REPORT OF A TRIP TO THE ORIENT TO COLLECT AND STUDY ORIENTAL PEARS

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Introduction

Pear culture is one of the chief fruit industries of the Pacific Coast. In fact, in some of the leading fruit districts here, pear growing is of greater importance than all other fruit industries combined. For example, a survey made of the fruit industry of the Rogue River Valley of Oregon in 1916 showed that there were more pear trees than all other fruit trees combined. It is well known that the climatic conditions in many of the valleys of the Pacific Coast are ideal for the production of high class pears, and in many cases the soils are better adapted to pears than to any other fruit. It has often been stated by fruit experts and fruit dealers that certain varieties of pears reach a degree of perfection here seldom attained in any other region.

The chief problem in the production of pears on the Pacific Coast and in most of the pear districts of America is the disease known as pear blight (Bacillus amylovorus). When weather conditions are favorable the disease here becomes extremely virulent, causes great losses, often destroying large portions of the trees, and at times killing entire trees. Furthermore, the disease causes considerable loss every season in practically every district. Under our conditions it may affect any part of the trees: blossoms, fruit spurs, small and large branches, the trunk, crown and root system. The disease is particularly destructive when it attacks the trunk and root system, and it is notably difficult to eradicate from the underground portions of the tree. There it may become established and progress for weeks before it is detected; and when finally detected it has often progressed to such an extent that it is expensive and difficult or impossible to eradicate it and save the tree. Even when the tree can be saved it is usually necessary to mutilate the trunk and root system to such an extent that its vigor and productiveness are markedly impaired. When a large pear tree is destroyed the loss is a heavy one as it requires from ten to fifteen years to bring another tree into full bearing. Pear growing is an expensive business and to be profitable under present conditions requires the production of large crops, and consequently a very small percentage of missing or unproductive trees.

The rootstock of all the older and many of the younger pear trees on the Pacific Coast is the French pear, Pyrus communis. This species is the wild type from which most of our cultivated varieties of pears have been derived. It makes an ideal stock for these cultivated vari-

eties, at least in many respects. Usually the union is good and it is well adapted to a great variety of soils. It has one very objectionable characteristic, however, and this is its great susceptibility to pear blight. It is also highly susceptible to the pear woolly aphis which has become well established in many pear districts on the Pacific Coast, and here often does considerable damage. It is very evident then, that while this stock possesses only one or two objectionable features, these are of such tremendous importance that they condemn it as a stock for pears under our conditions. It is the opinion of many pear growers that unless a more desirable stock can be obtained for pears, the industry in some districts will become unprofitable. It is certainly evident that the loss to pear industry due to this stock is an enormous toll, and in many cases has already forced pear growers to give up the business.

WORK AT THE SOUTHERN OREGON EXPERIMENT STATION

Blight Resistant Pear Stock

The writer became thoroughly convinced during the great pear blight epidemic in this valley during the summer of 1913 that every effort must be made to produce a more blight resistant stock. At that time only two other stocks besides the French stock were in use in this country: namely the Japan Sand pear and the Quince both of which were used in only a limited way. The Quince is so susceptible to blight, and also dwarfs most varieties to such an extent that its use here is not permissible. There was no experimental evidence regarding the blight resisting qualities of the Japan Sand pear. However, observations made here and there indicated that while not by any means immune to blight, it was at least more resistant than the French stock. It should be stated that while some of the American species of Crataegus had occasionally been used as a stock for pears, and in some instances apparently with success, it had generally proved a failure, and so far as could be determined no commerical orchards existed on this stock. Since the Japan Sand pear is notably distinct from our cultivated varieties, and it had been used in such a limited way as a stock, it was impossible to predict its value as a stock for these varieties.

It is very apparent from this that there was very little material to select from, and that the known available pear stocks at that time did not present a very encouraging outlook for our conditions. It was known to botanists that other species of Pyrus existed in Europe, Northern Africa, and Asia, but nothing was known regarding their abilities to resist blight, and their suitableness as stocks for our cultivated varieties.

Establishing a Pyrus Collection

It was evident then that the field was a comparatively new one, and that a large amount of foundation work must be done. The writer felt that the conditions in the Rogue River Valley of Southern Oregon were suitable for such work. For this work it was necessary first to estab-

lish a complete collection of the various species of Pyrus and a large number of varieties. To obtain material of the various species was not a simple matter. Aside from the French and Japan pears already in use as stocks, none of the species could be obtained from the nurseries in this country, and most of them were not in the nursery trade anywhere. No complete collection was in existence anywhere; and the material must be obtained from various sources.

The material was obtained from the Office of Plant and Seed Introduction of the USDA Arboretums, European and Oriental nurserymen, botanical gardens, private collections, Experiment Stations, missionaries, and herbariums. Some excellent material had been collected in China by the late and lamented Frank N. Meyer, of the U.S. Department of Agriculture, Mr. E. H. Wilson of the Arnold Arboretum, and by Mr. George Compere of the California Commission of Horticulture. In 1882 some valuable material was collected near Peking, China, and sent to the Arnold Arboretum, by Dr. E. Bretschneider.

Many cultivated varieties were obtained from nurserymen and individuals in this country, England, and France.

It was impossible to obtain trees of most of the species, and this material usually consisted of scions, budwood and seeds. It was necessary, therefore, to propagate this material before any work could be done. In the propagation work we were quite successful, and by midsummer of 1915 many of the species had made sufficient growth to begin certain phases of the work.

Blight Resistance of Pyrus Species

The first phase of the work was to determine which species, if any, were resistant and which were susceptible to pear blight. To determine this, blight cultures were prepared in considerable quantities, and vigorous trees of the various species inoculated from time to time throughout the season. In all cases check trees were inoculated to determine the value and virulence of the blight cultures. These check trees consisted of varieties which were known to be susceptible to blight, and those most extensively used were Bartlett, Forelle, Howell, Bosc, Comice, Anjou, and Winter Nelis.

It is really quite surprising how quickly valuable preliminary results can be obtained in this manner. In some instances valuable and reliable results were obtained the first summer by inoculating young trees grown from the scions inserted in the spring. In many other cases, however, it was not possible to determine the degree of resistance of a species until the trees were at least a year old, and in some cases two or three years old. This is true where a type shows only a moderate degree of resistance; for example, where it blights readily in one-year-old wood, but shows considerable resistance in wood that is two or three years old or older.

Species Susceptible to Pear Blight

During the first three seasons of work it was determined that certain species were quite susceptible to this disease. The following species blighted readily when inoculated in any wood from one to three years old, some of them, of course, blighting more quickly and more seriously than others: Pyrus amygdaliformis, balansae, betulaefolia, canescens, communis, cordata, cotinifolia, elaeagrifolia, fascicularis, glabra, heterophylla, longipes, malifolia, michauxii, nivalis, pashia, persica, phaeocarpa, salicifolia, siniaca, and some types of P. serotina.

It will be observed from this that all of the European species are susceptible, that the only variety from northern Africa tested is susceptible, and that some of the Oriental species are also susceptible.

In this work the following blighted readily in young wood, but proved quite resistant in older wood: P. bretschneideri, calleryana, ovoidea, variolosa, one type of serrulata, certain forms of P. serotina, and some forms of the mongrel type P. sinensis.

P. ussuriensis proved very resistant to this disease, and some forms of it practically immune.

The type which we received under the name P. variolosa and which we have listed under that name in our records is distinct from any known wild species. It is probably a hybrid and its seedlings indicate that one of its parents may be P. communis.

Oriental Species Most Resistant

It will be noted in the results discussed above that the most resistant species are natives of the Orient. In all of our work, P. ussuriensis has proved far more resistant to this disease than any other species. This is a distinct species and a native of northern China, Manchuria, northern Korea, and eastern Siberia. The second most resistant of the pure and well defined species is P. calleryana. This is a native of central, western, and southern China. Very little was known regarding the other species or types showing considerable resistance. With the exception of P. serrulata nothing was known regarding their native habitat or abundance and their suitability as stocks. Nothing was known regarding these species or types as to their ability to breed true to type from seed. None of them were in the nursery trade, and no dealers anywhere were handling the seed.

Object of Trip to the Orient

Since certain of these species apparently possessed a very high degree of resistance to blight, it was decided to test them thoroughly as stocks for our cultivated varieties. The amount of stock which we had at that time was too limited for this work. The writer, therefore, decided to go to the Orient to collect sufficient material of the various kinds to enable him to carry on the necessary experimental work.

It was also apparent that little was known regarding the most accessible localities in which seed could be obtained in quantity in the future if experimental results should create or justify a demand for large quantities of such stock. One of the objects of the trip was to determine such localities.

Since China possesses no nurserymen from whom such material could be purchased, and since some of the larger Japanese nurseries were already shipping large quantities of nursery stock to this country, it was evident that the importation of such desirable types would be facilitated and simplified if such material could be procured in Japan. For this reason, a study was made of the wild pear species of Japan to determine whether these resistant species were also native there.

This study in Japan was particularly timely since some of the leading Japanese nurseries were listing and selling the native Sand Pear of that country under the botanical name Pyrus ussuriensis. All of the seedlings which I had seen imported from Japan under this name were not Pyrus ussuriensis. For this reason, it was decided to identify their species and to familiarize their nurserymen with the various types so that the various kinds could be purchased from them under their proper names in the future.

Another object of the trip was to determine whether any of the susceptible and undesirable species grew in the localities where the desirable species occurred and, if so, whether there would be any danger of seed collectors confusing them; also whether such desirable and undesirable species growing in proximity readily hybridized.

Another important object of the trip was to make a systematic study of the various Oriental species, and determine, if possible, which of the types that have been given specific rank were really species and which were simply subspecies or hybrids. It is well known that until recently comparatively little was known regarding the Oriental species of pears and that the various species were considerably confused by botanists and horticulturists. During recent years efforts have been made to straighten out this tangle, and some progress had really been made. However, no entirely satisfactory classification has yet appeared.

It was also important to secure further information regarding these species from the horticulturists standpoint. Such information, for example, as geographical distribution, climatic requirements, soil preferences, vigor of trees, size and age attained by the trees, would be of great value. Furthermore, practically nothing was known regarding the botany of the cultivated varieties of north China. Since our work had determined that certain of the Oriental species were highly resistant to pear blight and others were very susceptible, it became of paramount importance to determine which of these species had given rise to their cultivated varieties. Also, to introduce the best cultivated varieties, particularly so if such had been derived from any of the highly blight resistant species. These would be of great value here in breeding desirable blight resistant varieties.

Further information was also needed regarding the kind or kinds of stock used in China for the various types of cultivated pears. It was often observed that usually a poor stand was obtained, and often a total failure, when the Oriental varieties were worked on the stocks commonly used in this country. This information would prove of value in a general study of pear stocks, and of special value in propagating and growing the more valuable cultivated Oriental varieties in this country.

A STUDY OF THE ORIENTAL PEARS

Itinerary of the Trip

The following gives a brief outline of the plan of the trip which I made. I sailed from San Francisco, California, on July 18, 1917, and arrived at Yokohama, Japan, on August 6th. The remainder of August was spent in Japan. First I visited the Horticultural Experiment Station at Ninomiya, Japan, to see the collection of cultivated varieties of pears growing there. One day was spent in studying the collection of Japanese and Korean pears in the Herbarium at the Botanical Garden of the University of Japan, at Tokyo. From there I went to Koriyama in East Central Japan where I saw a small collection of cultivated pears at the Koriyama Experiment Station, and a small number of wild pear trees in the mountains nearby.

From there I went to Morioka, Tono, and Ayaori in the Iwate Province, in northeastern Japan, to study the wild pears which are quite abundant in the surrounding mountains. I then returned to southern Japan to investigate the pears near Yokkaichi, in the Iso Province, at which place P. calleryana had been found by Japanese botanists. From there I went to Mt. Yatsugatake which is located in the high mountainous region of central Japan, to determine whether P. calleryana was indigenous there as had been reported.

The first half of September was spent in Korea investigating the pears around Seoul, Suigen, in the central part; and around Koshu, and Cyokka in the southwestern portion; and around Genaan, Kanko, Teihei, and Yeiko on the coast of east central Korea.

From Korea I went to Lioyang and Lishan in southern Manchuria where I spent only five days. At Liaoyang I studied the varieties grown in that region, and from Lishan I went to the Chien Shan (mountains) to study the wild pears which are quite abundant there.

Finally I went to China where I spent just three months. The first month was spent in northern China, particularly west, north, and northeast of Peking, in studying the wild species and the cultivated varieties. The work in northern China included an extensive trip to Hsing Lung Shan about 80 miles northeast of Peking where exists numerous wild trees of P. ussuriensis. From Peking I went to Hankow and then up the Yangtze Kiang River to Shasi. From this place I traveled sixty miles north across the country to Kingman, studying the wild pears along the way. At Kingman I met Mr. F. N. Meyer of the U.S. Department of Agriculture, with whom I spent the

the following eighteen days. Eight days were spent around Kingman collecting and studying the numerous trees of P. calleryana and P. betulaefolia. From there we travelled overland to Ichang, a distance of 80 miles, observing the pear trees which were quite common all along the way. Several days were in the Diamond Mountains about fifteen miles north of Ichang, studying the various types of P. calleryana, P. betulaefolia, P. serotina, and P. serrulata there.

In the Diamond mountains my left leg became badly infected and it was necessary to spend the following three weeks in a hospital at Hankow. From Hankow I returned to Peking on December 18th. I again made Peking headquarters, and from there made trips to Cheng Ann Saz, Matou, Pai Hsi Kou, and the Ma An Shan mountains collecting scionwood of important cultivated varieties.

From Peking I returned home via Manchuria, Korea, and Japan, arriving at San Francisco on January 14th, 1918.

TYPES OF PYRUS WHICH I FOUND IN THE ORIENT

Classification Followed

Until recently, much confusion has existed among botanists, generally, regarding the botany of the Oriental pears. All the cultivated varieties of the Orient were designated by botanists and horticulturists as Pyrus sinensis, Lindley. Most botanists and horticulturists also used P. ussuriensis Maxin indiscriminately as a synonym of P. sinensis. This was also true in a large measure of the Orient.

During recent years, progress has been made by botanists in preparing a proper classification of the Oriental pears. The Monograph by Alfred Rehder, entitled "Synopsis of the Chinese Species of Pyrus," and published in June, 1915, is the best work that has appeared on this subject. In this work, Rehder substitutes the specific name P. Lindleyi for P. sinensis, and points out the distinction between P. ussuriensis and P. Lindleyi and other species.

In this classsification Rehder also creates five new species. In the discussion which follows, I will use the classification and specific names as adopted by Rehder. However, I agree with him only so far as the well-established and well-defined species are concerned. I shall take exception to some of his new species, a discussion of which will appear in another part of this report.

The Wild Pears of Japan

Owing to the fact that Japan is now shipping considerable quantities of pear seeds and seedlings to this country, and to the ease of obtaining nursery stock from them, and the difficulty and uncertainty of obtaining it from Chinese sources, and further, that much confusion exists regarding Japanese species, I made a hurried survey of their species, and particularly of those usually exported to the United States. One of the chief objects of this survey was to determine whether P. ussuriensis and P. calleryana were native to Japan.

Pyrus ussuriensis

I did not find a single tree of P. ussuriensis in Japan. My survey in Japan was not at all exhaustive, and did not cover all the regions in that country in which wild pears are found. Therefore, it cannot be positively stated that the species does not occur anywhere in that country. I collected in south central, central, east central and northeastern Japan, and found wild pear trees in all of these regions, but no P. ussuriensis. This survey included a study in three different places in northeastern Japan, where wild pear trees are extremely abundant, and where great quantities of pear seeds are collected for the nursery and export trade. Seed collected in this region has been listed during the past years by some of the Japanese nurserymen as P. ussuriensis. None of the many trees observed, however, belonged to this species.

During the fall of 1917 after I had left Japan, Prof. Miyazawa collected specimens of a Pyrus at the southern base of Mt. Fuji. This has been named P. hondoensis by Prof. Kikuchi and Prof. Nakai of Japan. Mr. E. H. Wilson of the Arnold Arboretum, who examined these trees in the spring of 1918, writes me that from the preliminary examination which he made, he regards this form as P. ussuriensis. He expected to study it further during the fall of 1918 when mature fruit could be obtained before deciding finally regarding its identity.

A very limited amount of herbarium material of this type was presented to me by Professors Kikuchi and Miyazawa last winter. While the material which I examined was too limited to enable me to decide the matter definitely, I do not think that it is P. ussuriensis. If this should prove to be a form of P. ussuriensis, it certainly is a unique form and very different from the species as it grows in northern China.

This type and the pears in certain other regions, particularly in northwestern Japan, should receive further study before we can state finally whether or not P. ussuriensis occurs in Japan. It is possible that P. ussuriensis may be native to northwestern Japan as it occurs in the Diamond Mountains of eastern Korea. Climatically, however, there is considerable difference, since Korea is cooler in summer, colder in winter, and has a much lower rainfall during both winter and summer than northwestern Japan.

Pyrus Calleryana

Previous to my trip, P. calleryana had been reported from Hadzmura, Ise Province, and from Mt. Yatsugatake, in Shinano Province, Japan. Some botanists questioned the statement that this species occurred at all in Japan. For this reason, I made a trip to both of these places to determine definitely whether this species occurred there, and if so whether these were desirable places in which to collect quantities of seed for the trade in the future.

This investigation proved conclusively that P. calleryana does occur in Japan. I found about one dozen trees of this species near the village of Hadzmura in Ise Province. These were growing wild at an elevation of 50 to 75 feet above sea level, and in situations which showed conclusively that the trees or seed has not been planted there by human beings. Whether the original trees or stock in southern Japan was native there or brought from China cannot be stated, as there is nothing in Japanese horticultural literature to determine this. However, the trees which I saw there were wild and were thriving so well that they appeared to be perfectly at home. The trees varied in height from 20 to 35 feet, and from 4 to 15 inches in diameter, and were bearing moderate crops of fruit.

At least a hundred small trees of this species were observed at various places around the villages of Tono and Kono in the Ise Province. One place three or four miles to the northeast of Kono is known as "Yama-nashi Plain," and natives told us that Yama-nashi (P. calleryana) was quite abundant there during former years. This was quite evident as many small trees could still be found there. Most of these trees were suckers or sprouts from stumps and small trees which had been cut off repeatedly for fuel by the natives in the villages nearby. These sprouts are repeatedly cut off and seldom are left long enough to produce fruit. Northwest of the small village of Kono at an elevation of 600 feet, I found about fifty small trees from three to ten feet high. Most of these were in bearing and were producing excellent crops. These too were cut off from time to time for fuel, but had sprouted repeatedly from the stumps. I was told by a native there that these trees had been planted there originally as a windbreak. This may be possible, although I saw no object in planting a windbreak at that place, and the trees were not allowed to get large enough to serve such a purpose. When this species was first described by Japanese botanists, it was named P. dimorphophylla, Makino. Further investigation, however, showed that this was a form of P. calleryana. Many of the trees, especially those near Hadzmura, produce two types of leaves, first the typical broad or ovate leaf of the species, and second many narrow comparatively long, almost lanceolate leaves. Seedlings grown at the Southern Oregon Experiment Station from these trees produce very characteristic pinnately lobed leaves the first year. Owing to the two types of leaves on the mature trees, Koidzumi has designated this as P. calleryana.

Dimorphophylla

Since my time was too limited to explore further in southern Japan, I asked Mr. Tojuda of the Yokohama Nursery Company, who investigated these trees with me, to explore southern Japan further for this species. His investigations have shown that this species is found in various places in Ise and Shima provinces.

I also asked Mr. E. H. Wilson of the Arnold Arboretum, who was in the Orient, to investigate this species. He did so during the spring of 1918 and wrote me that the species certainly could be considered as indigenous to this region. Whether native or originally introduced from China is still a question.

I also made a trip to Mt. Yatsugatake in the mountainous district of central Japan to study this species. I could not find a single plant of it there. Specimen branches containing leaves and fruits were also shown to the natives and to one seed collector there, and they told me that they had never seen any such plant in that region. Later investigation showed that the original report of this species growing at Mt. Yatsugatake was not based on good evidence. I think that it can be safely concluded that it does not grow there; or if it does, it is so extremely rare that this district is out of the question as a possible source of commercial quantities of seed.

It is evident then that the only known source of seed of this species in Japan at present is in Ise and Shima provinces. The trees there apparently are not very abundant, and the supply of commercial quantities of seed from there will be comparatively limited. However, if the natives can be made to realize the commercial possibilities of such trees and seed, the trees will be spared and probably more planted. With the interest of the Japanese nurserymen aroused in the matter, this region should prove a promising and certainly a readily accessible source of seed.

Mr. E. H. Wilson, who has botanized extensively in Japan, including southern Japan, told me that he had never seen P. calleryana in Japan until he saw it in the Ise Province in the spring of 1918. It is evident from this that it is not generally nor widely distributed even in southern Japan. This fact lends color to the belief that it may not be a native of Japan, but has become indigenous from introduced plants.

P. calleryana has been found only in the mild climate of southern Japan, where hardy oranges can be grown. The ability of this form to withstand colder climates has not been determined. It is quite probable that it will not endure very severe winter climates. It is very probable that it will endure the mild climate of western Oregon and California.

Pyrus serotina

According to Mr. Alfred Rehder, P. serotina includes the large, roundish, russet pears with generally a deciduous calyx and five cells, commonly found in Japan, central and western China, and generally known in America as the Japan Sand Pear. This species, or perhaps group, is widely distributed in Japan, and is an extremely variable one in some respects.

It is, so far as I observed, the only species cultivated in Japan, and is extensively grown from extreme southern to extreme northern Japan. In the wild state it is widely distributed in all of the mountainous districts, and is particularly abundant in the mountains of northern Japan.

It is especially abundant in the mountains north of the village of Ayaori, in Iwate Province in northern Japan. It is the stock used for all cultivated varieties in Japan. Large quantities of seed from the cultivated trees, and especially from the wild and semi-wild trees, are collected and shipped to America every year to be used as stock.

Naturally a tree which is so widely distributed, and grows under such varied conditions shows considerable variation.

The trees are found at all elevations ranging from near sea level to more than 5,000 feet. On Mt. Yatsugatake I found it at an elevation of 5,600 feet, and it probably occurs still higher. They grow on all exposures and on a great variety of soils, sometimes along streams, but more commonly on mountain sides and in mountain coves.

The trees are usually rapid growers and attain a very large size. Trees with trunks from 18 inches to 2 feet in diameter, forty to sixty feet high are quite common, and at the foot of Mt. Yatsugatake, I saw one old specimen nearly three feet in diameter.

The leaves of this specimen are usually very large, in fact the largest of any species of Pyrus that I have ever seen. There is more or less variation in the leaves, especially the form of the base, and the character of the margin.

However, in nearly all specimens it is a simple matter to recognize the species, so far as the leaves are concerned.

Undoubtedly the most noticeable peculiarity of this species is the extreme variation in the character of the calyx. This varies from a perfectly deciduous calyx through all stages to a perfectly complete and persistent calyx. Some trees have fruit where every calyx is completely deciduous, others where most of the calyxes are deciduous, other with about half deciduous and half persistent, and still others with nearly all calyxes persistent. However, I did not see any trees where every fruit had a persistent calyx, except rarely a tree where the entire crop consisted of just a few fruits. The calyx was very variable, the number of lobes varying all the way from 1 to 5 and in rare cases 6. Here for example is the count on one tree: 50% deciduous, 14% only one lobe, 7% two lobes, 3% three lobes, 7% four lobes, and 19% five lobes. It is interesting to note that in this case, 50% of the calyxes were deciduous, and 50% were partially or wholly persistent.

I have observed this variation in the cultivated varieties of this species as well as the wild, although a larger percent of the cultivated varieties have a deciduous calyx. It is very evident from this that this is an extremely variable character in this species, and that possibly the species is changing from one type of calyx to another, or that the type as we know it today is not a pure species, but a hybrid. That pollination and fertilization

determine the character of the calyx in some of the Oriental pears was observed by the writer. For example, in central Korea, I noted one tree of P. calleryana where the unfolded corollas were still present in the calyx cups in late summer, the fruit fully grown, but fertilization had not taken place, and the fruit was all seedless and the calyx persistent. This in a species which normally has a deciduous calyx. The same thing was observed on a tree of P. phaeocarpa where a large percentage of the fruits contained the unfolded corolla, were seedless and had a persistent calyx. The other fruit on this tree had a deciduous calyx and normally develop seeds. In these vases the persistent calyx evidently was correlated with seedlessness.

In the Japan Sand Pears, however, perfectly developed seeds were just as common in fruits with a persistent calyx as in those with a deciduous calyx. That the persistent calyx in these cases may be correlated with some other character is quite possible.

In northeastern Japan I found many trees on which most of the fruit possessed a persistent calyx with rather characteristic upright lobes, and this has been designated as Pyrus ferruzinea by one of the Japanese botanists. Whether this is a distinct species or not remains to be determined. I saw every gradation between this and the typical Sand Pear with the deciduous calyx; hence, it is possible that this is simply the extreme variation from the type. Mr. E. H. Wilson is inclined to regard this as a form of P. serotina. Certainly in leaf and other character it is very similar to P. serotina.

Another fact which lends color to the supposition that this group may include hybrids is the variation the seedlings often exhibit in resistance to pear blight. In our inoculation experiments some of the seedlings are far more resistant than others. This greater resistance in some seedlings may be due to a difference in parentage; or it may be due simply to market variation within the species. We will soon have a large number of these seedlings fruiting and can then determine whether this variation in resistance is correlated with other characteristics.

It is certain, however, that if all these forms are simply pure P. serotina then the description of this species must be rewritten at least so far as the calyx is concerned. According to Rehder's description of this species, the calyx is deciduous.

Among the seedlings of the Japan Sand Pear, I have observed trees which in shape and serration of leaf resembled P. ussuriensis somewhat. It will be interesting to determine whether this species has hybridized with P. serotina in some instances.

The question has also been raised whether P. serotina is really a native of Japan or an introduced species from China which has escaped from cultivation. I am strongly inclined to believe that it is a native of Japan as well as China. It is perfectly at home in

the mountains of Japan and behaves like a native. Originally it was so abundant in the mountains of central Japan and reached such a high degree of development that one of the provinces was named "Yami-nashi prefecture" meaning "mountain pear prefecture".

It is apparent that much more work must be done to settle finally the question of the botany of the group known as the Japan Sand Pear. This will necessarily include more exploration work in Japan, and also a thorough experimental study of the seedlings grown from seed of which both parents are known.

Other Japanese Species

The Japanese botanists have created several new species based on material which certainly does not deserve specific rank. The following P. aromatica, P. hondoensis, and P. ferruginea I regard as simply forms of P. serotina.

The Japan Sand Pear is a very rapid grower, and usually is more resistant to pear blight than the French pear P. communis, and also more resistant to the pear woolly aphis. It is now extensively used as a stock for cultivated varieties on the Pacific Coast. Whether it will prove as well adapted to as varied conditions, especially to wet soil, still remains to be determined. In our experiment this type has not proved as resistant to pear blight as P. ussuriensis and P. calleryana.

The Pears of Korea

I spent comparatively little time in Korea, and did not explore the extreme northern part of that country at all. Most of my time was spent in central and southwestern Korea.

Pyrus calleryana

The chief object of my trip to Korea was to determine whether P. calleryana is abundant there and whether it is a desirable source from which to obtain commercial quantities of seed. I found comparatively few trees of this species around Seoul, although it is quite common around Suigen -- about twenty-five miles to the south of Seoul. In southwestern Korea, I found many plants of it around Gyokka to the east of Kanko. The northern limit of this species appears to be approximately one hundred miles to the north of Seoul. I observed isolated specimens of it growing at various places for the first eighty miles northeast of Seoul, along the Seoul-Gensan railroad line. Near Fukkei, just seventy-seven miles from Seoul and at an elevation of 1300 feet, I observed the last small specimen. I also saw occasional specimens for the first 110 miles to the northwest of Seoul along the Seoul-Antung line. The last plant observed along this line was a specimen four feet high, near Kosui, just 110 miles from Seoul.

Central Korea is undoubtedly the extreme northern limit of this species. It has never been observed as far north as this in any other country by any collector. This is unquestionably responsible for the comparatively small size of the trees there. Most of the plants observed varied in height from three to eight feet. Three trees were found which were from 12 to 15 feet high. These were found about five miles south of Suigen and were growing in good soil in a small, well protected valley, which is probably responsible for the larger size. It is very probably that in extreme southwestern Korea on fertile moist soil and where well protected from cold winter winds, larger trees may occur than those observed.

Another reasons for the small size of these trees in Korea is the extremely poor soil on which these trees usually occur. With very rare exceptions, all the valley soils are devoted to agricultural crops and wild pear trees can be found only on the poor and usually badly leached hillsides, where all vegetation indicates a great deficiency of plant food.

Lastly, the fuel problem in Korea is a serious one. Every few years all the trees and shrubs are cut off just above the surface of the soil and used for fuel. It is difficult to find any P. calleryana pear trees which have not been repeatedly cut off. With such treatment, the trees naturally remain small and stunted.

Often the branches of the trees are covered with numerous galls due to the larvae of an insect, which Prof. H. Ueke of Suigen, Korea, tells me is the larvae of a moth. This often causes considerable dwarfing of the plant.

Not only are the trees dwarf, but the leaves are also proportionately small, although typical of the species in shape and other characters. The fruit, when well developed, is just as large as in Japan and China.

At the present time, Korea is not a very suitable source of P. calleryana seed. As a rule, the trees and better shrubs usually occur as scattered specimens and are cut off for fuel so often that they seldom reach sufficient size to produce much fruit. If, in regions where the trees are most abundant, the natives could be induced to protect the trees, in a few years considerable quantities of seed could be collected. This, owing to the fierce struggle for fuel, is not an easy thing to do.

The dwarf habit and slow growth of this species is reproduced, at least the first year, in the seedlings when grown in the United States. During the season of 1918, the seedlings of this type at the Southern Oregon Experiment Sta. made only one-half as much growth as those from central China. Whether this condition will remain permanent remains to be determined. If it does, then this type from Korea cannot be recommended as a stock for our rapidly growing varieties. As a dwarfing stock, it may prove valuable.

It is very probable that this form of P. calleryana will prove more hardy in this country than the form from southern Japan and from central China, and, therefore, can be used in colder fruit regions. This matter will be determined by planting the two types in various parts of America.

Pyrus calleryana var. Fauriei

Mr. C. K. Schneider, a botanist, collected material around Seoul, Korea, which he named Pyrus Fauriei. I searched very diligently for this type, but could find nothing but this dwarf P. calleryana. In fact, many specimens of this dwarf P. calleryana fulfill Schneider's description of P. Fauriei perfectly. There are no good botanical differences between these two species. The dwarf habit of P. Fauriei is undoubtedly due to climatic and soil conditions. The peculiarity which probably misled Schneider is the small fruit often found on plants of this type. This small fruit, in all cases which I observed, was due to seedlessness. Sometimes all the fruit on a plant was of this character; more often, however, only part was small and seedless, and part of it possessed normal seeds and normal size. Whether this species should be classed with P. calleryana or given specific rank depends entirely upon the attitude of each botanist, since it is very difficult to designate the exact boundaries of a species in many cases. In my studies of Pyrus under such varied conditions, I have observed that the various species will often exhibit marked variations due to climatic and soil conditions. For this reason, I have been forced to the conclusion that we must often give considerable latitude in determining the boundaries of a species. I cannot regard P. Fauriei as a distinct species and have concluded that this is simply a variety of P. calleryana, and designate it as P. calleryana var. Fauriei.

P. usseriensis

Pyrus ussuriensis has been found in various parts of northern Korea by several botanists. Mr. E. H. Wilson tells me that he observed many trees of this species in extreme northeastern Korea during the summer of 1917. Several botanists have observed and collected it in the Diamond Mountains of east central Korea. In central Korea it appears to be rare, and I did not find any specimens in southern Korea, and none have ever been quoted from that region.

My observations of this species were confined to a limited region along the coast of east central Korea, around Gensan and along the coast for 50 or 60 miles to the north of Gensan. In this region it is not at all abundant, usually occuring here and there as isolated specimens. Furthermore, owing to the extremely poor fruit crop in this region during the summer of 1917, and the limited time available, it was impossible to make a critical study of it there.

The pears around Gensan, Korea, constitute a variable group. It is still a question in my mind whether these pears all belong to P. ussuriensis or whether another species also occurs there, and the two have hybridized. Some of the trees are unmistakably pure P. ussuriensis, possessing the typical leaves and fruit of this species. There are other trees with leaves typical of P. serotina with similar russet brown fruit, but usually with a persistent calyx. Every gradation between the two types can be found. On some trees part of the fruits have a persistent calyx and part of them deciduous calyx.

It is very evident that if we assign all these types to P. ussuriensis, as some botanists are doing, then we must give far more latitude to certain characters in that species. The fruit of Pyrus ussuriensis as it occurs in north China normally possesses a persistent calyx and is yellow or greenish yellow in color. Hence, if the type in eastern Korea which often possesses leaves with serrate margins, russet brown fruit, and often a deciduous calyx, are to be included in this species, then the description of P. ussuriensis must be rewritten. It is possible that the russet color may be due to the heavier rainfall of eastern Korea during spring and early summer. That such russetting is sometimes markedly increased by a very moist atmosphere during the spring months has been observed in some of the cultivated pears in this country.

It is difficult, however, to account for the variation in the calyx and the character of the margin of the leaves. The writer is inclined to believe that two species are represented by the wild pears of east central Korea. Only very thorough study of this group, and especially of the seedlings from seed of known trees will determine this matter.

Most of the trees of P. ussuriensis northeastern Korea are so inaccessible at present that it would be very expensive to obtain large commercial quantities of seed from this source.

Undoubtedly the most suitable, certainly the most accessible place to collect seed of P. ussuriensis in Korea is the northwestern part of the country. This region should be thoroughly explored to discover the best localities.

Pears of Southern Manchuria

The only pear districts which I visited in Manchuria are Liaoyang, where only two cultivated orchards were available for study, and the Chien Shan mountains, about twenty-five miles southeast of Liaoyang.

Trees of P. ussuriensis are abundant in the Chien Shan mountains. Unfortunately, the pear crop of the wild trees there in 1917 was almost a total failure. On most of the trees no fruit whatever could be found, and on the remainder only very few fruits. Here, as in Korea, great variation was observed in the foliage and fruit of these trees. Most of the trees possessed the typical short, broad leaves

with long slender bristles on the margins, and the typical fruit of this species. Some trees possessed slightly longer foliage and obovate fruit with typical calyx. Other trees, however, had rather long leaves, serrate margins, and large, slightly oblate and brownish russet fruit with persistent calyx. Among the cultivated trees, which in this region are usually semi-wild, some trees were observed with yellow fruit and a deciduous calyx. Here then is a situation similar to that in eastern Korea and one which requires considerable more systematic work, especially when there is a crop on most of the trees so that sufficient material is available for study.

Seedlings grown from seed of the type with obovate fruit cannot be distinguished from seedlings of typical pure P. ussuriensis. Several cultivated varieties of P. ussuriensis are grown in this district. Among these are: Mo Pan Shan Li, Bobo Li, Hsui Hong Hsau Li, Champa Li, and Ping Li. With the exception of Ping Li, the fruit of these is of poor quality, and not worth introducing except for use as stocks and possibly for breeding purposes. The Ping Li, which is a very valuable variety, will be discussed at length under another heading.

Pyrus ussuriensis has also been reported as abundant in various parts of northern and eastern Manchuria. It was collected by Maximowiez, in 1859, along the Ussuri River, in southeastern Siberia, along the eastern Manchurian border. This tree must be very abundant in the thinly settled and well-wooded portions of northern and eastern Manchuria. These regions should be thoroughly explored for this species and the most accessible localities determined.

Pears of Northern and Central China

China can truly be designated as a veritable pear land. No other country possesses such a rich pear flora, and such a wealth of material for the horticulturist and plant breeder. It contains a large number of extremely interesting and well-defined species. These species certainly present the greatest variety and the most diverse types of pears known to botanists. The genus Pyrus in China includes species which present such vast differences that the layman can hardly believe that all of them belong to the same group. These species produce fruit which ranges in size from the smallest to the largest in this genus.

The trees vary in size from near shrubs in some species to the largest known trees of this genus in other species. Numerous wild pear trees are found in all parts of the country from the coast to extreme western China, and from the tropical portions of southern China to the coldest regions of northern Manchuria. These are found at all elevations from sea level to the tops of the highest mountains; and on all soils ranging from submerged swamps to the driest, sandy, wind-blown alkali soils.

The cultivated varieties of pears in China have been derived from their native wild pears. These varieties are grown in all parts of the country, and with the exception of size, present almost as great a diversity as the wild species. Until recently, the

cultivated varieties of China were all classed as Pyrus sinensis Lindl. The great diversity of these types indicated that more than one species had contributed to the composition of these varieties. One of the chief objects of my trip was to determine, if possible, the botany of these cultivated varieties, particularly those of northern China.

Wild Pear Species of China

Pyrus ussuriensis

Pyrus ussuriensis is unquestionably the most important species of Pyrus in northern China, and appears to be the only species of extreme northeastern China, northern Manchuria, and eastern Siberia.

The writer studied this species in only one locality in China proper, and this was in the various small valleys surrounding the small village of Hsing Lung Shan, about twenty-five miles northwest of Malanyu, in Pechilli Province. I went to this place because this species was found growing there in great abundance by the late F. N. Meyer in 1907, and again in 1916 at which time the trees were being destroyed and the land cleared for agricultural purposes. According to Mr. Meyer this species was found there in great abundance in 1907 and was at that time one of the dominant trees of this region. The valleys were well forested at that time due to the fact that the Manchus many years ago had driven all the people out of this region and had converted it into a great forest preserve in the extreme southern portion of which their emperors were buried. In 1912 when the republic was established the Manchus were driven out of office, but retained this great burial ground and the accompanying lands. These lands were then opened for settlement and people flocked into this region in great numbers, and the great forests on the rich valley soils were rapidly and recklessly destroyed. Hence, when I visited this region in the fall of 1917, these magnificent pear forests had largely disappeared, and in their places I found fields of corn, millet, kaoling, and indigo. However, one splendid small grove was found near the village of Hsing Lung Shan and many scattering trees along the margins of the valleys and the banks of the streams, and thousands of stumps in the newly cleared fields, all of which revealed a glorious past.

The trees which I found varied in diameter from six inches to two and one-half feet. Most of them were from forty to sixty feet high, and rarely as much as seventy feet. The annual rings of the stumps proved that most of these trees had passed the century mark, and some of the largest ones were more than two hundred years old.

The trees begin growth early in the season, but their growing season is a short one, and they must be classed as only moderate or slow growers. The bark in old specimens is deeply furrowed, and the wood is hard, tough, and heavy. The branches are grayish or yellowish gray in color, with remarkably close grained and hard wood. The leaves are medium to large in size, roundish or broadly ovate, with

with roundish or truncate base, and abrupt point and margins fringed with small serrate teeth and very long slender bristles. The trees foliate and bloom very early and the white flowers are of medium size. The ends of the branches are often terminated by several leaves forming a rosette, and each leaf peculiarly twisted. The leaves assume a beautiful red color late in the fall. The fruit is green or greenish yellow in color, and roundish or slightly oblate or oval in shape, from three-fourths to one and one-quarter inch in diameter, and possesses a persistent calyx and a short stem. The flesh is hard, bearing numerous large grit cells, especially around the core, and juicy and very tart. The core is five celled. One of the distinguishing characteristics of this species is the manner in which the flesh separates very readily from the core when thoroughly ripe.

This species is distinctly a native of the north and of cold climates. In China proper its native habitat apparently begins in the mountains north of Peking and extends northward through Manchuria and eastern Siberia. At Hsing Lung Shan my aneroid barometer showed an elevation of 2350 feet. In this region the climate is very constant and the seasons regular. The winters are intensely cold and very dry, and the snowfall is comparatively light. The summers are cool and the rainfall is moderate and comes mostly during the three summer months.

The trees prefer to grow in the valleys and mountain coves; and are very rarely found on exposed mountain sides. They prefer the deep, moist, well-drained, fertile, sandy loam soils of the valleys.

Wild P. ussuriensis as a Stock

Since P. ussuriensis is very resistant to pear blight, it should be thoroughly tested as a stock for our cultivated varieties of pears. This work has already been started at the Southern Oregon Experiment Station, but has not been carried on long enough to enable us to draw final conclusions. The preliminary results, however, indicate that the wild trees of this species are too slow growers to make an ideal stock for the European varieties. Varieties like Bartlett and Winter Nelis on this stock do not make as rapid growth as on the Japan Sand Pear P. serotina. Furthermore, the union of Bartlett on P. ussuriensis is a rough one, making a large undesirable bulge, due to the fact that the Bartlett top outgrows the stock. Whether this difference in growth will become accentuated as the trees become older, and whether the union then will become too weak to support the larger top remains to be determined. Another point which must still be determined is whether this stock will be adapted to the very heavy clay and adobe soils often planted to pears on the Pacific Coast. Also, whether it will thrive on the river bottom soils which are very suitable for pear culture, and which are often extremely wet during the winter months. This is highly important, since this species in its native habitat is usually found on mellow sand loam and well-drained soils, and which are usually quite dry during the winter months. In other words, whether this species will thrive under conditions quite the reverse of those under which it has been developed. It must also be determined whether this cool climate

species will endure the extremely hot and dry summers of the interior valleys of the Pacific Coast. Until we have further evidence on this matter, the wild types of this species should not be recommended as a stock here on the Pacific Coast. This species has produced many cultivated varieties. These including a discussion of their value as stocks, will be considered under another heading.

Pyrus betulaefolia

Description:

Pyrus betulaefolia usually produces a tree from one to two feet in diameter and from twenty-five to fifty feet in height. Occasionally trees are found from two to three feet in diameter and seventy-five feet in height. The bark of the trunks is characteristically fissured and checkered, and dark gray to grayish-black in color. The trees are densely headed, with long, slender, spreading or drooping branches; and when young these branches are covered with a very light gray tomentum. The numerous short side branchlets or spurs usually terminate in a short point. The leaves are medium in size, thick, ovate with broadly wedge-shaped base, and long acute apex, distinctly trough shaped, curved, and margins consisting of very large, coarse, blunt serrations. The leaves change little in color before falling, simply assuming a greenish yellow and in this respect differ markedly from the brilliant red assumed by P. ussuriensis and P. serotina. The leaf and flower buds are very small. The trees bloom very late, and the flowers are produced in great abundance, and are borne in large, long, compact, leafy, and densely pubescent clusters. The individual flowers are small, measuring only two-thirds inch across, with pubescent calyx, and with white, rounded petals, and numerous short stamens, with pretty reddish anthers; and two or three spreading styles. The fruit borne is in clusters of from two to ten and is very small, one-fourth to one-third inch in diameter, round, rusty brown in color, covered with numerous whitish dots; the calyx is deciduous leaving a well-marked scar in the slightly depressed basin. The fruit contains two or three seed cavities, with one or two small seeds in each cavity. The flesh is greenish firm but not hard, moderately juicy, insipid, and quite remarkable in that it contains no grit cells. This latter characteristic is of great value in distinguishing it from other species, as will be noted later.

Distribution:

P. betulaefolia is one of the most remarkable, and one of the most widely distributed species of Pyrus in China. I found it in many places ranging from Huang Yen Ying, which is in the mountains sixty miles northeast of Peking, where the winters are severe, to Ichang in central China where the summers are hot and the winters mild, numerous specimens were observed in the Tung Ling (Eastern Burial Grounds) near Malanyu, in the Panshan district, at various places between Lou Li Ho and Matou south of Peking, between Shaui and Kingmen, at Kingmen, between Kingmen and Ichang, and in the mountains northwest of Ichang. It was found at all elevations ranging from 100 feet above sea level near Peking to 2900 feet in the mountains

northwest of Ichang. Mr. F. N. Meyer has also collected it in the Shang Tung province of eastern China, and Mr. W. Purdom as far west as Yenan-fu in Shensi. Mr. George Schlosser, a missionary, writes me that many very large specimens of this are found along the Yellow River, near Kaifung in northern Honan.

It appears to thrive equally as well throughout this range. The largest specimen observed was at the margin of a ricefield two miles south of Kingmen, in Hupeh, which had a trunk diameter of nearly three feet and was seventy-five feet high. The largest specimen observed in northern China was in the Tung Ling near Malanyu, and this had a trunk diameter of eighteen inches and was sixty feet high. In America it has proved hardy at Boston, Massachusetts, at Ames, Iowa, and at the South Dakota Experiment Station at Brookings, South Dakota.

Soils:

This species is remarkable in its ability to thrive in various soils, and to endure adverse soils. It is found on soils ranging from very coarse sands to heavy clay loams. It succeeds on the wind blown soils of central Honan where it is often planted for sandbreaks although under these conditions it does not attain a large size. It is often found on the dry alkali soils of central China and generally along the margins of ponds and streams, and sometimes in ponds of water a foot to eighteen inches deep.

As a Stock:

P. betulaefolia is a very useful species in northern China, where it is extensively used as a stock for pears, and is admirably suited for this purpose. There it is readily obtained, easily propagated, readily grafted and makes a good union with the scion, produces a vigorous growth, and is adapted to the poor granitic soils commonly planted to pears. One of the notable characteristics of this species is the ease with which it can be propagated from cuttings. The cuttings callus readily, and quickly form a large, fibrous root system. While it can be grown from seeds, this method of propagation is not widely employed in northern China, owing, I judge, to the poor stand often obtained on the dry soils due to the scant rainfall at this season of the year.

Its value as a permanent stock for the cultivated varieties of the United States still remains to be determined. The buds of scions of our varieties unite readily when worked on this stock, the union appears strong, and the young trees make a satisfactory growth. So far as I am aware, all the trees on this stock in America are still young, and no one can predict how satisfactory the union will be as the trees become older. Judging simply from the growth of the young trees on this stock, it appears as though the union will be a permanent one.

This species, however, has certain very objectionable characteristics as a stock in this country. First, it is susceptible to pear blight, which eliminates it from those regions of America where root blight is troublesome. Second, it sprouts readily from the roots wherever the root is injured or broken by the plow or cultivator. This trouble, I fear, would prove serious on the very heavy clay and adobe soils often planted to pears in some of the valleys on the Pacific Coast. Even P. communis often sprouts badly when used as a stock on some of the adobe soils. Such sprouts interfere more or less with cultivation, and when infected with blight endanger the root system of the tree. For this reason, it cannot be recommended as a stock in this country until further experimental work has determined its value.

Fruit:

The fruit of this species is extremely small, it offers very little prospect of producing valuable new cultivated varieties when used by itself. I did not find a single cultivated variety of pure P. betulaefolia in the Orient.

Hybrids:

P. betulaefolia appears to hybridize with at least one other species, and some of these hybrids may prove of great value as stocks, and possibly also for their fruit. That this species has hybridized with other species, and in this way has entered into the composition of some of the cultivated varieties, appears quite probable. This matter will be discussed under the subject of varieties.

This species certainly possesses characteristics which should prove of value in breeding work. It is extremely hardy enduring very low temperatures; is a vigorous grower; endures adverse soil conditions; can be propagated from cuttings; and above all is a very late bloomer. These characteristics, particularly the late blooming habit, can be used to advantage by pear breeders in America.

Pyrus calleryana

Description:

In central China, P. calleryana produces a tree from 30 to 60 feet high with a trunk from one to two feet in diameter. Rarely specimens are found, where soil conditions are ideal, which are even larger. The trees are very vigorous growers with usually a straight trunk and upright spreading branches. The trunks of young trees are quite smooth, but in old specimens become somewhat furrowed. The branches possess a very smooth, shining, dark reddish or greenish purple bark, and with numerous small, elongated, light colored lenticles. The leaves vary from medium to very large in size, are glossy, rather thick, broadly ovate, with rounded or heart shaped base, and medium size distinctly crenate, or rarely, crenate-serrate teeth. The flower buds are either lateral or borne on short, thick spurs, and are very large, roundish ovate, very plump, and densely covered with a brownish-gray pubescence. The flowers appear very early in the spring, are produced in great abundance, and are borne in dense clusters.

The flowers are small, about two-thirds inch across, with pure white roundish petals, numerous stamens, and usually two or three pistils. The fruit is borne in clusters of from three to ten, on rather long, slender pedicels, is round, from one-fourth to one-half inch in diameter, brownish russett with small white dots, and a deciduous calyx; the flesh is cream colored, firm barely eatable, with a thick layer of grit cells around the core; there are usually either two or three cells, with one or two small, dark seeds in each cell. The fruit of this species can be readily distinguished from that of P. betulaefolia by the presence of the grit cells in the fruit.

Distribution:

P. calleryana is a native of central and southern China. I found it abundant between Shasi and Kingmen, between Kingmen and Ichang, and to the northwest of Ichang, in Hupeh province. Mr. E. H. Wilson has collected it around Ichang, and also Kuling, in Kiangsi province. Mr. George Schlosser writes me that he has collected it in southern Honan. Mr. J. Callery collected specimens of it at Macao in Kwangtung in extreme southern China, and the species was founded on his material. It was also collected near Canton in Kwangtung by Mr. G. Compere, and at the Botanical Garden at Hong Kong by Mr. C. S. Sargent. From this it will be noted that it is a widely distributed species.

It grows at all elevations from a few feet above sea level to an elevation of slightly more than 5000 feet.

Soils:

In its ability to endure diverse and adverse soil conditions, this species certainly is a marvel, and in this respect is equalled by only one other Oriental species, Pyrus betulaefolia. In the Hupeh province, I found it growing in all the various soil types observed there. Ranging from heavy clays to light sandy soils and disintegrated rock. I found it growing in shallow ponds, along streams, well-drained moist loams, and on very dry poor hillsides and hilltops. In places it was observed where the layers of soil above the bed rock were not more than eight inches deep.

While this species can endure very adverse conditions, it reaches its greatest development on the deep, moist, well-drained clay and sandy loams. At Kingmen, at an elevation of 700 feet above sea level, it is abundant and very thrifty along the banks of small ravines. There this species and P. betulaefolia appeared to be perfectly at home and growing side by side. Again, splendid specimens were observed in the valleys and on the mountain sides at elevations varying from 2000 to 3500 feet. On the high, dry, poor mountain tops, it is usually much smaller in size, often not more than from four to eight feet high. Often small trees or mere shrubs not more than four feet high were fruiting abundantly.

The tree, under favorable conditions is a rapid, vigorous grower, has a long growing season, and its leaves remain green and lusty until very late in the fall. On most of the mountain sides in central China

the trees are cut off for fuel every few years, but they put out new sprouts from the stumps and continue to live for many years.

Hardiness:

The trees of this species grown from seed collected in western Hupeh have proved perfectly hardy at the Arnold Arboretum near Boston, Massachusetts, during the past ten years. This is quite remarkable, since the winters at Boston are much more severe than in central and western Hupeh. At the Southern Oregon Experiment Station this species appears to be hardy. The first season the vigorous seedlings retain their leaves until early winter, and the tender tops are injured by the first heavy freezes. The root system has never been injured.

Cultivated Varieties:

I did not find any cultivated varieties of this species in central China. At Kingmen, several strains of a cultivated type are grown which are known as Chia Tan Li, and in leaf characters these resemble P. calleryana quite closely. However, I regard these as hybrids between this and another species, and these will be discussed under another heading.

Rootstocks:

During the past, several reports have appeared in the California press of certain trees of a Chinese pear growing at Oroville, California, which has never shown a trace of pear blight, while trees of the common cultivated varieties near them had blighted vigorously. The writer examined these trees in 1915 and identified them as the south China form of P. calleryana. I could find no traces of pear blight on these trees, and the owner told me that the trees had never shown a trace of the disease. Neither could I find any pear woolly aphis on the roots, although this insect was abundant on the roots of other pear trees near them. The seed which had produced these trees had been collected by Mr. George Compere near Canton, China.

Since these trees appeared to be highly resistant to pear blight, pear woolly aphis, and were extremely vigorous growers, and adapted to a great variety of soils, I concluded that this species had possibilities as a rootstock for other pears, and decided to test it thoroughly for this purpose. As this type comes from extreme southern China, a region just inside the tropics, it retains its leaves until mid-winter in southern Oregon, and during severe winters the young wood is injured. The type from central China drops its leaves in late fall and is perfectly hardy. Hence, I decided that the type from central China was more promising and should be tested as a stock for other pears.

Several of our most important local cultivated varieties of pears have been grafted onto this species. A good stand was obtained, the union appears to be a good one, and the young trees have made a satisfactory growth. Whether the union will remain a satisfactory

and permanent one as the trees become older remains to be determined. Judging simply from these preliminary results, this appears to be a very promising stock, and it should be thoroughly tested for this purpose. To carry on this work satisfactorily it was necessary to obtain a considerable quantity of seed of this species from China. In this work I was very fortunate to obtain the cooperation of the Office of Foreign Seed and Plant Introduction, of the U.S. Department of Agriculture. The late Mr. F. N. Meyer was delegated to go to central China to collect a considerable quantity of seed of this species, which he did in the fall of 1917. I also collected a considerable quantity of seed from typical trees of this species near Kingmen, and in the mountains northwest of Ichang in western Hupeh. From this seed thousands of seedlings have been grown which will enable us to test this species thoroughly as a stock for our cultivated varieties, and for our various soil conditions.

One interesting and important observation was made in the spring of 1918 on the hardiness of small seedlings of this species. The seed planted in the early spring of 1918 germinated quickly and an excellent stand was obtained, and these seedlings were about one inch high on April 1st. On the morning of April 2nd, the thermometer went down to 22 degrees above zero F. These seedlings showed practically no injury and continued to make a splendid growth. In the fall of 1918 these seedlings were from 30 to 36 inches high on the poorest soil and from four to five feet on very fertile soil.

All of our important commercial varieties will be grafted and budded onto these seedlings, and a careful study made of the growth and the unions.

Pyrus Serotina

This species has already been described in the discussion of the wild pears of Japan.

Distribution:

In China I had an opportunity to study this species in only one region in the mountain from ten to fifteen miles northwest of Ichang. There it is quite common at elevations varying from 2000 to 4000 feet above sea level. Mr. E. H. Wilson has collected it in several places in the mountains of western Hupeh province, and also in the Tachienlu district of western Szechuan province. He had found it at various altitudes varying to 2000 to 8000 feet above sea level. It has never been reported from any portion of north China.

I found this on mountain sides and in small valleys, but always on well-drained soil. The rainfall in this region is quite heavy and this may be necessary for its best development, and may explain its absence in north China where the rainfall is much lighter.

Characteristics:

This species is a very vigorous grower, and attains enormous size on suitable soils. On the poor, dry mountainside soils the trees are usually not more than one foot in diameter and twenty to thirty feet high. On the fertile moist valley soils, some of the largest specimens observed were two feet in diameter and fifty feet high, with a great spread of branches. In central China it drops its foliage much earlier in the fall than either P. calleryana, P. betulaefolia, and P. serrulata.

Hardiness:

P. serotina is perfectly hardy in southern Oregon and also at Boston, Massachusetts. For this reason, it is rather strange that it has not been reported from regions farther north in China. It is quite possible that it occurs further north in China than the regions from which it has been reported. If it does not then it must be due to the light rainfall in that region.

Varieties:

Most of the cultivated varieties observed in central China belong to this species. These are usually roundish or oval in shape, a dull russet brown in color, usually with a deciduous calyx, but occasionally varieties are found with a persistent calyx. The flesh is hard, juicy, possesses many grit cells, and is usually of poor quality.

Seed:

Since seeds and plants of this species have been shipped to this country in great quantities for years by the Japanese nurseries, and can readily be obtained at any time from that source, no effort was made by the writer to collect quantities of seed. Furthermore, the crop on the wild trees last year was a very poor one, and I arrived in central China too late to see very much of that.

Stock:

This species is the only one used as a stock for the cultivated pears of Japan and is very generally used for this purpose in central China. During the past twenty years, it has been used for this purpose as a stock in America, especially by some of the southern nurserymen, who prefer it because it is more vigorous and freer from leaf blight than the French pear. During the past ten years it has become very popular on the Pacific Coast, and at the present time it is more extensively used here than the French pear. This is due to the fact that it is a vigorous grower and is more resistant to pear blight and to the pear woolly aphis.

Our common cultivated varieties unite very readily when budded or grafted on this stock, and the trees make a vigorous growth on it.

Whether the trees will be as long lived on this stock as on the French pear remains to be determined. It is already evident that the Anjou does not thrive as well on this stock as on the French pear when grown on soils which are very wet during the winter months.

QUESTIONABLE SPECIES

Pyrus serrulata

According to Rehder, P. serrulata is closely related to P. serotina. It has ovate or oblong-ovate leaves, with rounded or broadly wedge-shaped base, and serrulate margins. The inflorescence consists of 6-10 flowers, which are borne in racemed umbels; with triangular-ovate sepals, and broadly oval white petals; stamens about 20, styles 3 or rarely 4. Fruit subglobose or globose-ovide, 1.5 to 1.8 cm. long, brown, and 3 or 4 celled.

Localities:

I found this type growing in the mountains about fifteen miles northwest of Ichang, and at elevations varying from 3000 to 3700 feet. E. H. Wilson collected the material on which Rehder founded this species in this same region in which I found it, and also at Hsing-shan Hsien, another region in western Hupeh.

Species Rare:

This type has not been reported from any other region than western Hupeh. Even there it is rare. I searched very diligently for trees of this type, but found only a comparatively small number. These trees which I saw always occurred as isolated specimens, and were on high, dry, well-drained soil. They were small to medium in size, varying from four to eight inches in diameter, and from fifteen to twenty-five feet high. The foliage was very dark green, clean, and remains on the trees remarkably late. For example, on the 14th of November, 1917, the leaves were still all on the trees, possessed a rich green color, while the leaves of P. serotina in the same region were practically all off the trees. The leaves are ovate or ovate-oblong, very thick, with serrulate or crenate-serrate teeth. The fruit is usually very abundant, borne in clusters of from 2 to 8, roundish or ovate in shape, from ¼ to 1¼ inch in diameter, russet in color, with firm edible flesh, and from 2 to 4 cells, usually 2 or 3, and with large, plump, dark seed.

Resistance to Pear Blight

Many of the trees of this type are only moderately resistant to pear blight, while one form shows rather a marked degree of resistance. It unites readily with the stock when grafted onto P. communis and P. serotina, but we have not yet grafted any of our cultivated varieties onto this species, but will do so next spring. Hence, we have very little information regarding this type as a stock for our cultivated varieties. Judging from the ease with which it unites with these varieties when it is grafted onto them, it seems likely that it will prove a satisfactory stock.

Probably Not a Species

The writer believes that P. serrulata is not a distinct species, but simply a group of hybrids. The following facts support this belief: First, it is a rare tree, occurring in its native home only here and there as isolated specimens. The other two species in this region: P. calleryana and P. serotina occur there in abundance. Second, it is a very variable type, ranging from specimens which closely resemble P. calleryana to others which closely resemble P. serotina. Most of them are intermediate between these two species. The leaves are intermediate in shape and with margins which are distinctly intermediate. The fruit is intermediate in size and number of seed cells.

Best evidence of hybridity, however, is found in the seedlings of this species. Seed collected from typical trees in China was planted at the Southern Oregon Experiment Station in the spring of 1918. These have been phenominally vigorous, attaining a height of five or six feet in one season, and this one indication of hybridity. These seedlings show remarkable variation in the leaves. Many of them cannot be distinguished from pure P. serotina, many resemble P. calleryana, and others again are intermediate. Final conclusions, of course, cannot be drawn until these seedlings produce fruit, but all the evidence at present strongly indicates that P. serrulata is not a species.

Mr. Alfred Rehder, who established this species, recently has written me that some of their seedlings of this type have fruited, and show marked variation, some of them actually producing fruit with persistent calyxes. He too, has reached the conclusion that at least part of the forms heretofore included in this species appear to be hybrids.

Varieties

This hybrid group has given rise to at least part of the cultivated varieties of central China, and possibly to many of them. The botany of many of the cultivated varieties of central China has been a puzzle to American botanists and horticulturists, as many of them could not be referred to any known species of Pyrus. Since it has been determined that these forms are probably of hybrid origin, we have made a beginning in straightening out their botany.

Near Kingmen, in the Hupeh Province, several varieties are cultivated, all of which are known an Chia Tang Li. The late Mr. F. N. Meyer regarded these as cultivated forms of P. calleryana. I cannot agree with this view. I regard them as hybrids with P. calleryana as one of the parents.

Pyrus phaeocarpa

Rehder's Pyrus phaeocarpa includes the group of pears commonly known as Tang Li in North China, and is most closely related to Pyrus betulaefolia. The tree is of medium size. Foliage ellitical-ovate or oblong-ovate, long gradually tapering point, and base usually broadly wedge-shaped, with open, large, blunt serrate teeth.

Inflorescence and unbelled-raceme, 5-7 flowered; sepals triangular lanceolate; petals oval, white, stamens about 20; styles 3 or 4, rarely 2. Fruit pyriform 2 to 3 cm. long and 1.5 to 2 broad, brown, 3 or 4 or rarely 2 celled. Variety globosa has roundish fruit with leaves ovate with a round base.

Variation:

This is an extremely variable type. The trees vary from vigorous upright growers to dwarfish forms with spreading or drooping branches. The leaves vary from short roundish or broadly ovate to long oblong ovate, with base either subcordate, rounded, or broadly wedge shaped. The serrations of the margins are large or small, coarse or fine, blunt or sharp. In color, the leaves vary from rusty pubescent to rich, glossy, dark green. The fruit is borne in clusters varying from one to ten specimens. It is small to medium in size, and is either round, oval, oblong, or obovate; and is usually russet or brown in color, although sometimes yellowish. The calyx is usually deciduous, although often partly or wholly persistent. The number of cells vary from two to five, generally two, three or four.

Distribution:

This group is a native of northeastern China. I found it in the foot hills and mountains to the west and north of Peking. Mr. F. N. Meyer had found it in the mountains in Poshan in central Shantung Province. The trees are comparatively rare and usually occur as isolate specimens.

Varieties:

This type has given rise to a small number of cultivated varieties, and to a good many seedlings which are grown in a limited way in the orchards of North China. All of these varieties and cultivated seedlings pass under the general name Tang Li. Only one of these, the Tang Li grown at Malanyu and in the Panshan district is really worthy of a varietal name. It is medium to large in size, russet in color, with hard flesh, and of poor quality.

Botany:

After a careful study of this type in the field in north China, and of the seedlings grown from it at this Experiment Station, I am of the opinion that this is not a distinct or well-defined species, but that it is simply a group of hybrids between other species. The following facts support this view: It is far more variable in form of tree, character of branches, character, form and margin of leaf, size, form, and character of fruit, and number of seed cells, than any distinct species of Pyrus that I have studied.

This group includes forms which in general can be classed as intermediate between P. betulaefolia and P. ussuriensis. They vary all the way from types which are truly intermediate to those which

closely resemble either one or the other of these two species. Some forms resemble P. betulaefolia, and others P. ussuriensis so closely in foliage, leaf and fruit character that only an expert can distinguish them. The number of seed cells in some forms is two and three as in P. betulaefolia, in others 5 as in P. ussuriensis, while in still others 3 and 4 which is an intermediate number. The writer collected one type in northern China which upon first examination appeared to be P. betulaefolia, but which upon a more critical and thorough examination, showed evidence of being a hybrid. In this case the shoots are densely pubescent, the small fruits are borne in large clusters and the fruit was two and rarely three celled as in P. betulaefolia. Some trees bear fruits which possess stone cells, while in fruits of other trees these are lacking as in P. betulaefolia. Other forms are very close to P. ussuriensis. For example, the variety Tang Li grown at Malanyu, shows unmistakable evidence of P. ussuriensis, although the fruit is russet in color.

The best evidence of hybridity, however, is revealed in the seedlings of this type. A considerable number of seedlings have been grown from three distinct and typical strains in this group. These seedlings are unusually vigorous, some of them attaining a height of six feet the first season, and are remarkable for their variation. In each lot part of them resemble the seedlings of P. ussuriensis, part those of P. betulaefolia, and part are intermediate between these two species. It will be highly interesting to study these seedlings after they begin fruiting.

The writer found this group of pears only along the border line where P. ussuriensis either wild or cultivated and P. betulaefolia meet.

Our work with this group has not proved beyond all question that P. phaeocarpa is not a distinct species. This can only be determined by careful hybridization work and a careful study of the seedlings. It is possible that this is a distinct species, but if that is true, it is certain that this species crosses freely with P. betulaefolia and P. ussuriensis.

Pyrus ovoidea

Mr. Alfred Rehder has based this species on a limited amount of material. One tree of this species is grown at the Arnold Arboretum and was propagated from material received from the Kew Botanical Gardens under the name Pyrus simoni.

The chief characteristic on which this species is based is the characteristic ovoid fruit, which is yellowish in color, has a long stem, a persistent calyx, and the fruit is five celled. The tree is a vigorous grower, has large ovate or ovate-oblong leaves, with coarse, open setose-serrate margins.

Distribution:

In China I did not find a single wild tree which corresponded in all respects with this form. A form of P. ussuriensis was found

in the Chien Shan mountains of southern Manchuria which resembled this form more closely than any other trees found. Even in this case the fruit was more oval, or in some specimens slightly obovate, than ovate. In this case the leaves also approached those of the true P. ussuriensis more closely than in the case of Rehder's specimen of P. ovoidea.

The writer did find certain cultivated varieties in the Orient which resembled P. ovoidea very closely, at least in fruit characters. One of these is the Tien Sui Li grown near Pingku, north of Peking. The fruit of this variety is perfectly ovoid in shape, has a persistent calyx, and is greenish-yellow in color. This variety unquestionably belongs to P. ussuriensis. Many of the fruits of the Ya Kuang Li are ovoid in shape. This is probably a hybrid, and P. ussuriensis is certainly one of its parents. The Ta'e erh li, another cultivated variety of north China, has ovoid fruit and a deciduous calyx.

Furthermore, the ovoid shape is not a specific characteristic. A cultivated variety of the Japanese Sand Pear, known as Imamura-Aki is distinctly ovoid in shape. This is unquestionably a variety of Pyrus serotina.

Botany of P. ovoidea:

The writer has been forced to the conclusion that P. ovoidea is not a distinct species, and that it is of hybrid origin, with P. ussuriensis as one of the parents. I have reached this conclusion for the following reasons: I found no wild trees of it in the region surrounding Peking, its supposed home. Types with ovoid fruits can be found in at least two other well-defined species. It is very vigorous, it is extremely hardy, enduring the severe winters at the South Dakota Experiment Station at Brookings, S.D. This extreme hardiness and the fact that it has proved very resistant to pear blight in our work and that it has a persistent calyx indicates that P. ussuriensis is probably one of its parents.

Furthermore, the seedlings of this type prove that it is either a hybrid or else crosses readily with at least one other species of northern China. Seed collected by myself from the type tree at the Arnold Arboretum and planted at the Southern Oregon Experiment Station have produced two distinct types of trees. Part of the seedlings resemble the parent tree and part of them are almost identical with P. betulaefolia. This proves that P. ovoidea is either a hybrid with P. betulaefolia as one of its parents, or that it crosses readily with P. betulaefolia, a tree of which is growing near it at the Arnold Arboretum.

Stock:

The seedlings of P. ovoidea are so variable that it is still a question whether they will always prove satisfactory as a stock for other pears. Furthermore, no one knows whether quantities of seed of this form can be obtained.

Pyrus bretschneideri

Description:

Rehder's Pyrus bretschneideri was founded on a tree at the Arnold Arboretum which was grown from seed obtained from Peking, China, and is described as follows: "Medium sized tree, closely allied to P. ovoidea, but distinguished by the deciduous calyx and the ovate or elliptic-ovate, acuminate leaves, which have a broadly cuneate or very rarely rounded base; leaf margins sharp-serrate, at first setose-acuminate but serratures becoming only acuminate and somewhat appressed; fruit subglobose or globose-ovoid, about 1 inch long and nearly or quite as thick, the base contracted into a stalk 1-1½ inch long, hanging, yellow and marked with pale dots; calyx deciduous. China. Supposed to be the species that yields some of the edible pears of Peking. "Hardy North."

Distribution:

This species is supposed to be a native of the region around Peking, China. I must state that it is extremely rare in the wild in that region. I did not find any trees of it wild near Peking. On Panshan mountains, I found two trees which resembled this type in a general way, but were not identical with it. Both of these trees were growing within one mile of a temple, and near a densely settled region; hence, were probably simply accidental seedlings of some cultivated pear.

Varieties:

A number of cultivated varieties are grown in northern China which belong to this group of pears. Among these are the following: Mi Li, possibly Pai Li, certain forms of Hung Li, Fo Chien Li, probably Ma Li.

Characertistics:

Trees at the Southern Oregon Experiment Station propagated from the type specimen are clean and extremely vigorous upright growers. In rapidity of growth, this form is equalled by very few other pears. The trees blight readily in the young wood when inoculated, but show a very marked degree of resistance in wood more than two years old.

Botany:

With our present knowledge of this group, it is impossible to say whether or not this is a distinct species. This can be determined finally only by further studies, especially experimental studies. The limited evidence that we have at the present time indicates that this is simply a mongrel group of hybrids. The following facts point to this conclusion: First, it is extremely rare in its native home. The phenominal vigor of the type trees indicates that it is

a hybrid. The leaves are in some respects very similar to P. ussuriensis. This is particularly true of the terminal leaves of the shoots. These possess the wavy margins and peculiar twisted forms so often found in P. ussuriensis. The serrations of the terminal leaves also are quite similar to those of this species. The yellow color of the fruit, and the peculiar soft core which separates very readily from the surrounding flesh when fully ripe are also characteristic of P. ussuriensis. Another similarity is the marked resistance to pear blight, at least in the older wood.

A Notable Mongrel Group

In the above discussion of P. phaeocarpa, P. ovoidea, and P. bretschneideri, attention has been called to the fact that all of these may be hybrids, and that some of them certainly are hybrids. It is well-known that the botany of the pears of northern China, particularly many of the cultivated varieties, has been a puzzle to botanists and horticulturists. It was difficult to classify many of the forms and varieties. The reasons for this are now becoming apparent. It now appears probable that many of these forms are hybrids and therefore rather difficult to classify. The botany of many of these forms can only be determined by a careful study of their seedlings. That their seedlings will reveal this information, and that these species are probably mongrels is strongly indicated in a remarkable lot of seedlings grown from one of these pears in north China.

In a pear orchard on Panshan mountain in north China, the writer collected a quantity of seed from a seedling pear tree, which in tree, leaf, and fruit characters, is almost identical with pure P. betulaefolia. It is unquestionably a P. betulaefolia hybrid. These seeds were planted at this Experiment Station, and the seedlings produced therefrom have been a revelation, and will unquestionably be the starting point in clearing up the botany of many of the pears of northern China. These seedlings present the greatest variety imaginable and among them can be found every described pear species of northern China. On the one extreme are forms of P. ussuriensis and on the other, forms of P. betulaefolia, and in between all the other described species. In addition to this, there are some which are different in at least some respects from any species so far described. Here is certainly a veritable Pandora's Box.

The tree was growing in an orchard which contains many of the common cultivated varieties of north China, including varieties of P. ussuriensis. Undoubtedly the blossom of this tree were pollinated with pollen from these varieties. This orchard is in the border line were P. ussuriensis and P. betulaefolia meet. After a careful study of these seedlings, and these various types in northern China, the writer is strongly inclined to believe that P. ussuriensis and Pyrus betulaefolia are the only two pure and distinct species of Pyrus in northeastern China. Furthermore, that P. ovoidea, P. bretschneideri and P. phaeocarpa are hybrids between these two species. P. ovoidea and P. bretschneideri are probably attentuated or secondary hybrids and resemble P. ussuriensis more closely than the other parent. P. phaeocarpa is a hybrid which resembles P. betulaefolia more closely than the other parent.

The parentage of these various types certainly can be conclusively determined by a study of their seedlings, and especially by a study of the seedlings produced by carefully conducted hybridization experiments. Such work will be undertaken at once by the Southern Oregon Experiment Station.

Pyrus Species of Western China

Pyrus pashia

Pyrus pashia has been collected in western China by Mr. E. H. Wilson. I did not have an opportunity to visit that region, hence, did not study this species in its native home. Experiments conducted at the Southern Oregon Experiment Station proved that at least the young trees of this species, ranging from one to four years old are susceptible to pear blight. For this reason this species does not appear very promising as a blight resistant stock for our cultivated varieties of pears.

A New Pyrus

The late F. N. Meyer collected a species of Pyrus (S.P.I. 40019) in the high mountains of the Kansu Province of northwestern China, which appears to be a new species. Young trees of this grown at this Experiment Station appear to be distinct from any other Pyrus in our collection. Very young trees of this form blight readily when inoculated with pear blight bacteria. As the trees become older, they may show a greater degree of resistance to this disease.

Cultivated Varieties of China

Introduction

American horticulturists have a very poor opinion of the cultivated varieties of Chinese pears. This opinion is well founded, as the Chinese varieties usually cultivated in America are hard, of poor quality, and generally unpalatable. This also applies to most of the varieties usually cultivated in China. Some of them are of fair quality, but the flesh is usually so hard that American palates cannot relish them. Since most of these are so unpromising and apparently offer so little to the American horticulturist I shall not enter into a discussion of these. However, attention should be called to the fact that most of these worthless varieties commonly found in America belong to a class known as the Chinese Sand Pear, which have been derived from P. serotina and its hybrids. These are mostly natives of central, western and southern China. None of the varieties of this group which I observed in China are worth introducing, except possibly as stocks. I had formed a very low estimate of these varieties before going to China, and this was not changed any after observing them in their native home.

Valuable Varieties:

The pears of northern China and Manchuria belong to a different group from those in central China. Most of these too are of poor or very ordinary quality, and are not worth introducing except for stocks.

I was very agreeably surprised to find among them a small number of very excellent and extremely promising varieties. From certain standpoints, they may prove among the most valuable, if not the most valuable, pears ever introduced into America from any country. When I first found these varieties, I could hardly believe that such valuable varieties existed in China and had never found their way into America. The reason for this has become obvious after my own experience in introducing them.

In going over the list of pears sent from China by the late Mr. F. N. Meyer, I find that he had sent scionwood of some of these desirable varieties to this country several years before I went to China. Upon inquiry to the U.S. Dept. of Agriculture, I find that not a single one of these scions ever survived. There is a very good reason for this. It is extremely difficult to transport scions of these varieties from China to America and get them to live. My own experience with them will illustrate this. I collected an abundance of scionwood of the most promising of these varieties. This was perfectly packed in moss and wrapped with several layers of oiled paper. Within a few days after collecting this material, I started for America, making close connections with the boat and making an unusually quick trip to America. As soon as I reached my boat, these bundles of scionwood were placed in the excellent cold storage room, under favorable conditions. These scions were very carefully grafted onto different stocks in America. Of all of these scions, only an extremely small number lived. On some stocks, all of them failed. Of one important variety -- the Pai Li -- all of my scions on all stocks failed. Part of the scionwood of this variety was sent to the U.S. Department of Agriculture, and in their propagating house under very favorable conditions, only four scions of this variety lived, and these made a miserable growth the first season. From this it is very evident why these varieties have never found their way into America heretofore.

While only a small number of scions of each variety were saved, these have made an excellent growth at this Experiment Station. Since we now have ideal propagating material, and have learned the stock requirements of these varieties, and fortunately now have an abundance of such stock, it will be a simple matter to propagate these varieties rapidly.

Ya Kuang Li:

When judged by American tastes and standards, the Ya Kuang Li is unquestionably the finest variety of China. It resembles the better American or European pears in tenderness, juiciness, flavor, and quality more closely than any other pear in China. In quality, it is equaled by only one other Oriental pear -- the famous Peking Pai Li. It is equal in this respect to our better American varieties, and certainly as good if not better than our Bartlett. It is large, somewhat variable in shape, although usually somewhat quince-shaped. The color is an attractive cinnamon yellow. The calyx is always persistent. The skin is rather thick and slightly rough. The flesh is tender, melting, juicy, creamy white in color, and grit cells not noticeable in eating, excepting around the core. It

is aromatic, sweet with slight acidity, sprightly, very agreeable. This variety is grown only in northern China. The fruit is found on the Peking market from early October until the first of January, and is one of the three most popular varieties on that market.

I regard this as the most promising Oriental variety ever introduced into this country. While the variety is good enough to introduce and grow just as it is, it may prove of even greater value for breeding purposes. This variety certainly contains considerable P. ussuriensis blood. It may have been derived solely from that species, although it appears to be a hybrid between this and some other species. Judging from this, we should expect it to show a high degree of resistance to pear blight, and should prove valuable in breeding new blight resistant varieties. Inoculation experiments have shown that it blights in the young shoots but appears to be very resistant in the older wood. Judging from its parentage, it should also prove valuable in breeding hardy varieties for cold regions. The tree is a vigorous, rather spreading grower.

Pai Li:

Pai Li is probably the most popular pear among the Chinese in north China, and it is also very highly regarded by all foreigners. The sweet flavor of this variety especially appeals to the Chinese, and it must also be added that most Orientals do not care for the tart and sub-acid fruits which we regard so highly in this country. For example, such fruits as strawberries and blackberries, and such drinks as lemonade do not appeal to the Oriental palate at all.

The Pai Li is medium in size, usually from 1½ to 2 inches, although occasionally 2½ inches in diameter. It is roundish or slightly oblate in shape. The color is a light lemon yellow, with many small inconspicuous cinnamon dots; and the skin is smooth, shiny and quite thin. The calyx is deciduous in about 80% of the fruits and persistent or partly so, in the remainder. At picking time, the flesh is firm, but becomes mellow, tender and is juicy when ready to eat. No grit cells are noticeable except around the core as in the European pears. The flavor is sweet and very agreeable. In quality, it compares very well with the better European pears. It is an excellent keeper and can be obtained on the Peking market from October to the first of March.

In north China, this is often known as the "Peking Pear", as it is very popular at Peking and many other markets obtain their supply there. It is also extensively grown in the neighborhood of that city. This should prove a valuable pear for home use in local markets in America. It should also prove of value in breeding work, as it is of excellent quality and a splendid keeper, and possibly also in breeding blight resistant varieties as it appears to be a hybrid with P. ussuriensis as one of its parents.

Ping Li:

In southern Manchuria, in the region of the Chian Shan mountains, I found an excellent variety known as Ping Li. This is a small, attractive pear, varying from 1¼ to 1½ inch in diameter. It is usually somewhat oblate, although occasionally roundish or short turbinate in shape. The skin is very smooth, shiny, bright yellow with often a pink blush on the sunny side, possessing many very small inconspicuous brownish specks. The stem is short, being about ¼ inch long. The calyx is always persistent, large, open, lobes spreading and noticeably pressed against the top of the fruit. The flesh is white, very tender, very juicy, possesses no grit cells. It possesses a very refreshing, delightful, tart flavor. I regard it of excellent quality. When ripe the flesh separates readily from the core as in nearly all varieties of the P. ussuriensis.

This should prove an excellent variety for home use and local markets. It is too small and the flesh probably too tender for the distant general market.

Since this variety is a pure P. ussuriensis, possesses fine flavor and excellent quality, it should prove of very great value in breeding work, especially when hybridized with our largest and best varieties of European pears. Surely here is an opportunity to breed new varieties of high quality, which will be resistant to pear blight. For this purpose, I regard this variety and Ya Kuang Li as the two most valuable which I saw in the Orient.

Owing to very serious illness, it was impossible for me to return to this region in winter to obtain scionwood of this variety. This is unfortunate and was the greatest disappointment of my entire trip. I shall return to the Orient again during 1919 to obtain scionwood of this and other valuable varieties.

I visited this region in September when the fruit was being harvested and obtained a considerable quantity of seed. The seedlings grown from this possesses the typical characteristics of P. ussuriensis, and fortunately are more vigorous than the seedlings grown from seed of the wild trees of that species.

Small Suan Li:

In a small valley in the mountains west of Peking, I found a variety locally known as Suan Li (meaning sour pear). This is an interesting variety and in some respects comes very close to the Ping Li. It differs chiefly from that variety in the longer stem of the fruit, color not quite so attractive, and perhaps hardly equal to it in quality. The leaves also are slightly longer. Aside from this, the description for Ping Li fits this variety very well. It should be tested as a variety for home use, local market, and should be extensively used in breeding work. I obtained scionwood of this and succeeded in getting a few of the scions to live. Inoculation experiments proved that this variety, while not immune in the tender shoots, is highly resistant to pear blight. It is a variety of P. ussuriensis.

Pan Chin asz:

I obtained scionwood of this variety, but the fruit was all gone when I visited the orchard. This variety is very large, in fact the name means Half Catty Pear, which is equal to slightly more than 10 ounces. It is said to be similar in appearance to Ya Kuang Li, and of very good quality, De Yamei Kin, a highly educated and trustworthy Chinese woman, describes it as "a very large pear with fine white flesh and good flavor."

This variety possesses a persistent calyx and the wood and leaves show that it is a variety of P. ussuriensis. Inoculation experiments at the Experiment Station proved that this variety is highly resistant to pear blight.

Ta Suan Li:

The Ta Suan Li (Big Sour Pear) is more extensively grown in the mountain districts north of Peking than any other variety. The fruit is medium to large in size, slightly flattened, and greenish yellow in color. The calyx is always persistent, and the stem is rather long. The flesh is hard, contains large grit cells, especially around the core, and has an extremely tart flavor. It is distinctly a pear of poor quality. It is a late pear and an excellent keeper, often remaining in good condition until spring under favorable conditions. The tree is a remarkably vigorous grower, and of spreading habit. The leaves are extremely large and the margins possess unusually large and long bristles. This variety certainly belongs to Pyrus ussuriensis. When inoculated it blights readily in the very young trees, but shows a good degree of resistance in the older harder wood. This variety cannot be recommended for its fruit, which is too poor in quality either for home use or market. Since it belongs to P. ussuriensis, it may prove of value in hybridization work, especially in breeding work in cold regions.

E Li:

The fruit of this variety is very large, oval or oblong in shape, and greenish in color. It ripens the latter part of September, is a poor keeper; and the flesh is very fragrant, rather soft, sub-acid in flavor, and of poor quality. The calyx is persistent. The tree is an extremely vigorous, upright grower, with very large leaves. It is to be regretted that the flavor of this variety is not better. However, its large fruit, extremely vigorous growth, and the fact that it belongs to P. ussuriensis may make it valuable for breeding purposes.

Chieh Li:

This is another variety possessing P. ussuriensis blood. The tree is a very vigorous, rather sprawling grower, and possesses very pubescent young shoots. The fruit is of medium size, oblong in shape, and greenish yellow in color. The calyx is persistent. The flavor is sub-acid, and the quality only fair. The fruit ripens the latter part of August. It may prove of value for breeding purposes.

Hung Li:

The name Hung Li means Red Pear. This term, of course, is very indefinite when applied to Chinese varieties of pears. In fact, there are a score of Chinese pears which are known by this name. The writer obtained scionwood of at least three varieties or strains all known as Hung Li. Any pear which possesses a red cheek may pass under the name Hung Li. The term, therefore, is so indefinite that one does not know what variety or type is being obtained unless one actually sees the trees and the fruit on the tree.

The most common type of Hung Li produces fruit of medium size, roundish in shape, with a yellow background and a red cheek on the sunny side, and a shiny skin. The calyx is deciduous. The flesh is hard, possesses a sub-acid flavor, and is not of very high quality. It is a remarkable keeper, and the fruit under favorable conditions will shrivel and dry up and seldom rot. The tree is a vigorous grower. The botany of this variety, in fact almost the entire group, has been a puzzle to botanists. A careful study leads me to the conclusion that this is a hybrid group with P. ussuriensis as one of the parents.

One very interesting and apparently very valuable variety was obtained near Malanyu under the name Hung Li. I did not see the fruit on this tree as it had all been picked and shipped when I visited the orchard. The leaves show the typical margins of P. ussuriensis, although the shape of the leaf is somewhat different. The young trees in the nursery are very vigorous growers. This variety has proved a perfect marvel in its ability to resist pear blight. Repeated inoculations on various dates and the virulent cultures have failed entirely in most instances. In some cases these were successful in the very tender and very vigorous growing tips and would blight down for a distance of two or three inches and then stop. No other cultivated variety so far tested in our entire collection has proved as resistant as this one. A splendid stand was also obtained in grafting this variety. Every effort is now being made to force this variety into early bearing, and we shall study with great interest the character of the fruit.

Guar Li:

The term Guar Li means Water Pear, alluding to the soft, very juicy character of the flesh. The fruit is small to medium in size, oblate, yellowish with a red cheek. The calyx is persistent, and the stem of medium length in some specimens, and long in others. The flesh is soft, juicy, and of fair quality in some strains and good in others. The leaves, at least of the strains which I studied, show the typical form and margins of P. ussuriensis. Unfortunately, I did not obtain scionwood of this variety. We have a large number of seedlings of it, and these are very vigorous growers, and show a very marked degree of resistance to pear blight. This is a very promising variety for breeding purposes and also as a stock for other pears. On my next trip to China, I shall obtain scionwood of this variety. There are several strains of this in China, and propagating wood should be obtained of each, and each one carefully

tested for blight resistance.

Hung Hua Guar Li:

This is the Red Flower Water Pear. The fruit is similar in appearance to the Guar Li, but the peduncle is very much longer and the soft flesh possesses a somewhat insipid flavor. It is not of high quality. It belongs to P. ussuriensis, the trees are very rapid growers, show a good degree of resistance to pear blight, and may prove valuable as a stock for other pears.

Yarr Li:

This is probably the most widely known pear of north China. It is large, has an attractive yellow color, and is distinctly pyriform or pear shaped, resembling the European pears very much. The calyx is deciduous. This is undoubtedly the most attractive pear of north China when judged from the viewpoint of Americans. The flesh is hard, juicy, and has a sweet flavor. It is not in ideal condition to eat until winter, and is at its best after the holidays. It is a splendid keeper and can be had on the market from October until March in north China. While it is grown only in northern China, the Chinese are so fond of it, and it is such a remarkable keeper and shipper, that large quantities are shipped to central and even southern China. The Chinese regard this and the Pai Li their two best varieties. The flesh is too firm for American taste. This appears to be a hybrid. The young trees blight very readily in the one-year-old wood when inoculated. It may prove of value in breeding long keeping varieties.

Ma Li:

Ma Li is a large, barrel shaped, yellow pear, with a deciduous calyx. The flesh is coarse and of fair quality. It is an early variety and a poor keeper. The trees are very vigorous growers and when inoculated blight very readily in the first season's growth. It has little to recommend it. It is probably of hybrid origin.

Mi Li:

Mi Li is a round, medium sized, attractive yellow pear, with a stem of medium length and a deciduous calyx. It ripens late and is an excellent keeper. The flesh is firm, juicy, and sweet. The tree is only a moderate grower, and the young shoots blight readily when inoculated. It appears to be of hybrid origin. Apparently of no special value for American conditions.

Fo Chien Hsi:

This is another pear of north China and its name means Buddah's Delight. It is of medium size, slightly flat, and yellow with russet toward the base. The peduncle is of medium length, and the calyx deciduous. The flesh is very firm, juicy, and a splendid keeper. It appears to be of hybrid origin. The young shoots blight readily when inoculated. Probably not worth introducing into American orchards.

Tang Li:

Tang Li is a large, russet pear, and distinctly ovate or apple shaped. It is one of the very few cultivated russet varieties of north China. The flesh is hard, juicy, somewhat sweet and not of high quality. The calyx is usually deciduous, although in some specimens persistent or partially persistent. Shoots of young trees blight when inoculated. Apparently of no special value for America, except possibly for stock or possibly breeding work. The leaves resemble those of P. ussuriensis very much, and this variety is chiefly interesting because it is the only cultivated russet variety which I saw that strongly resembles P. ussuriensis in leaf characters. Its seedlings may prove of great value in our study of the botany of many of the perplexing varieties of north China.

Japanese Varieties

All the varieties that are extensively grown in Japan are of russet color, hard fleshed, usually of poor quality, and most of them are roundish in shape. Practically all of those that have been brought to America heretofore are of such poor quality that the American public cares nothing for them. A few of those grown in Japan, however, are much better in quality and appearance than those of this class commonly grown in America. Japanese horticulturists are agreed that the Imamura Aki and the Meigetsu are the two best varieties grown in that country. I obtained scionwood of these two varieties in Japan and now have young trees of them growing at this station.

Imamura Aki:

This is a large, russet pear, and distinctly ovoid in shape. The flesh is firm, juicy, sweet, and of good quality. The calyx is usually deciduous, although in some specimens all of it or part of it is persistent. The fruit ripens late and is in good condition to eat during late fall and early winter. The Japanese regard this as their second best pear. It is extensively grown in Japan and southern Korea. The tree is a very vigorous and clean grower. The young shoots of small trees blight readily when inoculated, but it appears to be more resistant in the older, harder wood. It is unquestionably a variety of P. serotina, var. culta.