THE FORESTRY MISSION TO CHINA 1979.

热烈欢迎

英国林业代表团

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THE FORESTRY MISSION TO CHINA

1979

THE FORESTRY MISSION TO CHINA, 1979

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Front Cover - A banner welcome for the Mission -

'A warm welcome to the British Forestry Delegation.
Victory Wood Processing Factory, 23 September 1979'

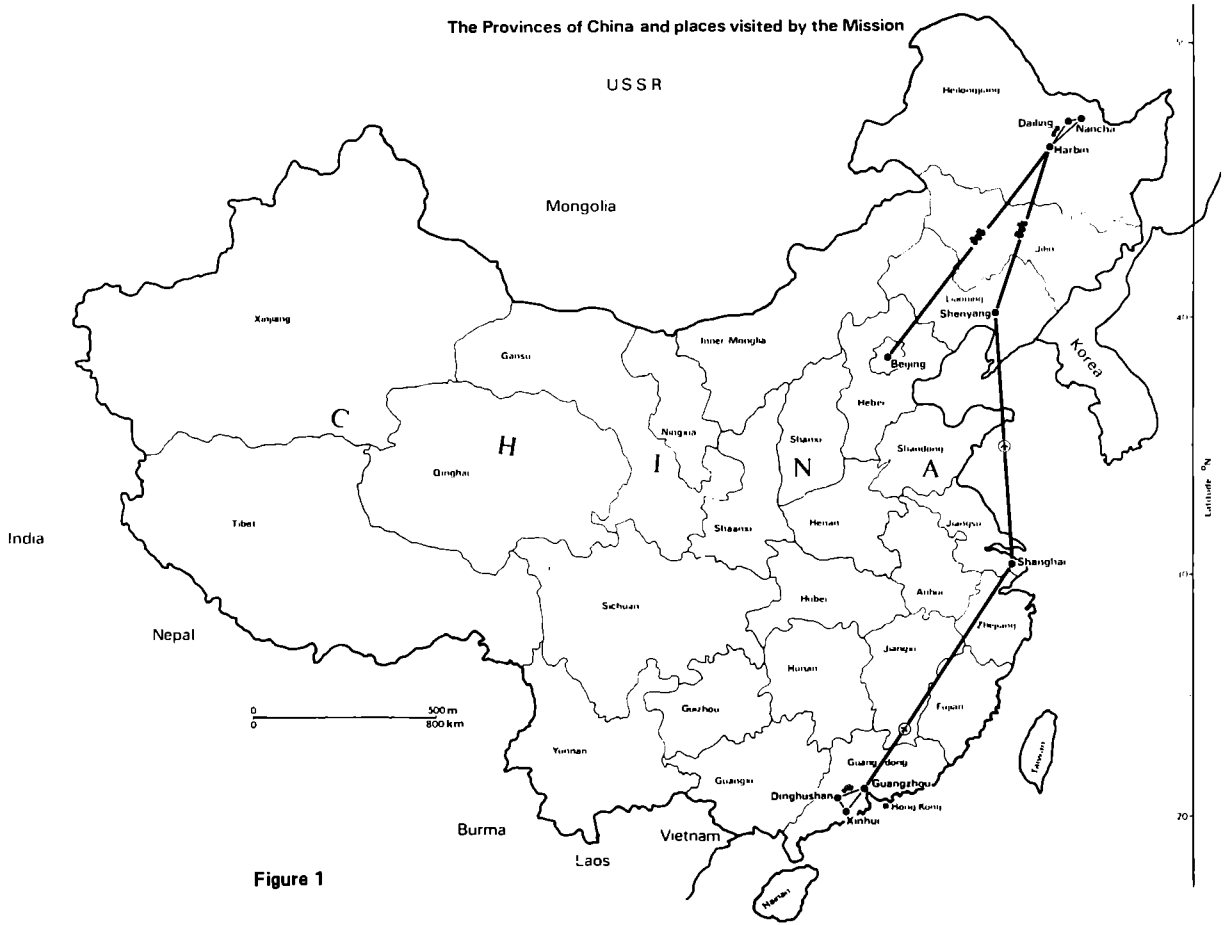
The Provinces of China and places visited by the Mission
USSR
Mongolia
India
Nepal
Burma
Laos
Vietnam
Korea
Taiwan
Hainan
C H I N A
Heilongjiang
Jilin
Liaoning
Inner Mongolia
Xinyang
Gansu
Qinghai
Tibet
Ningxia
Shanxi
Hebei
Shandong
Shaanxi
Henan
Jiangsu
Anhui
Hubei
Sichuan
Zhejiang
Hunan
Jiangxi
Guizhou
Fujian
Yunnan
Guangdong
Guangxi
Daqing
Nanchai
Harbin
Shenyang
Beijing
Shanghai
Guangzhou
Dinghushan
Hong Kong
Xinhui
0 500 m
0 800 km
Latitude °N

Figure 1

INTRODUCTION

In recent years, the culture, sporting and technology-based contacts between the People's Republic of China and Western Countries have become more common and have fostered greater understanding of their several and mutual needs and the benefits from further collaboration.

The need for a visit to China by British foresters was first mooted in January 1978 to the Chairman of the Great Britain - China Centre by the Earl Bathurst when President of the Royal Forestry Society of England, Wales and Northern Ireland. The visit subsequently followed, sponsored and arranged by the Centre, opportunely upon the establishment of an independent Chinese Ministry of Forestry and a new emphasis on the place of forestry in rural land management and on the amelioration of living conditions in urban areas.

Miss Penny Brooke, Deputy Director of the Great Britain - China Centre who had been responsible for much of the liaison and organisation for the Mission, accompanied the delegation as secretary and guide. The Mission represented many of the aspects of forestry in Britain - policy, education, research, the timber trade and the long-established connection with forestry in Commonwealth countries - and the papers which follow reflect those interests.

The Leader of the delegation was Sir Ralph Verney, Commissioner, Forestry Commission of Great Britain and member of the Royal Commission on Environmental Pollution 1973-9.

Other members were:

The Earl Bathurst	Past President of the Royal Forestry Society of England, Wales and Northern Ireland.
David R. Johnston	Director of Research and Development, Forestry Commission. Chairman, Commonwealth Forestry Association.
Ronald H. Kemp	Forestry Adviser, Overseas Development Administration, Member of FAO Committee on Forest Gene Resources.
Professor John D. Matthews	Forestry Department, Aberdeen University; Chairman of the Forestry Training Council and a Past President of the Institute of Foresters of Great Britain and Northern Ireland.
Thomas S. Smith	Managing Director, Kirkoswald Sawmills, Ayrshire, Scotland: Member of the Technical Sub-Committee of the Home Grown Timber Advisory Committee.

The delegation entered China by train from Hong Kong on 18 September 1979 and left Beijing almost three weeks later on 5 October. The itinerary set out below is also illustrated on the map (Figure 1) showing the provinces of China.

September	18-19	Guangzhou, Guangdong Province.
	20-21	Xinhui, Jiangmen Handicraft Factory, Dinghushan Forest Reserve
	22	Baiyushan Park, Guangzhou Pulp Mill
	23-24	Shanghai, Longhua Botanic Gardens, Wood Processing Factories
	25	Shenyang, Fushun, Jiabang Nursery, Liaoning Pr.
	26	Harbin, Jinshui Research Station, North East China Forestry Institute, Heilongjiang Pr.
	27	Dailing Sawmill, Bishui Forest Farm
	28	Dailing Forest Experimental Bureau, Nancha Wood Processing complex
	29	Nancha - Harbin - Beijing
	30	Beijing - 30th Anniversary Banquet
October	1-4	Great Wall, Xiuanjiao Nursery, Academy of Forest Science
	5	Depart Beijing

The reader will be puzzled by lack of reference to many places with which he will be familiar, e.g. Canton, Peking, Muckden, and so on. In the past, perhaps the most commonly used transcription system for Chinese followed the Wade-Giles spellings - see *The Times Atlas of China* (1974) but as the Pinyin system was formally adopted by the Chinese Government in 1979, this convention has been followed. Some Pinyin forms of Wade-Giles spellings are given below

Peking	-	Beijing
Canton	-	Guangzhou
Kwangtung (Province)	-	Guangdong
Shin-hui	-	Xinhui
Leichow	-	Leizhou
Tai-ling	-	Dailing
Tientsin	-	Tianjin
Yangtze	-	Yangzi
Muckden	-	Shinyang
Pearl River	-	Zhujiang

Where costs have been given, the equivalent £(sterling) value has been based on an exchange rate of 1 yuan for 27 pence.

Keith W. Wilson

Editor

BRITISH FORESTERS IN CHINA

by

Sir Ralph Verney

The first obvious fact about China is its vast size - about 4000 km miles from south to north and 4900 km from east to west. The number of hectares are about the same as the population - 960 million - and the climate extends from tropical in Hainan Island to near-arctic in North Manchuria on the boundary with Russia on the Amur River. The Gobi desert is one of the world's most sterile areas, the Himalayas, of course, the world's highest and the great rice bowl of the Yangzi river the world's most productive. The Chinese invented printing and the timepiece and studied calligraphy and carved jade and ivory when we were still savages, and yet today China is classified in the world hierarchy as an under-developed country. So, for the forester on his first visit to this great country it begins by being difficult to see the wood for the trees.

China had, in 1979, 120 million hectares classified as forest, covering 12.7 per cent of the total land area, and including 2,800 varieties of tree species. In 1949, the tree cover was estimated to be 8.6 per cent, so in the thirty years of the People's Republic it has been increased by almost 50 per cent. But the actual effect on the ground is much more striking than this because there are enormous areas of virgin forest, tropical, temperate and alpine, in the provinces of Yunnan, Tibet, Xinjiang and the north of Heilongjiang, which are inaccessible and therefore unchanged, while in the eastern and highly populated parts of the country we are told that there were hardly any trees left after the depredations of the Opium and other wars, the Japanese occupation and the insatiable demands for firewood of a desperate peasantry.

One can only judge by what one sees, and certainly, apart from our fascinating visits to virgin forests in Guangdong and Heilongjiang, we saw very few trees indeed that were more than 30 years old. Yet eastern China is now clothed with trees and every road, every river, every canal and every city we visited has been adorned and decorated and made safe and productive by lines and groves and shelterbelts of trees. Chairman Mao decreed that agriculture and forestry and animal husbandry should work together to make China green like a garden with millions of trees, and this has happened in every city and commune that we visited.

As a conservationist, this is a humbling experience. We get angry, in this country, about the large blue butterfly and the disposal of radio-active waste and the monstrous regiments of Sitka spruce, but in China you are really confronted by the basic necessities of conservation. Beijing, a city of 8 million people, could be buried in sand in 50 years if the desert were not tamed. Hence the enormous project of the Green Wall, a shelterbelt 6000 km long to halt nature's depredations, to be completed by 1985 by a specially designated Department of the Ministry of Forestry. Natural disasters are a commonplace of Chinese history, and the millions of tons of silt which are washed down her three great rivers - the Pearl, the Yangzi and the Yellow - every year have been a major topic of poetry and economics for the last 1,500 years.

Canals and dams and trees have largely stopped these natural disasters, and we spent a memorable day in the delta of the Pearl River south of Guangzhou being shown how the treacherous banks of the river could be made safe and profitable by the planting by the commune, under the enlightened leadership of its 27-year old chairman, and with the scientific help of the Province's Forest Academy, of *Taxodium distichum* and *Livistona chinensis*, interspersed with guava and lichee, to provide fruit and timber and the raw material in leaves for the local fan factory, at the same time making safe for rice production the paddy fields of that fertile estuary.

On every road and railway we travelled - and we covered about 1,000 miles on each - the shelter belt and the so-called 'Four around' planting have made the environment shady and green with trees suitable to the climate. In Guangzhou acacias and eucalypts, in Shanghai oriental plane, in Beijing poplars and in Harbin ash and *Quercus manchurica;* but the commune has taken the initiative and established its own nursery to ensure continuity. The peasant may prune the trees for firewood, and in the countryside this is often overdone so that the communal forest of *Pinus massoniana* looks like a distorted collection of shaving brushes, but in the cities communal pride or discipline is more rigid or sensitive and the trees grow and flourish.

Before leaving the subject of conservation it is right, I think to mention the immaculate condition of those fabulous relics of Imperial China, the Great Wall, the Ming Tombs, the Forbidden City and the Heavenly Temple, all fully restored since 1949 with exquisite craftsmanship and authentic colouring and all open for a small fee to a flocking public who are patently proud and happy with their inheritance.

The manner and style of our welcome by our Chinese hosts was overwhelming, and perhaps only possible in a corporate state. As leader of the delegation I had the constant use of an enormous black limousine, built in China but in the style of a pre-war Cadillac, with a red star on the front; my interpreter sat with the driver in front and I reclined in the back with the Ministry representative and the Director of Forestry for whichever Province we were in. An outrider car, filled with officials, led the way enthusiastically hooting cyclists out of the way, and the rest of the delegation followed in two more cars and my dust. As there are no private cars in China, it was a formidable cavalcade, but there was never any whistling or protest or hostility as far as I, from behind my lace curtains, could see.

We were regaled with eight banquets, the most elaborate being at Shanghai of 14 courses presided over by the deputy mayor, and the most bizarre at Nancha where the directors of the timber company, which was processing 225,000 cubic metres of timber a year and manufacturing the waste into industrial alcohol, yeast, adhesives and activated carbon, fed us on bear's paw caviar and sea slug washed down by copious toasts of a spirit which was remarkably akin to the product of the factory.

The highlight was the banquet given by Chairman Hua in the People's Palace at Beijing on 30 September to celebrate 30 years of the People's Republic to which we were most honoured to receive an invitation, together with 1,000 guests of all Chinese nationalities, many in their colourful national costumes.

The culmination of our tour was the audience we received at the People's Palace at 9 o'clock on the morning of 2 October from Vice-President Wang Zhen, to tell him of our impressions and comments after two-and-a-half weeks of touring a small sample of the forests of China. Vice-Premier Wang is an elderly man, a veteran of the Revolution, slow of speech but with a strong handshake and a bright eye, who took every point we made and weighed it and replied with wisdom and charm, finishing with a brief, clear exposition of China's problems in agriculture and forestry and an undertaking that they were going to be tackled with all the resources available. He accepted my invitation to send a return delegation of Chinese foresters to Britain, under the auspices of the Great Britain-China centre, in the summer of 1980.

I put three points to the Vice-Premier, which were endorsed by the delegation as our first comments at the end of our brief tour.

* On administration and management we formed the impression that the forests managed by the State or the Provinces (about 50 per cent of the whole) were more efficient than those managed by the communes, because the commune was naturally more interested in the comparatively immediate return from agriculture and the improvement of the environment close to its homes. This impression was subsequently endorsed by the Ministry when they gave us some detail about the grant fund of 100M yuan (£27M) a year which they had recently established for the improvement of communal forestry. But the more important point was that there are millions of hectares of virgin or semi-virgin forest which are not being managed at all. Most of this forest is mature and producing no increment. It cannot be felled because there are no roads or railways or communities which can reach it. If at least a part of it could be cut and replanted it would have a dramatic and permanent effect on China's timber production, as well as making it acceptable for a number of years to cut more than the annual increment from the existing forest estate as a whole, without compromising the maximum that you must replant when you fell.

But the Planning Commission of the State Council, which has to decide priorities for public expenditure, cannot provide the very large capital sums required for this development. This is exactly the kind of situation for which the United Nations Development Programme and the World Bank were created, and we suggested that if an approach to them was politically acceptable a very strong case could be made for substantial aid for this most desirable purpose. Two members of our delegation had experience of working with the UNDP on similar projects in Yugoslavia and elsewhere.

* On silviculture we were not convinced that everywhere the most suitable species were being planted in a country with such enormous variety of soils and climate as China. We suggested that detailed species trials should be planned and established of both indigenous and exotic species near the main cities where they can, incidentally, provide pleasant recreation for the people (this we saw admirably done at Guangzhou); and also in forest areas, using standard statistical methods and of sufficient size to enable yield tables to be compiled. This should be combined with a practical and simple classification of types of forest sites as the basis for trials of species, provenances, and progenies and the use of fertilizers. There are standard methods of doing all this which our experts would be most happy to discuss and exchange with the Academy of Forest Sciences and the Ministry of Forestry.

We had seen and admired and coveted some outstanding species, especially *Taxodium* in the south and Korean pine and larches in the north east, which had very high potential on the world market, and we hoped that the great range of species could and would be maintained and, where labour was abundant, well tended to the extent of appropriate pruning. The common Chinese tree, *Pinus massoniana,* we had not seen on its native site, but we had some doubt about its potential.

* Timber utilization. We visited a paper mill in Guangzhou, two plywood factories in Shanghai, and two sawmills in Heilongjiang, the bigger of which was processing 25,000 cubic metres of timber a year - about the same, I was told, as the whole production of all the home timber mills in Britain. We felt there was an urgent need for much more ruthless selection of the quality of timber which goes to different mills. Central depots to select logs into three grades for coniferous and two grades for broadleaved species would enable the best timber, which is of outstanding world quality, to be processed in mills equipped with high technology for the purpose: low grade timber for packaging and mining timber should be processed separately with full use of waste materials.

The mills we saw are substantially over-manned by western standards and there is clearly scope for a much higher degree of mechanisation, but as this affects employment it is, to an extent, a matter of political decision. The development of the virgin forest, suggested above, which would create many extra jobs, might provide alternative employment from some existing sawmills. The Vice-Premier's reply to this suggested was immediate and definite. He accepted the criticism and said that in a socialist state the implications presented no problem.

So, after innumerable cups of green tea and many briefings one has to try to answer the typically sceptical question asked by an intelligent member of our present British Government: What possible benefit could this mission of British foresters to China accomplish for Britain? First, a vast and exciting new source of seed species, provenances and progenies which could be of great value to our national forests. Second, foresters throughout the world tend to work well together because they have very few secrets from each other and so may be as good ambassadors as diplomats. And third, because our science and our technology are ultra-doctrinaire, when friends come from far, as Confucius said, that makes for the greatest happiness.

FOREST ADMINISTRATION IN CHINA

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FOREST ADMINISTRATION IN CHINA

by
D.R. Johnston

INTRODUCTION

This account, dealing primarily with forest administration, planning and management, is almost certainly incorrect in a number of details, because it was not possible in the time available either to see a truly representative cross-section of all aspects of Chinese forestry or to discuss the subject, in detail, with all levels of management. Furthermore, the Chinese Government is in the process of introducing new laws and regulations, some of them on a trial basis, and this further confused the picture. Nevertheless it is believed that the report gives a reliable overall impression of Chinese forestry at the present time.

CIVIL ADMINISTRATION

China covers an area of 960 million hectares and has a population of 960 million people, concentrated mainly in the eastern third of the country. Of the total population about 80 per cent live in rural areas. There are 120 million hectares of forest which cover 12.7 per cent of the land surface.

For political and administrative purposes the country is divided into 26 provinces and autonomous regions and three autonomous cities - Beijing, Tianjin and Shanghai. Each province is divided into about eight prefectures, 80 counties, and 2000 communes. The provincial centres are very large towns or cities, the prefectures are based upon medium-sized towns and the communes upon small towns. The communes are the principal administrative centres of the rural peasants who are grouped into production brigades, each of which covers several villages or production teams. The operational unit is the production team which works communally on the collective land. Each family is also allocated a small area of land, about 36 square metres, per head, which they work privately. A production brigade typically comprises about 3000 people and a production team about 300.

The income of the peasants depends upon the output of their collective farms but the majority of the people who work in the towns and factories and in public services are paid a fixed wage depending upon their qualifications and experience.

Most wage earners can earn some sort of bonus depending upon their performance and production, and upon the profitability of their enterprise. There is little movement from one job to another.

It is occasionally possible for peasants in a wealthy commune to earn more than the wage earners in the towns but in the less fertile areas their earnings are very low. Most housing in the rural areas is privately owned but in the towns and cities almost everyone rents accommodation from the local administration or from his enterprise.

Many of the welfare services such as health and education are provided by the communes or factories but the public services such as roads, regional transport and higher education are generally the responsibility of the provinces. Education is free in the towns but the peasants have to make a contribution to the primary education of their children. There appears to be no welfare system for the small proportion of people who are not within the system and these people may become beggars, black market operators or criminals.

The Government is making energetic efforts to control the population. This is done by exhortation and education, by the provision of free birth control facilities and by fiscal means. People who have only one child are paid a child allowance of five yuan (£1.30) per month. This ceases if a second child is born and a third child is taxed at five per cent of the parents' income. There are also no clothing coupons for more than two children. Any couple who sign a declaration promising to have only one child are given various benefits. In the country these include free schooling and an additional allocation of private land to compensate them for the land which would have been allocated to their children.

The Mission was told that everyone who has been in recognised employment qualifies for an unemployment benefit and, on retirement, for a pension. Each of these amounts to about 70 per cent of average earnings.

FOREST ADMINISTRATION

The national forest authority is the Ministry of Forestry in Beijing which, like the other executive ministries, is subordinate to the State Council.

Although the Ministry of Forestry has an overall concern with all forestry activities it is only directly responsible for about half of the total forest area. The other half is owned by the communes and by Heilongjiang province.

There is a bureau of forestry in each province, prefecture and county which is technically responsible through the chain of command to the Minister of Forestry but administratively responsible to the civil administration.

These bureaux are responsible for giving advice and guidance to the communes and for allocating national planting and felling targets at each level of administration. They are also responsible for distributing state aid to the collective forests which amounts in total to 100 million yuan per annum. These funds are used to supplement contributions from the communes to establish new plantations and to buy new equipment. The provincial bureaux are responsible for the provincial research institutes and for forest survey, inventory and production forecasting within the province. The state forests are managed primarily by the bureaux at county level with a permanent labour force of forest staff. If there is a relatively small plantable reserve contiguous to a collective forest the bureaux may employ collective labour to undertake the state planting.

One of the objects of the cultural revolution was to eliminate inequalities in wages and to that end piecework was abolished. Experience has shown that communist workers are probably no more motivated than workers in other countries and piecework is now gradually being reintroduced in an effort to improve a very low level of productivity.

The organisation of the forest administration is shown in Table 1.

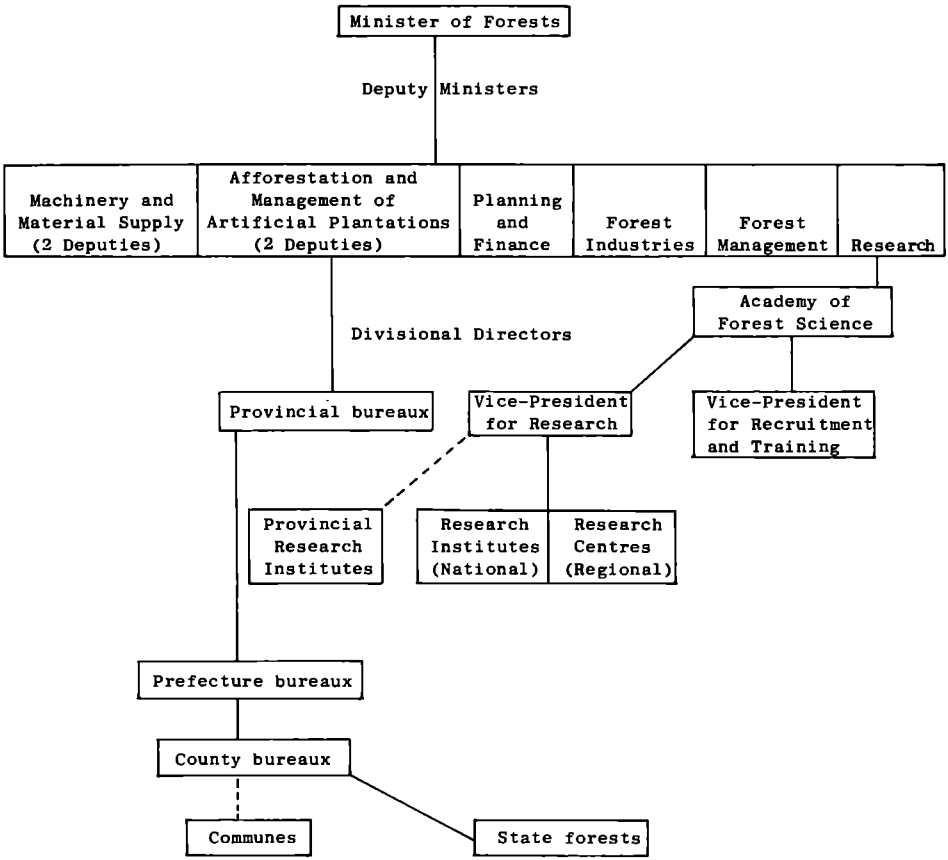
Heilongjiang province has a unique system of administration which results from the over-riding importance of forestry in that province. There is very little collective forestry in Heilongjiangand the only state forests are the reserves of inaccessible and largely untouched forest in the north of the province.

Most of the very large area of managed forest belong to and is managed by the forestry bureaux within the province whose work is directed by the General Forestry Administration of Heilongjiang Province.

Furthermore, owing to the dominating importance of forestry, the whole of the civil administration in rural areas is incorporated within the forest administration which is responsible for schools, hospitals and factories. The organisation of the Heilongjiang forest administration is shown in Table 2.

Table 1

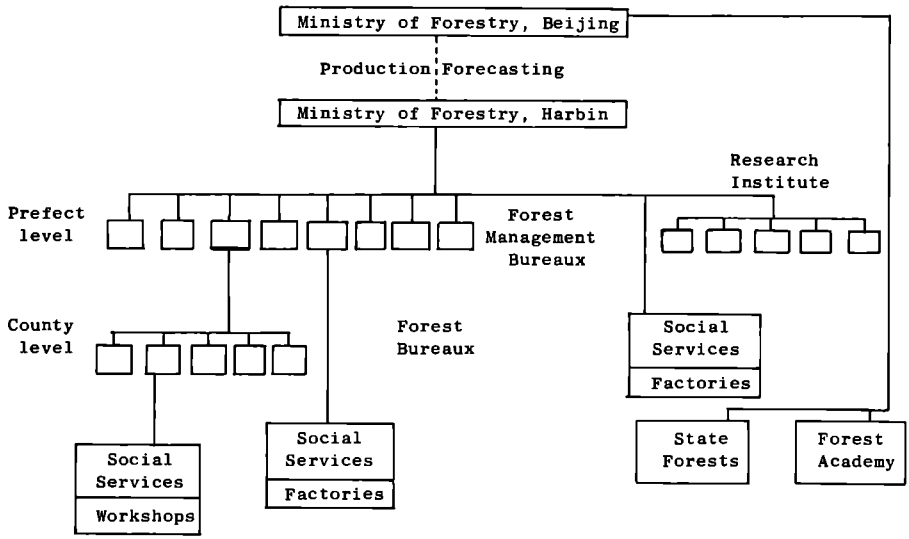
The Organisation of Forest Administration



Broken line shows indirect relationship; solid lines show direct supervisory functions.

Table 2

The Organisation of the Forest Administration in Heilongjiang



FORESTRY OBJECTIVES

The People's Republic of China took over a country devastated by a long period of warfare and natural catastrophes. It is logical, therefore, that the initial impetus for tree planting was inspired by an urgent need to protect the agricultural land against windblown sand and flood and to humanise the treeless landscape of the plains.

It is possible to identify six parallel forestry objectives. These are:

1. To protect the agricultural land from windblown sand and flood water.

To this end a series of shelterbelts is being planned as a barrier to the wind and sand from the Mongolian desert. The shelterbelts which will, *in toto*, be about 7000 km in length, are to be established in a zone about 320 km deep and running approximately parallel with and to the north of the Great Wall. The total cost of the project, which is the particular responsibility of a Vice Minister, will be about 900M yuan (£243M) and special departments of all the forestry bureaux in the area have been established to implement the work. Flood protection takes two forms. One is the afforestation of bare hills to prevent erosion and uncontrolled run-off; another is the building up of rivers and canal banks and their consolidation by tree planting.

2. To improve the human environment in rural areas, especially in the northern and central plains, by planting trees around houses, villages, roads and watercourses. This is referred to as 'Four around' planting and has the additional merit of providing firewood and local protection for the land.

3. To improve the urban environment by street and park planting.

4. To establish new, timber producing forests, mainly south of the Yangzi river.

5. To conserve and improve the existing productive forests in the north-east and the south-west by restricting the cut to the current annual increment and by replanting after felling.

6. To protect all forests against fire and disease.

FOREST MANAGEMENT

From the management point of view the forests can be classified in two ways, by functional types and by ownership classes.

Functional types

The functional classification is shown in Table 3.

Table 3

Classification of Forests by Function

Function	*Percentage*	*Area Million hectare*
1. Timber producing	80	96
2. Shelterbelts	6	7.2
3. Non-timber tree crops	7	8.4
4. Bamboo	3	3.6
5. Amenity etc.	4	4.8
		120.0

Ownership classes

Although China is a communist country there are marked differences in the *de facto* ownership pattern. These are as follows:

1. Collective forests belonging to the communes

(a) 'Four around' planting. This is the planting around houses, villages, roads and streams in the rural areas. This is done primarily for amenity but partly for fuelwood and local soil protection. Because the benefits are obvious,

quickly achieved and close to home, the standard of planning, execution and maintenance appears to be very good and this class of planting is a realistic example of the integration of forestry with agriculture and of practical conservation.

(b) Forests planted for timber production. The Mission saw only a relatively small area of this class of planting on the hills in Guangdong Province where *Pinus massoniana* has been planted. Much of this forest was established by a massive mobilisation of the peasants in the 1950's, and from observation and discussion it is apparent that a large proportion of the 22 million hectares planted by the peasants throughout China is in a poor condition. This is due to a combination of circumstances which include poor species and provenance choice, disease, neglect and heavy and coarse brashing for firewood. Although the forests belong to the collectives it is apparent that they do not arouse the same enthusiasm as agriculture or 'Four around' planting. The Government makes available, via the forestry bureaux, an annual sum of 100 million yuan to help the communes plant their forest land and to purchase seed and equipment. But not even this is sufficient to stimulate a sufficient and sustained interest in the management and protection of the developing forests and the Government is now proposing to distribute further funds and to establish integrated land-use planning units at county level to resolve the conflicts between forestry and agriculture.

2. State forests

(a) Unexploited reserves. There are very large reserves of unexploited forest in the extreme north of the country, in Tibet and in S.W. China and Hainan. In Northern China, for example, there are about 580,000 ha of untouched forest and in Tibet there are estimated to be 1400 million cubic metres of over-mature, unexploited forest, 800 million cu.m of which are in the disputed zone between Tibet and India. Some of this forest is alpine and some is sub-tropical.

(b) New planting. Out of a planned target of about four million hectares the Ministry of Forestry is responsible for only about 150,000 ha and the communes and Heilongjiang province for the remainder.

The state planting is done by permanent forest staff organised primarily by the forest bureaux at county level.

3. Heilongjiang Province

There are 18 million hectares of mixed broadleaved and coniferous forest in Heilongjiang Province containing 300 woody species of which twenty have a

commercial value. The principal coniferous species are *Larix dahurica, Pinus sylvestris, Pinus koriensis, Picea jezoensis, Picea asperata,* and *Abies holophylla* and the more common broadleaved species are *Fraxinus mandshurica, Phellodendron amurensis, Juglans mandshurica, Betula costata* and *Quercus mongolica*. Much of the forest has been overcut and degraded in the past but something like 30 per cent by area but 42 per cent by volume is inaccessible and virtually unexploited. This virgin forest belongs to the Ministry of Forestry. The remainder of the forest area, about 12.5 million hectares, is owned by the semi-autonomous forest administration under a provincial Minister of Forestry in Harbin and is yielding, at present, about 14 million cubic metres per annum or a little over one cubic metre per hectare per annum which is approximately equal to the current annual increment. The Heilongjiang forests are therefore providing more than one third of the industrial wood currently produced in China (see below).

The forests are being exploited by the removal of individual, mature or over-mature trees and also by clear felling and replanting. The coupes are of irregular shape and those seen by the Mission ranged from about 10 to 20 hectares in area.

4. Amenity planting in cities and towns.

There is great enthusiasm for urban planting in china. This is not usually the responsibility of the forestry bureaux but of various departments of the civil administration.

Data collection

Mapping, forest inventory and production forecasting are done within each province by a specialist team within the forestry bureau. The data are sent to the Ministry of Forests in Beijing where they are collated to form the basis for strategic planning.

Annual cut

The forest law of 1979 limits the cut to the current annual increment. The object of this law is to prevent the overcutting and forest degradation which has occurred in the past but there is some evidence that it is applied uncritically at the lower levels of management. The cut in a young plantation forest or in a seriously over-cut natural forest should be less than the current annual increment, whereas in a forest with a surplus of over-mature trees it is both prudent and economical to cut more than the increment. It would be a surprising coincidence if the optimum cut from the managed forest should equal

the current annual increment in a county or province or even over the country as a whole and there would appear to be a need for a more flexible approach to the calculation of allowable cut. This would require less emphasis on increment assessments and more on future growth potential, standing volume and expectation of life.

It is difficult to obtain reliable figures of production and consumption but total production appears to be of the order of 75 million cubic metres per annum of which about 35 million cubic metres are industrial wood and 40 million cubic metres are fuelwood. There are some imports of industrial wood from S.E. Asia.

The areas of unmanaged reserve are a special case. Their standing volume is high and they represent a capital reserve of great value which is currently producing little or no increment and yielding no produce. They are all in relatively inaccessible areas and considerable capital investment in survey and inventory, roading, machinery, transport, and human settlement would be required to bring them into production.

This investment would appear to be worthwhile were the capital available. The valuable overmature growing stock could be cut at a rate determined by the expectation of life of the standing trees, by the rate at which new roads and labour could be provided, by the time required to install new processing capacity and by the ability of the Ministry of Forests to replant the felled area.

In view of the heavy demands upon China's limited capital resources it is at least possible that a good case could be made for a major loan from the World Bank to open up these unexploited reserves of wealth.

FOREST PLANNING

The principal planning agency in China is the Planning Commission which ranks above the Ministries and which is responsible for all planning at the strategic level.

So far as forestry is concerned the Planning Commission determines a national planting programme and assesses the requirement of wood for industry. The Commission then calculates a national cut which the Minister of Forestry is asked to produce. The Minister in turn calls representatives of all the provincial forestry bureaux to a meeting in Beijing to discuss the practicability of the planting and felling programme and to decide how it shall be allocated between provinces.

The required felling programme is not arbitrary because it is based upon the production forecasts prepared at the provincial level and collated by the Ministry of Forests which passes the information to the Planning Commission. Nevertheless there are disagreements between the Planning Commission and the Ministry of Forestry which, on occasions, considers that the programme set by the Commission is either not achievable or is in excess of what is prudent from a management point of view. It is unlikely that the estimates of standing volume, increment or growth potential are very precise and it is therefore possible that the provincial bureaux and the Ministry of Forests err on the safe side.

When agreement has been reached between the Planning Commission and the Ministry the process of allocation and discussion is repeated at the provincial, prefecture and county levels.

CONTROL

The control of felling and planting programmes and of the use of government funds does not appear to be very strict. Some communes have been known to spend money intended for afforestation and management on the construction of waterways and even on providing themselves with a troupe of singers and dancers.

The impression was gained that failure to achieve targets is by no means uncommon but it is not clear how seriously this is taken. It is obvious, however, that as from next year the Government intends to tighten up its system of financial and operational control. This is in line with the current policy of strengthening the whole legal system in China.

RESEARCH

Organisation

The fountain head of forest research in China is the Academy of Forest Science in Beijing which is responsible directly to the Ministry of Forestry.

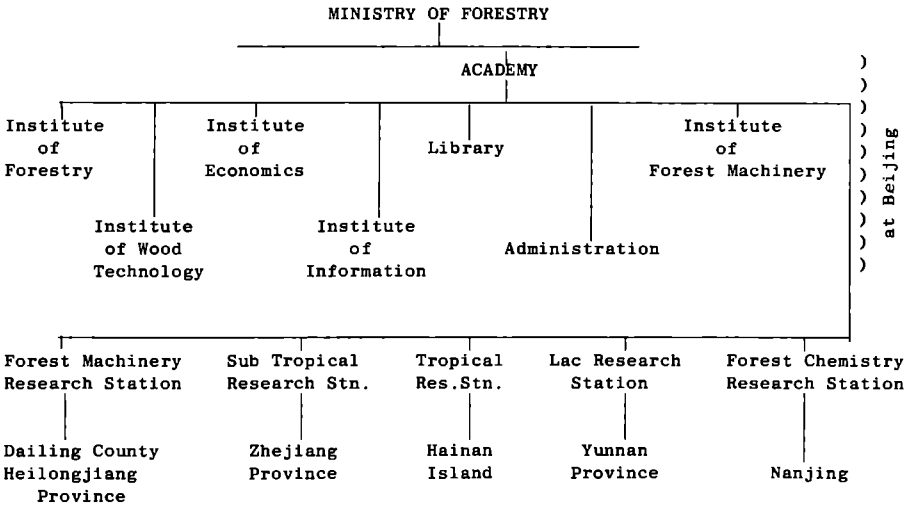
This Academy was established in 1958 and it succeeds an earlier forestry research institute. From 1966 until May 1978 the work of the Academy was either abandoned or amalgamated with the Academy of Agricultural Sciences.

The Academy is organised into twelve sub-institutes or department, seven of which are situated in one complex in Beijing and five of which are located in the provinces.

The organisational chart is shown in Table 4 below.

Table 4

Organisation of the Academy of Forest Science



In addition to the main research institutes there are a number of new experimental field stations throughout China.

The department of most direct interest to foresters is the Forest Institute in Beijing which consists of 14 branches. These are:-

(1) Management and inventory and statistics
(2) Mensuration (Measurement)
(3) Silviculture
(4) Shelterbelts and sand fixation
(5) Non-timber commercial trees
(6) Soils and site
(7) Physiology
(8) Genetics, tree breeding and provenance
(9) Botany - mainly taxonomy
(10) Exotic introduction
(11) Entomology (12) Pathology (13) Ecology
(14) Urban planting and environmental protection

This institute also has a number of silvicultural field stations in various parts of China.

The total staff of the Academy is 700 of whom 70 per cent are engaged in research and the total staff of the Forest Institute is 244 of whom 199 are technically or professionally trained.

There is a research institute in each province which reports to the provincial bureau and in Heilongjiang there are twenty-four research or experimental stations at the Forestry bureau (or County) level.

Research is also carried out in teaching establishments such as the Academy of Forestry in Harbin and by various provincial departments responsible for arboreta and conservation areas.

The provincial research institutes are not responsible to the Academy but the Academy has a considerable influence upon their work and acts as a coordinating body in national forest research. The coordination is effected by periodic meetings in Beijing of the Directors of Provincial Institutes. There are also special meetings of research workers concerned with a particular aspect of research and regional operational meetings to communicate the results of research to foresters in the field.

The Heads of the various institutes appear often to be political appointees with no experience of or qualifications in research. They are advised by professionally qualified deputies.

Current programmes

The Academy of Forest Science is responsible for both basic and applied research while the provincial institutes are, in theory, primarily concerned with practical forestry problems and possibilities in their provinces. The work done at the higher teaching establishments appears to be mainly academic in nature. The research work in the arboreta and parks appears to be almost entirely taxonomic.

It is difficult to summarise the research programme because there was no opportunity to see more than a small part of it but it is clear that genetics, tree breeding and the establishment of seed orchards, forest protection, site studies, ecology, shelterbelts and sand stabilisation are regarded as important areas of research. The seed orchards are so far composed of non progeny-tested phenotypically superior grafted parent trees but preliminary work on progeny testing is underway.

In general, the Chinese concentrate on natural as opposed to artificial techniques. Thus they emphasise mycorrhizal and soil research rather than fertilising, and biological control rather than the use of pesticides and fungicides. This derives, in part, from their inbuilt philosophy and in part from their large reservoir of cheap labour and the absence of a large petro-chemical industry.

They are able to develop crude but effective methods of biological control because they are not constrained by considerations of safety. The standard method of producing control material is to collect or breed insects infected with a viral, bacterial or fungal disease and to macerate the dead bodies in water which is then sprayed on infected crops from the air or by hand. Effective virus control is said to have been obtained with about 20 pests, notably *Dendrolimus punctata* on *Pinus massoniana* and *Clostera anachoreta* on poplar. It is probable, however, that for most of the diseases control has so far only been achieved in the laboratory.

Another form of biological control of *Dendrolimus punctata*- which is a serious pest - is the use of macerated mycelia and spores of the fungus *Beauveria bassiana* which is sprayed on to the infected trees. There is so far, however, a serious snag in this project because the life cycle of the moth is such that the spraying has to be done in the dry season when the fungus cannot survive. Attempts are being made to induce a mutation in the fungus by subjecting it to a laser beam in the hope that a more drought resistant mutant will be developed. This seems to be a very long shot indeed.

There is widespread interest within the research stations in detailed soil studies and soil analyses, in the more academic aspects of genetics, such as chromosome counting, and in tissue culture.

A number of research organisations are trying to develop natural phenolic glues to replace phenol formaldehyde in chipboard, plywood, and furniture manufacture.

The formulation of research programmes

The research workers themselves appear to be unduly preoccupied with basic or adademic research, but this is not surprising. If left to their own devices most research workers prefer to develop a theme in which they are personally interested. It is more satisfying and in some ways easier than having to identify the practical aspects of management which may benefit from research and to draw up a list of priorities based upon an assessment of the expected benefit/cost ratios of various projects. This preference for academic research is reinforced if there

is a shortage of support staff and if there are constraints upon travelling. Most applied research involves field trials which require the employment of manual workers and technical staff. There is probably no shortage of manual workers in China but the ratio of technical support staff to graduate research workers appears to be very low. There is also an impression that project leaders in the institutes may not find it at all easy to travel freely to the sites of field experiments due to a shortage of vehicles and to the considerable distances involved. It is also something of a constraint that few people in China have learned to drive a car, so that research workers are dependent upon official drivers.

Another factor which tends to encourage academic research is the fact that research workers are permanent scientists. There is no interchange with field management. One of the objectives of the Cultural Revolution of 1966 appears to have been to break the barrier between research and practice by sending research workers to work as peasants in the fields. The main object of the Cultural Revolution was to impose equality upon the population of China. The effect seems to have been to lower material standards generally and to halt or even reverse economic development. The effect on research and education was disastrous because research workers and teachers were seen as an élite group. It is said that the reasons for appointing political as opposed to scientific directors of research institutes at the present time is, in part, an attempt to prevent research from becoming too academic. This also is unlikely to be effective because the political directors themselves have no research or forestry experience and therefore have no basis on which to judge the relative merits of different research projects. There is also a suspicion that the political directors may favour research which they think will gain China international prestige.

Finally, the research institutes have barely had time, since their reinstatement after the Cultural Revolution, to forge strong links with field management.

It was not possible in the limited time available to learn in detail how the research programmes are agreed. At the policy or strategic level the Ministry of Forestry plays a major role in the formulation of the research policy of the Academy of Forestry and the Academy, in turn, exerts a strong influence upon the strategies of the provincial institutes. Although the central direction appears to be very strong there is discussion at the provincial level between the provincial, prefecture and county forest bureaux and the provincial research institutes.

The Academy of Forestry Science guides provincial research policy by way of the periodic - often biennial - conferences in Beijing attended by senior officials of the provincial forestry bureaux and the provincial research institutes. The size of these gatherings must preclude any real discussion and they appear to be occasions at which the Academy identifies the main areas of applied research to be undertaken by the various provinces.

The inter-provincial meetings of research workers working in a particular field, which are held from time to time under the leadership of the Academy of Forest Science, serve to exchange information and promote collaboration at the project or experimental level.

Most of the work of a provincial institute is intended to serve the needs of the province itself but the Academy of Forest Science sometimes commissions and pays for work of a more general nature from a particular institute.

The final research programmes undertaken by the Academy of Forest Science and by the provincial research institutes appear to be a compromise between the requirements of management and the predilections of the institutes themselves.

Assessment of research work

Any assessment of current forest research in China has to take account of the Cultural Revolution which brought almost all forest research to a complete standstill from 1966 to about 1976-78. During this time the research stations were closed, some equipment and books were destroyed and the research workers were sent into the country to work as peasants and to 're-educate' themselves by reading arid tracts on revolutionary communism. Therefore the research stations seen by the Mission had barely re-established themselves after this inter-regnum and a number of the senior people were over 60 or even over 70 years of age.

The general impression is that the quality of staff seen by the Mission is surprisingly high but that they have been largely isolated from outside influences. It is unlikely, however, that these people represent a true cross-section of research workers in China. They may well be an élite sample. The nature of the work and the high ratio of project leaders to support staff suggest that there is an undue preoccupation with academic research not only in the Academy but also in the provinces. On the other hand, if people have been away from the intellectual life for ten years there has hardly been time to establish strong links with practising foresters and the research workers will tend to carry on with the work with which they are familiar.

There is also duplication and lack of communication. This was dramatically revealed by the attempt of the Mission to discover the status of Dutch elm disease in China. At a meeting in Beijing attended by a pathologist from the Academy of Forest Science, the Deputy Minister of Forestry, and several senior officials from the Ministry, the Mission was told unequivocally that *Ceratocystis ulmi* did not cause Elm disease in China. During the same week a Chinese delegation in Britain from Heilongjiang province told our pathologists that *Ceratocystis ulmi* caused a serious elm disease in China and that there was an active pathological and tree breeding programme to deal with it.

OBSERVATIONS ON TREES AND FORESTS IN CHINA

CONTENTS

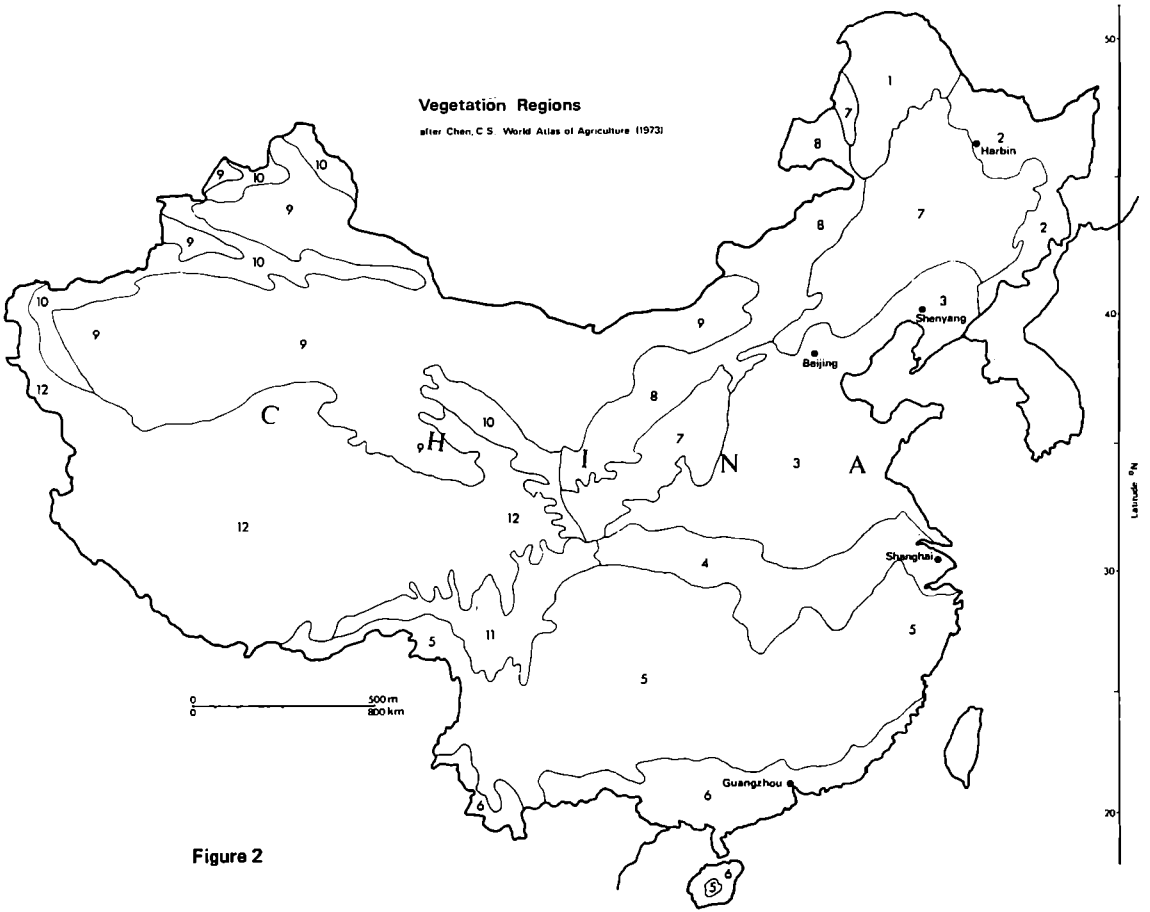

Vegetation Regions
after Chen, C S World Atlas of Agriculture (1973)
Harbin
Shenyang
Beijing
Shanghai
Guangzhou
C H I N A
0 500 m
0 800 km
50
40
30
20
Latitude °N

Figure 2

OBSERVATIONS ON TREES AND FORESTS IN CHINA

by

John D. Matthews

INTRODUCTION

In his review of the state of agriculture and forestry in China, Chen (1973) drew on the work of Hou (1956) and Richardson (1966) to summarise the characteristics of the main vegetation and soil regions of the country. He described 12 regions which are outlined in Figure 2 opposite.

(1) the coniferous forest region;
(2) the region of mixed coniferous and deciduous broadleaved forest;
(3) the deciduous broadleaved forest region;
(4) the region of mixed deciduous and evergreen broadleaved forest;
(5) the evergreen broadleaved forest region;
(6) the tropical monsoon rain forest region;
(7) the forest steppe;
(8) the steppe region;
(9) the region of semi-desert and desert;
(10) the north-western mountains;
(11) the mountains and plateaux of south-east Tibet;
(12) the Tibetan plateau.

The Mission was able briefly to visit cities and forests in six of these regions and Chen's summary characteristics for these appear in Table 6. (page 30).

Some idea of the changing conditions as the Mission travelled over the route from Guangzhou to Beijing can be gained from Table 5.

Table 5

Length of Seasons at Selected Stations

Station	*Latitude*	*Number of days* *Winter*	*Summer*	*Spring and Autumn*
Guangzhou	23°12'N	0	195	170
Shanghai	31°14'N	120	110	135
Shenyang	41°30'N	185	75	105
Harbin	45°49'N	200	50	115
Beijing	39°56'N	155	105	105

Source: Chen 1965

Table 6

Characteristics of Six Vegetation-Soil Regions of China - see Figure 2 opposite

Vegetation	*Soil*	*Climate* *Mean annual precipitation mm*	*Mean Max temperature °C*	*Mean Min temperature °C*	*Frost free period days*	*Characteristic tree species*
(6) Tropical monsoon rain forest	Yellow lateritic	1200-2800	27-29	13 to -2	350-365	Myrtaceae Moraceae Lauraceae Leguminosae Palmae etc.
(5) Evergreen broadleaved forest	Yellow podsolic and rendzinas	1000-2000	21-31	4 to -6	250-300	Castanopsis Schima Cinnamomum Phoebe Photinia etc.
(4) Mixed deciduous and evergreen broad-leaved forest	Brown forest soils; yellow podsolic; yellow korichnevie	1000	26-30	2 to -5	230-280	Acer, Tilia Fraxinus Cunninghamia Crytomeria etc.
(3) Deciduous broadleaved forest	Brown forest soils; korichnevie	300-700	23-29	0 to -13	150-240	Quercus, Ulmus, Acer, Betula, Tilia
(2) Mixed coniferous and deciduous broad-leaved forest	Podsols; brown forest soils; gleys	650-1000	20-24	-16 to -25	120-130	Pinus, Abies, Picea, Larix, Quercus, Betula, Acer, Tilia
(7) Forest Steppe	Grey forest soils; chernozems; solonchaks.	500-650	21-25	-14 to -27	140-160	Quercus, Betula, Populus, Salix

The first comprehensive account in English of forestry in China, as distinct from the many excellent records of the forest flora by botanists, was compiled by Richardson (1966) and he drew on most of the literature in English to write it. The Mission followed the route he took in 1963 quite closely and in one case met the same forest scientist after 16 years, so *Forestry in Communist China* proved a valuable guide and made possible some comparisons to aid in assessing the progress made by Chinese foresters. But Richardson was not the first British forester to interest himself in China. Professor Augustine Henry, first incumbent of the Chair of Forestry in Dublin University, spent much of his youth (Matthews, 1955) as a doctor in the Chinese Imperial Maritime Customs and *The Trees of Great Britain and Ireland* (Elwes and Henry, 1913) draws heavily on his experiences there. Perhaps as remarkable is the work of Norman Shaw (1914) who provided in *Chinese Forest Trees and Timber Supply* the first comprehensive picture of the state of the forests and a plan for replacing the greatly depleted timber resources of the country.

It is not known when the destruction of the natural indigenous forests began but Wen Chieh (1959) says that historical data show that the Yellow River valley, with serious soil erosion over a vast expanse of 580,000 square kilometres, was originally covered with forests which were destroyed in the civil wars among the feudal lords in the Warring States period (403-221 BC). Shaw (1914) gives many examples of destructive fellings during the 19th century and showed that only near monasteries and in the remotest parts of the country were the forests preserved.

The first step towards recognition of the importance of trees and forests to the economy came with the establishment of a forest school at Shenyang in 1907 and a foreign adviser to the Bureau of Forestry in Beijing was appointed in 1913. In the early years of this century Russians, Japanese, British and others exploited the forests of Manchuria and the Japanese continued to do this from 1931 to 1945. Uncontrolled fellings by the Chinese people for fuel and timber also continued and,when after Liberation the Chinese Government finally took stock of the forests for the first five-year plan, 1952-57, only 7.9 per cent of the total land area was tree covered and the demands on the remaining forest were enormous.

China has already reached a point that many tropical countries are approaching and the effects and achievements of the past thirty years deserve study. There is no doubt that since 1949 tremendous progress has been made in all aspects of forestry and it is hoped that Britain can contribute expertise toward further progress.

FORESTRY SUPPORT FOR AGRICULTURE

China's economy is predominantly agricultural and more than 700 million people live in the countryside. The strategy of the Government since 1949 has been to encourage expansion of agriculture because this will in turn encourage the development of almost every sector of the national economy (FAO, 1978). One vital role of forestry is to support agriculture by reinforcing the efforts that have been made to tame rivers, regulate water supplies, reverse soil erosion and establish a favourable microclimate for agriculture.

In 1958 (at the beginning of the Great Leap Forward) Chairman Mao proposed that trees should be planted along roads, rivers and canals, around homes and villages and around fields. The species used were those which, in addition to fuel and wood would produce fodder, fruits and other so-called minor products. The success of 'Four around' planting, as it is called, has led to its extension into the use of trees in rural development and the influence of the 'Four around' idea can also be seen in urban tree planting.

The Mission was able to see the system at close quarters in only one place and a description of this is given by David Johnston (p. 16) and Ron Kemp (p. 59); but in the journeys by train from Shenyang to Harbin and Dailing and the return train journey from Harbin to Beijing we were able to see forestry support for agriculture in panoramic view. We also had the FAO Forestry Paper 12 published in 1978 which is a very good account of the origins and progress of the 'Four around' movement.

A NOTE ON POPLARS

Northwards from the Yangzi river poplars become progressively more common in the 'Four around' plantations, along the roads, canals and rivers, in towns and cities and in forest areas (Huang and Liang, 1979). The Mission saw in passing extensive plantings of poplar in Shenyang and Fushun, great 'Four around' plantings on the plains south and north of Harbin,in the city itself, and more 'Four around' plantings on the plain north of Beijing and in and around the city. Travel in cars and trains makes positive identification difficult but sampling at stopping places, cross checking with planting stock in nurseries and reference to observations of other visitors and to papers originating in China lead to the conclusion that the most common poplars are:

Populus tomentosa, a grey poplar also called *P. pekinensis*. According to Augustine Henry (1913) this can be a large tree and he described it as "similar in size and bark to *P. alba*'. It is widely used in the streets of Shenyang and Beijing.

P. simonii, a balsam poplar. It is a natural indigenous species, widely distributed in north-east China and making a tree of medium size. *P. cathayana* is closely related to it. There are several named varieties of *P. simonii.*

P. x canadensis Moench (or *P. x euramericana*). These are hybrids between the European black poplar and the north American *P. deltoides.* The most common cultivars seen were cv "robusta", cv "I 214" of Italian origin, and cv "Sacrau 79". "I 214" was seen frequently in Beijing and "Sacrau 79" is reported by Huang and Liang (1979) to have grown particularly well in the suburbs of that city.

P. nigra, the black poplar is represented chiefly by the cultivar "thevestina" or "Afghanica" which resembles the Lombardy poplar in its fastigiate habit.

P. ussuriensis, a balsam poplar, was seen in the natural forest reserve at Dailing in Heilongjiang Province where it reached very large sizes.

P. bolleana is a fastigiate cultivar of the white poplar *P. alba.*

The drive to establish the Great Green Wall of shelterbelts and the success of the 'Four around' planting has stimulated hybridisation to obtain cultivars that combine cold hardiness, resistance to drought or tolerance of alkaline soils with high rates of growth. The common diseases of poplar are also present in China. *P. simonii* is being crossed with other species and the hybrids *P. simonii x nigra* and *P. cathayana x nigra* have already been produced. Another line of research being followed in the poplar breeding programme is anther culture with the object of producing haploid plants to shorten the cycle of breeding. Ths Mission saw this work at the North East China Forestry Institute in Harbin and the Royal Society delegation of 1976 (Harley, 1976) reported that 150 units in China were working on anther culture in wheat, rye, *Triticale*, maize, pepper and poplar.

In poplar the establishment of *in vitro* cultures of anthers and induction of haploid plantlets (preferably without intermediate formation of callus) is followed by treatment with colchicine to double the chromosome number and so produce true-breeding diploid plants. The woman scientist doing the work in Harbin had many commendations on the walls of her room (see Acta Genetica Sinica 6, 1977) and she had produced haploid, diploid and triploid poplars by culturing anthers.

The amount of work being done on anther culture in China was assessed by Riley (1976) who concluded that it appeared excessive. China is very well endowed with indigenous poplars, some of which have been used in poplar breeding programmes in North America. It would be preferable to finance a large-scale

programme of selection and hybridisation followed by vegetative propagation of the most promising cultivars. The anther culture and tissue culture seen at Harbin and Guangzhou will be useful in poplar genetics research and in training specialists in poplar culture.

In 1963, Richardson (1966) followed a similar route to the Mission in north east China and although 16 years ago poplar planting was common north of the Yangtzi river, the 'Four around' movement was only five years old (it had begun in 1958, FAO 1978) and the visual impact of the young plantations was not so great. Now after 21 years of effort the great virtues of the poplars - easy propagation and establishment, rapid production of timber, fuel and fodder and adaptability to a wide range of sites - have made them firm favourites on the agricultural communes and in the towns and cities.

In rural areas the ground is prepared for planting by ploughing and the planting stock is raised in commune nurseries. Planting distances are unusually close - often 2 x 2 metres or less - and yields per tree are correspondingly low. However, Huang and Liang (1979) quote volumes of 1.2 cubic metres per tree after 10 years for *Populus* cv "I 214" and this implies excellent site conditions and more usual spacings. The next step in China is to base plywood, timber production and paper making on poplar plantations and this will probably not be long delayed.

FORESTRY IN URBAN AREAS

Introduction to trees in urban areas. The use of trees and shrubs in the southern city of Ghangzhou set the pattern seen later in Shanghai, Shenyang, Harbin and Beijing. The species used and scale of planting differed in each city but the single, double and triple rows and even wider belts of trees and shrubs along streets and boulevards, in central reservations and on round-abouts, around public buildings, factories and blocks of flats were common to all.

The larger stock is prepared for moving one year before lifting with rope netting or matting retaining the soil around the roots and with rope bound around the stem as protection against damage in transit and immediately after planting. March 12 is China's official Tree Planting Day, when the people make special efforts to increase the growing stock of trees and shrubs in their towns and cities. Students, schoolchildren and soldiers of the People's Liberation Army turn out to make their contribution to tree planting (Lancaster, 1979; Xinhua News Agency 1978, 1979). Another time for planting is October.

Street trees and shrubs are planted closely. Distances range from 2 metres (7 feet) upwards with 3.6 to 4 metres (12 to 14 feet) the most common. Most

are planted as standards 3 to 3.6 metres tall (10 to 12 feet) but examples 8 metres tall (26 feet) were seen in Guangzhou and these were held in position with a crutch of two or three bamboo poles until established.

Trees in the streets were generally healthy, well-provided with leaves and growing strongly and this must reflect careful nursery preparations, the good depth of soil available to them and their young age (Lothian, 1978). The practice of protecting roots within a ball of soil while transporting gives the trees a good start and this is reinforced by flood irrigation of a basin around each tree during the first year. The water is brought by tankers or provided by the local residents. Pruning is also well done, the stems of established trees being clear of branches for 3 to 4 metres (10 to 13 feet). The branches quietly disappear for fuel.

In the south of China, the basal one or two metres of the stem is often lime washed as a protection against insects (and perhaps also to reflect light to aid drivers?). One snag repeatedly seen and noted by several other visitors (Pollard, 1977: Lancaster, 1979) is the severe compaction of ground below older trees, especially outside large blocks of flats. It is difficult to see how those species less tolerant of compaction can survive for long unless protected. Pollard (1977) reports that urban forestry is taught in schools as a component of the national health movement so maybe education can be one long-term solution.

The range of species is very wide but there is clear indirect evidence of careful and systematic selection of species and cultures. As an example from Shenyang, the older clones of *Populus x canadensis* were evidently not long lived and suffered from die back; they have been superseded in the more recent plantings by new clones of *P. tomentosa* and black poplar hybrids.

Urban forestry in Guangzhou, Guangdong Province. Guangzhou is one of the major cities in China. It lies on the Zhujiang or Pearl river, one arm of the Xijiang delta. It is said that there were about 50,000 street trees in the city at Liberation (Xinhua News Agency, 1978). Since then more than 300,000 trees have been planted along streets, around public buildings, schools and factories under the direction of the Municipal Afforestation Bureau.

Historical evidence of past development could be seen in the street plantings. In the earliest days of replanting, following the establishment of the People's Republic in 1949, protection of the young trees in the face of extreme need for fuelwood was no doubt largely dependent on direct supervision and control. For that reason the oldest trees in the street and roadside

plantings are found near the town centre and there is a progressive change outwards, not only in age but frequently in species also. For example, in the centre of Guangzhou some of the oldestshade trees are banyan fig *(Ficus retusa)*,no doubt readily propagated and robust, *Aleurites moluccana, Salmalia (Bombax) malabaricum, Casuarina equisetifolia,* and *Melaleuca leucadendron,* with the ornamental flowering trees *Delonix regia, Bauhinia blakeana* and *B. purpurea.* The official Guest House was surrounded by some of the largest trees, including less familiar ornamental and fragrant species such as *Heteropanax fragrans* (Aralianaceae) and *Michelia alba* (Magnoliaceae). Among other important species were *Acacia confusa, Celtis* species, *Cinnamomum camphora, Grevillea robusta, Salix babylonica* and *Swietenia mahagoni.* Notable and colourful trees reported by Lothian (1978) are *Diospryos kaki, Jacaranda mimosifolia, Hibiscus tiliaceous* and *Lagerstroemia speciosa.*

Xinhui Town, Guangdong Province. This thriving town of 65,000 people is about 90 kms west and south of Guangzhou in the Pearl river (Xijiang) delta. It has boat-building yards, a small paper mill using bagasse as raw material, a sawmill, the Jiangmen Handicrafts factory for converting fan palm to many varied products and other industries. The town occupies 462 hectares, the surrounding rural area extends to 1428 hectares and there are 334 hectares of cultivated land. Before Liberation the town and neighbouring hills were largely bare of trees and there were only a few trees along the roadsides. In 1958, in a transformation well-documented by a display of photographs, the people planted the streets with trees, created a series of fine public gardens and afforested the hills around the town. 110,000 trees were planted along the roads, streets and lanes and open ground around the houses and the area so covered is estimated at 81 hectares. Thirty four hectares were set aside for recreation and a 'Garden of One Hundred Fruits', children's garden, lake garden, zoo, gymnasium, swimming pools and boating lakes were created. On the Guifeng hill 100 hectares were planted with *Pinus massoniana* to provide a wooded background to the town.

Now about 115 hectares, or an area equivalent to quarter of the land surface of Xinhui town, is provided with trees and shrubs (and each member of the commune has access to an average 17.7 square metres of greenery). This landscaping work has also brought financial benefit to the town; an income of 200,000 yuan each year is gained from the production of fruits, fan leaves from the Livistona palm, bamboos, timber and flowers. The pleasant environment of Xinhui makes it a popular place for tourists, especially Chinese from overseas coming in via Hong Kong. This must bring in more currency.

The fruit trees include litchi, mango *(Mangifera indica)*, *Euphoria longan*, citrus fruits, peach *(Prunus persica)*, tea-oil *(Thea oleosa)*, *Sapium sebiferum*, Chinese banyan *(Ficus retusa)* and bananas. The tree species include *Aleurites montana* (Tung oil) in white flower, *Bombas (Salmalia) malabaricum*, *Casuarina equisetifolia*, *Eucalyptus citriodora*, *Ginkgo biloba*, *Grevillea robusta*, *Melaleuca leucadendron* and *Taxodium distichum*.

Baiyunshan Park, Guangzhou, Guangdong Province. This is a pleasant area of wooded hills just outside Guangzhou reached by a winding scenic road leading to fine views of the city and countryside from the summit. The White Cloud Hills (Baiyunshan) once carried a natural forest of tall 'fir trees' (perhaps *Cunninghamia lanceolata)* but Shaw (1914) records that in 1854 these were destroyed. Some replanting began in 1930 but the major re-afforestation took place from 1952 onwards, the main species being *Pinus massoniana* with some *Eucalyptus citriodora*. The area of 2700 hectares has been developed for tourism and is now called the Peak Park. The area is attractively signposted, a new guest house is well furnished for overseas tourists and lakeside pavilions are being built. The botanist Hu (1975) returning on a visit to her native country after 20 years found the planting on the White Cloud Hills completely new to her and Ching and Ching (1973) record that the whole area had been planted in eight years. At the base of the hills the *Pinus massoniana* are quite well grown and well provided with foliage but on the steep slopes facing east and west trees planted in 1958 had only the foliage of the current years, were attacked by larvae of the pine caterpillar *Dendrolimus punctata* Walk, and had been repeatedly lopped for fuel. Because of the value of the plantations for tourism strenuous efforts are being made to control the insect pest. Since 1969 a suspension of virus-infected larvae has been sprayed to control *Dendrolimus* with reasonable success. Before this method became available an insecticidal chemical was applied from a helicopter. In 1977, trees on the upper slopes began to die and this could be due to the combined effects of dry soils, premature death of needles and perhaps a rust infection. Another species of pine is needed to replace *Pinus massoniana* on many sites.

Urban forestry in Shanghai. The autonomous city of Shanghai is the largest in China. It is situated on the eastern edge of the great plain of China on the delta of the Yangzi river. The modern city was built when Shanghai was an international settlement and a treaty port and the streets and the residential areas are greatly embellished with trees and shrubs. Shanghai is also a major industrial centre and there is much less and often no room for trees near the factories.

Almost the entire length of the route from the airport to the city is lined with plane trees and past connections with Britain and other European countries probably explains why the London plane *Platanus x acerifolia* (Lancaster, 1979) is more common than the Oriental plane *(P. orientalis)*. The trees were planted 3.6 to 4 metres apart and have 3 to 4 metres of clear stem before branching begins. The branches meet overhead to provide an attractive, arched, green canopy over the street. Summer pruning removes branches that would hinder the passage of laden lorries and trolley buses. Hu (1975) reports that the trees also receive a daily spraying with insecticide in July and August. Other species common in Shanghai are *Euonymus japonicus, Ginkgo biloba, Juniperus chinensis, Ligustrum* spp., *Magnolia grandifolia, Metaseguoia glyptostroboides, Pittosporum* spp., *Robinia pseudoacacia* and *Sophora japonica*. Another pleasant feature of some parts of the city are small public gardens where *Cedrus deodara* often is planted.

Longhua Botanic Garden, Shanghai. The Mission visited this new Botanic Garden on the outskirts of Shanghai. It is served by trolley-bus and is clearly a very popular place for outings from the city. A garden had been established in 1953 as a nursery producing flowers, shrubs and trees for the city and Richardson (1966) records that it had developed into a training centre for the art of P'san tsai or bonsai. Longhua was only designated a botanical garden in 1973 and parts of it are still under construction, but when complete it is likely to become one of the largest in China (Hu, 1975). The site is almost entirely flat, so earth has been imported to create hill and dale and give scenic variety and contrast. The Botanic Garden covers 70 hectares and has a staff of 400.

Shanghai lies in the eastern monsoon region and the climate of the Yangzi delta is classed as sub-tropical. Mean annual rainfall is 1000 mm, the air temperature ranges from a monthly maximum 26° to 30°C to a minimum of +2 to -5°C and the frost-free period is 230 to 280 days. A large glasshouse, 20 metres to the ridge, is being built to house a collection of tropical and sub-tropical species from Hainan Island and elsewhere as part of the programme of introduction, cultivation and study of woods and herbaceous plants. The staff of the Botanic Garden have contacts with colleagues in Hong Kong, West Germany, the United States and Britain.

After the briefing, members of the Mission walked through several pavilions, courtyards and paved, open spaces separated by stone frames or bamboo screens to view a very fine collection of bonsai. Richardson (1966) says that although

originally only four tree species were grown in bonsai now many more are used. Some of the older specimens were grafted; most were grown in large and deep earthenware pots, artistically arranged; some were in shallow rectangular trays to display the surface roots. All were tended regularly and often daily, the shoots are pinched two or three times each year and the roots are also pruned. The bonsai seen included *Ilex cornuta* 40 years, *Buxus microphylla* var. *sinica* 120 to 140 years, *Podocarpus macrophyllus* var. *maki* 40 years and *Pinus parviflora, P. tabulaeformis* and *Pseudolarix amabilis* all over 40 years. The oldest specimen was a pomegranate *Punica granatum* reputedly 240 years old (see Lancaster, 1979) which had been planted by the Emporer himself! A range of smaller bonsai being brought on in smaller pots was remarkable for diversity of species and growth habit. Wire supports were common and the pots were plunged in raised beds. Broadleaved species included *Acer palmatum, A. truncatum, Cytisus* spp., *Diospyros sinenis, Euonymus fortunei, Gardenia jasminoides, Jasminum nudiflorum, Lagerstroemia indica, Prunus persica, Ulmus parviflora, Wistaria sinensis* and *Zelkova serrata*. Some gymnosperms were *Ginkgo biloba, Juniperus chinensis, P. massoniana, P. thunbergii, P. bungeana, Podocarpus macrophyllus* and *Taxus cuspidata* (see Lothian, 1978 and Hu, 1975).

Moving to the specimen trees arranged around lakes and winding pathways, we saw *Acer palmatum, Buxus sinensis, Cornus wilsonii, Carya cathayensis, Ilex* spp., *Liriodendron chinense, Lagerstroemia speciosa, Paulownia tomentosa, Phellodendron chinense, Cupressus funebris* and *Metasequoia glyptostroboides*. The last named also lined the roadsides and banks of drainage canals on the approach to the Botanic Garden but in some cases looked unhealthy, perhaps because after the trees had grown vigorously for ten years to a height of 10 metres their roots reached an unfavourable subsoil.

The nursery was run on traditional lines to produce plants for display at civic functions. Much of the stock was in clay pots set in upturned earthenware trays or bricks in the open or in cold frames. A good range of cacti and succulents were seen, all well-grown and often superb specimens.

Urban forestry in Shenyang. Shenyang in Liaoning Province is another industrial city that has made good use of trees in the streets. *Robinia pseudoacacia, Populus x canadensis* and willows are particularly notable. There are about 1,000 factories in the area and Pollard (1977) reports an agreement between the Shenyang Institute of Forestry and Pedology and a local chemical factory so that trees with resistance to air pollution could be identified.

With assistance from the municipality over 2,000 trees were planted between 1972 and 1977 in the vicinity of this soda lime factory.

Trees with strong resistance to air pollution include:

Ailanthus altissima
Ginkgo biloba
Gleditschia japonica
Maackia amurensis
Prunus davidiana
Populus canadensis
Robinia pseudoacacia
Salix matsudana
Sophora japonica
Tamarix chinensis
Ulmus pumila
Zizyphus jujuba

Trees with weak resistance to air pollution include:

Larix
Pinus koraiensis
P. tabulaeformis
Juglans mandschurica
Malus baccata
M. pumila

Urban forestry in Harbin. Harbin lies on the 46th parallel of north latitude in the cool temperate climate of north east China. It is a city with a distinct Russian flavour to its older buildings. On Liberation there were said to have been only 85,000 trees within the city boundaries; by 1979 there were 3.6 million and an area equivalent to 14 per cent of the city had been planted to trees and shrubs. Now there are a dozen parks totalling 200 hectares and one of these is on the eastern bank of the Songhua Jiang. This promenade beside the river is made attractive by rows of *Populus x canadensis* and *Salix matsudana*.

A programme of increased municipal plantings was begun in 1979 and during the spring some 330,000 trees and shrubs were planted in disused sewage ditches, around factories, offices and schools and in the courtyards of houses. The appearance of thirty squares and public gardens was also improved. On one of the main boulevards a dual carriageway was divided by a broad central reservation bearing four rows of trees; this together with the three or four rows on each side made 10 to 12 rows in all. The extensive use of fruit trees in the public gardens and the orchards within the city boundaries softens the stark outlines of the modern buildings and gives a colourful background to the city.

The species commonly used in addition to poplars and willows are *Pinus sylvestris* var. *mongolica*, *P. koraiensis*, *Picea* spp., *Ligustrum lucidum*, *Syringa* spp., and *Forsythia suspensa*.

Urban forestry in Beijing Municipality. Perhaps the most heroic efforts to transform the urban environment with greenery - the lu-hua movement - are being made in Beijing where people from all walks of life have planted and are tending trees, shrubs and flowers to beautify their surroundings. By the end of April 1979, 680,000 trees had been planted, 15 per cent more than in the same period of 1978 (Xinhua News Agency 1979).

For much of the year Beijing is extremely dusty because strong winds blow off the dry plateau to the north-west. Water tankers can lay the dust for a while but many streets are unpaved, the ground in front of large blocks of flats is trampled bare of vegetation and wind whips up the dust in great quantities. More grass is to be sown in the parks and on the streets but the design of the older dwelling houses, arranged around small courtyards still looks very appropriate to the prevailing conditions.

Beijing has a monsoon climate despite lying at 40^{o} north latitude and in summer it is hot but when the wind blows humidity drops considerably and before the monsoon breaks flood irrigation is used on the street trees, the ground around each tree being saucer-shaped to retain water. Where the water wagons cannot reach it is believed that the local residents organise watering and spraying.

The main street of Beijing is an immense boulevard several miles long and bearing four lanes of traffic in each direction with ample space at the sides for pedestrians. The trees planted along it and in neighbouring streets are mainly *Populus tomentosa, P. canadensis* cv I 214 and *Sophora japonica* with *Amorpha fruticosa* as understorey. Other species commonly planted are *Robinia pseudoacacia, Koelreuteria paniculata* and *Salix matsudana*.

The route from Beijing to the airport provided a fitting climax to the use of trees in urban areas. Each side of the road was planted with up to eight rows of poplars, planes, birches, willows, pines and many other trees. The effect on arriving or departing travellers is tremendous and will increase with the years.

Palace Museum, Temple of Heaven Park and Ming Tombs, Beijing. The Palace Museum, also called the Forbidden City, forms a very large and complete group of ancient buildings built during the period 1406 to 1429 of the Ming Dynasty (1368-1644). It occupies 64.75 hectares (160 acres) and has more than 900 rooms. Within the garden are some large and notable specimens of *Pinus bungeana* (a three-needled pine with whitish peeling bark somewhat like plane), *Juniperus chinensis* of very great age, possibly 500 years, with the branches supported by

massive props, the stem bound with iron bands and the crevices carefully filled, *Ginkgo biloba* said by Lothian (1978) to be over 350 years old, *Aesculus chinensis, Ulmus* spp., *Magnolia denudata, Ailanthus altissima,* an *Albizzia jilibrissia* 8 metres tall and many fine fruiting pomegranates *(Punica granatum)* in pots.

The Temple of Heaven Park (about 4 km south of the Museum) is laid out very formally to set off the remarkable Temple of Heaven built in 1420 of an intricate timber construction, very colourfully decorated and of perfect proportions. The promenades are flanked by fine young trees of *Juniperus (Sabina) chinensis, Pinus bungeana* and *Populus x canadensis* with old trees of *Biota (Thuja) orientalis* up to 500 years old. The great popularity of this park (150,000 people on May 1) has severely reduced the ground cover and compacted the soil around the old arbor vitae (*Thuja* spp.) trees; some remedial action is essential or the trees will succumb.

The Ming Tombs belong to the Ming Dynasty (1368-1644) during which there were sixteen emperors. The whole area around the tombs is heavily planted with mature or old *Biota orientalis* and *Juniperus chinensis.* Other notable trees are the persimmon *(Diospyros kaki), Buxus sempervirens, Cedrus deodora, Fraxinus ornus, F. chinensis, Gleditsia sinensis, Koelreuteria paniculata, Wistaria* and *Zizyphus jujuba.*

The Chinese gardeners have created a very distinctive style of landscape in their gardens in which rocks play as important a part as trees and shrubs. Perhaps they keep the older trees too long and the pressure of people on the public parks in Beijing has grown too great for the landscapes to be kept in good condition. In any event, the Longhua Botanic Garden in Shanghai and others visited by Lothian (1978), Lancaster (1979) and others are keeping alive and developing a fine tradition. The gardens created since 1958 in Xinhui town are also in this tradition and because the pressure of people is not so great, they are likely to last many years.

Xinanjiao Nursery, Beijing Municipality. The continued large-scale planting of trees in urban areas requires a regular supply of planting stock of many species and various sizes and the Mission visited a nursery in the south-western suburbs of Beijing run by the Horticultural Bureau.

The total area of this nursery is 32 hectares and 25 to 26 hectares are productive, the rest being in roads, buildings and shelterbelts and hedges. The total number of people employed is 150. There were 515,600 plants in stock and annual production was 116,000 so the average time to produce trees was

5 years, the range being from 2 year stumped plants of *Populus tomentosa* to 8 years for *Cedrus deodora*. There are 500 square metres of glasshouse producing seedlings all year round and the finished planting stock could also be planted in most periods of the year (although one imagines that the driest and coldest periods would be avoided).

The nursery catalogue contained the names of 308 species, varieties and cultivars, 23 being broadleaved and 95 coniferous. Ten grasses and herbs were grown for ground cover. Many of the trees were raised in small quantities and the most common seen were *Cedrus deodara, Pinus bungeana, Biota (Thuja) orientalis, Juniperus chinensis, Buxus microphylla, Populus tomentosa, Hibiscus* spp., *Diospyros kaki* and *Liriodendron chinensis*. *Pinus ponderosa* was thriving in the nursery although quite slowly grown.

Seedlings and cuttings of several species were raised or rooted in earthenware pots under polythene cloches, further protected by high lath shelters. Seed was also sown in standard nursery seedbeds covered by matting to conserve moisture; and in paper pots, the soil being sterilised chemically.

The transplant lines were irrigated by flooding from ditches. The weeding of the large area of transplant lines or wide-spaced plants was being done at the time of our visit by small petrol-driven harrows which were rather clumsy machines. Sewage sludge is an important but not the sole source of nitrogen and is brought from the city by tanker lorry. Other nutrients are given in inorganic form and lime is also applied for broadleaved species. Chemical weed control was being tested.

The procedure for raising plants varied with species. Stool sets of poplar provided cuttings which were stumped back after one year and lifted at two years. *Cedrus deodara* and clones of *Thuja, Cupressus, Juniperus*,etc. were raised from cuttings rooted under glass or polythene. The *Cedrus deodara* plants were lined out and staked until a leading shoot had developed. One-year-old seedlings raised in clay or paper pots and rooted cuttings were lined out at close spacing for two years, then at wider spacing for at least two more years until sufficiently large for planting on city sites, that is, at one to three or four metres tall. One summer prior to final lifting the roots of *Juniperus* and *Cedrus* are undercut, the trees are fertilised and the roots surrounded with matting or netting. The considerable amount of soil lost at lifting is made good from building sites in the city and at the time of our visit in early October lifting, planting and replacement of soil were all in progress.

As a small sidelight, in the climate of Beijing *Ficus microphylla* is being grown under glass whereas in Guangzhou it is widespread out of doors.

Conclusions on urban forestry. Urban forestry has enjoyed high priority during the 30 years since the foundation of the People's Republic in 1949 and it follows that much of the growing stock throughout the country is quite young. China's record of roadside planting goes back to the Zhou and Han dynasties and greatly impressed Marco Polo in the thirteenth century (Pollard, 1977). Massive strides have been made since Liberation and the full benefits of the planting with some very striking effects are still to come.

So-called economic species are planted for oil, nuts and fruit; dead limbs and litter are collected for fuel. The discipline of the people and their involvement in planting and tending keeps vandalism low or absent so that staking can be reduced to a minimum. The care with which the trees are raised, planted and tended ensures their success.

Thinnings will be required and presumably these will provide welcome sources of fuel. The common linear arrangement of trees although difficult to avoid could sometimes be broken up and made less formal. The continued scale of planting should encourage innovation in the choice of species and the production of new improved cultivars.

Mention has been made of the danger to the trees of soil compaction; one solution might be to plant an understorey or ground cover to deter people from leaving the pathways.

SILVICULTURE IN SOUTH CHINA

Dinghushan Forest Reserve. Over much of southern China the natural forests have long since gone and any trees now seen have been planted, usually during the past twenty to thirty years. There is a remnant of natural mountain forest on Dinghushan about 100 km west of Guangzhou which was visited recently by the Royal Society (Harley, 1976) and Green and Simmons (1978). The Forestry Mission was also glad of the opportunity to see it.

It appears that this fragment of native mountain flora was protected down the centuries by the presence of a notable temple of the Tang dynasty and there are written records of the forest extending over 500 years. Since 1956 it has been administered by the Guangdong Institute of Botany who have a laboratory and field station there. The mountain range is about 150 km long and the field station is responsible for about 1070 hectares of land. This area includes 140 hectares of scrub or grassland which is essentially degraded forest. In the

central part there are about 266 hectares of forest reserve which is strictly protected against fire and natural regeneration is being encouraged. Around this is a zone of mixed broadleaved forest with some introductions and around this again *Pinus massoniana* and *Eucalyptus* plantations. These planted or modified areas together make up 666 hectares.

The geology of the reserve is granite and sandstone and the soil is podsolic with some loess on the mountain. The slopes are steep. The average temperature is 21°C, the range being from 0.5°C to 36°C. Mean annual rainfall is 2000 mm and the relative humidity 80 per cent. On the highest peak at 1076 metres freezing conditions occur on one or two days in each year.

Some 2400 species belonging to 1100 genera and 278 families have been identified by the staff of the field station and 700 of these are trees. A *Handbook of the Plants of Dinghushan* was published in 1978.

The Royal Society party (Harley, 1976) say that the 'climax vegetation would be best classified as mixed monsoon forest in the lower parts and sub-tropical rain forest on the massif' and it appears to have components of Chen's evergreen broadleaved forest and tropical monsoon rain forest (Chen, 1973). In the list of species which follows attention is focussed on the timber trees and some palms. Most frequent among the larger timber trees is *Castanopsis chinensis,* said to be up to 300 years old. It is an evergreen member of the Fagaceae and produces edible fruit; *C. fissa* is also present. There are large specimens *Canarium album* (Burseraceae) and some very tall *Schima superba* (Theaceae) and *Cryptocarya chinensis* (Lauraceae). Two leguminous species are *Erythrophleum fordii* (Caesalpinaceae) and *Ormosia glaberrin* (Papilionaceae). A notable member of the Anacardiaceae is *Dracontomelum dao*. Two species of palm are *Caryota ochlandra* and *Pandanus austrosinensis*.

It is notable that a number of the oldest trees present in the forest reserve produce edible fruit. *Canarium album* has already been mentioned and there are also venerable specimens of *Litchi chinensis* and *Averrhea carambola* suggesting that these might have been favoured by protection in the past. Both the British botanical parties mentioned the red herbal tea made from leaves of *Begonia fimbristipula* which are collected commercially and dried to make an acid, sweet and refreshing drink. Green and Simmons (1978) also mentioned *Rhododendron mariesii* used for bronchitis and the Mission also saw wild ginger and dined off local mushrooms and algae.

A note on Eucalyptus species. The rail journey from Hong Kong to Guangzhou provided examples of the great potential of *Eucalyptus* for planting in southern China. The plantations of *E.citriodora* seen from the train had been closely planted and were unthinned but despite having very restricted crowns they appeared healthy. The *E.citriodora* planted in rows up to four or five deep beside the main roads west and north of Guangzhou and the small but vigorous stands on the hills confirmed the success of this species. One tree of *E. citriodora* planted in 1959 in the arboretum of the Forest Research Institute had attained a diameter of 44 cm at breast height and this was exceeded only by a nearby specimen of *Albizzia falcataria* of the same age but poorer stem form.

Travelling out from Guangzhou along the main road *E. robusta* began to appear but it had evidently been among the first to have been planted and the trees were generally unhealthy, often stag-headed and exuding gum from large areas of the stem. *Melaleuca leucadendron*, also a member of the Myrtaceae, is common in south China and is another species planted in earlier years. It is easy to establish but the slow growth rate and poor stem form of this species limits its usefulness for shade and timber production.

Chi (1979) reports that Eucalypts were introduced to China from Italy to Hong Kong and Guangzhou in 1890 but they were grown only as ornamentals or roadside trees before 1949. In 1954 the National Leizhou Forest Farm situated in the Leizhou Peninsula of Guangdong Province at 20^{o} to 21^{o} north latitude began to plant *E. excerta* and *E. citriodora* to produce mining timber and by the end of the 1960's small areas of *Eucalyptus* hybrids were being planted. Now there are 43,000 hectares of plantations comprising 67 per cent *E. excerta* 11 per cent *E. citriodora* and 22 per cent hybrids.

Eucalyptus have proved easy to raise from seed in container nurseries and the plants are put out in beds prepared by ploughing. Plantations of *E. citriodora* are felled at 15 years and of *E. excerta* at 16-20 years. The timber is used for pit props, in constructing buildings, for furniture, vehicles and boat building and for making spools and spindles for spinning and weaving. *Eucalyptus* timber can be used for poles, pulp and boards. The by-products include eucalyptus oil, tannin and honey from the flowers. It seems likely that the use of suitable species of *Eucalyptus* will increase and the scope for species and provenance trials and for selection and breeding is very great.

Wendao Forest Farm, Fushun, Liaoning Province. The broad tree-lined road from Shenyang to Fushun at first traversed farmland but soon the coalmines and steelworks of Fushun came in sight and rows of massive, rectangular apartment blocks for the workers revealed the immense scale of the opencast and deep coal mining and steel making. After taking lunch at Fushun Guest House the Mission went on past petrol-producing plants to Dahuofang Reservoir, one of several supplying the city and its industries. There we inspected by boat the Wendao Forest Farm managed by the Fushun Municipal Forestry Bureau and set on hills surrounding the lake (height of dam 48 metres; length 1700 metres; volume of impounded water 2.1 billion cubic metres).

The plantations extend to 7,000 hectares and the species used are *Pinus tabulaeformis, P. koraiensis, Larix dahurica* and *Robinia pseudoacacia* planted through broadleaved scrub of oak, birch, poplar and *Malus* spp. The broadleaves were beginning to show autumn colour and the whole area of forest was impressive despite the wind and rain of the day. Planting began in 1956 and the spacing adopted for the conifers was 1.5 x 1.5 metres. The larch plantations appeared from a distance well grown (yield class 6 or 8) and straight stemmed. The pine plantations were vigorous but less straight and often crooked but their appearance could have been improved by removal of the poorer trees in thinnings. Annual production was said to be 10,000 cubic metres, the small wood being absorbed by the nearby mines. The Wendao Forest Farm appeared adequately roaded, caterpillar tractors were used for extraction and the whole enterprise employed 120 work people (1 per 60 hectares) and six supervisors, four of whom were University graduates.

Jiabang Nursery, Fushun, Liaoning Province. The Mission had only a short time at this nursery which was maintained by the Fushun Mining Bureau. The nursery was formed in 1948 and appeared in remarkably good condition after 30 years of regular working during which 60 million plants had been produced. The current stock of plants is 4 million one-, two- and three-year seedlings. In a given year half the stock goes for planting and half is held over in the nursery.

Species raised include *Larix olgensis, L. Principis-Rupprechtii, Pinus sylvestris* var. *mongolica, P. tabulaeformis, Abies* spp., *Betula ermanii, Populus nigra, P. x canadensis, Robinia pseudoacacia* and *Amorpha fruticosa*. The planting season is 1st to 20th April and 15th October to 15th November.

The nursery manurial regime comprises organic manure and inorganic fertilisers and the whole nursery is worked on a four-year rotation. Fresh soil is imported to replace that lost when lifting plants. Seed is obtained from standard registered sources in neighbouring forests and seed orchards. The establishment and testing of seed orchards is the responsibility of the Liaoning Provincial Forestry Institute and provenance tests are said to be controlled by the Chinese Academy of Forest Science.

Jinshui Research Station of the North East China Forestry Institute. This large building has teaching and research facilities with accommodation for staff and students nearby and is used as a field study centre. The surrounding forest in Heilongjiang is a good example of the mixed conifer and broadleaved forest described by Richardson (1966) as a transition type between the coniferous forest of northern Manchuria (forest region 1) and the deciduous broadleaved forest in southern Manchuria (forest region 3).

The tree and shrub species seen are listed below and this agrees in most respects with Richardson's list. *Abies nephrolepis*, the main silver fir of the region: *Acer mono*, a medium-sized tree: *Acer ukurunduense*, a small tree with very strong autumn colour: *Actinidia kolomikta*, a slender climber: *Alnus (mandshurica?)*: *Aralia elata*, about 10 metres tall: *Ampelopsis* spp., a climber: *Betula costata*, related to *B. ermanii*, with varied colour of bark, including pink: *Betula platyphylla*: *Corylus sieboldiana* var. *mandshurica*: *Deutzia amurensis*: *Fraxinus mandshurica*: *Juglans mandshurica*: *Maackia amurensis*, a deciduous tree with peeling bark: *Picea koyamae* var. *koraiensis*, with four-sided needles: *Pinus koraiensis*, a five-needled pine often very large (diameter at breast height up to 75 cm) and with good stem form: *Phellodendron amurense* (Rutaceae) with corky bark and aromatic foliage: *Populus maximowiczii*, a very fine balsam poplar much used in hybridisation to improve the cultivated poplars in the United States: *Populus tremula*: *Populus ussuriensis*, reaching very large sizes (1 metre diameter at breast height) and often dying back in the tops of the crowns: *Quercus mongolica*, growing throughout the forest and the region: *Ribes* spp. *(mandshurica?)*: *Rosa acicularis*, a vigorous bush rose, widely distributed: *Salix* spp., several species in the forest: *Shizandra chinensis*, a deciduous climbing shrub: *Tilia amurensis* which often makes a very fine tree: *Ulmus laciniata*: *Ulmus propinqua*, this being the name given locally to this tree which may be *U. japonica*; and *Vitis amurensis*.

Jinshui Reserve of natural indigenous forest. The Mission then entered an area of almost virgin forest with all the species labelled and mensurational

data for the most important. The composition of the timber trees in the stand was 90 per cent *Pinus koraiensis* the remainder *Tilia amurensis* with *Abies nephrolepis, Ulmus laciniata, Quercus mongolica, Ulmus propinqua* Kordz. and *Picea koyamae* var. *koraiensis*.

The site was at an elevation of 380 metres and had a south westerly aspect. The trees were growing on a brown forest soil 57 cm deep of pH 5.5 to 6.5. Only dead, dying and diseased trees are removed from the reserve which extends to 6,400 hectares.

The mensurational data given for the timber trees were mean age 220 years: number of stems 480 per hectare: mean height 30 metres: mean diameter 49 cm: volume 713 m^3/ha: volume of dead trees 13m^3/ha: current annual increment 1.2 per cent: natural regeneration 4,500 per hectare.

For the past century, since about 1875, this kind of forest has been exploited by Russians, Japanese, British and other nationalities in addition to the Chinese. Shaw (1914) describes the use of timber on the upper Amur (Heilong Jiang) and middle Sungari (Soughua Jiang) rivers to fuel river steamers and railway trains and says that'in 1909 parcels of pine, fir, oak, ash and walnut were sent to England and Germany from Vladivostock' and 'three whole cargoes of larch, spruce and fir to Australia'. He further reports that the 'ornamental woods - oak, ash and walnut - are generally admitted to be superior to the Japanese varieties'. The exploitation went on until Liberation in 1949.

When cut the regrowth consists largely of broadleaved species, many of which coppice vigorously to produce huge areas of broadleaved scrub with scattered conifers seen from the train south of Dailing in Yichun Prefecture and from the road en route to Nancha. Scattered plantations of larches, pines and spruce have been planted since the first five year plan for forestry (1953-1957) but near settlements where the broadleaves are not protected and are cropped for fuel and where no planting of conifers has been done the forest gradually deteriorates to scrub.

The silvicultural treatment of the exploited forest is taken up later. For the present it was encouraging to learn that other parts of the mixed coniferous and deciduous broadleaved forest have been placed in reserves. One such is the Fengling Forest Reserve of 20,000 hectares and it is large enough to maintain itself as natural indigenous forest.

Bishui Forest Farm : preparing ground for planting. From Dailing the Mission visited a site which had been recently felled and cleared for planting. The tree trop had comprised *Pinus koraiensis, Picea jezoensis* (a tree felled for

demonstration purposes was 110 years old, 20 metres tall and 35 cm diameter at breast height), *Ulmus laciniata, Betula ermanii, Acer mon,* etc. and all the produce had been harvested down to small branches used for fuel. The ground was therefore completely clear of lop and top.

The terrain was moderate to steep and strip cuttings some 50 to 60 metres wide extended for several hundred metres up the slope to the top edge of the forest. The site was to be planted with *Pinus koraiensis* after ploughing between the stumps. Planting is done from the end of April to the end of May and the stocking preferred is 4,000 per hectare.

Dailing Experimental Forest Bureau

Supplies of seeds. Seed is collected from selected seed stands in the area and it will eventually be produced in seed orchards, nine having been established. The Mission visited a well-maintained and thriving seed orchard of *Larix dahurica* established in 1973/74 with plants of 14 clones derived from trees selected in the three north eastern provinces (Heilongjiang, Jilin and Liaoning). The clonal seed trees had produced a small seed crop in 1978 and some controlled pollinations had been done as part of the progeny testing programme. The seed trees were planted at 3 x 5 metres, the distribution of the clones within the seed orchard being systematic.

Seed orchards have also been established of *Pinus koraiensis, Picea jezoensis, P. koyamae* var. *koraiensis, Tilia amurensis* and *Phellodendron amurense.*

Production of planting stock. The nursery outside Dailing township had been established in 1952 and the present area is 20 hectares. Annual production of plants is 6 to 8 million and the stock of seedlings and transplants held is 15 to 20 million. It was therefore a nursery enterprise somewhat smaller than those of Christie of Fochabers in north-east Scotland, the Economic Forestry Group in Wales and Tilhill in England. The soil is light textured and the pH was said to be in the range 5.5 to 6.5. The species raised are *Larix dahurica, L. Principis-Rupprechtii, Pinus koraiensis, P. sylvestris* var. *mongolica, Fraxinus mandshurica, Tilia amurensis, Juglans mandshurica, Phellodendron amurense* and *Populus maximowiczii.* Pine plants considered suitable for planting are 15 to 20 cm tall and three to five mm basal stem diameter; these are produced as 3-year old plants, either 2 undercut 1 or 2 x 1. For larch the desired height is 30 to 40 cm and two-year seedlings are used. Broadleaved planting stock is apparently 1+1 or 2+1 transplants and the poplars are raised from cuttings.

Sixty per cent of the work in the nursery has been mechanised. Seed is sown in drills arranged along or across the seedbeds. The manurial regime is organic supplemented by urea, wood ash and other fertiliser plus breaks for green cropping. The irrigation system is used from May to August. The standard of work is good; the nursery is free of weeds and the plants generally well grown. This nursery had been worked for more than 25 years and there were some signs of nutrient deficiencies but none that could not be readily corrected.

Since Richardson (1966) described the nursery techniques in 1963 some mechanisation has been introduced but the age and type of plants produced has remained much the same. If the planting programme were increased or labour became less plentiful it would be worth introducing polythene tunnels or cloches to speed up production of the pines but the planting technique might then have to be changed and the Mission did not see planting being done.

Enrichment of the exploited forest. *Pinus koraiensis* has been planted through regrowth of broadleaved coppice and this crop represents one useful method of re-establishing conifers and increasing the production of the huge areas of broadleaved scrub. Although planting of *Pinus koraiensis* began before 1937 there was little control of fires which repeatedly damaged the forest. From 1960 Korean pine was planted extensively and the crop inspected had been established in two lines, 2 metres apart, and more closely in the lines, the result being a stocking of 4,400 to 5,000 per hectare. The result was 80 per cent *Pinus koraiensis* and 20 per cent broadleaves, mainly *Quercus mongolica*. Korean pine grows slowly up to 20 years and reaches its best increment at 40 to 60 years. It is felled at 80 to 120 years. Eight years after planting a cleaning was done to favour the pines. The broadleaved coppice protects the young trees, keeps the size of the lower branches small and improves decomposition of the litter, thus maintaining soil fertility. Now the pine crop has a mean height of 7 metres, a mean diameter at breast height of 7 cm and a volume of 18 cubic metres per hectare. The volume of the oak is 20 cubic metres per hectare and another cleaning is needed to help the pine through the canopy of broadleaves. The rotation anticipated is 80 years and the anticipated final yield was said to be 800 cubic metres per hectare.

A plantation of *Pinus sylvestris* var. *mongolica* was inspected. It had been planted in 1957 with 2-year seedlings at a spacing of 2 x 1 metres or 5,000 trees per hectare. The crop was rather branchy and needed pruning but the growth was good, equivalent to yield class 12. Scots pine is considered a coarse timber when compared with *Pinus koraiensis*.

At Nancha a typical area of broadleaved coppice had been enriched with *Larix dahurica, Pinus koraiensis* and *Pinus sylvestris* var. *mongolica*. The result was very pleasing because of the increased value of the crop, the ecological suitability of the mixture and the richness of autumn colour.

It is vital to the future of forestry in China that these large areas should be brought under systematic management. The selection-cum-improvement practised in the exploited forests of south central India could be used with good effect to favour the better broadleaved stands and fill gaps with Korean pine and larch. As Shaw (1914) indicated, many of the broadleaved species produce timber of world class capable of earning foreign exchange. The presence of two dozen plots of broadleaved and coniferous trees in the grounds of the official Guest House confirmed the impressions gained in the forest about the stature of the broad-leaved trees.

A thinning trial in *Larix dahurica* The Mission inspected a comparative trial of thinning which is one of 15 such trials established by tne Forest Research Bureau of Dailing in 1964. The larch trees were planted in 1953 on a good site at 2 x 2 metres and the four treatment plots were each 0.25 hectares, unreplicated. The rotation for this crop is 40 years. Selected data are given below.

Treatment

0 - no thinning in 1964 or 1974.

20 - thinned in 1964 when 369 trees and 6.5 m^3 were removed.
thinned in 1974 when 377 trees and 26.5 m^3 were removed.

30 - thinned in 1964 when 683 trees and 10.6 m^3 were removed.
thinned in 1974 when 458 trees and 46.2 m^3 were removed.

49 - thinned in 1964 when 1078 trees and 24.6 m^3 were removed.
not thinned in 1974.

Treatment	*Mean height* *m*	*Mean diameter* *cm*	*Volume of mean tree* m^3	*Total volume* m^3 *u.b.*
0	16.5	13.8	0.129	269
20	17.0	16.0	0.176	252
30	17.7	16.9	0.210	221
49	17.9	17.1	0.209	234

The stems of the trees are very straight but the crowns are short and even the 49 treatment could have been thinned more heavily. There were some deaths of trees from an unidentified cause. Larch looks a very suitable tree for afforestation being quick to establish and reaching small sawlog sizes when quite young.

Fire protection. At the time of our visit the full glow of autumn colour was appearing, the forest was very dry and logging had been suspended. The forest managers clearly are strict about fire prevention and it was noticeable that the workers were encouraged to cultivate areas on the fringe of the forest as an additional fire precaution.

The research station Several members of the Mission commented on the lack of bird life throughout the journey in China and this has since been confirmed with other naturalists including Hu (1975). The Research Bureau at Dailing had a comprehensive display of stuffed wild animals and birds from the forest.

RESEARCH AND EDUCATION

North East China Forestry Institute In February/March 1979 a British academic delegation led by Sir Harry Pitt visited China to assess the standard and facilities of Chinese university education (British Council, 1979). During the decade beginning in 1966 the Cultural Revolution threw Chinese education into chaos. Adverse aspects of the period were the rustication of the teaching staff including older professors who had been educated abroad, the introduction of worker-soldier-peasant students selected on idealogical rather than academic grounds, removal of equipment and damage, destruction and neglect of many laboratories. Colleges were closed down for several years and no post-graduate studies were undertaken during the whole period.

Following the overthrow of the Gang of Four in 1976 China began to face the problems of catching up after a decade lost. The old professors were reinstated and at the North East China Forestry Institute Professor Yang Xianjin, Vice-President of the Institute, returned in 1977. He had been educated as a forest taxonomist together with 14 other Chinese students at Yale University in 1945/46 after the Second World War. In his words 'the main root of the Institute had been removed for 10 years'. The staff returned in 1973 to re-open the College and began the work of reconstruction and repair of damaged equipment.

The North East China Forestry Institute was built in 1956 and has two parts, the teaching block and the research centre. The original and present specialties were and are forest chemistry, forest economics and mechanical and civil engineering for logging in addition to the normal biological and managerial subjects. The staff number 560 including 40 professors and associate professors. The Institute manages an area of natural indigenous forest at Dailing in Yichun Prefecture, a farm-forestry demonstration area and two forest enterprises, the whole totalling 26,000 hectares. Now there are 2,400 undergraduate and 24 post-graduate students and during the past 20 years 7,000 people have graduated.

One third of the students come from the forest areas of the north-east, the remainder coming from all over China; people with practical experience of forestry are encouraged to apply. The students,one quarter of whom are women, live on the campus. They begin the day with physical training and after breakfast study until 4 pm. The forestry course lasts four years.

The Mission visited the Herbarium and a series of teaching laboratories equipped for forest botany, seed identification, structure and identification of wood, geology and soils, forest zoology and forest entomology. Each laboratory held 15 to 30 students and all had extensive collections for teaching. The botanical and tree seed collections were impressive in scope and the wood collection comprised 600 specimens from 90 families. Zoological teaching is supported by a good range of preserved animals and birds typical of forest areas; the insects and fungi also appeared to be well presented. A class in practical meteorology was in progress with simple but adequate equipment.

We did not meet the professors of forest mensuration or forest management nor did we see the facilities for surveying, remote sensing and logging engineering. A new library will be built to house a central collection of books.

The impression gained was of an undergraduate course practically orientated (one third of the curriculum is devoted to practicals) for the purpose of training forest managers. The facilities for teaching science in schools are apparently still poor (Dickinson, 1979) and the forestry course must take account of this. The final year students work closely with members of staff, for example in collecting specimens to augment the teaching material. In the forest area at Dailing the Jinshui Research Station of the Institute also had teaching collections of a similar kind to those at Harbin but not so extensive.

The ten-year gap in trained manpower caused by the Cultural Revolution is being partly closed by extra-mural courses. In 1979 (Xinhua News Agency 23.6.79)

165 directors of forestry administrations completed a six-month training course at the North East China Forestry Institute and the Minister for Forestry, Luo Yuchuan, presented certificates to them at the end of the course. The participants came from five provinces and most of them had 20 to 30 years experience. They studied philosophy and political economy, forest science, harvesting and transport of timber, wood using industries, forest economics and the management of forest enterprises. The course was directed by Professor Yang Xianjin, Vice-President, with the assistance of the teaching staff of the Institute. Forest extension courses are an important part of the work of the Institute and 10,000 people are said to have attended short training courses during 20 years. The staff go out to help the production brigades and production teams.

Professor Yang Xianjin believes that teaching and research complement each other and many of the staff are engaged in research, the programme being guided by the Chinese Academy of Forest Science. There are about 60 research projects and the results are published. There was time to inspect only two research projects, one concerned with dormancy in *Pinus koraiensis* seed and the other with anther culture of poplar. The latter is discussed in the section on poplars (p. 32).

SUMMARY AND CONCLUSIONS

The Mission travelled in China for only three weeks and saw no more than a small fraction of that great country. We did have the observations of Richardson (1966), the report of the FAO study on forestry support for agriculture (FAO, 1978) and the notes of other recent travellers to help us so some things can be said with confidence.

Forestry support for agriculture does appear to be a great success. It supplies an urgent need for fuel, wood, fodder, fruit and shelter and surplus produce can be sold for cash. North of the Yangzi river poplars are much used. The benefits are quickly gained, the techniques of establishment and tending are simple and readily applied by the agricultural communes. It is surely to be expected that the 'Four around' planting movement will flourish and in the process some of the pressure on the natural and plantation forest will be relieved.

The concept of the Great Green Wall against wind, desertification and erosion is an extension of forest support for agriculture as also are the plantations formed to reinforce river protection works. Central Government's

plans for the Great Green Wall appear to be gathering momentum and seem well within the capacity of the Chinese people. Choice of species, provenance and cultivar, amelioration of difficult soils, the finer details of spacing and tending, protection against pests and diseases and utilisation of produce are some aspects that should occupy attention in future.

The embellishment of streets and gardens with trees and their use to protect roads and railways from extremes of wind, heat, snow and cold thus making travel a little easier is also very successful. Again the benefits are quickly gained and readily seen. British foresters and arboriculturists can learn much from the Chinese. One secret of success of street trees is the care taken in raising, transplanting and tending them in the early years. The value of arboreta and plantation forests for recreation of local people and tourists is recognised and being exploited.

The Mission did not see sufficient plantation forestry to form a firm opinion. The communal plantings of *Pinus massoniana* on the hills in the south of China need considerable improvement and choice of more vigorous and long-lasting, sub-tropical pine species is required. Some plantations of *Eucalyptus* showed promise and the potential of this genus requires thorough exploration. We did not see the plantations of *Robinia, Paulownia, Cunninghamia* and *Pinus* in the region south of Shanghai. The sample of plantation forestry inspected at Fushun, Dailing, and Nancha was really quite restricted but *Laris dahurica, Pinus tabulaeformis* and especially *P. koraiensis* all looked a suitable basis for production plantations in the north-east of China. The foundation of successful plantation forestry is laid but needs strengthening with work on provenances, tree breeding, pathology and entomology. The mensurational trials of forest management, thinning regimes and tree nutrition are all at an early stage of development.

Tending of the great areas of broadleaved scrub by a local variant of the selection-cum-improvement method adopted in India would bring rapid improvement of the quantity and quality of broadleaved timber available. Many of the species at present reduced to scrub are world-class timber trees. One needs to see more extensive contiguous areas of plantations, as at Dailing and Nancha, to be convinced that a suitable silvicultural system has been evolved.

If the sample of research institutes and the school of forestry visited is representative they must be encouraged to regain their strength (after the damage done by the Cultural Revolution) and forest policy must be backed up by a stronger forestry field cadre sufficient to stop the repeated unlawful cutting of trees

reported in the press and develop standard systems of silviculture and forest management.

The remnants of natural forest in south China and the very extensive areas of natural indigenous forest in the north-east are evidently receiving some protection. The Mission did not see the natural forest of Hainan Island in the south and wondered what was happening to the deciduous broadleaved forests that yielded logs of *Tilia* for the veneer mills of Shanghai. We saw little silviculture aimed at extensive regeneration of large areas of forest except for the clear cuttings at Dailing which were to be replanted with *Pinus koraiensis*. The Mission hopes that the fragmentary picture will be filled out by forestry observers south, north and west of the Yangzi. For the present it might perhaps be said that the mass of Chinese people are conscious of the need for and the value of trees. Whether they are also fully conscious of the need for and the value of forests is not yet certain.

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CHINA : A COMMONWEALTH CONNECTION

by
Ronald H. Kemp

Many Commonwealth countries concerned with tropical forestry will have particular interest in Guangdong Province which, lying between 18° and 25°N, with a mean annual rainfall of 1,400mm to 1,600mm falling mainly between May and September, includes the most tropical area of mainland China. With less than three weeks for the entire visit the delegation could spend only four days in Guangdong and the rail journey from Hong Kong, apart from any symbolic significance, was thus also a significant part of the experience, giving as it did the first view of the 'Four around' plantings (FAO, 1978) which have been one of the most successful developments in the modern Chinese approach to forestry. The stop at the border to change trains, and the seemingly timeless pause to take tea in a high-ceilinged waiting room with Victorian furnishings, while watches were put back one hour, might also have seemed symbolic of the way in which Chinese technology has been held back in recent years. But in two important respects, in density of population and degree of deforestation, China has already reached a point that many tropical countries are now approaching and the efforts and achievements in the planting of the past thirty years deserve study.

Four around plantation

The journey north-westwards to Guangzhou, at 23°N, took two hours from the border and the prevailing impression was of intensity in land use, the flatter areas either side of the track, between low hills, being occupied by rice and other food crops such as beans, cassava, sweet potato, sugar cane, lotus and water chestnut, often in a complex pattern of quite small plots apparently designed to make best use of the variety of sites and the water available. Trees were part of the pattern, along both sides of the track, along roads, around and between houses, and on the areas of higher ground apparently too poor for cultivation. Few of the trees could have been more than twenty years old and many appeared younger, an impression which was repeated in most areas visited throughout China.

Some of the larger *Litchi chinensis*, their dark, heavy crowns reminiscent of mango, and some exotic species, could have been exceptions to this rule. *Melaleuca leucadendron* and *Casuarina equisetifolia* were prominent among the earlier plantings alongside the track while the hills, grass covered but with evidence of past erosion, had been extensively planted with *Pinus massoniana* which is at the extreme southern fringe of its natural range and clearly unsuited. Apart from a few denser patches the coverage of pines was thin and the majority of trees small, stunted and badly formed. Their poor appearance may have been partly due to past damage by fuel collecting or grass fires, but none showed vigorous growth. More promising were occasional plantings of *Eucalyptus citriodora* and although many were suffering from close planting and complete lack of thinning, resulting in very restricted crowns, they appeared healthy. Some of the crown restriction may have been due to removal even of small branches for firewood, using a hook on a long bamboo pole, as we saw later elsewhere in Guangdong. The overcrowded stands of *E. citriodora* seemed symptomatic of improved survival among more recent plantings but lacked management. Thinning would have helped the crop whilst providing some early fuelwood. On this interpretation there was evidence of past improvements in establishment techniques and choice of species, which might have gone further but for the restrictions on research during the Cultural Revolution.

Similar historical evidence of past development could be seen in street plantings. In the earliest days of replanting following the establishment of the People's Republic in 1949, protection of the young trees in the face of extreme need for fuelwood was, no doubt, largely dependent on direct supervision and control. For that reason the oldest trees in the street and roadside plantings are found near the town centres and there is a progressive change outwards, not only in age but frequently in species also. For example, in the centre of Guangzhou some of the oldest shade trees are banyan fig *(Ficus retusa)*, robust and no doubt readily propagated, *Aleurites moluccana, Bombax malabaricum, Casuarina equisetifolia,* and *Melaleuca leucadendron,* with the ornamental flowering trees *Delonix regia, Bauhinia* and frangipani, *Plumeria rubra* (Apocynaceae). The official Guest House was surrounded by some of the largest trees, including less familiar ornamental and fragrant species such as *Heteropanax fragrans* (Araliaceae) and *Michelia alba* (Magnoliaceae).

Travelling outwards along the main highways some eucalypts appear, *Eucalyptus robusta* among the first to have been planted and generally unhealthy, frequently stag-headed and exuding gum from large areas of the trunk.

E. citriodora was the most successful of the later introductions, planted in rows up to four or five deep beside the road, and in small but vigorous stands on some hills. One tree of this species planted in 1959 in the Forest Research Institute arboretum had attained a diameter at breast height (dbh) of 44 cm in twenty years, only exceeded by a nearby specimen of *Albizzia falcataria* (60 cm) of the same age but poorer form. *M. leucadendron,* represented in the earliest plantings, is still being used to some extent along roadsides, the choice perhaps influenced by its abundant seed production and ease of establishment, and not by its slow rate of growth and limited usefulness for either shade or wood production. *Casuarina* similarly is still being planted, particularly along roadside canals, but seems likely to be replaced soon in that situation by another species seen growing exceptionally well in the Forest Research Institute arboretum, the American swamp cypress *Taxodium distichum* and *T. ascendens*. The small pilot plantation of the former species (P. 1964) in the arboretum contained trees over 30 cm dbh, with exceptionally fine stem form and less pronounced taper than is characteristic of open-planted specimens. Swamp cypress is now making an important contribution to the success of integrated rural development schemes such as we saw on our visit to the Li-le commune in the Pearl River Delta.

Rural development

Integrated rural development schemes, involving not only agriculture but a wide spectrum of other activities including forestry (and nowadays agro-forestry), communications, health care and other aspects of community development, have become a main preoccupation of aid organisations in recent years, but there are, as yet, very few in operation. It was therefore refreshing to find in the flat expanse of the Pearl River Delta a natural example of this almost mythical species. The Li-le commune is a social organisation composed of 40,000 people, divided into 24 production brigades, subdivided into 160 production teams. There was need to combat and canalise the disastrous flooding in an area where, according to the official figures, the mean altitude of the land is 0.5 to 0.6 metre a.s.l. and the river level now 1.5 to 1.6 metres, rising more than a metre above this during peak floods. The network of canals, their earth banks stabilised by tree planting, has held without breach in the last twenty years, and this has permitted the planned development of irrigated agriculture, now highly productive. The main canals are controlled through modern water gates in concrete and steel, with new ones under construction by the commune members, while the large and elegant concrete bridge they had recently built was designed wide enough for the future traffic of carts and motor vehicles which they confidently foresee.

The trees on all the canal banks, and along other raised paths between fields, also contribute to the production of food and other commodities. Many of them are fruit trees, including litchi, guava, bananas and papaya, with bands of sugar cane on the lower slopes of some broader banks. For wood and pole production *Glyptostrobus pensilis* was first planted but is now being progressively replaced in new planting by its exotic relatives *Taxodium distichum* and *T. ascendens,* because of their faster growth. The latest pattern of planting on the main canal banks involves three or more species with different life expectancy in combination, e.g. *Taxodium,* banana and guava or litchi. The rate of growth of the *Taxodium* is such that they expect to harvest it selectively about a mean age of 15 years, some individuals being taken and replaced earlier, for use mainly by commune members for house construction, furniture and, no doubt, fuel. It was significant that the communal hut where we met with leaders of the commune, and were given tangible evidence of the produce in the shape of bananas, guavas, peanuts, sugar cane and star apple, *(Averrhoa carambola)* had walls of bark of *Cunninghamia lanceolata* which must have come from plantations in other regions. Within a few years local produce from *Glyptostrobus* and *Taxodium* will no doubt have filled that niche.

Of major importance in the bank stabilisation is the slow growing Fan palm *Livistona chinensis.* The palm leaves are harvested regularly and apart from any minor local use are transported in bulk by barge to communal factories where they are made into a wide variety of products such as fans, floor mats, table mats, baskets, hats, wall hangings (for painting), car seats and toothpicks, for use elsewhere within China and also for export.

This commune is undoubtedly among the more successful models shown to outside visitors but also of great value for demonstration to other communities elsewhere in the Delta region. The local conditions, which produce such remarkable growth of *Taxodium* for example, are peculiarly appropriate to the production systems which have been developed, where previously they were peculiarly disastrous. The success is due to the enterprise and efficient organisation of the people, now led by a young man aged 27, assisted by elected committees for management, water conservation, etc. It is significant that when lack of seed frustrated planting of the introduced *Taxodium* the problem was solved by local development of techniques for multiplication by cuttings taken from one-year-old plants.

Over most of southern China the natural forests have long since gone and any trees now seen are the result of recent plantings. A notable example of this

is seen on the hills around Xinhui County Town, where in 1958 the people undertook communal tree planting along the streets, around houses, along main roads and on the nearby bare hills. Twenty one years later, a view to forested hills from a roof top in the 'Garden of One Hundred Fruits' overlooks a landscape of trees, among them *Aleurites montana* (Tung oil) in white flower. This is representative of the best that has been achieved during the past twenty to thirty years and it was such views that our hosts were naturally keen to show us. In contrast we did not see any example of successful fast growing industrial plantations during our brief visit. The nearest we came to this was a drive through part of the 2,500 hectares of *P. massoniana* plantations on the White Cloud Mountain just outside Guangzhou. It seems that the original forest cover here was destroyed in the latter part of the 19th century and although some replanting was done the major reforestation began in 1952. Although we had no opportunity to examine the plantations closely the general appearance was of poor form and lack of vigour. In addition to past attacks on shoot tips by a lepidopteran caterpillar, *(Dendrolimus punctata)*, there is evidence of needle diseases. Some small but very vigorous stands of *Eucalyptus citriodora* were also present in the plantation. It was unfortunate that our short stay in Guangdong Province did now allow for a visit to the eucalypt plantations on the Leizhou Peninsula where this species is being successfully managed on a larger scale. The eucalypt plantations there are expected to attain an annual production of 400,000 cu.m on a 25 year rotation.

Natural forest

The limited time also prevented a visit to the remaining areas of tropical forest on Hainan Island. However, at our request, provision was made for a brief look at an interesting remnant of natural forest in the Dinghushan Forest Reserve, about 100 km west of Guangzhou. In 1956, the Botanical Institute established a laboratory and field station with responsibility over an area of more than 1,100 ha. Much of this land had been deforested and some has been replaced with pine and eucalypts, with dense regrowth of indigenous broadleaves under fire protection. There is a strict natural reserve of about 300 ha, originating from the protection given to the forest by a religious community on the mountain. Some 2,400 species have been identified within the area covered from the station, of which over 700 are trees, the main families being Lauraceae and Leguminosae. Among the largest trees *Castanopsis chinensis* is apparently most frequent and *Schima superba* also common, both being valuable timbers. It was notable that a number of the oldest trees present produced edible fruit, including very large specimens of *Canarium album*, and venerable specimens of *Litchi chinensis* and *Averrhoa carambola*, suggesting that these might have been favoured by protection in the past.

It seems very probable that some species of the natural tropical forest, particularly on Hainan Island, could be valuable introductions to other countries. *Homalium hainanense* (Samydaceae), seen growing vigorously with tall, narrow crowns in recent roadside plantings is a good timber species which might do well in plantations. At Dinghu, *Aphanamixis grandifolia* and *A. polystachya* (Meliaceae) were also seen as recent roadside plantings. Elsewhere in southern China three species of *Toona* are recognised of which two *(T. sureni* and *T. sinensis)* were seen planted in the Forest Research Institute arboretum at Guangzhou. The third, *T. microcarpa,* is the most tropical in natural range and said to be adapted to poor acid soils. Conversely there is considerable interest within China in further introductions of exotic Meliaceae, notably *Swietenia macrophylla.* There is thus the basis for possible seed exchange with countries in suitable latitudes in Latin America and Africa, for example. This is a field in which both the Academy of Forest Science, Beijing, and the Forest Research Institute of Guangdong Province, are keenly interested.

Forest Research Institute, Guangzhou

The Institute was officially established in 1959, by development from a forestry extension station opened originally in 1952, to reforest the bare and eroding hills. By 1979, 7,000 ha had been established and the need for research towards further and improved afforestation was recognised. During the height of the Cultural Revolution, which started in 1966, the Institute, in common with most other scientific organisations, was closed, and a new start had to be made in 1973, when the Deputy Director (Dr Zhu Zhisong) the senior scientist at the Institute, was able to return after spending four years in a 'school of re-education'. In the account of his visit to China in 1963 Richardson (1966) commented on the excellent work of the Institute under the direction of Dr Zhu and one can only speculate on what might have been achieved, and what valuable information and material must have been lost, during the years when the research programme was abandoned.

The Institute now has a staff of 52, covering four main fields, Silviculture, Forest Protection, Forest Products, and Forest Machinery and Tools. The silvicultural research covers species, provenance and progeny trials of both indigenous and exotic species, seed orchards, and many aspects of establishment and management of plantations (including aerial seeding) windbreaks, shelter-belts and sand dune stabilisation. For this purpose it has field trial areas elsewhere in the Province but none, unfortunately, could be visited for lack of time which permitted only a brief tour of the arboretum and some laboratories.

Dr Zhu was responsible for most of the introductions of exotic species and continues to take particular concern for this aspect of the programme. There is now greater interest in exotic tropical pines, especially *Pinus caribaea P. oocarpa,* and it was especially pleasing during the tour of the arboretum with Dr Zhu to come unexpectedly on some provenances of both species from the Commonwealth Forestry Institute (CFI) collections of 1970 and 1971 in Central America, which had been forwarded to China via FAO in 1972 but subsequently lost from view, and to find them so well cared for, with permanent labels securing the identification of each provenance. Most trees (P. 1973) had suffered severely from the tip moth *(Dendrolimus punctata)* which seriously affected tree form. The yellowish needles, particularly in *P. oocarpa,* suggested mycorrhizal deficiencies. Nevertheless, some individual trees in several plots had suffered less, and remained healthy and vigorous. An excellent specimen of *P. caribaea* var. *hondurensis* (K29) from Poptun, Guatemala (one of the most northerly provenances in the natural range of the variety) was particularly noteworthy, but there was no time to examine all the plots. Further trials, using new mycorrhizal material under study at the Institute (and perhaps new introductions of cultures from the research collections of mycorrhizal fungi at CFI, Oxford) are planned. It was fortunate that the delegation had brought fresh seed from the CFI collections of these species to China, in response to a request from Dr Pan Zhigang of the Chinese Academy of Forest Science, Beijing, and this seed was formally presented to Dr Zhu during our visit.

The pest and mycorrhizal problems of the tropical pines are among subjects under study at the Institute. Dr Tong Jingxin, who is conducting the mycorrhizal studies, told us that most introductions of exotic pines up to 1974 were adversely affected, and many failures occurred through lack of satisfactory mycorrhizal associations. Attempts to inoculate, using material from stands of *P. massoniana*, were not successful but recent inoculations using material from well-established plantations of *P. elliottii* have produced much better results. The fungus in this case is apparently *Pisolithus tinctorius* which is a known associate of *P. elliottii* in the southern USA and has been found in the natural pine forests of *P. caribaea* and *P. oocarpa* in Central America, where it was obtained by Dr Ivory for the CFI collections of mycorrhizal fungi. Apparently it is not the main associate in the stands of *P. massoniana*, in which a number of mycorrhizal fungi (including *Boletus* spp.) have been found.

Research into control of *D. punctata* at the Institute centres on use of the pathogenic fungus *Beauveria bassiana* but it seems unlikely to reach the stage of being an effective treatment on a field scale in the near future.

Brief visits were made to other laboratories concerned with forest soils, tissue culture experiments and forest products. The latter under the charge of Dr Cai Shaosong, Technical Director, is one of the most active sections of the Institute and holds a wood collection of over 2,000 specimens, comprising 800 species in 90 families, most of the wood samples being authenticated by correlated voucher herbarium specimens. The forest products laboratory is also concerned with resin production in Guangdong Province, which produces half the total national output of China. The rest of the world is now showing increased interest in China as a major source of naval stores.

Also of interest to tropical countries is the programme of bamboo hybridization aimed at producing stronger and larger diameter varieties to be grown in the tropical lowlands. At present there is no truly tropical species equivalent to the best *Phyllostachys* spp. grown in the more temperate areas. We saw hybrid material resulting from a pollen mix of *Bambusa textilis* and *Synocalamus latiflorus* used to pollinate *B. pervariabilis*, looking much more vigorous than the parents growing nearby. The problem of inducing flowering had apparently been overcome by manipulating the water table to reduce moisture availability for a period.

David Johnston gives more information on p.20 about research at the Research Institute at Beijing.

Conclusions

In length and breadth Guangdong Province is roughly equal to Great Britain and impressions based on so brief a stay must be inadequate. Some aspects, such as forest industries, are best considered on a national basis and an account of them is given by Tom Smith in the next chapter (see also FAO, 1979). During the remainder of our stay in China some of the initial impressions received in Guangdong Province were modified and others reinforced but the overriding impression is of the remarkable achievement of the Chinese people in agriculture and forestry, in the face of problems which must initially have seemed overwhelming. A measure of this can be taken from a statement on China made in 1948 by a conservationist, William Vogt, that 'Millions are going to die as tragic sacrifices on the altars of uncontrolled reproduction and uncontrolled abuse of the land and resources'. That China is now able to feed about twice the population of 1948 is attributable in some measure to the support tree planting has given to agricultural production (FAO, 1978) and at the same time the environment of the cities, towns and rural communities, and domestic wood supplies have been greatly improved.

Forest area data are given in the paper by David Johnston. These fell short of the targets originally set and there is no doubt that much remains to be done to intensify wood production, particularly for industrial use. The successes so far are due to the effective mobilisation and motivation of a large part of the population towards tree planting, and the rapid application of research results in the field, areas in which China has much to teach the world. In rural development the Chinese model has successfully combined central planning and guidance with local area development based on a policy of self-reliance and an appropriate degree of autonomy. Although this is due in large measure to social and political factors such as communal ownership of land, there is much to be learnt from study of the organisation and methods used, particularly as recent developments are introducing a greater measure of personal and group incentive through bonus payments or profits.

Other countries could also benefit from the Chinese experience in actual techniques in the field of agro-forestry, for example in shelterbelts, bank and dune stabilisation, intercropping 'Four around' planting and in extension and demonstration work. However, China does not seem to have got farther in the scientific study of agro-forestry systems, or in quantifying their efficiency in terms of production achieved or foregone, than other tropical countries now developing an interest in this field. In this, as in many aspects of forest research, international co-operation with China could be valuable.

Possibly the most significant event of our visit was the meeting with Vice-Premier Wang Zhen in the Great Hall of the People in Beijing towards the end of our stay. This signal honour was a mark of the importance attached to forestry at the highest levels of government in China and the knowledge displayed by Vice-Premier Wang in the course of our prolonged discussion with him was further evidence that this understanding, established originally by Mao Tse-tung, is the prime cause of the success which has been achieved. It was especially significant that, in reply to the comments made by Sir Ralph Verney and other members of the British forestry delegation, the Vice-Premier said 'We know that much has been done both in the United Kingdom and in the Commonwealth in the forestry field, especially as regards selecting good species and choosing good seeds. This is where we would like to learn from you ..... Our present aim is to increase the ratio of funds given to agriculture, animal husbandry and forestry'. In understanding the need for appropriate priority to be given to forestry in national development plans other governments, in industrialised as well as developing countries, have much to learn from China.

Acknowledgements

The kindness and hospitality received by the delegation in China were on a scale in accordance with the country and the population and the list of only the senior scientists and officials who assisted us in many ways has over eighty names. However, in tropical forestry, special mention must be made of Dr Cai Shaosong, Technical Director of the Provincial Forest Research Institute, who accompanied us during our stay in Guangdong, and whose professional knowledge, combined with impeccable English, added greatly to the value of our visit.

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HARVESTING, UTILISATION AND MARKETING OF TIMBER IN THE PEOPLE'S REPUBLIC OF CHINA

by
Thomas S. Smith

CONTENTS

INTRODUCTION

The Mission visited only one area with substantial forest reserves, Heilongjiang Province in N.E. China, but there are others, principally in S.W. China and in Tibet. The Province of Heilongjiang was experiencing a period of extreme fire danger at the time of the visit. Consequently, harvesting operations had been suspended and the Mission only saw a specially arranged demonstration. Seven factories giving examples of a broad field of timber utilisation were visited throughout the tour. Trading and marketing as known in the western world do not exist in China. An outline of these aspects is given for each processing unit. Costs, where given, are as stated, but should be treated with some caution because of the arbitrary manner in which they were given and the peculiar system of Chinese accounting.

FACTORIES VISITED

Guangzhou Pulp and Paper Mill

Process. Originally built in 1933, this mill did not operate fully until 1950 because of the Sino-Japanese War and later the Civil War. It eventually developed into a combined chemical and groundwood mill, with an annual production on a three shift basis, seven days per week, of 100,000 tonnes of newsprint, printing paper and coarse paper for corrugating. The principal raw material, pine *(Pinus massoniana)*, with lesser quantities of various Eucalypts is drawn from within the province - 85 per cent being delivered by river, 15 per cent by road. The mill is located some distance from the river, necessitating final transfer by road, and little or no stock of raw material appeared to be carried within the confines of the factory. The bark, which is removed by rotary debarkers fabricated at the factory, is used as fuel.

The sulphite mill, which produces 15 per cent of the annual national output, was originally equipped with Swedish and Finnish machines, some of which were copied and reproduced locally. Difficulty was experienced in producing a satisfactory pulp from *Pinus massoniana* because of its high resin content. The two original groundwood mills were supplied around 1950 by East Germany. These were copied and four locally built mills were installed in the late 1950s. Grindstones used were of reconstituted granite and concrete. The pulp tended to be dark, and white Swedish pulp was added to improve the colour, the mixture comprising 85 per cent mechanical pulp and 15 per cent chemical pulp. A new Finnish forming and drying machine has been installed and alongside it there is a similar locally built machine. One line produces printing paper, the other

line produces coarse paper from waste brought in from Hong Kong, which is processed and then resold to Hong Kong for final manufacture into corrugated paper. By-products include industrial alcohol, vanilla essence, and resin (for use as a coagulant for briquettes and cement manufacture).

There is a labour force of 3,000 male and female workers, each earning an average of 50 yuan a month for an 8 hour day, 6 day week, throughout the year. Workers join from school at the age of 15, and normally spend their entire working life in the same job, retiring at 60 years.

Costs. The timber costing 50 yuan (£13) per m^3 delivered to the factory, is manufactured into paper and sold for 730 yuan (£197) per tonne. This price was fixed in 1958 by the Ministry of Forestry. It is expected that the price of timber will be increased by 20 per cent in the near future, as part of the Government's new policy to stimulate supply and improve standards of living and reduce the profit which the management consider to be excessive. Currently, production costs amount to 430 yuan (£116) per tonne, leaving a profit of 300 yuan (£81) per tonne. At present, all profits go to the State, but under a new system which is being implemented, the factory will be allowed to keep a small percentage of any profit in excess of an imposed target. This will be used to finance a bonus incentive scheme and to improve the social services provided by the factory.

Observations. This plant, whilst outdated, has been well maintained. It is, by western standards, very labour intensive. Safety standards are low, with inadequate guarding around moving machine parts. A modern plant with modern technology would greatly reduce the labour force, increase output, and produce a more acceptable product in the form of white paper.

Xinhui County, Guangdong Province Jiangmen Handicrafts Factory

This factory is a good example of maximum utilisation, employing over 200 men and women. It produces a variety of goods, such as fans, tablemats, hats and floormats, from the unopened shoots of the Chinese fan palm *(Livistona chinensis)*. The quality of the products is excellent, most of the work being carried out by hand- or treadle-operated sewing machines. Particularly fine ornamental woven bamboo wall hangings are produced on hand looms. Products are exported to Hong Kong and other foreign countries.

Shanghai Victory Wood Processing Factory

Process - Plywood Manufacture. The Shanghai Victory Wood Processing Factory is owned by Shanghai municipality and controlled by the Ministry of Light Industry. It was built in 1939 to produce plywood, the layers of which were air-dried. The original labour force was 100 workers. It was expanded after liberation, and currently produces 20,000 cu.m of plywood per annum, ranging in thickness from 3 to 19 mm, on a three shift, seven day week basis. Melamine-laminated sheets form a part of the total production. The highest quality plywood is exported - other grades serve the domestic market. In addition to the standard thickness, a 32 mm marine type plywood and a very light five-ply for the construction of model aircraft are occasionally manufactured.

Raw material. 60 per cent of the raw material is supplied from native Chinese forests, mainly in Heilongjiang Province, and transported by sea and rail to the factory, where it is ponded until required. 40 per cent is imported from the Philippines and Indonesia. The native species used are:

Lime	*(Tilia mandshurica)*
Ash	*(Fraxinus mandshurica)*
Birch	*(Betula mandschurica)*

Ash and birch logs require steaming prior to rotary peeling. The lime, being a less dense timber, can be rotary cut without pre-steaming. The imported species are:

Apitong *(Dipterocarpus)* and Luan *(Shorea* spp*)*

Logs from indigenous sources are spiked at each end to minimise splitting. Despite this precaution, serious splitting had occurred in most logs, necessitating the removal of 0.3 metre from each end. A German type de-barker, fitted with a 150 mm wide, revolving, high-speed cutterhead, traverses the length of the log to remove the bark. After traversing, it is automatically returned to allow the removal of another 150 mm wide strip as the machine reverses. The process continues until the log is bark free. Crosscutting into one metre lengths is carried out by electric power saw, a type equipped with a spring-set cutting chain, common in the United Kingdom in the late 40's.

Rotary cutting or peeling of the logs is carried out on a machine of Chinese manufacture. The newly cut veneer is wound on to a spool to await drying. Logs of lime were being peeled at the time of the visit. Recovery was stated to be between 50 per cent and 60 per cent. After passing through the drier, the core ply is coated with phenol formaldehyde glue, and the top and bottom layers positioned by hand, with final pressing being carried out on a

multi-daylight press. From the press the process is reasonably automated, sheets being side and end trimmed, and finally passed through a machine with fixed knife and power rollers to shave off any excess thickness. Since much of the indigenous timber is of low grade, constant defect cutting out and plugging is required. Cutting is done by a machine in 50 mm and 100 mm wide circles, and plugs are glued and ironed into place by hand. The export quality (one good face), is selected out. The domestic grade often has two or three narrow strips to make up the face board, joined with a thin adhesive strip ironed on with a simple domestic electric iron.

A large stock of excellent quality logs from Indonesia was held at the time of the visit. They ranged from 60 to 100 cm in diameter, but none was being processed. The lime and birch were very similar in appearance to similar species grown in the United Kingdom, but the ash was very dark and suggested over-mature timber. One third of the production is exported, mainly to Hong Kong and Japan, by the Shanghai export department. The factory was being credited with 700 yuan per cu.m, irrespective of thickness.

Log costs. Native species - 120 yuan (£32) per cu.m delivered to the factory.
Imported species - 170 yuan (£46) per cu.m delivered to the factory.

Process - Melamine production. A section of the factory produces 2 x 1 m sheets of simulated mahogany melamine, 2.65 mm thick. The process of laying eight layers of dry, melamine-treated paper one on top of the other is done by hand. A layer of adhesive paper is then added, to which is added the surface coat of mahogany grained melamine-treated paper. The laminate is then loaded into a multi-daylight hot press, and cured at high temperature for seven minutes. After curing, side and end trimming operations are carried out. Most of the production is exported to Hong Kong and Japan.

The factory employs 1100 male and female staff, who join at the age of 17 and remain with the factory until retirement, which is 60 years of age for men and 50 for women. Average earnings amount to 55 yuan (£15) a month. A bonus incentive scheme for workers is currently under consideration.

Observations. The factory is old, technically outdated, extremely labour intensive, and lacking sufficient space to modernise on the present site. It is tidy and well run within the limitations of the outdated buildings and equipment. Safety standards are low. Dangerous machines, such as the veneer guillotine, are inadequately guarded, as are conveyors and pulleys. The quality

of timber from indigenous sources, appears to lack proper selection. Whilst low grade timber is adequate for core material, many of the logs were of such a low grade with a high wastage factor that it must have been uneconomic to have transported them from Heilongjiang to Shanghai. It was stated that a plan of modernization is currently being considered. In so doing, the management should seriously consider looking for a green field site with purpose-designed buildings; permitting the installation of a highly automated plant with flow-line production.

Serious delays occur during peeling operations. Much time is required to clear the machine of small sections of the veneers which constantly jam the cutter knife. Machine effectiveness is, at best, 50 per cent. It was noted that the discarded peeler cores ranged from 15-22 cm. Modern plants in the West peel logs down to a 6.3 cm diameter core.

No.1 Wood Processing Factory, Shanghai

Plywood manufacture. This factory is under the same ownership as the Victory Factory. The complex employs 1,000 people of both sexes in three workshops and one maintenance shop. It produces, on a 3 shift, 7 day week basis, 20,000 cu.m of plywood per annum. Plywood is produced by almost exactly the same method as in the Victory Factory, and it has a similar history, having been built in 1932 to produce 340 cu.m of plywood annually, and expanded after liberation to the present level of production, using both foreign and locally built machines.

Medium density fibreboard manufacture. This plant, working a two shift system, seven days a week throughout the year, produces 6,300 cu.m of medium density (hardboard) fibreboard. It is a relatively modern plant, using residues from the plywood mill and sawmills in the Shanghai area. Little description is required, as this type of plant is common throughout the world. Urea is used to bond the fibres, with paraffin wax added to stabilize the board in conditions of high humidity.

Sewing machine cabinet manufacture. The sewing machine cabinet section of the factory manufactures its own blockboard, using small offcuts of both native and imported species. The blockboard is cut to size, shaped, routed and sanded, for various components of the cabinet. Fabrication of the components is carried out on a variety of locally made machines. Great care is taken to ensure that all parts fit closely, the final fitting being done by hand. Despite the lack of space within the works, a well-finished cabinet is produced and despatched to the Company manufacturing the sewing machines.

Sawmill. A small sawmill, equipped with a 1.2 vertical band headrig, is used to plank native ash into 25 mm thick boarding. The boards, after kilning, are used in the manufacture of sewing machine cabinets.

Observations. The comments made on the Victory Wood Processing Factory, are equally applicable to this factory, particularly regarding space for future expansion. The sewing machine cabinet manufacture is labour intensive and much could be done to increase production and reduce the labour force with a modern building and equipment. The boarding produced by the sawmill could be sawn more cheaply in Heilongjiang and then sent to Shanghai.

Safety. There is a serious lack of guarding of dangerous machines, belts and conveyors, and workers using sanding machines are not equipped with protective masks.

Heilongjiang Province Sawmill, Dailing, Yichun Prefecture

Process. The mill, built in 1958, first operated in 1960. The labour force of 1,100 male and female, working on a one shift six days a week basis, produces annually 45,000 cu.m sawn timber of mixed hardwoods and softwoods.

The following species are used:

Pine	- *Pinus koraiensis*	Fir	- *Abies* spp.
"	- *Pinus sylvestris*	Larch	- *Larix dahurica*
Spruce	- *Picea jezoensis*	Birch	- *Betula* spp.
"	- *Picea koyamai*	Lime	- *Tilia mandshurica*
"	- *Picea asperata*	Ash	- *Fraxinus mandshurica*
		Elm	- *Ulmus* spp.

It is typical of the elevated mills built in Scandinavia in the 1950s and is equipped with a log-haul, vertical band headrigs, resaws and powered and belt conveyors, all manufactured in China. Two 1.5m headrigs process the large logs and two 1.2m headrigs process the medium and smaller logs. Six 1.2m resaws with horizontal powered-roller feeds reduce the cants and slabs to deals, battens and boards. Board edging is done by twin circular edgers with end-trimming carried out on fixed short breast benches. Recovery is stated to be 65 per cent. A horizontal bandsaw with a rise and fall table is used to recover short boards down to 30 cm from butt swellings off slabs. The boards thus recovered are edged on a short, hand-fed breast bench. Sawn timber is slid down chutes at the end of the mill to the ground floor and loaded by hand on to bogies which are taken by electric-powered tram to the stacking yard. Minimum

selection is carried out by hand, the timbers being close-piled for periods up to six months prior to despatch, by rail, to various parts of China.

Products. Railway sleepers, scaffold board, building and construction timbers, railway wagon and vehicle timbers, mining and packaging timbers.

Costs. Timber - 60 yuan (£16) per cu.m delivered to the mill.
Production cost - 38 yuan (£10) per cu.m.
Average value of sawn timber - 99 yuan per cu.m. ex mill.
First quality timber, if selected, can command 100-120 yuan (£30) per cu.m ex mill.

Observations. The mill is extremely labour intensive with productivity per man only seven to 10 per cent of that of a softwood sawmill in the United Kingdom. Logs are not debarked. In many instances, full tree-lengths are delivered by narrow-gauge railway direct from the forest to the log yard. Trees often arrive with whole branches still attached. Hardwoods and softwoods are processed indiscriminately as are prime butts, midcuts and rough tops. No distinction appears to be made between hardwoods and softwoods when deciding on the end product. The saw blades are only 120-125 mm wide, whereas similar machines in other countries use blades from 200-225 mm wide which are conducive to faster and more accurate sawing.

Much of the timber which arrives at the mill is totally unsuitable for saw timber, due to serious heart rot, dead wood, small and badly twisted tops. Many of the rough tops with branch stumps of up to 30 cm long are fed into the mill. The mill does not possess facilities to chip slabwood and relies on local villagers to remove it for use as firewood. Sawdust is despatched by rail for particle board manufacture.

Safety. There is a serious lack of guarding of saws, conveyors and moving machine parts. Workers are not provided with protective ear muffs. Floors tend to be uneven and so unsafe.

Nancha Wood-Processing Complex

Sawmill. This mill was also built in 1958 and has a labour force of 900 male and female, operating on a two-shift basis, six days per week throughout the year. Annual production is 225,000 cu.m of sawn timber. Similar species of timbers, similar equipment and layout are used here as at the Dailing Mill. There is, however, the addition of a

short, green chain for the removal of the sawn timber which is taken by rail to the stacking yard. Again, as at Dailing, sawn timber is solid piled. The log yard held a large reserve of well-selected logs but, at the time of the visit, very mixed quality logs were being processed, some complete with large branch stumps.

Products. These are the same as at Dailing with the exception of *Larix dahurica*, the best of which is sawn for bridge building timbers, its strength and durability being recognised. Slabwood is reduced to chips and transferred to the hydrolysis and medium density fibreboard plants. Sawdust is also used by these plants.

Costs. No meaningful figures were obtained at this mill.

Observations. The mill, although larger and somewhat less labour intensive, is still over-manned by Western standards. Modern equipment and improved log selection would have the dual effect of improving productivity and reducing the staff required. The comments made regarding safety in the Dailing mill are equally pertinent to the mill at Nancha.

Wood hydrolysis plant

On arrival the delegation was shown a working scale model, built by the workers at the plant. By the use of flashing neon lights and sound effects it gave one a superficial knowledge of the different processes and proved beneficial during the subsequent tour of the factory.

The plant originally purchased from Poland in 1958 and expanded with the addition of Russian equipment in 1960, was not completed for some years due to the break in Sino-Soviet relations. During the Cultural Revolution production ceased for a period of seven years.

Raw material in the form of wood-chips and sawdust is supplied by the adjacent sawmill and, making use of the hydrolysis process, the annual out-turn (tonnes) of products is:

Ethanol	- 3,000	Yeast	- 400
Methanol	- 70	Activated Carbon	- 100

In addition, carbon dioxide in sufficient quantity to fill 200 fire extinguishers per day and an undetermined volume of furfural are produced. Furfural, a versatile aldehyde compound, is used in the manufacture of nylon, dyes, refining of oil, synthetic resins, preparation of rocket fuels and as a solvent in the rubber industry.

Production of alcohol from wood is unusual in the Western world although Germany used this process during the Second World War to produce petrol. No attempt is made to describe the highly technical process of hydrolysis apart from stating that the raw material is cooked and fermented. The alcohols are used in various industrial processes. Yeast, in powder form, is marketed in Finland as an additive to foodstuffs for sable and mink farming. Yeast tablets for human consumption are also manufactured.

The activated carbon is used for air purification and is obtained from lignin, another by-product. Only 20 per cent of the lignin is currently utilised although plans are in hand to increase this to 100 per cent in the near future.

Observations. Due to the highly technical nature of the process, comment is difficult. The plant appears to be working to capacity, around the clock, throughout the year. It is well maintained but since it was designed in the 1950s it is highly probable that the process is outdated. Unlike the sawmills visited, this plant is not labour intensive. The unused balance of the lignin production is made into briquettes by local workers for use as household fuel.

Medium density fibreboard (hardboard) factory

5,000 tonnes of board are produced annually using equipment made entirely in China and working two shifts, six days a week throughout the year system. The fibre and glue mix is batch-weighed and spread on forming and cauls which are loaded into two multi-daylight presses with paraffin-wax added to give greater stability to the board in humid climates. Built in the late 1960s, it is typical of this type of plant throughout the world.

Observations. A relatively modern and reasonably automated plant. Board production varied slightly in thickness. The entire production is used within the People's Republic of China.

RECOMMENDATIONS ON HARVESTING AND SAWMILLING PROCESSES

It is assumed that the section of the forest industry seen in this area is typical of that of the Province as a whole, and if this assumption is correct, then the industry requires a large injection of capital to enable it to be modernised. Most of the operations, from harvesting to processing, are outdated by at least 20 years. They are labour-intensive in the extreme, and productivity per man in the harvesting sector is only 7 per cent to 10 per cent of that of the United Kingdom.

Harvesting process

Felling is carried out throughout the year, except when suspended during periods of extreme fire danger. Extraction by ground skidding is normally done throughout the year, but is dependent on weather conditions. Haulage from forests to mill is usually done only in winter during periods of hard frost, as earth roads quickly become impassable in wet weather conditions.

In the harvesting sector, the following observations are made:

1. Power saws are of antiquated design, and speed of cutting is less than half of that obtained with a modern saw. The labour force should be equipped with and trained in the use of modern power saws.

2. The demonstration of extraction by four-wheel-drive, frame-steering skidder was excellent, but we were told that most of the timber extraction is done by track-laying skidders, which are slow, cumbersome and expensive to maintain. Full conversion to wheeled skidders should take place as soon as possible.

3. Two modern log transporters were seen in the Province, equipped with hydraulic grapple loaders with heelbooms. Many more are required to replace the slow and labour-intensive derrick pole and ramp method of loading which, although seen but not in use, is suspected to be the normal method employed in the loading of timber.

Sawmilling process

It is this part of the industry which aroused the feeling of great need for modernisation. Timber, in tree lengths, is delivered by both road and light railway. In many cases, delimbing appears to be non-existent, as much of the timber arrives at the mill complete with branches and broken branch stubs. Debranching should be done at stump, with branches removed close to the stem. Timber of both broadleaved and coniferous species is delivered in mixed loads. Little or no selection, either by species or by grade, is carried out. Tree lengths are simply crosscut (many without due consideration being given to bends) into log lengths and fed into the mill without debarking and, in many cases, without branch stumps being removed. This was particularly noticeable at the sawmill visited 5 km west of Dailing. Both Dailing and Nancha mills are 20 years old and highly labour-intensive, with production per employee being only a small percentage of that of an average United Kingdom softwood sawmill. No log grading appears to be carried out, logsof both broadleaved and coniferous species being processed together for the same end use. Sawn timber is close-

piled in the yards, and is not seasoned. One of the mills has no facilities for chipping residues, relying on the local people to remove the waste.

GENERAL OBSERVATIONS AND RECOMMENDATIONS

It may be considered presumptuous to make recommendations after only a brief stay in one county of the Province of Heilongjiang. Nevertheless, despite the brevity of the visit, certain clear impressions were gained. Heilongjiang has a vast forest reserve, stated to be 1.8Bn.m^3, with an annual cut of 1.45M.m^3 of which 80 per cent of the logs are sent in the round outwith the Province. There appears to be an over-riding need to modernize and expand the existing industry and to further integrate by the introduction of more processing within the Province. One example would be more plywood manufacture in Heilongjiang, thus avoiding the costly transportation of logs to Shanghai.

It is the Chinese Government's stated intention to modernise industry as rapidly as possible and one must assume that this includes the forest industry. To achieve this goal, radical changes require to be implemented in the shortest possible time. In making recommendations, the tremendous upheaval to established communities which would result within the Province is clearly understood. In the Western world, this would be a major stumbling block and a serious deterrent. When briefly outlined, however, to Vice-Premier Wang Zhen on the 3rd October 1979, he stated that he did not foresee this as an obstacle, as, in a socialist state, labour could be re-located to suit the needs of the country.

Complete restructuring of the processing industry is urgently required to:

i. achieve maximum utilisation and integration,

ii. improve the productive capacity of the industry,

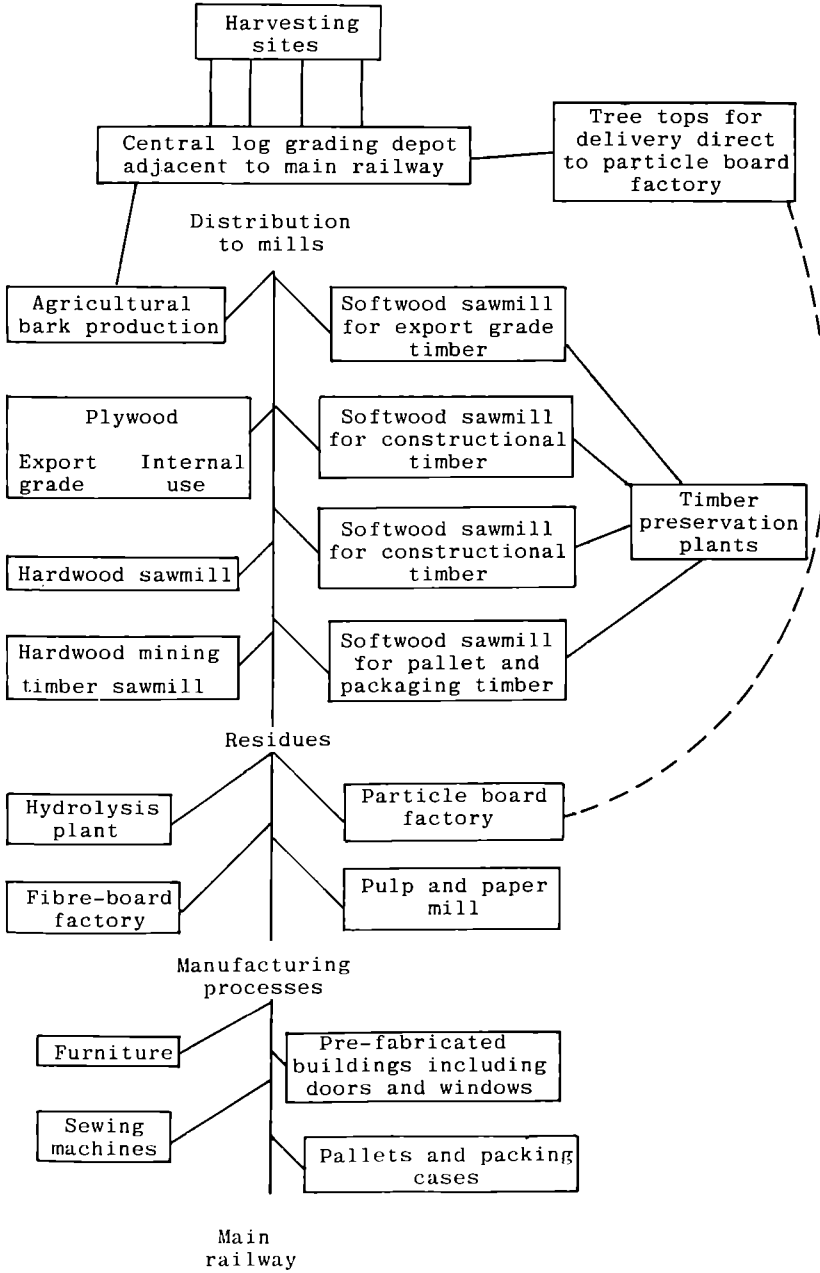
iii. enable it to meet the needs of the People's Republic of China for timber and other wood-based products, and

iv. improve the industry's capacity to earn hard currency by exporting a larger volume of the higher value products.

The main proposals (Figure 3, p.81) are confined to the processing section of the industry. Since Heilongjiang has a vast forest reserve of timber, albeit some of it currently in inaccessible areas, there is an urgent need for the establishment of central depots strategically located, into which all classes of timber would be delivered. The function of these depots would be to classify, grade, debark and crosscut logs to supply purpose-built mills. They would require unloading equipment capable of discharging vehicles rapidly, and with

Proposed structure of Forest Industry

Figure 3



sufficient hardstanding to store and handle a large volume of logs per annum. No attempt is made to quantify the capacity of such depots, as insufficient time was spent in the area to form a clear picture of the scale of exploitation.

After selection, logs from the depots would be despatched to appropriate sawmills located within the province. It is envisaged that separate mills would be built to process broadleaved and coniferous species. At least two types of hardwood mills are envisaged, one processing high quality logs and one for medium and low quality logs.

It is considered that three different types of softwood mills are required.

1. A mill designed to process high quality timber, such as Korean pine, which has a particularly fine grain, and which, it is felt sure, would be highly prized in world markets. This mill could produce either plywood or high quality sawn wood (a cargo of Korean pine battens was imported into Glasgow 16 years ago. This timber was well received but the importer was unable to secure further supplies).

2. A constructional grade sawmill for the production of building, bridge, railway and vehicle timbers, and railway sleepers.

3. A small-wood sawmill for the production of cross sections of prefabricated building timbers, palletwood, packaging and mining timbers.

Each of the above categories of mills would require to have full residue producing facilities to permit slabwood and offcuts to be chipped and despatched to factories utilising chips and sawdust. All mills should carry out timber grading. In addition, end squaring and sorting prior to seasoning should be done. Seasoning should be by kilning, although air drying may be possible in the continental type climate of Heilongjiang. An element of pride of product would be introduced if each mill end-stamped its own production.

To obtain maximum utilisation within the province and to create employment for the surplus labour force displaced by modern methods, a fully integrated industry is envisaged, with hydrolysis, plywood, furniture, medium density fibreboard and particleboard plants suitably located. Pulverised bark for agriculture would be produced at central depots. By seasoning sawn timber, a saving in transportation would result, in addition to supplying the end user with a product ready for use.

From the information given on timber reserves within the province, it is felt that the People's Republic of China would be fully justified in establishing

and sustaining an industry based on these proposals. Whilst no serious appraisal of the labour requirements has been possible, it is anticipated that the 450,000 currently employed in the forest industry in Heilongjiang will be more than adequate to meet the manpower requirements of a reconstructed forest industry, producing more timber, adding value at source, and thus avoiding the necessity of transporting logs to other parts of China.

THE PROBLEM OF IMPLEMENTATION

The impression was gained that some of the forest industry staff who had studied modern techniques in Scandanavia understood the problems, and had the knowledge and ability to carry out this restructuring. If, however, this impression is erroneous, there are Finnish and North American Consultancy Companies which could be employed to put forward detailed proposals.

The overall impression is that the main constraint is a financial one. This was accepted on the 3rd October 1979 by Vice-Premier Wang Zhen, who recognised the importance of increasing the funds to be made available to the forest industry.

CONCLUSION

The scope and potential for growth of the forest industry in the People's Republic of China is vast and the gain from developing the industry will be equally great.

A PRIVATE FORESTER'S EYE ON THE CHINESE SCENE

by

The Earl Bathurst

We were the first British Forestry Delegation to have the privilege of seeing forestry the length of China from south to north. Three weeks of relentless but meticulously planned travel and the politest of old world hospitality to see forestry, wherein there are no secrets, gives hard proof of how little can be seen of so huge a country and how little one can know of a culture bred and nurtured by 30 years of Communism.

That we saw so much that was good, bad and indifferent so freely, was due to the privileges given to our delegation because of the real and genuine interest that forestry receives from the Chinese Government. The policy of a green China was laid down by Chairman Mao and is carried on by Chairman Hua and his present team. Agriculture is the key link to China's modernisation. This means growing sufficient protein for nearly 1,000 million people with only about one tenth of a hectare or 1,000 square metres of cultivatable land per head. Forestry protects the existing food-producing land and in future will make it possible to cultivate new land reclaimed. A separate Ministry of Forestry has been re-established this year under a Minister charged with this function, including planting of the great new green wall to fix the Gobi Desert, with the implementation of a new forest law to protect all forests and controlling the resultant timber production. Well might these measures be needed when, as the Ministry has stated, 'one hoe plants a tree and several axes fell it'. Food for themselves and their animals and fuel for cooking and warmth are the major essentials for the Chinese countryman. Could this action taken by the Chinese State Council in 1979 be a pattern for governments world-wide? Foresters have been crying to their democratic parliaments for measures such as these and will be on tenterhooks to hear if they succeed. Chairman Mao stated that trees have no votes. Nevertheless, he set a green revolution on its way by mobilising the masses and it would appear that Chairman Hua intends to carry it through.

The facts and figures come as thick as ladybirds at Dailing and as inevitably as bicyclists in Shanghai. Surprises were every bit as many, as no doubt would have been the two flights of the Birds of Paradise from their island sanctuary near Xinhui, Guangdong Province. Game shooting of protected species is prohibited in China but giant bears are hunted for their skins, as well as for their paws which are considered a gourmet dish.

There are 120 million hectares of forestry in China. Of this, 580 thousand hectares is untouched virgin forest in North East China under the Heilongjiang Province Forestry Administration. Tibet has as much and more again, complete with 800 million cubic metres of timber in an area in dispute with India. There is no way to see it let alone make a management plan. All this we heard, together with the fact that 28 million hectares of new forest have been planted in thirty years of revolution. 2.5 million men and women work in these forests to a plan. Most forest workers have the use of private plots of a few dozen square metres each and are encouraged to grow food to eat and for private sale. They can now hire out their bullock carts for profit.

We soon learnt that anything in China is believable. China, where the Cultural Revolution stopped the clock in 1966, is a land of make do and mend. The water buffalo tills the rice paddies with good effect and it will be long before he is ousted by two-wheeled garden-type tractors. Bamboo is woven into intricate baskets and fans as well as used for scaffold poles on high-rise buildings. Stands of magnificent timber, both hard and soft wood vie with mile upon mile of mountainside scrub. Mixed up together, it is laboriously hauled to sawmills, grimy wood production factories, the building industry and for firewood. A prime butt of Korean pine can as well land up in a methanol plant as in a craftsman's workshop. Mules and tough little chestnut ponies pull rubber-tyred trailers side by side with the latest German-made timber trucks equipped with heavy duty Jonsered mounted cranes, together with Bobcat type skidders. There are very few of these yet, but those we saw were being skilfully driven. It was not clear whether the drivers were town technicians or countrymen. China needs to buy her technology from the West for the forest, as for most other industries. In the Shanghai Palace of Industry, we saw that she intends to compete with the West in manufacturing such sophisticated machinery for the modernisation of the Revolution. We noted skilful copies in the factories, forests, fields and on the roads. At Bishui Forest Farm in Yichun we saw workers' houses in a far away forestry village. Chairman Hua's observations upon the Oxfordshire "peasant" house may be useful back home if Chinese forestry is to progress still further into the vast land of backwoods.

In the guesthouse of furthest flung Nancha (100 kilometres from the Russian border), Messrs Shanks and Armitage had done their work many years ago and intermittently prodigious flushes could still be obtained. With the assistance of home-made taps and valves, the hottest of water was also produced but for some reason beyond the realms of logic, available only to the last ones to wash. The

biggest surprise of all came three days before our visit ended when we were given a detailed brief in English on Chinese forestry in the comparitive serenity of the Nationalities Hotel in Beijing.

This stated that half of China's forestry area, i.e. 60 million hectares, is not owned by the Communist State Government at all but is made up of some 240,000 forestry farms directly owned by the Communes and their Production Brigades. Furthermore, the Communes can decide within limits what and when they cut and they pocket the cash within a very broad production target decided by Provincial heads of the Forestry Bureaux. If the Chairman of a Commune, of perhaps some 40,000 people, is not keen on forestry there can be problems which even a one hundred million yuan (3.7 yuan to the pound) national subsidy per year will not resolve. This subsidy meets only the basic costs of planting.

The price of timber is decided nationally in Beijing along with wages and most else. We had heard an after-dinner speech by Chairman Hua which exorted all his 1,000 or so guests to do better for the motherland whilst the women folk of China held up half the sky. To encourage this end, we had already heard that the price of timber in the round had been increased by decree, a fact unknown at the time to the Manager of a plywood factory. Country workers' wages had been increased and piecework encouraged. We had seen the stamp of Chairman Mao's thumb upon the land of China, the result of the 'Four around' planting policy. Less red earth from the mountainsides now flows into the rivers.

Vast shelterbelts give shade and stability to farmsteads, rivers and canals and roads and railways - 16 hours at 40 miles an hour with four lines of various tree species planted each side of the track. How many trees? We knew too, from a most able and engaging 27-year-old Chairman of a Commune that a spell of re-education would be handed out to a member of a production team who declined to change his life style from say, tending a water buffalo or flocks of duck, to the more arduous vocation of mountain forestry. Yes, there are surely many problems between the forestry headquarters of the Communist state in Beijing and the Communes over which the complex bureaucratic system must have doubtful control. It can take three years to obtain a decision. We had already noted that forestry management and procedures in the State and Provincially-owned forests which we had seen were invariably better than those of the Communes. Already, much of their forest and "Four around' planting, some already 20 years old, was sadly in need of care and good management, if not complete replacing. For just over two weeks we had not appreciated the reason.

Within hours of this amazing information that Communist China has undoubtedly more non-State-owned forest than anywhere in the world, our delegation was met in the Great Hall of the people in Beijing by Vice-Premier Wang. He is one of 18 Vice-Premiers for a population of 1,000 million. Vice-Premier Wang takes a personal interest in the new Ministry of Forestry and the new Forest Law of 1979 already referred to. He loves forests and he knows that the vast forestry resources of China must be carefully husbanded. He told us that for many years he had lived in the forests with the soldiers of the People's Revolutionary Army in the old days of 1927. That is something very special in the People's Republic.

Sir Ralph Verney, our leader, was invited to make comments upon our exacting tour. In his brilliant resumé of our countless impressions, number one was that forestry in the Communes seemed to lag behind what we had seen in the State and Provincial forest enterprises. Yes, indeed, this was so, agreed Vice-Premier Wang putting aside his brief. He agreed too, and with great interest,with the other points made by this delegation which Sir Ralph put forward. The effect on the dozen or so high-ranking Beijing Ministry of Forestry officials was less easy to guess. Furthermore, Vice-Premier Wang received Sir Ralph's invitation for a Chinese delegation to visit Britain next year with great pleasure. This was confirmed when we departed two days later, and also, as we had asked, that this Chinese delegation would include members from the Provinces which we had visited. In any ordinary country, such a high-ranking Minister would surely by now have closed a similar interview, making it plain that he had other and better things upon his programme. Not so Vice-Premier Wang, who immediately asked all members of the Delegation to give their individual views on what they had seen in the three weeks. On such an occasion, and especially so when last in the line, the mind tends to a blockage. Can one really have suggested, before such a company in Beijing, that the private sector of British forestry has faced, and is facing, almost exactly the same problems as half the Chinese forestry industry? Did one further suggest that the ideals and the working practice of the British Forestry Dedication Scheme, under the guidance of the Forestry Commission, might be the most useful contribution that Great Britain can make whereby the Chinese State could help and encourage the forestry effort of the Communes now and in the future? There was Vice-Premier Wang saying that only by forestry could food-growing land be protected and new land be brought into cultivation in the deserts and on the plains. The people of China must have food and the modernisation of China needs still more food. He said that he must find an answer to managing and harvesting this huge part of China's forestry resources owned and worked by the

Communes. This was not a dream, but could it be that Chairman Hua has made a secret deal to take over our Forestry Commission and set it up in Beijing? If so, David Johnston is already working out the tonnage of *Metasequoia* and Korean pine seed that he would require in exchange. *Castanea Henryi*, commonly called Henry's Chestnut or Chinkapin, would be unacceptable as its provenance was not noted by John Matthews.

APPENDIX

The Location (*) of Trees and Shrubs featuring in the foregoing reports

B - indicates Bonsai

City or Province	Guangdong	Shanghai	Beijing	Liaoning	Heilongjiang
Latitude °N	23° 12'	31° 14'	39° 56'	41° 31'	45° 49'
Abies halophylla					*
nephrolepis					*
Acacia confusa	*				
Acer mono					*
palmatum		*B			
truncatum		B			
ukuranduense					*
Actinidia kolomikta					*
Aesculus chinensis			*		
Ailanthus altissima			*	*	
Albizzia falcataria	*				
gillibrissia			*		
Aleurites maluccana	*				
montana	*				
Alnus (mandshurica?)					*
Amorpha fruticosa			*	*	
Ampelopsis sp.					*
Aphanamixis grandiflora	*				
polystachya	*				
Aralia elata					*
Averrhoa carambola	*				
Bambus pervariabilis	*				
textilis	*				
Bauhinia blakeana	*				
purpurea	*				
Begonia fimbristipula	*				
Betula costata					*
ermanii				*	*
mandshurica					*
platyphylla					*
Biota (Thuja) orientalis			*		

City or Province	Guangdong	Shanghai	Beijing	Liaoning	Heilongjiang
Latitude °N	23° 12'	31° 14'	39° 56'	41° 31'	45° 49'
Bombax malabaricum	*				
microphylla			*		
microphylla var. *sinica*		B			
Buxus sempervirens			*		
sinensis		*			
Canarium album	*				
Carya cathayensis		*			
Caryata ochlandra	*				
Castanopsis chinensis	*				
fissa	*				
Casuarina equisetifolia	*				
Cedrus deodara		*	*		
Celtis spp.	*				
Cinnamonum camphora	*				
Cornus wilsonii		*			
Corylus sieboldiana var. *mandshurica*					*
Cryptocarya chinensis	*				
Cunninghamia lanceolata	*				
Cupressus funebris		*			
Cytisus spp.		B			
Delonix regia	*				
Deutzia amurensis					*
Diospyros kaki	*	*B	*		
sinensis		B			
Dracontomelum dao	*				
Eucalyptus citriodora	*				
exerta	*				
robusta	*				
Erythrophleum fordii	*				
Euonymus fortunei		B			
japonicus		*			
Euphorbia longan	*				
Ficus microphylla			*		
retusa	*				
robusta	*				

City or Province	Guangdong	Shanghai	Beijing	Liaoning	Heilongjiang
Latitude °N	23° 12'	31° 14'	39° 56'	41° 31'	45° 49'
Forsythia suspensa					*
Fraxinus chinensis			*		
mandshurica					*
ornus			*		
Gardenia jasminoides		B			
Ginkgo biloba	*	*B	B	*	
Gleditsia japonica				*	
sinensis			*		
Glyptostrobus pensilis	*				
Grevillea robusta	*				
Heteropanax fragrans	*				
Hibiscus spp.			*		
tiliaceous	*				
Homalium hainanense	*				
Ilex spp.		*			
cornuta		B			
Jacaranda mimosifolia	*				
Jasminum nudiflorum		B			
Juglans mandshurica				*	*
Juniperus chinensis		*B	*		
Koelreutaria paniculata			*		
Lagerstroemia indica		B			
speciosa	*	*			
Larix dahurica (syn. *L. gmelini*)				*	*
olgensis				*	
Principis Rupprechtii				*	*
Ligustrum spp.		*			
lucidum					*
Liriodendron chinensis		*	*		
Litchi chinensis	*				
Livistona chinensis	*				
Maackia amurensis				*	*
Magnolia denudata			*		
grandifolia		*			

City or Province	Guangdong	Shanghai	Beijing	Liaoning	Beilongjiang
Latitude ^{o}N	23^{o} 12'	31^{o} 14'	39^{o} 56'	41^{o} 31'	45^{o} 49'
Malus baccata				*	
pumila				*	
Mangifera indica	*				
Melaleuca leucadendron	*				
Metasequoia glyptostroboides		*			
Michelia alba	*				
Ormosia glaberrin	*				
Pandanus austrosinensis	*				
Paulownia tomentosa		*			
Phellodendron amurense					*
chinense		*			
Phyllostachys spp.	*				
Picea asperata					*
jezoensis					*
koyamae var. *koraiensis*					*
Pinus bungeana		B	*		
caribaea	*				
var. *hondurensis*	*				
elliottii	*				
koraiensis				*	*
massoniana	*	*			
oocarpa	*				
parviflora		B			
ponderosa			*		
sylvestris					*
var. *mongolica*				*	*
tabulaeformis		B			
thunbergii		*			
Pittosporum spp.		*			
Platanus x acerifolia		*			
orientalis		*			
Plumeria rubra	*				
Podocarpus macrophyllus		*			
var. *maki*		B			

City or Province	Guangdong	Shanghai	Beijing	Liaoning	Heilongjiang
Latitude °N	23° 12'	31° 14'	39° 56'	41° 31'	45° 49'
Populus bolleana				*	*
x canadensis			*	*	*
cathayana			*	*	*
nigra			*	*	*
cv. I 214			*	*	*
maximowiczii					*
nigra				*	
cv. Thevestina			*	*	*
cv. Robusta			*	*	*
cv. Sacrau 79			*		
simonii	*		*	*	*
x nigra			*		
tomentosa (syn. *pekinensis*)			*	*	
tremula	*				*
ussuriensis					*
Prunus davidiana				*	
persica	*	*B			
Pseudolarix amabalis		B			
Punica granatum		B	*		
Quercus mongolica					*
Rhododendron mariesii	*				
Ribes (mandshurica?)					*
Robinia pseudoacacia		*	*	*	
Rosa acicularis					*
Salix babylonica	*				
matsudana			*	*	*
Sophora japonica		*	*	*	
Sopium sebiferum	*				
Schima superba	*				
Shizandra chinensis					*
Swietenia macrophylla	*				
mahagoni	*				
Synocalamus latiflorus	*				
Syringa spp.					*
Tamarix chinensis				*	

City or Province	Guangdong	Shanghai	Beijing	Liaoning	Heilongjiang
Latitude °N	23° 12'	31° 14'	39° 56'	41° 31'	45° 49'
Taxodium ascendens	*				
distichum	*				
Taxus cuspidata		B			
Thea oleosa	*				
Thuja orientalis			*		
Tilia amurensis					*
mandshurica					*
Toona microcarpa	*				
sinensis	*				
sureni	*				
Ulmus spp.			*		
lacinata					*
japonica (syn. *propinqua?*)					*
parviflora		*			
pumila				*	
Vitis amurensis					*
Wistaria sinensis		*B	*		
Zelkova serrata		B			
Zizyphus jujuba			*	*	

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