers, fed by a commissariat of 20,000 more and supported by 30,000 others in the transport, quarry and potters' service, she would then have been using less than eight tenths per cent of her population, on a basis of 60,000,000 at the time; while according to Edmond Théry's estimate, the officers and soldiers of Europe today, in time of peace, constitute one per cent of a population of 400,000,000 of people, and these, at only one dollar each per day for food, clothing and loss of producing power would cost her nations, in ten years, more than $14,000 million. China, with her present habits and customs, would more easily have maintained her army of 470,000 men on thirty cents each per day, or for a total ten-year cost of but $520,000,000. The French cabinet in 1900 approved a naval program involving an expenditure of $600,000,000 during the next ten years, a tax of more than $15 for every man, woman and child in the Republic.

Leaving Shanhaikwan at 5:20 in the morning and reaching Mukden at 6:30 in the evening, we rode the entire day through Manchurian fields. Manchuria has an area of 363,700 square miles, equal to that of both Dakotas, Minnesota, Nebraska and Iowa combined. It has roughly the outline of a huge boot and could one slide it eastward until Port Arthur was at Washington, Shanhaikwan would fall well toward Pittsburg, both at the tip of the broad toe to the boot. The foot would lie across Pennsylvania, New York, New Jersey and all of New England, extending beyond New Brunswick with the heel in the Gulf of St. Lawrence. Harbin, at the instep of the boot, would lie fifty miles east of Montreal and the expanding leg would reach northwestward nearly to James Bay, entirely to the north of the Ottawa river and the Canadian Pacific, spanning a thousand miles of latitude and nine hundred miles of longitude.
The Liao plain, thirty miles wide, and the central Sungari plain, are the largest in Manchuria, forming together a long narrow valley floor between two parallel mountain systems and extending northeasterly from the Liao gulf, between Port Arthur and Shanhaikwan, up the Liao river and down the Sungari to the Amur, a distance of eight hundred or more miles. These plains have a fertile, deep soil and it is on them and other lesser river bottoms that Manchurian agriculture is developed, supporting eight or nine million people on a cultivated acreage possibly not greater than 25,000 square miles.

Manchuria has great forest and grazing possibilities awaiting future development, as well as much mineral wealth. The population of Tsitsihar, in the latitude of middle North Dakota, swells from thirty thousand to seventy thousand during September and October, when the Mongols bring in their cattle to market. In the middle province, at the head of steam navigation on the Sungari, because of the abundance and cheapness of lumber, Kirin has become a ship-building center for Chinese junks. The Sungari—Milky—river, is a large stream carrying more water at flood season than the Amur above its mouth, the latter being navigable 450 miles for steamers drawing twelve feet of water, and 1500 miles for those drawing four feet, so that during the summer season the middle and northern provinces have natural inland waterways, but the outlet to the sea is far to the north and closed by ice six months of the year.

Not far beyond the Great Wall of China, fast falling into ruin, partly through the appropriation of its material for building purposes now that it has outlived its usefulness, another broad, nearly dry stream bed was crossed. There, in full bloom, was what appeared to be the wild white rose seen earlier, further south, west of Suchow, having a remarkable profusion of small white bloom in clusters resembling the Rambler rose. One of these bushes growing wild there on the bank of the canal had over-
spread a clump of trees one of which was thirty feet in height, enveloping it in a mantle of bloom, as seen in the upper section of Fig. 204. The lower section of the illus-

Fig. 204.—Wild white rose in bloom west of Suchow, June 2d, and in southern Manchuria, June 18th. Lower section, close view of same, showing clusters.

stration is a closer view showing the clusters. The stem of this rose, three feet above the ground, measured 14.5 inches in circumference. If it would thrive in this country nothing could be better for parks and pleasure drives.
Later on our journey we saw it many times in bloom along the railway between Mukden and Antung, but nowhere attaining so large growth. The blossoms are scant three-fourths inch in diameter, usually in compact clusters of three to eleven, sometimes in twos and occasionally standing singly. The leaves are five-foliate, sometimes trifoliate; leaflets broadly lanceolate, acuminate and finely serrate; thorns minute, recurrent and few, only on the smaller branches.

In a field beyond, a small donkey was drawing a stone roller three feet long and one foot in diameter, firming the crests of narrow, sharp, recently formed ridges, two at a time. Millet, maize and kaoliang were here the chief crops. Another nearly dry stream was crossed, where the fields became more rolling and much cut by deep gulleys, the first instances we had seen in China except on the steep hillsides about Tsingtao. Not all of the lands here were cultivated, and on the untilled areas herds of fifty to a hundred goats, pigs, cattle, horses and donkeys were grazing.

Fields in Manchuria are larger than in China and some rows were a full quarter of a mile long, so that cultivation was being done with donkeys and cattle, and large numbers of men were working in gangs of four, seven, ten, twenty, and in one field as high as fifty, hoeing millet. Such a crew as the largest mentioned could probably be hired at ten cents each, gold, per day, and were probably men from the thickly settled portions of Shantung who had left in the spring, expecting to return in September or October. Both laborers and working animals were taking dinner in the fields, and earlier in the day we had seen several instances where hay and feed were being taken to the field on a wooden sled, with the plow and other tools. At noon this was serving as manger for the cattle, mules or donkeys.

In fields where the close, deep furrowing and ridging was being done the team often consisted of a heavy ox.
and two small donkeys driven abreast, the three walking in adjacent rows, the plow following the ox, or a heavy mule instead.

The rainy season had not begun and in many fields there was planting and transplanting where water was used in separate hills, sometimes brought in pails from a nearby stream, and in other cases on carts provided with tanks. Holes were made along the crests of the ridges with the blade of a narrow hoe and a little water poured in each hill, from a dipper, before planting or setting. These must have been other instances where the farmers were willing to incur additional labor to save time for the maturing of the crop by assisting germination in a soil too dry to make it certain until the rains came.

It appears probable that the strong ridging and the close level rows so largely adopted here must have marked advantages in utilizing the rainfall, especially the portions coming early, and that later also if it should come in heavy showers. With steep narrow ridging, heavy rains would be shed at once to the bottom of the deep furrows without over-saturating the ridges, while the wet soil in the bottom of the furrows would favor deep percolation with lateral capillary flow taking place strongly under the ridges from the furrows, carrying both moisture and soluble plant food where they will be most completely and quickly available. When the rain comes in heavy showers each furrow may serve as a long reservoir which will prevent washing and at the same time permit quick penetration; the ridges never becoming flooded or puddled, permit the soil air to escape readily as the water from the furrows sinks, as it cannot readily do in flat fields when the rains fall rapidly and fill all of the soil pores, thus closing them to the escape of air from below, which must take place before the water can enter.

When rows are only twenty-four to twenty-eight inches apart, ridging is not sufficiently more wasteful of soil moisture, through greater evaporation because of increased surface, to compensate for the other advantages gained,
and hence their practice, for their conditions, appears sound.

The application of finely pulverized earth compost to fields to be planted, and in some cases where the fields were already planted, continued general after leaving Shanhaikwan as it had been before. Compost stacks were common in yards wherever buildings were close enough to the track to be seen. Much of the way about one-third of the fields were yet to be, or had just been, planted and in a great majority of these compost fertilizer had been laid down for use on them, or was being taken to them in large heavy carts drawn sometimes by three mules. Between Sarhougon and Ningyuenchow fourteen fields thus fertilized were counted in less than half a mile; ten others in the next mile; eleven in the mile and a quarter following. In the next two miles one hundred fields were counted and just before reaching the station we counted during five minutes, with watch in hand, ninety-five fields to be planted, upon which this fertilizer had been brought. In some cases the compost was being spread in furrows between the rows of a last year’s crop, evidently to be turned under, thus reversing the position of the ridges.

After passing Lienshan, where the railway runs near the sea, a sail was visible on the bay and many stacks of salt piled about the evaporation fields were associated with the revolving sail windmills already described. Here, too, large numbers of cattle, horses, mules and donkeys were grazing on the untilled low lands, beyond which we traversed a section where all fields were planted, where no fertilizer was piled in the field but where many groups of men were busy hoeing, sometimes twenty in a gang.

Chinese soldiers with bayonetted guns stood guard at every railway station between Shanhaikwan and Mukden, and from Chinchowfu our coach was occupied by some Chinese official with guests and military attendants, including armed soldiers. The official and his guests were an attractive group of men with pleasant faces and winning manners, clad in many garments of richly figured silk of
bright, attractive, but unobtrusive, colors, who talked, seriously or in mirth, almost incessantly. They took the train about one o’clock and lunch was immediately served in Chinese style, but the last course was not brought until nearly four o’clock. At every station soldiers stood in line in the attitude of salute until the official car had passed.

Just before reaching Chinchowfu we saw the first planted fields littered with stubble of the previous crop, and in many instances such stubble was being gathered and removed to the villages, large stacks having been piled in the yards to be used either as fuel or in the production of compost. As the train approached Taling ho groups of men were hoeing in millet fields, thirty in one group on one side and fifty in another body on the other. Many small herds of cattle, horses, donkeys and flocks of goats and sheep were feeding along stream courses and on the unplanted fields. Beyond the station, after crossing the river, still another sand dune tract was passed, planted with willows, millet occupying the level areas between the dunes, and not far beyond, wide untilled flats were crossed, on which many herds were grazing and dotted with grave mounds as we neared Koupantze, where a branch of the railway traverses the Liao plain to the port of Newchang. It was in this region that there came the first suggestion of resemblance to our marshland meadows; and very soon there were seen approaching from the distance loads so green that except for the large size one would have judged them to be fresh grass. They were loads of cured hay in the brightest green, the result, no doubt, of curing under their dry weather conditions.

At Ta Hu Shan large quantities of grain in sacks were piled along the tracks and in the freight yards, but under matting shelters. Near here, too, large three-mule loads of dry earth compost were going to the fields and men were busy pulverizing and mixing it on the threshing floors preparatory for use. Nearly all crops growing were one or another of the millets, but considerable areas were
yet unplanted and on these cattle, horses, mules and donkeys were feeding and eight more loads of very bright new made hay crossed the track.

When the train reached Sinminfu where the railway turns abruptly eastward to cross the Liao ho to reach Mukden we saw the first extensive massing of the huge bean cakes for export, together with enormous quantities of soy beans in sacks piled along the railway and in the freight yards or loaded on cars made up in trains ready to move. Leaving this station we passed among fields of grain looking decidedly yellow, the first indication we had seen in China of crops nitrogen-hungry and of soils markedly deficient in available nitrogen. Beyond the next station the fields were decidedly spotted and uneven as well as yellow, recalling conditions so commonly seen at home and which had been conspicuously absent here before. Crossing the Liao ho with its broad channel of shifting sands, the river carrying the largest volume of water we had yet seen, but the stream very low and still characteristic of the close of the dry season of semi-arid climates, we soon reached another station where the freight yards and all of the space along the tracks were piled high with bean cakes and yet the fields about were reflecting the impoverished condition of the soil through the yellow crops and their uneven growth on the fields.

Since the Japanese-Russian war the shipments of soy beans and of bean cake from Manchuria have increased enormously. Up to this time there had been exports to the southern provinces of China where the bean cakes were used as fertilizers for the rice fields, but the new extensive markets have so raised the price that in several instances we were informed they could not then afford to use bean cake as fertilizer. From Newchwang alone, in 1905, between January 1st and March 31st, there went abroad 2,286,000 pounds of beans and bean cake, but in 1906 the amount had increased to 4,883,000 pounds. But a report published in the Tientsin papers as official, while we were there, stated that the value of the export of
bean cake and soy beans for the months ending March 31st had been, in 1909, only $1,635,000, gold, compared with $3,065,000 in the corresponding period of 1908, and of $5,120,000 in 1907, showing a marked decrease.

Edward C. Parker, writing from Mukden for the Review of Reviews, stated: "The bean cake shipments from Newchwang, Dalny and Antung in 1908 amounted to 515,198 tons; beans, 239,298 tons; bean oil, 1930 tons; having a total value of $15,016,649 (U. S. gold)."

According to the composition of soy beans as indicated in Hopkins' table of analyses, these shipments of beans and bean cake would remove an aggregate of 6171 tons of phosphorus, 10,097 tons of potassium, and 47,812 tons of nitrogen from Manchurian soils as the result of export for that year. Could such a rate have been maintained during two thousand years there would have been sold from these soils 20,194,000 tons of potassium; 12,342,000 tons of phosphorus and 95,624,000 tons of nitrogen; and the phosphorus, were it thus exported, would have exceeded more than threefold all thus far produced in the United States; it would have exceeded the world's output in 1906 more than eighteen times, even assuming that all phosphate rock mined was seventy-five per cent pure.

The choice of the millets and the sorghums as the staple bread crops of northern China and Manchuria has been quite as remarkable as the selection of rice for the more southern latitudes, and the two together have played a most important part in determining the high maintenance efficiency of these people. In nutritive value these grains rank well with wheat; the stems of the larger varieties are extensively used for both fuel and building material and the smaller forms make excellent forage and have been used directly for maintaining the organic content of the soil. Their rapid development and their high endurance of drought adapt them admirably to the climate of north China and Manchuria where the rains begin only after late June and where weather too cold for growth comes earlier in the fall. The quick maturity of these crops
also permits them to be used to great advantage even throughout the south, in their systems of multiple cropping so generally adopted, while their great resistance to drought, being able to remain at a standstill for a long time when the soil is too dry for growth and yet be able to push ahead rapidly when favorable rains come, permits them to be used on the higher lands generally where water is not available for irrigation.

In the Shantung province the large millet, sorghum or kaoliang, yields as high as 2000 to 3000 pounds of seed per acre, and 5600 to 6000 pounds of air-dry stems, equal in weight to 1.6 to 1.7 cords of dry oak wood. In the region of Mukden, Manchuria, its average yield of seed is placed at thirty-five bushels of sixty pounds weight per acre, and with this comes one and a half tons of fuel or of building material. Hosie states that the kaoliang is the staple food of the population of Manchuria and the principal grain food of the work animals. The grain is first washed in cold water and then poured into a kettle with four times its volume of boiling water and cooked for an hour, without salt, as with rice. It is eaten with chopsticks with boiled or salted vegetables. He states that an ordinary servant requires about two pounds of this grain per day, and that a workman at heavy labor will take double the amount. A Chinese friend of his, keeping five servants, supplied them with 240 pounds of millet per month, together with 16 pounds of native flour, regarded as sufficient for two days, and meat for two days, the amount not being stated. Two of the small millets (Setaria Italica and Panicum miliaceum), wheat, maize and buckwheat are other grains which are used as food but chiefly to give variety and change of diet.

Very large quantities of matting and wrappings are also made from the leaves of the large millet, which serve many purposes corresponding with the rice mattings and bags of Japan and southern China.

The small millets, in Shantung, yield as high as 2700 pounds of seed and 4800 pounds of straw per acre. In
Japan, in the year 1906, there were grown 737,719 acres of foxtail, barnyard and proso millet, yielding 17,084,000 bushels of seed or an average of twenty-three bushels per acre. In addition to the millets, Japan grew, the same year, 5,964,300 bushels of buckwheat on 394,523 acres, or an average of fifteen bushels per acre. The next engraving, Fig. 205, shows a crop of millet already six inches high planted between rows of windsor beans which had matured about the middle of June. The leaves had dropped, the beans had been picked from the stems, and a little later, when the roots had had time to decay the bean stems would be pulled and tied in bundles for use as fuel or for fertilizer.

We had reached Mukden thoroughly tired after a long day of continuous close observation and writing. The Astor House, where we were to stop, was three miles from the station and the only conveyance to meet the train
was a four-seated springless, open, semi-baggage carryall and it was a full hour lumbering its way to our hotel. But here as everywhere in the Orient the foreigner meets scenes and phases of life competent to divert his attention from almost any discomfort. Nothing could be more striking than the peculiar mode the Manchu ladies have of dress-
ing their hair, seen in Fig. 206, many instances of which were passed on the streets during this early evening ride. It was fearfully and wonderfully done, laid in the smoothest, glossiest black, with nearly the lateral spread of the tail of a turkey cock and much of the backward curve of that of the rooster; far less attractive than the plainer, refined, modest, yet highly artistic style adopted by either Chinese or Japanese ladies.

The journey from Mukden to Antung required two days, the train stopping for the night at Tsahokow. Our route lay most of the way through mountainous or steep hilly country and our train was made up of diminutive coaches drawn by a tiny engine over a three-foot two-inch narrow gauge track of light rails laid by the Japanese during the war with Russia, for the purpose of moving their armies and supplies to the hotly contested fields in the Liao and Sungari plains. Many of the grades were steep, the curves sharp, and in several places it was necessary to divide the short train to enable the engines to negotiate them.

To the southward over the Liao plain the crops were almost exclusively millet and soy beans, with a little barley, wheat, and a few oats. Between Mukden and the first station across the Hun river we had passed twenty-four good sized fields of soy beans on one side of the river and twenty-two on the other, and before reaching the hilly country, after travelling a distance of possibly fifteen miles, we had passed 309 other and similar fields close along the track. In this distance also we had passed two of the monuments erected by the Japanese, marking sites of their memorable battles. These fields were everywhere flat, lying from sixteen to twenty feet above the beds of the nearly dry streams, and the cultivation was mostly being done with horses or cattle.

After leaving the plains country the railway traversed a narrow winding valley less than a mile wide, with gradient so steep that our train was divided. Fully sixty per cent of the hill slopes were cultivated nearly to the summit
and yet rising apparently more than one in three to five feet, and the uncultivated slopes were closely wooded with young trees, few more than twenty to thirty feet high, but in blocks evidently of different ages. Beyond the pass much of the cultivated slopes have walled terraces. We crossed a large stream where railway ties were being rafted down the river. Just beyond this river the train was again divided to ascend a gradient of one in thirty, reaching the summit by five times switching back, and matched on the other side of the pass by a down grade of one in forty.

At many of the farm houses in the narrow valleys along the way large rectangular, flat topped compost piles were passed, thirty to forty inches high and twenty, thirty, forty and even in one case as much as sixty feet square on the ground. More and more it became evident that these mountain and hill lands were originally heavily wooded and that the new growth springs up quickly, developing rapidly. It was clear also that the custom of cutting over these wooded areas at frequent intervals is very old, not always in the same stage of growth but usually when the trees are quite small. Considerable quantities of cordwood were piled at the stations along the railway and were being loaded on the cars. This was always either round wood or sticks split but once; and much charcoal, made mostly from round wood or sticks split but once, was being shipped in sacks shaped like those used for rice, seen in Fig. 180. Some strips of the forest growth had been allowed to stand undisturbed apparently for twenty or more years, but most areas have been cut at more frequent intervals, often apparently once in three to five, or perhaps ten, years.

At several places on the rapid streams crossed, prototypes of the modern turbine water-wheel were installed, doing duty grinding beans or grain. As with native machinery everywhere in China, these wheels were reduced to the lowest terms and the principle put to work almost unclothed. These turbines were of the downward discharge type, much resembling our modern windmills, ten to six-
Manchuria and Korea.

Teen feet in diameter, set horizontally on a vertical axis rising through the floor of the mill, with the vanes surrounded by a rim, the water dropping through the wheel, reacting when reflected from the obliquely set vanes. American engineers and mechanics would pronounce these very crude, primitive and inefficient. A truer view would regard them as examples of a masterful grasp of principle by some man who long ago saw the unused energy of the stream and succeeded thus in turning it to account.

Both days of our journey had been bright and very warm and, although we took the train early in the morning at Mukden, a young Japanese anticipated the heat, entering the train clad only in his kimono and sandals, carrying a suitcase and another bundle. He rode all day, the most comfortably, if immodestly, clad man on the train, and the next morning took his seat in front of us clad in the same garb, but before the train reached Antung he took down his suitcase and then and there, deliberately
attired himself in a good foreign suit, folding his kimono and packing it away with his sandals.

From Antung we crossed the Yalu on the ferry to New Wiju at 6:30 A. M., June 22, and were then in quite a different country and among a very different people, although all of the railway officials, employes, police and guards were Japanese, as they had been from Mukden. At Antung and New Wiju the Yalu is a very broad slow stream resembling an arm of the sea more than a river, reminding one of the St. Johns at Jacksonville, Florida.

June 22nd proved to be one of the national festival days in Korea, called "Swing day", and throughout our entire ride to Seoul the fields were nearly all deserted and throngs of people, arrayed in gala dress, appeared all along the line of the railway, sometimes congregating in bodies of two to three thousand or more, as seen in Fig. 207. Many swings had been hung and were being enjoyed by the young people. Boys and men were bathing in all
sorts of "swimming holes" and places. So too, there were many large open air gatherings being addressed by public speakers, one of which is seen in Fig. 208.

Nearly everyone was dressed in white outer garments made from some fabric which although not mosquito netting was nearly as open and possessed of a remarkable stiffness which seemed to take and retain every dent with astonishing effect and which was sufficiently transparent to reveal a third undergarment. The full out-standing skirts of five Korean women may be seen in Fig. 209, and the trousers which went with these were proportionately full but tied close about the ankles. The garments seemed to be possessed of a powerful repulsion which held them quite apart and away from the person, no doubt contributing much to comfort. It was windy but one of those hot sultry, sticky days, and it made one feel cool to see these open garments surging in the wind.

Fig. 209.—Group of five Korean women in their stiff white clothing.
The Korean men, like the Chinese, wear the hair long but not braided in a queue. No part of the head is shaved but the hair is wound in a tight coil on the top of the head, secured by a pin which, in the case of the Korean who rode in our coach from Mukden to Antung, was a modern, substantial ten-penny wire nail. The tall, narrow, conical crowns of the open hats, woven from thin bamboo splints, are evidently designed to accommodate this style of hair dressing as well as to be cool.

Here, too, as in China and Manchuria, nearly all crops are planted in rows, including the cereals, such as wheat, rye, barley and oats. We traversed first a flat marshy country with sandy soil and water not more than four feet below the surface where, on the lowest areas a close ally of our wild flower-de-luce was in bloom. Wheat was coming into head but corn and millet were smaller than in Manchuria. We had left New Wiju at 7:30 in the morning and

Fig. 210.—Group of Korean farm houses with thatched roofs and earthen walls, standing at the foot of wooded hills.
at 8:15 we passed from the low land into a hill country with narrow valleys. Scattering young pine, seldom more than ten to twenty-five feet high, occupied the slopes and as we came nearer the hills were seen to be clothed with many small oak, the sprouts clearly not more than one or two years old. Roofs of dwellings in the country were usually thatched with straw laid after the manner of shingles, as may be seen in Fig. 210, where the hills beyond show the low tree growth referred to, but here unusually dense. Bundles of pine boughs, stacked and sheltered from the weather, were common along the way and evidently used for fuel.

At 8:25 we passed through the first tunnel and there were many along the route, the longest requiring thirty seconds for the passing of the train. The valley beyond was occupied by fields of wheat where beans were planted between the rows. Thus far none of the fields had been as thoroughly tilled and well cared for as those seen in China, nor were the crops as good. Further along we passed hills where the pines were all of two ages, one set about thirty feet high and the others twelve to fifteen feet or less, and among these were numerous oak sprouts. Quite possibly these are used as food for the wild silkworms. In some places appearances indicate that the oak and other deciduous growth, with the grass, may be cut annually and only the pines allowed to stand for longer periods. As we proceeded southward and had passed Kosui the young oak sprouts were seen to cover the hills, often stretching over the slopes much like a regular crop, standing at a height of two to four feet, and fresh bundles of these sprouts were seen at houses along the foot of the slopes, again suggesting that the leaves may be for the tussur silkworms although the time appears late for the first moulting. After we had left Seoul, entering the broader valleys where rice was more extensively grown, the using of the oak boughs and green grass brought down from the hill lands for green manure became very extensive.
After the winter and early spring crops have been harvested, the narrow ridges on which they are grown are turned into the furrows by means of their simple plow drawn by a heavy bullock, different from the cattle in China but closely similar to those in Japan. The fields are then flooded until they have the appearance seen in Fig. 12. Over these flooded ridges the green grass and oak boughs are spread, when the fields are again plowed and the material worked into the wet soil. If this working is not completely successful men enter the fields and tramp the surface until every twig and blade is submerged. The middle section in this illustration has been fitted and transplanted; in front of it and on the left are two other fields once plowed but not fertilized; those far to the right have had the green manure applied and the ground plowed a second time but not finished, and in the immediate foreground the grass and boughs have been scattered but the second plowing is not yet done.

We passed men and bullocks coming from the hill lands loaded with this green herbage and as we proceeded to-
wards Fusan more and more of the hill area was being made to contribute materials for green manure for the cultivated fields. The foreground of Fig. 211 had been thus treated and so had the field in Fig. 212, where the man was engaged in tramping the dressing beneath the surface. In very many cases this material was laid along the margin of the paddies; in other cases it had been taken upon the fields as soon as the grain was cut and was lying in piles among the bundles; while in still other cases the material for

![Fig. 212.—Rice paddy covered with oak leaves and grass brought down from the hills, one half of which has been tramped beneath the surface by the laborer at work.](image)

green manure had been carried between the rows while the grain was still standing, but nearly ready to harvest. In some fields a full third of a bushel of the green stuff had been laid down at intervals of three feet over the whole area. In other cases piles of ashes alternated with those of herb-age, and again manure and ashes mixed had been distributed in alternate piles with the green manure.

In still other cases we saw untreated straw distributed through the fields awaiting application. At Shindo this straw had the appearance of having been dipped in or smeared with some mixture, apparently of mud and ashes or possibly of some compost which had been worked into a thin paste with water.
After passing Keizan, mountain herbage had been brought down from the hills in large bales on cleverly constructed racks saddled to the backs of bullocks, and in one field we saw a man who had just come to his little field with an enormous load borne upon his easel-like packing appliance. Thus we find the Koreans also adopting the rice crop, which yields heavily under conditions of abundant water; we find them supplementing a heavy summer rainfall with water from their hills, and bringing to their fields besides both green herbage for humus and organic matter, and ashes derived from the fuel coming also from the hills, in these ways making good the unavoidable losses through intense cropping.

The amount of forest growth in Korea, as we saw it, in proximity to the cultivated valleys, is nowhere large and is fairly represented in Figs. 210, 213 and 214. There were clear evidences of periodic cutting and considerable
amounts of cordwood split from timber a foot through were being brought to the stations on the backs of cattle. In some places there was evident and occasionally very serious soil erosion, as may be seen in Fig. 214, one such region being passed just before reaching Kinusan, but generally the hills are well rounded and covered with a low growth of shrubs and herbaceous plants.

Southernmost Korea has the latitude of the northern boundary of South Carolina, Georgia, Alabama and Mississippi, while the northeast corner attains that of Madison, Wisconsin, and the northern boundary of Nebraska, the country thus spanning some nine degrees and six hundred miles of latitude. It has an area of some 82,000 square miles, about equaling the state of Minnesota, but much of its surface is occupied by steep hill and mountain land. The rainy season had not yet set in, June 23rd. Wheat and the small grains were practically all harvested southward of Seoul and the people were everywhere busy with their flails threshing in the open, about the dwellings or in the fields, four flails often beating together on the same lot of grain. As we journeyed southward the valleys and the fields became wider and more extensive, and the crops, as well as the cultural methods, were clearly much better.
Neither the foot-power, animal-power, nor the wooden chain pump of the Chinese were observed in Korea in use for lifting water, but we saw many instances of the long handled, spoonlike swinging scoop hung over the water by a cord from tall tripods, after the manner seen in Fig. 215, each operated by one man and apparently with high efficiency for low lifts. Two instances also were observed of the form of lift seen in Fig. 173, where the man walks the circumference of the wheel, so commonly observed in Japan. Much hemp was being grown in southern Korea but everywhere on very small isolated areas which flecked the landscape with the deepest green, each little field probably representing the crop of a single family.

It was 6:30 P. M. when our train reached Fusan after a hot and dusty ride. The service had been good and fairly comfortable but the ice-water tanks of American
trains were absent, their place being supplied by cooled bottled waters of various brands, including soda-water, sold by Japanese boys at nearly every important station. Close connection was made by trains with steamers to and from Japan and we went directly on board the Iki Maru which was to weigh anchor for Moji and Shimonoseki at 8 P. M. Although small, the steamer was well equipped, providing the best of service. We were fortunate in having a smooth passage, anchoring at 6:30 the next morning and making close connection with the train for Nagasaki, landing at the wharf with the aid of a steam launch.

Our ride by train through the island of Kyushu carried us through scenes not widely different from those we had just left. The journey was continuously among fields of rice, with Korean features strongly marked but usually under better and more intensified culture, and the season, too, was a little more advanced. Here the plowing was being done mostly with horses instead of the heavy bullocks so exclusively employed in Korea. Coming from China into Korea, and from there into Japan, it appeared very clear that in agricultural methods and appliances the Koreans and Japanese are more closely similar than the Chinese and Koreans, and the more we came to see of the Japanese methods the more strongly the impression became fixed that the Japanese had derived their methods either from the Koreans or the Koreans had taken theirs more largely from Japan than from China.

It was on this ride from Moji to Nagasaki that we were introduced to the attractive and very satisfactory manner of serving lunches to travelers on the trains in Japan. At important stations hot tea is brought to the car windows in small glazed, earthenware teapots provided with cover and bail, and accompanied with a teacup of the same ware. The set and contents could be purchased for five sen, two and a half cents, our currency. All tea is served without milk or sugar. The lunches were very substantial and put together in a neat sanitary manner in a three-compartment wooden box, carefully made from clear lumber joined with
wooden pegs and perfect joints. Packed in the cover we found a paper napkin, toothpicks and a pair of chopsticks. In the second compartment there were thin slices of meat, chicken and fish, together with bamboo sprouts, pickles, cakes and small bits of salted vegetables, while the lower and chief compartment was filled with rice cooked quite stiff and without salt, as is the custom in the three countries. The box was about six inches long, four inches deep and three and a half inches wide. These lunches are handed to travelers neatly wrapped in spotless thin white paper daintily tied with a bit of color, all in exchange for 25 sen,—12.5 cents. Thus for fifteen cents the traveler is handed, through the car window, in a respectful manner, a square meal which he may eat at his leisure.
XVII.

RETURN TO JAPAN.

We had returned to Japan in the midst of the first rainy season, and all the day through, June 25th, and two nights, a gentle rain fell at Nagasaki, almost without interruption. Across the narrow street from Hotel Japan were two of its guest houses, standing near the front of a wall-faced terrace rising twenty-eight feet above the street and facing the beautiful harbor. They were accessible only by winding stone steps shifting on paved landings to continue the ascent between retaining walls overhung with a wealth of shrubbery clothed in the densest foliage, so green and liquid in the drip of the rain, that one almost felt like walking edgewise amid stairs lest the drip should leave a stain. Over such another series of steps, but longer and more winding, we found our way to the American Consulate where in the beautifully secluded quarters Consul-General Scidmore escaped many annoyances of settling the imagined petty grievances arising between American tourists and the ricksha boys.

Through the kind offices of the Imperial University of Sapporo and of the National Department of Agriculture and Commerce, Professor Tokito met us at Nagasaki, to act as escort through most of the journey in Japan. Our first visit was to the prefectural Agricultural Experiment Station at Nagasaki. There are forty others in the four main islands, one to an average area of 4280 square miles, and to each 1,200,000 people.
The island of Kyushu, whose latitude is that of middle Mississippi and north Louisiana, has two rice harvests, and gardeners at Nagasaki grow three crops, each year. The gardener and his family work about five tan, or a little less than one and one-quarter acres, realizing an annual return of some $250 per acre. To maintain these earnings fertilizers are applied rated worth $60 per acre, divided between the three crops, the materials used being largely the wastes of the city, animal manure, mud from the drains, fuel ashes and sod, all composted together. If this expenditure for fertilizers appears high it must be remembered that nearly the whole product is sold and that there are three crops each year. Such intense culture requires a heavy return if large yields are maintained. Good agricultural lands were here valued at 300 yen per tan, approximately $600 per acre.

When returning toward Moji to visit the Agricultural Experiment Station of Fukuoka prefecture, the rice along the first portion of the route was standing about eight inches above the water. Large lotus ponds along the way occupied areas not readily drained, and the fringing fields between the rice paddies and the untilled hill lands were bearing squash, maize, beans and Irish potatoes. Many small areas had been set to sweet potatoes on close narrow ridges, the tops of which were thinly strewn with green grass, or sometimes with straw or other litter, for shade and to prevent the soil from washing and baking in the hot sun after rains. At Kitsu we passed near Government salt works, for the manufacture of salt by the evaporation of sea water, this industry in Japan, as in China, being a Government monopoly.

Many bundles of grass and other green herbage were collected along the way, gathered for use in the rice fields. In other cases the green manure had already been spread over the flooded paddies and was being worked beneath the surface, as seen in Fig. 216. At this time the hill lands were clothed in the richest, deepest green but the tree growth was nowhere large except immediately about
temples, and was usually in distinct small areas with sharp boundaries occasioned by differences in age. Some tracts had been very recently cut; others were in their second, third or fourth years; while others still carried a growth of perhaps seven to ten years. At one village many bundles of the brush fuel had been gathered from an adjacent area, recently cleared.

A few fields were still bearing their crop of soy beans planted in February between rows of grain, and the green herbage was being worked into the flooded soil, for the crop of rice. Much compost, brought to the fields, was stacked with layers of straw between, laid straight, the alternate courses at right angles, holding the piles in rectangular form with vertical sides, some of which were four to six feet high and the layers of compost about six inches thick.

Just before reaching Tanjiro a region is passed where orchards of the candleberry tree occupy high leveled areas between rice paddies, after the manner described for the mulberry orchards in Chekiang, China. These trees, when seen from a distance, have quite the appearance of our apple orchards.

At the Fukuoka Experiment Station we learned that the usual depth of plowing for the rice fields is three and a half to four and a half inches, but that deeper plowing gives somewhat larger yields. As an average of five years trials, a depth of seven to eight inches increased the yield from seven to ten per cent over that of the usual depth. In this prefecture grass from the bordering hill lands is applied to the rice fields at rates ranging from 3300 to 16,520 pounds green weight per acre, and, according to analyses given, these amounts would carry to the fields from 18 to 90 pounds of nitrogen; 12.4 to 63.2 pounds of potassium, and 2.1 to 10.6 pounds of phosphorus per acre.

Where bean cake is used as a fertilizer the applications may be at the rate of 496 pounds per acre, carrying 33.7 pounds of nitrogen, nearly 5 pounds of phosphorus and 7.4 pounds of potassium. The earth composts are chiefly
applied to the dry land fields and then only after they are well rotted, the fermentation being carried through at least sixty days, during which the material is turned three times for aeration, the work being done at the home. When used on the rice fields where water is abundant the composts are applied in a less fermented condition.

The best yields of rice in this prefecture are some eighty bushels per acre, and crops of barley may even exceed this, the two crops being grown the same year, the rice following the barley. In most parts of Japan the grain food of the laboring people is about 70 per cent naked barley mixed with 30 per cent of rice, both cooked and used in the same manner. The barley has a lower market value and its use permits a larger share of the rice to be sold as a money crop.

The soils are fertilized for each crop every year and the prescription for barley and rice recommended by the Experiment Station, for growers in this prefecture, is indicated by the following table:

### FERTILIZATION FOR NAKED BARLEY.

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<tr>
<th>Fertilizers</th>
<th>Pounds per acre.</th>
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<th>P</th>
<th>K</th>
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<td>Manure compost</td>
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<td>33.0</td>
<td>7.4</td>
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<tr>
<td>Rape seed cake</td>
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<td>16.7</td>
<td>2.8</td>
<td>3.5</td>
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<td>Night soil</td>
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<td>26.4</td>
<td>2.6</td>
<td>10.2</td>
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<td>Superphosphate</td>
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<td>9.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td><strong>11,705</strong></td>
<td><strong>76.1</strong></td>
<td><strong>22.7</strong></td>
<td><strong>47.5</strong></td>
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</tbody>
</table>

### FERTILIZATION FOR PADDY RICE.

<table>
<thead>
<tr>
<th>Fertilizers</th>
<th>Pounds per acre.</th>
<th>N</th>
<th>P</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manure compost</td>
<td>5,291</td>
<td>26.4</td>
<td>5.9</td>
<td>27.1</td>
</tr>
<tr>
<td>Green manure, soy beans</td>
<td>3,306</td>
<td>19.2</td>
<td>1.1</td>
<td>19.6</td>
</tr>
<tr>
<td>Soy bean cake</td>
<td>397</td>
<td>27.8</td>
<td>1.7</td>
<td>6.4</td>
</tr>
<tr>
<td>Superphosphate</td>
<td>198</td>
<td>12.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td><strong>9,192</strong></td>
<td><strong>73.4</strong></td>
<td><strong>21.5</strong></td>
<td><strong>53.1</strong></td>
</tr>
<tr>
<td><strong>Total for year</strong></td>
<td><strong>20,897</strong></td>
<td><strong>149.5</strong></td>
<td><strong>44.2</strong></td>
<td><strong>100.6</strong></td>
</tr>
</tbody>
</table>

Where these recommendations are followed there is an annual application of fertilizer material which aggregates some ten tons per acre, carrying about 150 pounds of nitrogen, 44 pounds of phosphorus and 100 pounds of potassium. The crop yields which have been associated with
these applications on the Station fields are about forty-nine bushels of barley and fifty bushels of rice per acre.

The general rotation recommended for this portion of Japan covers five years and consists of a crop of wheat or naked barley the first two years with rice as the summer crop; in the third year *enge*, "pink clover" (*Astragalus sinicus*) or some other legume for green manure is the winter crop, rice following in the summer; the fourth year rape is the winter crop, from which the seed is saved and the ash of the stems returned to the soil, or rarely the stems themselves may be turned under; on the fifth and last year of the rotation the broad kidney or windsor bean is the winter crop, preceeding the summer crop of rice. This rotation is not general yet in the practice of the farmers of the section, they choosing rape or barley and in February plant windsor or soy beans between the rows for green manure to use when the rice comes on.

It was evident from our observations that the use of composts in fertilizing was very much more general and extensive in China than it was in either Korea or Japan, but, to encourage the production and use of compost fertilizers, this and other prefectures have provided subsidies which permit the payment of $2.50 annually to those farm-

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*Fig. 216.—Working green herbage into a flooded rice paddy for green manure, preparatory for the following crop of rice.*
ers who prepare and use on their land a compost heap covering twenty to forty square yards, in accordance with specified directions given.

The agricultural college at Fukuoka was not in session the day of our visit, it being a holiday usually following the close of the last transplanting season. One of the main buildings of the station and college is seen in Fig. 217, and Figs. 218, 219 and 220, placed together from right to left in the order of their numbers, form a panoramic view

![Fig. 217.—One of the main buildings of the Fukuoka Experiment Station.](image)

of the station grounds and buildings with something of the beautiful landscape setting. There is nowhere in Japan the lavish expenditure of money on elaborate and imposing architecture which characterizes American colleges and stations, but in equipment for research work, both as to professional staff and appliances, they compare favorably with similar institutions in America. The dormitory system was in vogue in the college, providing room and board at eight yen per month, or four dollars of our currency. Eight students were assigned to one commodious room, each provided with a study table, but beds were mattresses spread upon the matting floor at night and compactly stored on closet shelves during the day.

The Japanese plow, which is very similar to the Korean
Fig. 218.—View of station grounds and buildings, Fukuoka Experiment Station, Japan.
Fig. 219.—View of station grounds and buildings, Fukuoka Experiment Station, Japan.
Fig. 220.—View of station grounds and buildings, Fukuoka Experiment Station, Japan.
type, may be seen in Fig. 221, the one on the right costing 2.5 yen and the other 2 yen. With the aid of the single handle and the sliding rod held in the right hand, the course of the plow is directed and the plow tilted in either direction, throwing the soil to the right or the left.

The nursery beds for rice breeding experiments and variety tests by this station are shown in Fig. 222. Although these plots are flooded the marginal plants, adjacent to the free water paths, were materially larger than those within and had a much deeper green color, showing better feeding, but what seemed most strange was the fact that these stronger plants are never used in transplanting, as they do not thrive as well as those less vigorous.

We left the island of Kyushu in the evening of June 29th, crossing to the main island of Honshu, waiting in Shimonoseki for the morning train. The rice planted valleys near Shimonoseki were relatively broad and the paddies had all been recently set in close rows about a foot apart and in hills in the rows. Mountain and hill lands were closely wooded, largely with coniferous trees about the base but toward and at the summits, especially on the south slopes, they were green only with herbage cut for fertilizing and feeding stock. Many very small trees, often not more than one foot high, were growing on the recently cut-over areas; tall slender graceful bamboos clustered along the way and everywhere threw wonderful beauty into the landscape. Cartloads of their slender stems, two to four inches in diameter at the base and twenty or more feet long, were moving along the generally excellent, narrow, seldom fenced roads, such as seen in Fig. 223. On the borders and pathways between rice paddies many small stacks of straw were in waiting to be laid between the rows of transplanted rice, tramped beneath the water and overspread with mud to enrich the soil. The farmers here, as elsewhere, must contend against the scouring rush, varieties of grass and our common pig-weeds, even in the rice fields. The large area of moun-
tain and hill land compared with that which could be tilled, and the relatively small area of cultivated land not at this time under water and planted to rice persisted throughout the journey.

Fig. 221.—Two Japanese plows.

If there could be any monotony for the traveller new to this land of beauty it must result from the quick shifting of scenes and in the way the landscapes are pieced
together, out-doing the craziest patchwork woman ever attempted; the bits are almost never large; they are of every shape, even puckered and crumpled and tilted at all angles. Here is a bit of the journey: Beyond Habu the foothills are thickly wooded, largely with conifers. The valley is extremely narrow with only small areas for rice. Bamboo are growing in congenial places and we pass bundles of wood cut to stove length, as seen in Fig. 224. Then we cross a long narrow valley practically all in rice, and then another not half a mile wide, just before reaching Asa. Beyond here the fields become limited in area with the bordering low hills recently cut over and a new growth springing up over them in the form of small shrubs among which are many pine. Now we are in a narrow valley between small rice fields or with none at all, but dash into one more nearly level with wide areas in rice chiefly on one side of the track just before reaching Onoda at 10:30 A. M. and continuing three minutes ride beyond, when we are again between hills without fields and where the trees are pine with clumps of bamboo. In four minutes more we are among small rice paddies and at 10:35 have passed another gap and are crossing another valley.
checkered with rice fields and lotus ponds, but in one minute more the hills have closed in, leaving only room for the track. At 10:37 we are running along a narrow valley with its terraced rice paddies where many of the hills show naked soil among the bamboo, scattering pine and other small trees; then we are out among garden patches thickly mulched with straw. At 10:38 we are between higher hills with but narrow areas for rice stretching close along the track, but in two minutes these are passed and we are among low hills with terraced dry fields. At 10:42 we are spinning along the level valley with its rice, but are quickly out again among hills with naked soil where erosion was marked. This is just before passing Funkai where we are following the course of a stream some sixty feet wide with but little cultivated land in small areas. At 10:47 we are again passing narrow rice fields near the track where the people are busy weeding with their hands, half knee-deep in water. At 10:53 we enter a broader valley stretching far to the south and seaward, but we had crossed it
in one minute, shot through another gap, and at 10:55 are traversing a much broader valley largely given over to rice, but where some of the paddies were bearing matting rush set in rows and in hills after the manner of rice. It is here we pass Oyou and just beyond cross a stream confined between levees built some distance back from either bank. At 11:17 this plain is left and we enter a narrow valley without fields. Thus do most of the agricultural lands of Japan lie in the narrowest valleys, often steeply sloping, and into which jutting spurs create the greatest irregularity of boundary and slope.

The journey of this day covered 350 miles in fourteen hours, all of the way through a country of remarkable and peculiar beauty which can be duplicated nowhere outside the mountainous, rice-growing Orient and there only during fifteen days closing the transplanting season. There were neither high mountains nor broad valleys, no great rivers and but few lakes; neither rugged naked rocks, tall
Fig. 225.—Looking up a terraced valley between Hongo and Fukuyama, Japan.
Millions of Terraces.

Millions of terraces set about by their raised rim, was a silvery sheet of water dotted in the daintiest manner with bunches of rice just transplanted, but not so close nor yet so high and over-spreading as to obscure the water, yet quite enough to impart to the surface a most delicate sheen of green; and the grass-grown narrow rims retaining the water in the basins, cemented them into series of the most superb mosaics, shaped into the valley bottoms by artizan artists perhaps two thousand years before and maintained by their descendants through all the years since, that on them the rains and fertility from the mountains and the sunshine from heaven might be transformed by the rice plant into food for the families.
and support for the nation. Two weeks earlier the aspect of these landscapes was very different, and two weeks later the reflecting water would lie hidden beneath the growing and rapidly developing mantle of green, to go on changing until autumn, when all would be overspread with the ripened harvest of grain. And what intensified the beauty of it all was the fact that only along the widest valley bottoms were the mosaics level, except the water surface of each individual unit and these were always small. At one time we were riding along a descending series of steps and then along another rising through a winding valley to disappear around a projecting spur, and anywhere in the midst of it all might be standing Japanese cottages or villas with the water and the growing rice literally almost against the walls, as seen in Fig. 226, while a near-by high terrace might hold its water on a level with the chimney-tops. Can one wonder that the Japanese loves his country or that they are born and bred landscape artists?

Just before reaching Hongo there were considerable areas thrown into long narrow, much raised, east and west beds under covers of straw matting inclined at a slight angle toward the south, some two feet above the ground but open toward the north. What crop may have been grown here we did not learn but the matting was apparently intended for shade, as it was hot midsummer weather, and we suspect it may have been ginseng. It was here, too, that we came into the region of the culture of matting rush, extensively grown in Hiroshima and Okayama prefectures, but less extensively all over the empire. As with rice, the rush is first grown in nursery beds from which it is transplanted to the paddies, one acre of nursery supplying sufficient stock for ten acres of field. The plants are set twenty to thirty stalks in a hill in rows seven inches apart with the hills six inches from center to center in the row. Very high fertilization is practiced, costing from 120 to 240 yen per acre, or $60 to $120 annually, the fertilizer consisting of bean cake and plant ashes, or in recent years, sometimes of sulphate of ammonia for
nitrogen, and superphosphate of lime. About ten per cent of the amount of fertilizer required for the crop is applied at the time of fitting the ground, the balance being administered from time to time as the season advances. Two crops of the rush may be taken from the same ground each year or it is grown in rotation with rice, but most extensively on the lands less readily drained and not so well suited for other crops. Fields of the rush, growing in alternation with rice, are seen in Fig. 45, and in Fig. 227, with the Government salt fields lying along the sea-shore beyond.

With the most vigorous growth the rush attain a height exceeding three feet and the market price varies materially with the length of the stems. Good yields, under the best culture, may be as high as 6.5 tons per acre of the dry stems but the average yield is less, that of 1905 being 8531
Fig. 228.—Group of Japanese girls playing the game of flower cards, in the usual attitude of sitting on the matting-covered floor.

Fig. 229.—Interior view of a well furnished guest room in a Japanese inn, where the meals are served on the matting floor and the bed is laid.
Japanese Furnishing.

pounds, for 9655 acres. The value of the product ranges from $120 to $200 per acre.

It is from this material that mats are woven in standard sizes, to be laid over padding, upholstering the floors which are the seats of all classes in Japan, used in the manner seen in Fig. 228 and in Fig. 229, which is a completely furnished guest room in a first class Japanese inn, finished in natural unvarnished wood, with walls of sliding panels of translucent paper, which may open upon a porch, into a hallway or into another apartment; and with its bouquet, which may consist of a single large shapely branch of the purple leaved maple, having the cut end charred to preserve it fresh for a longer time, standing in water in the vase.

"Two little maids I've heard of, each with a pretty taste,
Who had two little rooms to fix and not an hour to waste.
Eight thousand miles apart they lived, yet on the selfsame day
The one in Nikko's narrow streets, the other on Broadway,
They started out, each happy maid her heart's desire to find,
And her own dear room to furnish just according to her mind.

When Alice went a-shopping, she bought a bed of brass,
A bureau and some chairs and things and such a lovely glass
To reflect her little figure—with two candle brackets near—
And a little dressing table that she said was simply dear!
A book shelf low to hold her books, a little china rack,
And then, of course, a bureau set and lots of bric-a-brac;
A dainty little escritoire, with fixings all her own
And just for her convenience, too, a little telephone.
Some oriental rugs she got, and curtains of madras,
With 'cunning' ones of lace inside, to go against the glass;
And then a couch, a lovely one, with cushions soft to crush,
And forty pillows, more or less, of linen, silk and plush;
Of all the ornaments besides I couldn't tell the half,
But wherever there was nothing else, she stuck a photograph.
And then, when all was finished, she sighed a little sigh,
And looked about with just a shade of sadness in her eye:
'For it needs a statuette or so—a fern—a silver stork—
Oh, something, just to fill it up!' said Alice of New York.

When little Oumi of Japan went shopping, pitapat,
She bought a fan of paper and a little sleeping mat;
She set beside the window a lily in a vase,
And looked about with more than doubt upon her pretty face:
'For, really—don't you think so?—with the lily and the fan,
It's a little overcrowded!' said Oumi of Japan."

(Margaret Johnson in St. Nicholas Magazine)
In the rural homes of Japan during 1906 there were woven 14,497,058 sheets of these floor mats and 6,628,772 sheets of other matting, having a combined value of $2,815,040, and in addition, from the best quality of rush grown upon the same ground, aggregating 7657 acres that year, there were manufactured for the export trade, fancy mattings having the value of $2,274,131. Here is a total value, for the product of the soil and for the labor put into the manufacture, amounting to $664 per acre for the area named.

At the Akashi agricultural experiment station, under the Directorship of Professor Ono, we saw some of the methods of fruit culture as practiced in Japan. He was conducting experiments with the object of improving methods of heading and training pear trees, to which reference was made on page 22. A study was also being made of the advantages and disadvantages associated with covering the fruit with paper bags, examples of which are seen in Figs. 6 and 7. The bags were being made at the time of our visit, from old newspapers cut, folded and pasted by women. Naked cultivation was practiced in the orchard and fertilizers consisting of fish guano and superphosphate of lime were being applied twice each year in amounts aggregating a cost of twenty-four dollars per acre.

Pear orchards of native varieties, in good bearing, yield returns of 150 yen per tan, and those of European varieties, 200 yen per tan, which is at the rate of $300 and $400 per acre. The bibo so extensively grown in China was being cultivated here also and was yielding about $320 per acre.

It was here that we first met the cultivation of a variety of burdock grown from the seed, three crops being taken each season where the climate is favorable, or as one of three in the multiple crop system. It is grown for the root, yielding a crop valued at $40 to $50 per acre. One crop, planted in March, was being harvested July 1st.
During our ride to Akashi on the early morning train we passed long processions of carts drawn by cattle, horses or by men, moving along the country road which paralleled the railway, all loaded with the waste of the city of Kobe, going to its destination in the fields, some of it a distance of twelve miles, where it was sold at from 54 cents to $1.63 per ton.

At several places along our route from Shimonoseki to Osaka we had observed the application of slacked lime to the water of the rice fields, but in this prefecture, Hyogo, where the station is located, its use was prohibited in 1901, except under the direction of the station authorities, where the soil was acid or where it was needed on account of insect troubles. Up to this time it had been the custom of farmers to apply slacked lime at the rate of three to five tons per acre, paying for it $4.84 per ton. The first restrictive legislation permitted the use of 82 pounds of lime with each 827 pounds of organic manure, but as the farmers persisted in using much larger quantities, complete prohibition was resorted to.

Reference has been made to subsidies encouraging the use of composts, and in this prefecture prizes are awarded for the best compost heaps in each county, examinations being made by a committee. The composts receiving the four highest awards in each county are allowed to compete with these in other counties for a prefectural prize awarded by another committee.

The "pink clover" grown in Hyogo after rice, as a green manure crop, yields under favorable conditions twenty tons of the green product per acre, and is usually applied to about three times the area upon which it grew, at the rate of 6.6 tons per acre, the stubble and roots serving for the ground upon which the crop grew.

On July 3rd we left Osaka, going south through Sakai to Wakayama, thence east and north to the Nara Experiment Station. After passing the first two stations the
route lay through a very flat, highly cultivated garden section with cucumbers trained on trellises, many squash in full bloom, with fields of taro, ginger and many other vegetables. Beyond Hamadera considerable areas of flat sandy land had been set close with pine, but with intervening areas in rice, where the growers were using the revolving weeder seen in Fig. 14. At Otsu broad areas are in rice but here worked with the short handled claw weeders, and stubble from a former crop had been drawn together into small piles, seen in Fig. 230, which later would be carefully distributed and worked beneath the mud.
Much of the mountain lands in this region, growing pine, is owned by private parties and the growth is cut at intervals of ten, twenty or twenty-five years, being sold on the ground to those who will come and cut it at a price of forty sen for a one-horse load, as already described, page 160.

The course from here was up the rather rapidly rising Kiigawa valley where much water was being applied to the rice fields by various methods of pumping, among them numerous current wheels; an occasional power-pump driven by cattle; and very commonly the foot-power wheel where the man walks on the circumference, steadying himself with a long pole, as seen in the field, Fig. 231. It was here that a considerable section of the hill slope had been very recently cut over, the area showing light in the engraving. It was in the vicinity of Hashimoto on this route, too, that
the two beautiful views reproduced in Figs. 151 and 152 were taken.

At the experiment station it was learned that within the prefecture of Nara, having a population of 558,314, and 107,574 acres of cultivated land, two-thirds of this was in paddy rice. Within the province there are also about one thousand irrigation reservoirs with an average depth of eight feet. The rice fields receive 16.32 inches of irrigation water in addition to the rain.

Of the uncultivated hill lands, some 2500 acres contribute green manure for fertilization of fields. Reference has been made to the production of compost for fertilizers on page 211. The amount recommended in this prefecture as a yearly application for two crops grown is:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic matter</td>
<td>3,711 to 4,440 lbs. per acre</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>105 to 131 lbs. per acre</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>35 to 44 lbs. per acre</td>
</tr>
<tr>
<td>Potassium</td>
<td>56 to 70 lbs. per acre</td>
</tr>
</tbody>
</table>

These amounts, on the basis of the table, p. 214, are nearly sufficient for a crop of thirty bushels of wheat, followed by one of thirty bushels of rice, the phosphorus being in excess and the potassium not quite enough, supposing none to be derived from other sources.

At the Nara hotel, one of the beautiful Japanese inns where we stopped, our room opened upon a second story veranda from which one looked down upon a beautiful, tiny lakelet, some twenty by eighty feet, within a diminutive park scarcely more than one hundred by two hundred feet, and the lakelet had its grassy, rocky banks over-hung with trees and shrubs planted in all the wild disorder and beauty of nature; bamboo, willow, fir, pine, cedar, red-leaved maple, catalpa, with other kinds, and through these, along the shore, wound a woody, well trodden, narrow footpath leading from the inn to a half hidden cottage apparently quarters for the maids, as they were frequently passing to and fro. A suggestion of how such wild beauty is brought right to the very doors in Japan may be gained
from Fig. 232, which is an instance of parking effect on a still smaller scale than that described.

On the morning of July 6th, with two men for each of our rickshas, we left the Yaami hotel for the Kyoto Experiment station, some two miles to the southwest of the city limits. As soon as we had entered upon the country road we found ourselves in a procession of cart men each

![Fig. 232.—Beauty at home in Japan.](image)

drawing a load of six large covered receptacles of about ten gallons capacity, and filled with the city's waste. Before reaching the station we had passed fifty-two of these loads, and on our return the procession was still moving in the same direction and we passed sixty-one others, so that during at least five hours there had moved over this section of road leading into the country, away from the city, not less than ninety tons of waste; along other roadways similar loads were moving. These freight carts and those drawn by horses and bullocks were all provided with long
racks similar to that illustrated in Fig. 108, page 197, and when the load is not sufficient to cover the full length it is always divided equally and placed near each end, thus taking advantage of the elasticity of the body to give the effect of springs; lessening the draft and the wear and tear.

One of the most common commodities coming into the city along the country roads was fuel from the hill lands, in split sticks tied in bundles as represented in Fig. 224; as

![Fig. 233.—Very old cherry tree in Maruyaami park, Kyoto, with its limbs supported to guard against injury from winds.](image)

bundles of limbs twenty-four to thirty inches, and sometimes four to six feet, long; and in the form of charcoal made from trunks and stems one and a half inches to six inches long, and baled in straw matting. Most of the draft animals used in Japan are either cows, bulls or stallions; at least we saw very few oxen and few geldings.

As early as 1895 the Government began definite steps looking to the improvement of horse breeding, appointing at that time a commission to devise comprehensive plans. This led to progressive steps finally culminating in 1906
in the Horse Administration Bureau, whose duties were to extend over a period of thirty years, divided into two intervals, the first, eighteen and the second, twelve years. During the first interval it is contemplated that the Government shall acquire 1,500 stallions to be distributed throughout the country for the use of private individuals, and during the second period it is the expectation that the system will have completely renovated the stock and fa-

Fig. 234.—Admiring cherry blossoms.

miliarized the people with proper methods of management so that matters may be left in their hands.

As our main purpose and limited time required undivided attention to agricultural matters, and of these to the long established practices of the people, we could give but little time to sight-seeing or even to a study of the efforts being made for the introduction of improved agricultural methods and practices. But in the very old city of Kyoto, which was the seat of the Mikado’s court from be-
Return to Japan.

Fig. 235.—Entrance way to Kiyomizu temple, Kyoto.
fore 800 A. D. until 1868, we did pay a short visit to the Kiyomizu temple, situated some three hundred yards south from the Yaami hotel, which faces the Maruyaami park with its centuries-old giant cherry tree, having a trunk of more than four feet through and wide spreading branches, now much propped up to guard against accident, as seen in Fig. 233. These cherry trees are very extensively used for ornamental purposes in Japan with striking effect. The tree does not produce an edible fruit, but is very beautiful when in full bloom, as may be seen from Fig. 234. It was these trees that were sent by the Japanese government to this country for use at Washington but the first lot were destroyed because they were found to be infested and threatened danger to native trees.

Kyoto stands amid surroundings of wonderful beauty, the site apparently having been selected with rare acumen for its possibilities in large landscape effects, and these have been developed with that fullness and richness which the greatest artists might be content to approach. We are thinking particularly of the Kiyomizu-dera, or rather of the marvelous beauty of tree and foliage which has overgrown it and swept far up and over the mountain summit, leaving the temple half hidden at the base. No words, no brush, no photographic art can transfer the effect. One must see to feel the influence for which it was created, and scores of people, very old and very young, nearly all Japanese, and more of them on that day from the poorer rather than from the well-to-do class, were there, all withdrawing reluctantly, like ourselves, looking backward, under the spell. So potent and impressive was that something from the great overshadowing beauty of the mountain, that all along up the narrow, shop-lined street leading to the gateway of the temple, seen in Fig. 235, the tiniest bits of park effect were flourishing in the most impossible situations; and as Professor Tokito and myself were coming away we chanced upon six little roughly dressed lads laying out in the sand an elaborate little park,
Fig. 236.—View of Kiyomizu temple and the wooded mountain slope rising beyond, showing how dense the forest growth may become when long protected.
quite nine by twelve feet. They must have been at it hours, for there were ponds, bridges, tiny hills and ravines and much planting in moss and other little greens. So intent on their task were they that we stood watching full two minutes before our presence attracted their attention, and yet the oldest of the group must have been under ten years of age.

Fig. 237.—Japanese park seats at Kiyomizu-dera, Kyoto.

One partly hidden view of the temple is seen in Fig. 236, the dense mountain verdure rising above and beyond it. And then too, within the temple, as the peasant men and women came before the shrine and grasped the long depending rope knocker, with the heavy knot in front of the great gong, swinging it to strike three rings, announcing their presence before their God, then kneeling to offer prayers, one could not fail to realize the deep sincerity and faith expressed in face and manner, while they were obliv-
Return to Japan.
ious to all else. No Christian was ever more devout and one may well doubt if any ever arose from prayer more uplifted than these. Who need believe they did not look beyond the imagery and commune with the Eternal Spirit?

A third view of the same temple, showing resting places beneath the shade, which serve the purpose of lawn seats in our parks, is seen in Fig. 237.

![Street flower-vender, Japan.](image)

That a high order of the esthetic sense is born to the Japanese people; that they are masters of the science of the beautiful; and that there are artists among them capable of effective and impressive results, is revealed in a hundred ways, and one of these is the iris garden of Fig. 238. One sees it here in the bulrushes which make the iris feel at home; in the unobtrusive semblance of a log that seems to have fallen across the run; in the hard beaten
narrow path and the sore toes of the old pine tree, telling of the hundreds that come and go; it is seen in the dress and pose of the ladies, and one may be sure the photographer felt all that he saw and fixed so well.

The vender of Oumi's lily that Margaret Johnson saw, is in Fig. 239. There another is bartering for a spray of flowers, and thus one sold the branch of red maple leaves in our room at the Nara inn. His floral stands are borne along the streets pendant from the usual carrying pole.

When returning to the city from the Kyoto Experiment Station several fields of Japanese indigo were passed, growing in water under the conditions of ordinary rice culture, Fig. 240 being a view of one of these. The plant is *Polygonum tinctoria*, a close relative of the smartweed. Before the importation of aniline and alizarin dyes, which amounted in 1907 to 160,558 pounds and 7,170,320 pounds respectively, the cultivation of indigo was much more extensive than at present, amounting in 1897 to 160,460,000 pounds of the dried leaves; but in 1906 the production had fallen to 58,696,000 pounds, forty-five per cent of which was grown in the prefecture of Tokushima in the eastern part of the island of Shikoku. The population of this prefecture is 707,565, or 4.4 people to each of the 159,450 acres of cultivated field, and yet 19,969 of these acres bore the indigo crop, leaving more than five people to each food-producing acre.

The plants for this crop are started in nursery beds in February and transplanted in May, the first crop being cut the last of June or first of July, when the fields are again fertilized, the stubble throwing out new shoots and yielding a second cutting the last of August or early September. A crop of barley may have preceded one of indigo, or the indigo may be set following a crop of rice. Such practice, with the high fertilization for every crop, goes a long way toward supplying the necessary food. The dense population, too, has permitted the manufacture of the indigo as a home industry among the farmers, enabling them to exchange the spare labor of the family for
Indigo.

The manufactured product from the reduced planting in 1907 was worth $1,304,610, forty-five per cent of which was the output of the rural population of the prefecture of Tokushima, which they could exchange for rice and other necessaries. The land in rice in this prefecture in 1907 was 73,816 acres, yielding 114,380,000 pounds, or more than 161 pounds to each man, woman and child, and there were 65,665 acres bearing other crops. Besides this there are 874,208 acres of mountain and hill land in the

**Fig. 240.—Field of Japanese indigo, Poligonum tinctoria, just outside the city of Kyoto.**

prefecture which supply fuel, fuel ashes and green manure for fertilizer; run-off water for irrigation; lumber and remunerative employment for service not needed in the fields.

The journey was continued from Kyoto July 7th, taking the route leading northeastward, skirting lake Biwa which we came upon suddenly on emerging from a tunnel as the train left Otani. At many places we passed water-wheels such as that seen in Fig. 241, all similarly set, busily turning, and usually twelve to sixteen feet in diameter but oftenest only as many inches thick. Until we had
reached Lake Biwa the valleys were narrow with only small areas in rice. Tea plantations were common on the higher cultivated slopes, and gardens on the terraced hill-sides growing vegetables of many kinds were common, often with the ground heavily mulched with straw, while the wooded or grass-covered slopes still further up showed the usual systematic periodic cutting. After passing the west end of the lake, rice fields were nearly continuous and ex-

Fig. 241.—Type of water-wheel seen very commonly on the mountain streams in Japan.

tensive. Before reaching Hachiman we crossed a stream leading into the lake but confined between levees more than twelve feet high, and we had already passed beneath two raised viaducts after leaving Kusatsu. Other crops were being grown side by side with the rice on similar lands and apparently in rotation with it, but on sharp, narrow, close ridges twelve to fourteen inches high. As we passed eastward we entered one of the important mulberry districts where the fields are graded to two levels,
Soils and Crops.

the higher occupied with mulberry or other crops not requiring irrigation, while the lower was devoted to rice or crops grown in rotation with it.

On the Kisogawa, at the station of the same name, there were four anchored floating water-power mills propelled by two pair of large current wheels stationed fore and aft, each pair working on a common axle from opposite sides of the mill, driven by the force of the current flowing by.

At Kisogawa we had entered the northern end of one of the largest plains of Japan, some thirty miles wide and extending forty miles southward to Owari bay. The plain has been extensively graded to two levels, the benches being usually not more than two feet above the rice paddies, and devoted to various dry land crops, including the mulberry. The soil is decidedly sandy in character but the mean yield of rice for the prefecture is 37 bushels per acre and above the average for the country at large. An analysis of the soils at the sub-experiment station north of Nagoya shows the following content of the three main plant food elements.

<table>
<thead>
<tr>
<th></th>
<th>Nitrogen</th>
<th>Phosphorus</th>
<th>Potassium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>1520</td>
<td>769</td>
<td>805</td>
</tr>
<tr>
<td>Subsoil</td>
<td>810</td>
<td>756</td>
<td>888</td>
</tr>
<tr>
<td>Soil</td>
<td>1060</td>
<td>686</td>
<td>1162</td>
</tr>
<tr>
<td>Subsoil</td>
<td>510</td>
<td>673</td>
<td>1204</td>
</tr>
</tbody>
</table>

The green manure crops on this plain are chiefly two varieties of the "pink clover," one sowed in the fall and one about May 15th, the first yielding as high as sixteen tons green weight per acre and the other from five to eight tons.

On the plain distant from the mountain and hill land the stems of agricultural crops are largely used as fuel and the fuel ashes are applied to the fields at the rate of 10 kan per tan, or 330 pounds per acre, worth $1.20, little lime, as such, being used.

In the prefecture of Aichi, largely in this plain, with an area of cultivated land equal to about sixteen of our
government townships, there is a population of 1,752,042, or a density of 4.7 per acre, and the number of households of farmers was placed at 211,033, thus giving to each farmer’s family an average of 1.75 acres, their chief industries being rice and silk culture.

Soon after leaving the Agricultural Experiment Station of Aichi prefecture at Anjo we crossed the large Yahagigawa, flowing between strong levees above the level of the rice fields. Mulberries, with burdock and other vegetables were growing upon all of the tables raised one to two feet above the rice paddies, and these features continued past Okasaki, Koda and Kamagori, where the hills in many places had been recently cut clean of the low forest growth and where we passed many large stacks of pine boughs tied in bundles for fuel. After passing Goyu sixty-five miles east from Nagoya, mulberry was the chief crop. Then came a plain country which had been graded and leveled at great cost of labor, the benches with their square shoulders standing three to four feet above the paddy fields; and after passing Toyohashi some distance we were surprised to cross a rather wide section of comparatively level land overgrown with pine and herbaceous plants which had evidently been cut and recut many times. Beyond Futagawa rice fields were laid out on what appeared to be similar land but with soil a little finer in texture, and still further along were other flat areas not cultivated.

At Maisaka quite half the cultivated fields appear to be in mulberry with ponds of lotus plants in low places, while at Hamamatsu the rice fields are interspersed with many square-shouldered tables raised three to four feet and occupied with mulberry or vegetables. As we passed upon the flood plain of the Tenryugawa, with its nearly dry bed of coarse gravel half a mile wide, the dwellings of farm villages were many of them surrounded with nearly solid, flat-topped, trimmed evergreen hedges nine to twelve feet high, of the umbrella pine, forming beautiful and effective screens.
At Nakaidzumi we had left the mulberry orchards for those of tea, rice still holding wherever paddies could be formed. Here, too, we met the first fields of tobacco, and at Fukuroi and Homouchi large quantities of imported Manchurian bean cake were stacked about the station, having evidently been brought by rail. At Kanaya we passed through a long tunnel and were in the valley of the Oigawa, crossing the broad, nearly dry stream over a bridge of nineteen long spans and were then in the prefecture of Shizuoka where large fields of tea spread far up the hillsides, covering extensive areas, but after passing the next station, and for seventeen miles before reaching Shizuoka we traversed a level stretch of nearly continuous rice fields.

The Shizuoka Experiment Station is devoting special attention to the interests of horticulture, and progress has already been made in introducing new fruits of better quality and in improving the native varieties. The native pears and peaches, as we found them served on the hotel tables in either China or Japan, were not particularly attractive in either texture or flavor, but we were here permitted to test samples of three varieties of ripe figs of fine flavor and texture, one of them as large as a good sized pear. Three varieties of fine peaches were also shown, one unusually large and with delicate deep rose tint, including the flesh. If such peaches could be canned so as to retain their delicate color they would prove very attractive for the table. The flavor and texture of this peach was also excellent, as was the case with two varieties of pears.

The station was also experimenting with the production of marmalades and we tasted three very excellent brands, two of them lacking the bitter flavor. It would appear that in Japan, Korea and China there should be a very bright future along the lines of horticultural development, leading to the utilization of the extensive hill lands of these countries and the development of a very extensive export trade, both in fresh fruits and marmalades, preserves and the canned forms. They have favorable clima-
Fig. 242.—Views of buildings and grounds at the Shizuoka Experiment Station.
Orchards and Rice.

Orchards and soil conditions and great numbers of people with temperament and habits well suited to the industries, as well as an enormous home need which should be met, in addition to the large possibilities in the direction of a most profitable export trade which would increase opportunities for labor and bring needed revenue to the people. In Fig. 242 are three views at this station, the lower showing a steep terraced hillside set with oranges and other fruits, holding out a bright promise for the future.

Peach orchards were here set on the hill lands, the trees six feet apart each way. They come into bearing in three years, remain productive ten to fifteen years, and the returns are 50 to 60 yen per tan, or at the rate of $100 to $120 per acre. The usual fertilizers for a peach orchard are the manure-earth-compost, applied at the rate of 3300 pounds per acre, and fish guano applied in rotation and at the same rate.

Shizuoka is one of the large prefectures, having a total area of 3029 square miles; 2090 of which are in forest; 438 in pasture and genya land, and 501 square miles cultivated, not quite one-half of which is in paddy fields. The mean yield of paddy rice is nearly 33 bushels per acre. The prefecture has a population of 1,293,470, or about four to the acre of cultivated field, and the total crop of rice is such as to provide 236 pounds to each person.

At many places along the way as we left Shizuoka July 10th for Tokyo, farmers were sowing broadcast, on the water, over their rice fields, some pulverized fertilizer, possibly bean cake. Near the railway station of Fuji, and after crossing the boulder gravel bed of the Fujikawa which was a full quarter of a mile wide, we were traversing a broad plain of rice paddies with their raised tables, but on them pear orchards were growing, trained to their overhead trellises. About Suduzuka grass was being cut with sickles along the canal dikes for use as green manure in the rice fields, which on the left of the railway, stretched eastward more than six miles to beyond Hara where we passed
Return to Japan.

into a tract of dry land crops consisting of mulberry, tea and various vegetables, with more or less of dry land rice, but we returned to the paddy land again at Numazu, in another four miles. Here there were four carloads of beef cattle destined for Tokyo or Yokohama, the first we had seen.

It was at this station that the railway turns northward to skirt the eastern flank of the beautiful Fuji-yama, rising to higher lands of a brown loamy character, showing many large boulders two feet in diameter. Horses were here moving along the roadways under large saddle loads of green grass, going to the paddy fields from the hills, which in this section are quite free from all but herbaceous growth, well covered and green. Considerable areas were growing maize and buckwheat, the latter being ground into flour and made into macaroni which is eaten with chopsticks, Fig. 243, and used to give variety to the diet of rice and naked barley. At Gotenba, where tourists leave the
train to ascend Fuji-yama, the road turns eastward again and descends rapidly through many tunnels, crossing the wide gravelly channel of the Sakawagawa, then carrying but little water, like all of the other main streams we had crossed, although we were in the rainy season. This was partly because the season was yet not far advanced; partly because so much water was being taken upon the rice fields, and again because the drainage is so rapid down the steep slopes and comparatively short water courses. Beyond Yamakita the railway again led along a broad plain set in paddy rice and the hill slopes were terraced and cultivated nearly to their summits.

Swinging strongly southeastward, the coast was reached at Noduz in a hilly country producing chiefly vegetables, mulberry and tobacco, the latter crop being extensively grown eastward nearly to Oiso, beyond which, after a mile of sweet potatoes, squash and cucumbers, there were paddy fields of rice in a flat plain. Before Hiratsuka was reached the rice paddies were left and the train was crossing a comparatively flat country with a sandy, sometimes gravelly, soil where mulberries, peaches, eggplants, sweet potatoes and dry land rice were interspersed with areas still occupied with small pine and herbaceous growth or where small pine had been recently set. Similar conditions prevailed after we had crossed the broad channel of the Banyugawa and well toward and beyond Fujishiwa where a leveled plain has its tables scattered among the fields of paddy rice, this being the southwest margin of the Tokyo plain, the largest in Japan, lying in five prefectures, whose aggregate area of 1,739,200 acres of arable lands was worked by 657,235 families of farmers; 661,613 acres of which was in paddy rice, producing annually some 19,198,000 bushels, or 161 pounds for each of the 7,194,045 men, women and children in the five prefectures, 1,818,655 of whom were in the capital city, Tokyo.

Three views taken in the eastern portion of this plain in the prefecture of Chiba, July 17th, are seen in Fig.
Fig. 244.—Three landscapes in the Tokyo plain, the upper two largely in sweet potatoes, following wheat, the lower in peanuts.
Fig. 245.—Two methods of utilizing coarse straw and litter for mulching and fertilizing at the same time.
244, in two of which shocks of wheat were still standing in the fields among the growing crops, badly weathered and the grain sprouting as the result of the rainy season. Peanuts, sweet potatoes and millet were the main dry land crops then on the ground, with paddy rice in the flooded basins. Windsor beans, rape, wheat and barley had been harvested. One family with whom we talked were threshing their wheat. The crop had been a good one and was yielding between 38.5 and 41.3 bushels per acre, worth at the time $35 to $40. On the same land this farmer secures a yield of 352 to 361 bushels of potatoes, which at the market price at that time would give a gross earning of $64 to $66 per acre.

Reference has been made to the extensive use of straw in the cultural methods of the Japanese. This is notably the case in their truck garden work, and two phases of this are shown in Fig. 245. In the lower section of the illustration the garden has been ridged and furrowed for transplanting, the sets have been laid and the roots covered with a little soil; then, in the middle section, showing the next step in the method, a layer of straw has been pressed firmly above the roots, and in the final step this would be covered with earth. Adopting this method the straw is so placed that (1) it acts as an effective mulch without in any way interfering with the capillary rise of water to the roots of the sets; (2) it gives deep, thorough aeration of the soil, at the same time allowing rains to penetrate quickly, drawing the air after it; (3) the ash ingredients carried in the straw are leached directly to the roots where they are needed; (4) and finally the straw and soil constitute a compost where the rapid decay liberates plant food gradually and in the place where it will be most readily available. The upper section of the illustration shows rows of eggplants very heavily mulched with coarse straw, the quantity being sufficient to act as a most effective mulch, to largely prevent the development of weeds and to serve during the rainy season as a very material fertilizer.
In growing such dry land crops as barley, beans, buckwheat or dry land rice the soil of the field is at first fitted by plowing or spading, then furrowed deeply where the rows are to be planted. Into these furrows fertilizer is placed and covered with a layer of earth upon which the seed is planted. When the crop is up, if a second fertilization is desired, a furrow may be made alongside each row, into which the fertilizer is sowed and then covered. When the crop is so far matured that a second may be planted, a new furrow is made, either midway between two others or adjacent to one of them, fertilizer applied and covered with a layer of soil and the seed planted. In this way the least time possible is lost during the growing season, all of the soil of the field doing duty in crop production.

It was our privilege to visit the Imperial Agricultural Experiment Station at Nishigahara, near Tokyo, which
is charged with the leadership of the general and technical agricultural research work for the Empire. The work is divided into the sections of agriculture, agricultural chemistry, entomology, vegetable pathology, tobacco, horticulture, stock breeding, soils, and tea manufacture, each with their laboratory equipment and research staff, while the forty-one prefectural stations and fourteen sub-stations are charged with the duty of handling all specific local, practical problems and with testing out and applying conclusions and methods suggested by the results obtained at the central station, together with the local dissemination of knowledge among the farmers of the respective prefectures.

A comprehensive soil survey of the arable lands of the Empire has been in progress since before 1893, excellent maps being issued on a scale of 1 to 100,000, or about 1.57 inch to the mile, showing the geological formations in eight colors with subdivisions indicated by letters. Some eleven soil types are recognized, based on physical composition and the areas occupied by these are shown by means of lines and dots in black printed over the colors. Typical profiles of the soil to depths of three meters are printed as insets on each sheet and localities where these apply are indicated by corresponding numbers in red on the map.

Elaborate chemical and physical studies are also being made in the laboratories of samples of both soil and subsoil. The Imperial Agricultural Experiment Station is well equipped for investigation work along many lines and that for soils is notably strong. In Fig. 246 may be seen a portion of the large immersed cylinders which are filled with typical soils from different parts of the Empire, and Fig. 247 shows a portion of another part of their elaborate outfit for soil studies which are in progress.

It is found that nearly all cultivated soils of Japan are acid to litmus, and this they are inclined to attribute to the presence of acid hydro-aluminum silicates.

The Island Empire of Japan stretches along the Asiatic coast through more than twenty-nine degrees of latitude.
from the southern extremity of Formosa northward to the middle of Saghalin, some 2300 statute miles; or from the latitude of middle Cuba to that of north Newfoundland and Winnipeg; but the total land area is only 175,428 square miles, and less than that of the three states of Wisconsin, Iowa and Minnesota. Of this total land area only 23,698 square miles are at present cultivated; 7151 square miles in the three main islands are weed and pasture land. Less than fourteen per cent of the entire land area is at present under cultivation.

If all lands having a slope of less than fifteen degrees may be tilled, there yet remain in the four main islands, 15,400 square miles to bring under cultivation, which is an addition of 65.4 per cent to the land already cultivated.

In 1907 there were in the Empire some 5,814,362 households of farmers tilling 15,201,969 acres and feeding 3,522,877 additional households, or 51,742,398 people. This is an average of 3.4 people to the acre of cultivated land, each farmer’s household tilling an average of 2.6 acres.

The lands yet to be reclaimed are being put under cultivation rapidly, the amount improved in 1907 being 64,448 acres. If the new lands to be reclaimed can be made as productive as those now in use there should be opportunity for an increase in population to the extent of about 35,000,000 without changing the present ratio of 3.4 people to the acre of cultivated land.

While the remaining lands to be reclaimed are not as inherently productive as those now in use, improvements in management will more than compensate for this, and the Empire is certain to quite double its present maintenance capacity and provide for at least a hundred million people with many more comforts of home and more satisfaction for the common people than they now enjoy.

Since 1872 there has been an increase in the population of Japan amounting to an annual average of about 1.1 per cent, and if this rate is maintained the one hundred million mark would be passed in less than sixty years. It
Fig. 247.—Part of equipment for chemical soil studies, Imperial Agricultural Experiment Station, Tokyo, Japan.
appears probable however that the increased acreage put under cultivation and pasturage combined, will more than keep pace with the population up to this limit, while the improvement in methods and crops will readily permit a second like increment to her population, bringing that for the present Empire up to 150 millions. Against this view, perhaps, is the fact that the rice crop of the twenty years ending in 1906 is only thirty-three per cent greater than the crop of 1838.

In Japan, as in the United States, there has been a strong movement from the country to the city as a natural result of the large increase in manufactures and commerce, and the small amount of land per each farmer's household. In 1903 only .23 per cent of the population of Japan were living in villages of less than 500, while 79.06 per cent were in towns and villages of less than 10,000 people, 20.7 per cent living in those larger. But in 1894 84.36 per cent of the population were living in towns and villages of less than 10,000, and only 15.64 per cent were in cities, towns and villages of over 10,000 people; and while during these ten years the rural population had increased at the rate of 640 per 10,000, in cities the increase had been 6,174 per 10,000.

Japan has been and still is essentially an agricultural nation and in 1906 there were 3,872,105 farmers' households, whose chief work was farming, and 1,581,204 others whose subsidiary work was farming, or 60.2 per cent of the entire number of households. A like ratio holds in Formosa. Wealthy land owners who do not till their own fields are not included.

Of the farmers in Japan some 33.34 per cent own and work their land. Those having smaller holdings, who rent additional land, make up 46.03 per cent of the total farmers; while 20.63 per cent are tenants who work 44.1 per cent of the land. In 1892 only one per cent of the land holders owned more than twenty-five acres each; those holding between twenty-five acres and five acres made up 11.7 per cent; while 87.3 per cent held less than five
acres each. A man owning seventy-five acres of land in Japan is counted among the "great land-holders". It is never true, however, except in the Hokkaido, which is a new country agriculturally, that such holdings lie in one body.

Statistics published in "Agriculture in Japan", by the Agricultural Bureau, Department of Agriculture and Commerce, permit the following statements of rent, crop returns, taxes and expenses, to be made. The wealthy land owners who rent their lands receive returns like these:

<table>
<thead>
<tr>
<th></th>
<th>For paddy field, per acre.</th>
<th>For upland field, per acre.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent</td>
<td>$27.98</td>
<td>$18.53</td>
</tr>
<tr>
<td>Taxes</td>
<td>7.34</td>
<td>1.98</td>
</tr>
<tr>
<td>Expenses</td>
<td>1.72</td>
<td>2.49</td>
</tr>
<tr>
<td>Total expenses</td>
<td>$9.06</td>
<td>$4.46</td>
</tr>
<tr>
<td>Net profit</td>
<td>18.92</td>
<td>9.07</td>
</tr>
</tbody>
</table>

It is stated, in connection with these statistics, that the rate of profit for land capital is 5.6 per cent for the paddy field, and 5.7 per cent for the upland field. This makes the valuation of the land about $338 and $159 per acre, respectively. A land holder who owns and rents ten acres of paddy field and ten acres of upland field would, at these rates, realize a net annual income of $279.90.

Peasant farmers who own and work their lands receive per acre an income as follows:

<table>
<thead>
<tr>
<th></th>
<th>For paddy field, per acre.</th>
<th>For upland field, per acre.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop returns</td>
<td>$55.00</td>
<td>$30.72</td>
</tr>
<tr>
<td>Taxes</td>
<td>7.34</td>
<td>1.98</td>
</tr>
<tr>
<td>Labor and expenses</td>
<td>36.20</td>
<td>24.00</td>
</tr>
<tr>
<td>Total expense</td>
<td>$43.54</td>
<td>$25.98</td>
</tr>
<tr>
<td>Net profit</td>
<td>11.46</td>
<td>4.74</td>
</tr>
</tbody>
</table>

The peasant farmer who owns and works five acres, 2.5 of paddy and 2.5 of upland field, would realize a total net income of $40.50. This is after deducting the price of his labor. With that included, his income would be something like $91.
Taxes and Rent.

Tenant farmers who work some 41 per cent of the farm lands of Japan, would have accounts something as follows:

<table>
<thead>
<tr>
<th></th>
<th>For paddy field, 1 crop. per acre.</th>
<th>For upland field, 2 crops. per acre.</th>
<th>Total expenses</th>
<th>Net profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop returns</td>
<td>$49.03</td>
<td>$78.62</td>
<td>$41.36</td>
<td>-0.97</td>
</tr>
<tr>
<td>Tenant fee</td>
<td>23.89</td>
<td>31.58</td>
<td>18.52</td>
<td>-0.27</td>
</tr>
<tr>
<td>Labor</td>
<td>15.78</td>
<td>25.79</td>
<td>14.69</td>
<td>-0.30</td>
</tr>
<tr>
<td>Fertilization</td>
<td>7.82</td>
<td>17.30</td>
<td>10.22</td>
<td>-0.27</td>
</tr>
<tr>
<td>Seed</td>
<td>.82</td>
<td>1.40</td>
<td>1.57</td>
<td>-0.30</td>
</tr>
<tr>
<td>Other expenses</td>
<td>1.69</td>
<td>2.82</td>
<td>1.66</td>
<td>-0.30</td>
</tr>
<tr>
<td></td>
<td>$50.00</td>
<td>$78.89</td>
<td>$41.66</td>
<td>-0.30</td>
</tr>
</tbody>
</table>

This statement indicates that tenant farmers do not realize enough from the crops to quite cover expenses and the price named for their labor. If the tenant were renting five acres, equally divided between paddy and upland field, the earning would be $73.00 or $99.73 according as one or two crops are taken from the paddy field, this representing what he realizes on his labor, his other expenses absorbing the balance of the crop value.

But the average area tilled by each Japanese farmer's household is only 2.6 acres, hence the average earning of the tenant household would be $37.95 or $51.86. A clearer view of the difference in the present condition of farmers in Japan and of those in the United States may be gained by making the Japanese statement on the basis of our 160-acre farm, as expressed in the table below:

<table>
<thead>
<tr>
<th></th>
<th>For 80 acres.</th>
<th>For 80 acres.</th>
<th>Total. 160 acres.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop returns</td>
<td>$4,400.00</td>
<td>$2,457.60</td>
<td>$6,857.60</td>
</tr>
<tr>
<td>Taxes</td>
<td>$587.20</td>
<td>$158.40</td>
<td>$745.60</td>
</tr>
<tr>
<td>Expenses</td>
<td>1,638.60</td>
<td>744.80</td>
<td>2,383.40</td>
</tr>
<tr>
<td>Labor</td>
<td>1,262.40</td>
<td>1,175.20</td>
<td>2,437.60</td>
</tr>
<tr>
<td></td>
<td>$3,488.20</td>
<td>$2,078.40</td>
<td>$5,561.60</td>
</tr>
<tr>
<td>Net return</td>
<td>916.80</td>
<td>379.20</td>
<td>1,296.00</td>
</tr>
<tr>
<td>Return including labor</td>
<td>2,179.20</td>
<td>1,554.40</td>
<td>3,733.60</td>
</tr>
</tbody>
</table>

In the United States the 160-acre farm is managed by and supports a single family, but in Japan, as the average household works but 2.6 acres, the earnings of the 160 acres are distributed among some 61 household, making
the net return to each but $21.25, instead of $1296, and including the labor as earning, the income would be $39.96 more, or $60.67 per household instead of $3733.60, the total for a 160-acre farm worked under Japanese conditions.

These figures reveal something of the tense strain and of the terrible burden which is being carried by these people, over and above that required for the maintenance of the household. The tenant who raises one crop of rice pays a rental of $23.89 per acre. If he raises two crops he pays $31.58; if it is upland field, he pays $13.52. To these amounts he adds $10.33, $21.52 or $13.45 respectively for fertilizer, seed and other expenses, making a total investment of $34.22, $53.10 or $26.97 per acre, which would require as many bushels of wheat sold at a dollar a bushel to cover this cost. In addition to this he assumes all the risks of loss from weather, from insects and from blight, in the hope that he may recoup his expenses and in addition have for his services $14.81, $25.52 or $14.39 for the season's work.

The burdens of society, which have been and still are so largely burdens of war and of government, with all nations, are reflected with almost blinding effect in the land taxes of Japan, which range from $1.98, on the upland, to $7.34 per acre on the paddy fields, making a quarter section, without buildings, carry a burden of $300 to $1100 annually. Japan's budget in 1907 was $134,941,113, which is at the rate of $2.60 for each man, woman and child; $8.90 for each acre of cultivated land, and $23, for each household in the Empire. When such is the case it is not strange that scenes like Fig. 248 are common in Japan today where, after seventy years, toil may not cease.

There is a bright, as well as a pathetic side to scenes like this. The two have shared for fifty years, but if the days have been full of toil, with them have come strength of body, of mind and sterling character. If the burdens
have been heavy, each has made the other's lighter, the satisfaction fuller, the joys keener, the sorrows less difficult to bear; and the children who came into the home and have gone from it to perpetuate new ones, could not

Fig. 248.—After seventy years, toll may not cease.

well be other than such as to contribute to the foundations of nations of great strength and long endurance.

Reference has been made to the large amount of work carried on in the farmers' households by the women and children, and by the men when they are not otherwise employed, and the earnings of this subsidiary work have materially helped to piece out the meagre income and to meet the relatively high taxes and rent.
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