FORESTRY AND FOREST INDUSTRY IN THE U.S.S.R.

REPORT OF A TECHNICAL STUDY GROUP

Forest Service

UNITED STATES DEPARTMENT OF AGRICULTURE

Foreword

An Agreement, concluded on January 27, 1958, between the Governments of the United States of America and the Union of Soviet Socialist Republics, provided for exchanges in the cultural, technical, and educational fields during the years 1958 and 1959. This Agreement has been regarded as a significant first step in the improvement of mutual understanding between the peoples of the two countries.

Agriculture, which plays an important role in the national economics of the two countries, was specifically included in the Agreement as a field for exchange of specialists. The U.S. Department of Agriculture accordingly sent to the Soviet Union in 1958 six technical study groups of specialists in the following subjects: Agricultural economics; agricultural crops, soil, and water use; veterinary science; mechanization of agriculture; cotton growing and plant physiology. In 1959, three additional study groups were sent as follows: Biological control of pests; animal husbandry; and forestry, lumbering, and millwork.

The Soviet Union in turn sent to the United States in 1958 six delegations of specialists in the following subjects: Farm mechanization; hydroengineering (irrigation) and reclamation; animal husbandry; cotton growing; agricultural construction and electrification; veterinary science. In 1959, three additional Soviet teams visited the United States, representing the following fields: forestry, lumbering, and millwork; mixed feeds; and horticulture.

Each U.S. exchange study group, on completion of its assignment, prepares a report. To date, six have been published. The following report sets forth the observations and analysis of Soviet forestry as seen and interpreted by the U.S. forestry delegation.

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Washington, D.C. March 1961

FORESTRY AND FOREST INDUSTRY IN THE U.S.S.R.

. . . Report of a Technical Study Group

Introduction

This report on forestry and forest industry in the U.S.S.R. is based on the observations made by a seven-man U.S. Forestry Delegation during July and August, 1959. Thirty days were spent in the Soviet Union studying on-the-ground forestry and timber harvesting practices, visiting educational institutions and research centers, and inspecting various types of forest industry. Even though the members of the group traveled more than 6,000 miles and talked to dozens of Soviet foresters and officials, preparation of this report served to emphasize the great many gaps in their information about forestry in the Soviet Union. Nevertheless, the report is as factual as possible. Since the trip was limited to portions of the European U.S.S.R. with no travel in Siberia, the reader should keep this important limitation in mind. The writers have tried also to keep this limitation in mind, in the interpretive sections of the report.

Members of the United States Forestry Delegation (fig. 1) and their affiliations are given below. All of them contributed to this report.

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Dr. George M. Jemison, Leader of the Delegation and Deputy Assistant Chief, U.S. Forest Service, Washington, D.C.

The trip began in Moscow on July 18. The accompanying map (fig. 2) and the following itinerary indicate the schedule and principal forestry activities and forest industries visited.

Itinerary

July 17	– Left New York City.
July 18	– Arrived Moscow, U.S.S.R., by way of Prestwick, Scotland, and Copenhagen, Denmark.
July 19	– Sightseeing in Moscow.
July 20	– Meeting at Ministry of Agriculture. Visit to U.S.S.R. Exhibition of Economic Achievements.
July 21	– Timiryazev Agricultural Academy, Chair of Forestry, Experimental Forest, Williams Soil Museum, Moscow.
July 22	– Central Scientific Research Institute of Mechanization and Energetics of Forest Industry, Khimki, near Moscow. All-Union Forest Project (Lesproekt), Moscow.
July 23	– Mostovskaya Logging Division of Olensky. Logging Operation (Lespromkhoz), Mostovaya.
July 24	– Visit opening of U.S. Exhibition, Moscow.
July 25	– Moscow Forest Technical Institute, Stroitel. All-Union Institute of Forestry and Forest Mechanization, Pushkino.
July 26	– Sunday—Sightseeing in Moscow.
July 27	– Travel to Krestzy Logging Operation (Lespromkhoz), Novgorod Province.
July 28	– At Krestzy Logging Operation and travel to Leningrad.
July 29	– Leningrad Forest Technical Academy.
July 30	– Leningrad Research Institute of Forestry. Ust-Izhorsky Plywood Factory, Pontonnaya Station, Leningrad. Central Scientific Research Institute for Timber Floating, Leningrad.
July 31	– Syversky Experimental Forest and Management Unit, Syversky, Leningrad Province.
August 1	– All-Union Scientific Research Institute for Plant Protection, Leningrad. Kommunar Paper Mill, Leningrad.
August 2	– Travel to Petrozavodsk, Republic of Karelia.
August 3	– Shoujsko-Vidansky Logging Operation and Lumber Camp, Karelia.
August 4	– Drazhinski Forest Management Unit. Solominsk Sawmill and Kondopozhsky Pulp Combine.
August 5	– Travel to Kiev.
August 6	– Ukrainian Academy of Agricultural Sciences, Forestry Department, Kiev. Kiev Agricultural Exhibition.

FIGURE 1.—The U.S. Forestry Delegation on the steps of the Ministry of Agriculture in Moscow. From left to right: Garratt, Seidl, Stamm, L.G. Kanevsky (Soviet forest economist who functioned as tour manager), Panshin, Jemison, Metz, V. G. Nesterov (Soviet silviculturist mentioned in text), and Pauley.

August 7	– Zhitomir State Forest and Management Unit, Zhitomir.
August 8	– Ministry of Agriculture, Kiev. Bozhenko Furniture Factory, Kiev. Travel to Yalta, Crimea.
August 9	– Nikitsky Botanical Garden, Yalta.
August 9–10	– Travel to Sochi, Krasnodar Region.
August 11	– Sochi Experimental Station for Forest and Park Management, Sochi Dendrological Garden, Yew-boxwood grove near Sochi.
August 12	– Lake Ritsa and Cork Plantation, Republic of Georgia.
August 13	– Travel to Stalingrad.
August 14	– All-Union Scientific Research Institute for Agro-Forest Amelioration, Stalingrad. Volga River Dam and hydroelectric plant, Stalingrad. Shelterbelts, vicinity of Stalingrad.
August 15	– Stalingrad sawmill. Travel to Moscow.
August 16	– Free day in Moscow.
August 17	– Final conference with Ministry of Agriculture and Forest Industry Representatives.
August 18	– Leave Moscow.
August 19	– Arrived in United States by way of Stockholm, Sweden, and Copenhagen, Denmark.

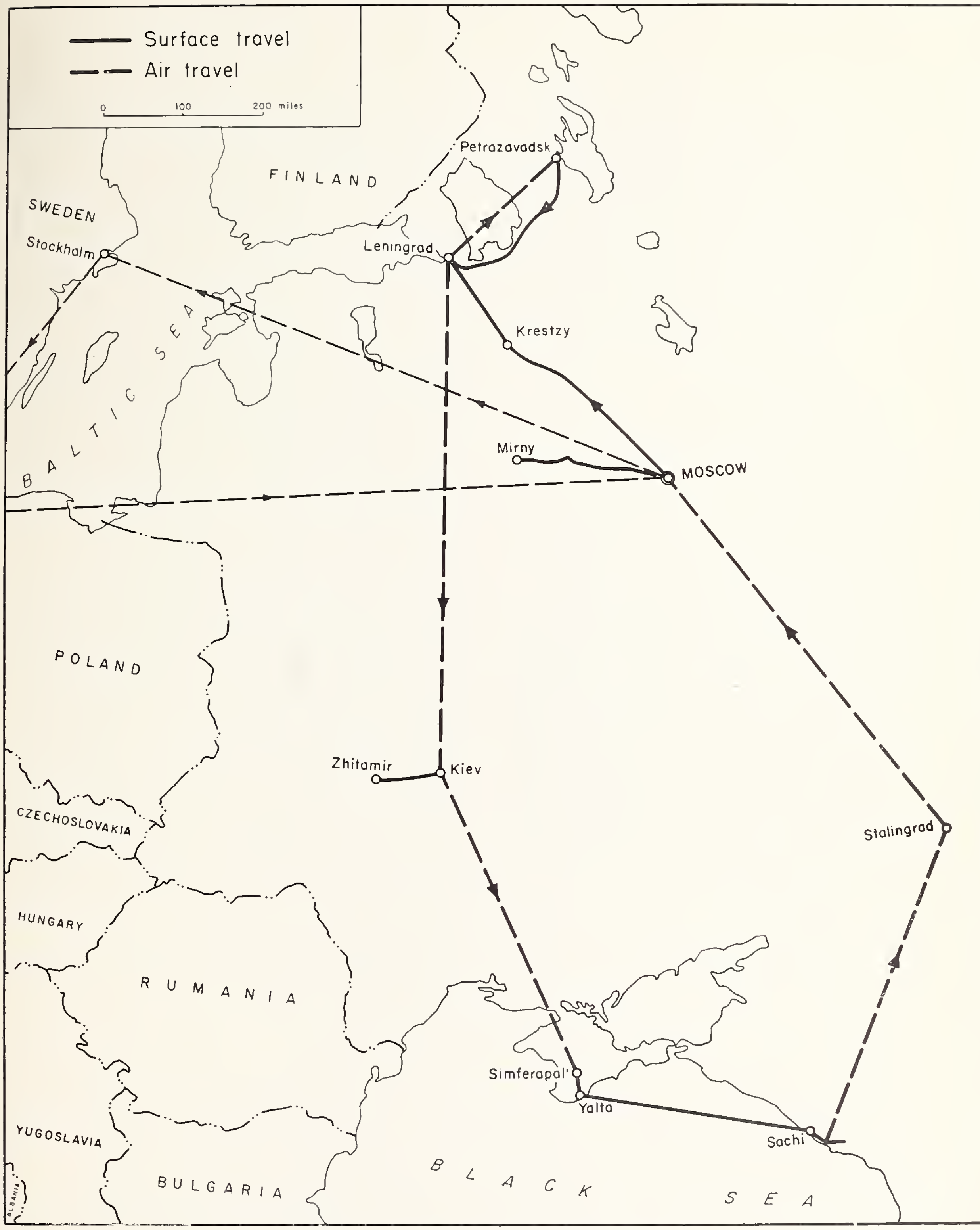

FIGURE 2.—Travel route in the U.S.S.R.

Timber Resources of the U.S.S.R.

At the present time it is difficult to obtain reliable data on the timber resources of the U.S.S.R. Soviet forest surveys are undoubtedly being extended and revised, giving rise to new sets of resource statistics. The problem may be illustrated by a selection of recently published figures on total wood production in the U.S.S.R.:

Source and year of production:	*Million cubic meters*
Vasilyev (*34*)[1], 1958	267.7
Voronitsin (*35*), 1958	376.0
FAO Yearbook (*12*), 1958	376.0
Statistical Handbook (*32*), 1955	334.1
Bukshtynov (*7*), 1959	379.7
Lamer (*15*), 1953	420 to 450

The United States Forestry Delegation was given the figure of 376 million cubic meters for 1958 production. We believe the most recent report by Bukshtynov (*7*) is reasonably accurate for basic resource statistics and the FAO Yearbook (*12*) for wood production data. Unless otherwise noted, these will be the source of the principal statistics given in this report. Metric units have been converted to U.S. units by means of the conversion factors given in the Appendix.[2]

Regardless of the source of data, there is no doubt that the Soviet Union has a large timber resource, roughly four times that of the United States in area and five times in volume. The country is, of course, extremely large and contains 8,650,000 square miles or one-sixth of the world's land area. This compares with 2,975,000 square miles for the continental United States, or 3,567,000 square miles for all 50 States.

[1] Numbers in parentheses refer to Literature Cited, p. 76.

[2] In addition, throughout the report where metric units are presented, equivalent U.S. units are given. Sometimes only approximate conversions are indicated.

Forest Area

Gross forest area in the U.S.S.R. totals 2,795 million acres, or about 28 percent of the forest area in the world. Approximately 2,066 million acres are productive forest lands. This figure is about 25 percent higher than many other recent reports of commercial forest area, but it is the figure given verbally by the Ministry of Agriculture and it agrees with Bukshtynov (*7*). About 78 percent of these forests lie in the Asiatic part of the U.S.S.R. The United States, including Alaska and Hawaii, has 529 million acres of commercial forests.[3] Table 1 summarizes the forest land categories for all the U.S.S.R.

Forest Types

Roughly speaking, the principal forest types of the country extend in parallel bands from east to west. The northernmost belt of forest vegetation is the Wooded Tundra, composed of scrubby willow, birch, and aspen. This forest is of no commercial value. The great Northern Coniferous Forest or "Taiga" immediately south of the Wooded Tundra stretches from the Finnish border to the Pacific Ocean. Principal species are Scotch pine, spruce, fir, Siberian stone pine, and larch in the order named from west to east. Associated hardwoods include birch, aspen, and alder.

South of the coniferous belt are the timber stands of the Forested Steppe region composed of birch, oak, elm, ash, basswood, maple, and Scotch

[3] All United States forest resource statistics, unless otherwise indicated, are from *Timber Resources for America's Future,* U.S. Dept. Agr. Forest Resource Report No. 14, 1958. Most data are for the year 1952.

TABLE 1.—*Forest land areas in the U.S.S.R.*

Forest land category	Total U.S.S.R.		European U.S.S.R.		Asian U.S.S.R.	
	Million acres	*Percent*	*Million acres*	*Percent*	*Million acres*	*Percent*
Productive forest land	2,066.0	74	448.7	22	1,617.3	78
Stocked forest	1,784.8	64	403.5	23	1,381.3	77
Nonstocked forest	281.2	10	45.2	16	236.0	84
Nonproductive forest	728.9	26	95.1	13	633.8	87
Total	2,794.9		543.8		2,251.1	
Total in percent		100		19		81

pine. Of the Mountain Forests, located along the southern borders of the U.S.S.R., only those in the Caucasus are of economic importance. Forests of oak, elm, beech, Nordmann fir, scotch pine, ash, maple, and walnut are found at medium elevations, 3,500 to 5,000 feet. The lower slopes and foothills are covered by a Mediterranean flora, including chestnut, Aleppo pine, juniper, and boxwood.

The Desert Forest of Central Asia is riparian with a predominance of willow, elm, poplar, and Russian-olive, following the sunken water courses.

Timber Volumes

The total growing stock of the U.S.S.R. forests is estimated to be 2,812 billion cubic feet as against 549 billion in the United States, including Alaska. Softwoods make up 86 percent of the total volume with Siberian larch, Scotch pine, and Norway spruce accounting for almost 85 percent of the coniferous volume. The principal hardwood species are birch, aspen, oak, and beech—in that order. All hardwoods comprise only 14 percent of total timber volume.

Average volumes per acre on productive forest lands are about 1,360 cubic feet per acre in the U.S.S.R. and 1,070 cubic feet in commercial forests of the continental United States. As would be expected, coniferous types have greatest per-acre volumes. However, the Asiatic part of the Soviet Union has stands that are lighter on the average than in the European portion, for both conifers and hardwoods. Volumes of coniferous stands in the United States exceed those in the U.S.S.R. by substantial margins and average over 3,030 cubic feet per acre. Large acreages of lightly stocked hardwood lands lower the United States average.

Growth

Total annual growth,[4] like the other features of the U.S.S.R. forest resource, substantially exceeds comparable data for the United States. Total growth for all forest land is almost 32 billion cubic feet per year compared with 14.2 billion cubic feet in the United States. With the short growing season characteristic of continental climates in high northerly latitudes, growth rates per acre are low. For example, the average annual growth for all productive forest lands in the U.S.S.R. is 15.7 cubic feet per acre, as against 29.2 cubic feet for the United States. Stands in the European part of the U.S.S.R. are growing almost twice as fast as those in Asia.

Timber Cut

The total yearly cut in the U.S.S.R. is 13.4 billion cubic feet, of which two-thirds is saw logs, pulpwood, poles, posts, and other roundwood products; and one-third fuelwood. In spite of the fact that only 22 percent of the productive forest land lies in European U.S.S.R., 8.7 billion cubic feet of the cut, or 65 percent, comes from the European part.

Significance of Basic Resource Data

It is obvious from the few data presented that the overall Soviet timber resource is extensive, and is composed of versatile and even preferred species. Further, the total annual growth volumes are high. But the per-acre volumes of coniferous growing stock are not great in comparison with those of the United States. Growth rates are low, and cutting is heaviest in regions where the available timber supply is the lowest. Detailed statistical tables appear in the Appendix.

[4] We presume this to be total net growth, although we have not determined this point for sure.

Organization of Forestry and Forest Industry

As is true in any large country with a complex economy and a major forest resource, the organization of a principal activity such as forestry may appear complicated to an outsider. The organization and direction of U.S.S.R. forest management and forest industry is especially difficult to understand because it undergoes frequent, sweeping changes. In 1957, for example, visitors reported that the Ministry of Timber Industry, previously responsible for all phases of forestry, was relieved of management and protection functions, which were then assigned to a newly created unit in the Ministry of Agriculture. In July 1959 we were given a detailed description of the functions and operation of the two governmental units that handled timber exploitation and forest management, the Department of Forest Industry and Forest Products, and the Department of Forests and Shelterbelts.

In October 1959, another major change was made in the Russian Soviet of Federated Socialist Republics (R.S.F.S.R.). At this writing the extent of this most recent change is not fully understood and it may not as yet be fully implemented or developed. Consequently, we are describing here the organization as we found it in July 1959. The principal features of the new organization are also reported, although the information we have is sketchy.

Forest Management Functions

Until late in 1959, the Department of Forests and Shelterbelts in the Ministry of Agriculture handled the forest land management activities, shelterbelt work, and fire and pest protection. Each of the 15 republics that make up the U.S.S.R. had some form of a governing board to take care of forest management programs. In most cases these were "ministries" of forestry or inspection boards which may be referred to as Union Republic Governing Boards. Those republics with the more advanced forest protection and management were subdivided into regions, each headed by a regional committee. Regions, in turn, were subdivided into large and small units for protection and management purposes. In 1959 there were 2,156 protection and management districts in the U.S.S.R. Figure 3 shows the details of the organization schematically.

Three basic classes of forest land are recognized as a basis for management practices throughout the Soviet Union. They will be referred to by number later in the report. The three classes are defined as follows:

Group 1.—Forests primarily of value for recreation and protective functions, including nature reserves, forest resorts, shelterbelts, and erosion control forests along streams. These forests average 125,000 acres to the management unit and make up about 6 percent of the forest land.

Group 2.—Managed forests under sustained yield (which make up about 9 percent of the productive forests). These districts average 350,000 acres in size.

Group 3.—Exploitation forests (85 percent) either now being cut or planned for harvest. These districts average 2,350,000 acres in size.

In addition to the three types of management districts, large "protection" or custodial forest districts up to 37 million acres in size are identified. A management region, prior to October 1959, was divided into districts (leskhozi) based on the principal intent of management in accordance with the foregoing three groups. The management districts were subdivided into one-man sections of 5,000 acres or more, the size being set so that one forest guard can handle all local activities.

The Leningrad Forest Management Region was probably typical of the better developed units in the group 2 forest category. It had a regional management committee, whose chairman directed the activities of 1,500 foresters managing the 13,800,000 acres in the region. Its 29 districts ranged in size from 200,000 to 3,700,000 acres, depending on the scope and intensity of activities on each.

The Union Republic Governing Boards controlled the allocation of timber to the government groups responsible for timber harvesting. The regional management committees prescribed cutting practices to some extent and were responsible for reforestation, thinning, weeding, and other cultural work. Income from the allocation of stumpage was available to the region to defray management costs. In the Leningrad region mentioned above, the annual income was reported as 55 million rubles ($13.75 million) [5] per year,

[5] The official conversion rate of 4 rubles to 1 dollar is used in this report rather than the tourist rate of 10 to 1. Regardless of the factor used, simple conversions of rubles to dollars may be misleading unless other aspects of costs and returns are understood.

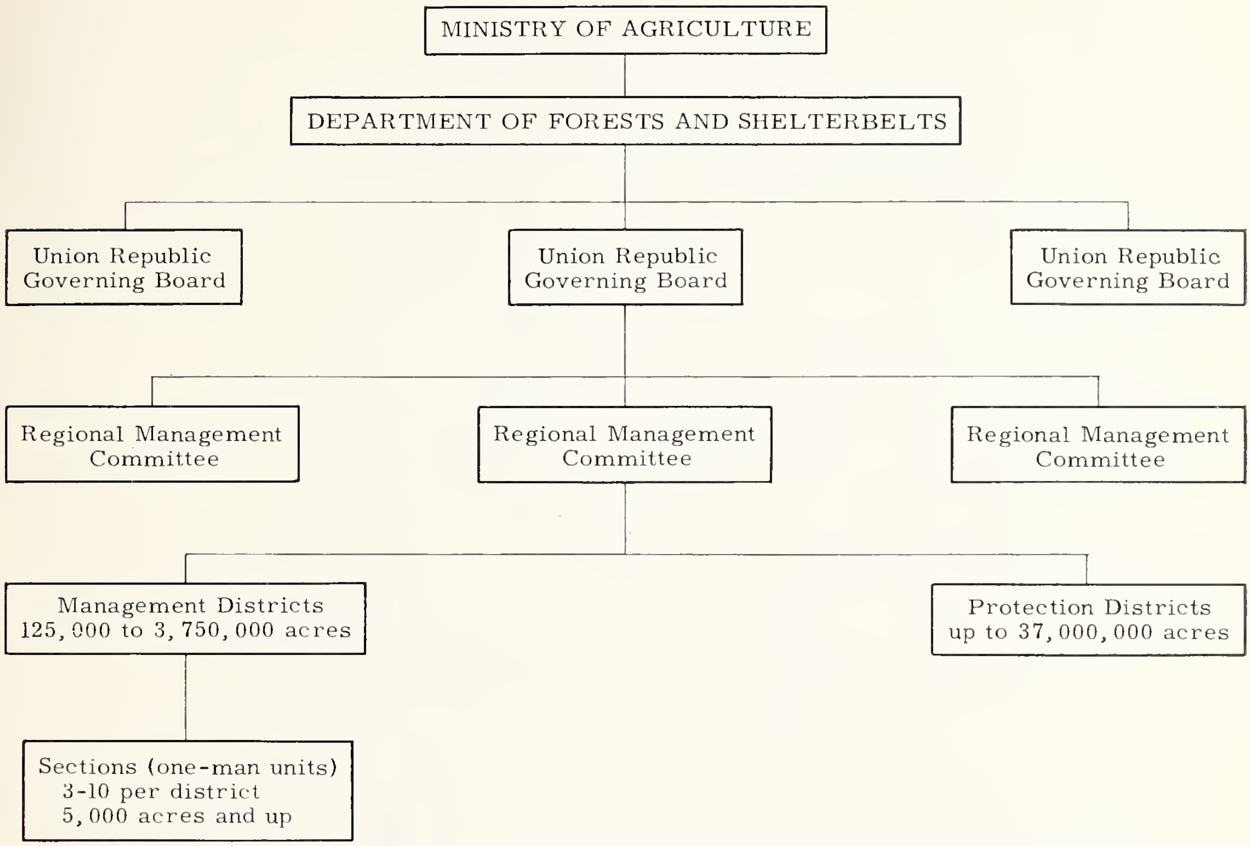

FIGURE 3.—Organization of forestry in the Ministry of Agriculture, U.S.S.R. (in effect July 1959).

with annual operating costs of 30 million rubles ($7.5 million). The "profit" is said to be distributed to other regions of the republic where needs are greatest.

Timber Harvesting and Forest Industry Functions

Prior to October 1959, timber harvesting and both primary and secondary manufacturing were directed for the central government by the Department of Forest Industry and Forest Products (in the State Planning Commission). Each subdivision of a republic had a Council of Peoples' Economy which operated and directed the local enterprises. Stumpage allocations received from the Union Republic Governing Boards were assigned to lumber camps (lespromkhozi). Cutting areas ranged from 30,000 to 70,000 acres. There were 192 such lumber camps in the Leningrad region, for example, in 1959. The average period of activity of a lumber camp is 10 to 20 years, the time required to exploit the assigned cutting area.

Industries also came under the direction of the regional councils. Allocation of raw materials and distribution of products were controlled locally. Prices were fixed by the State Planning Commission in Moscow. Figure 4 is a schematic diagram of the industrial organization.

The New Forestry and Industrial Organization

According to an unsigned editorial,[6] as of October 1959 all forestry activities in the R.S.F.S.R. are concentrated in a newly created Main Forest Management Unit (Glavleskhoz), subordinated to the Council of Peoples' Economy (Sovnarkhoz). By a directive of the Council of Ministers, the new order . . .

> . . . will apply to the regions where forests of "industrial importance" are located. Their exploitation is subordinated to the national needs for wood, and will be based on "rational" utilization of the annual growth, with rapid liquidation of the mature and overmature timber in the vast eastern regions

[6] "Important Step in Development of Forestry," Lesnaya Promyshlenost (in Russian), Moscow, Dec. 1, 1959.

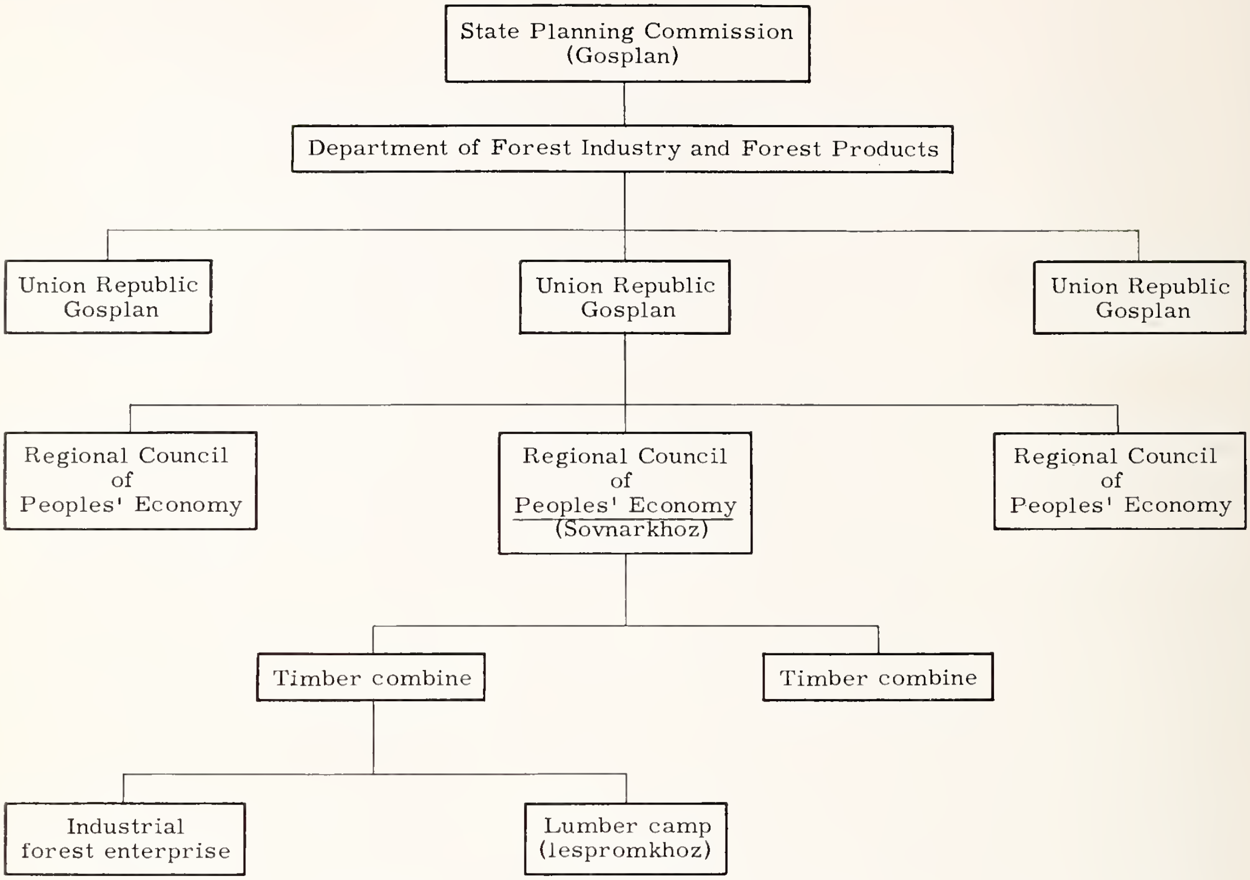

FIGURE 4.—Organization of forest industry in the State Planning Commission, U.S.S.R. (in effect July 1959).

of the Soviet Union. In other areas, where lespromkhozi [exploitation units] now exist, they will absorb the leskhozi [management districts] and all operations will be directly responsible to the newly created Main Forest Management Agency (Glavleskhoz), subordinated to the Council of Peoples' Economy of the Russian Federated Republic. If there are no lespromkhozi in the region, forest exploitation will be carried on by the leskhozi. But the new central agency assumes the responsibility for management of all forests, no matter under whose jurisdiction they might be otherwise. To control the cutting practices and to promote forest management and forest regeneration, this agency will establish an inspection division.

The new organization has existed for several years in the Latvian and Lithuanian Soviet Republics. Now that the Russian Federated Republic has adopted the same pattern, forestry activities on about 94 percent of the total forest area of the U.S.S.R. are so organized. This latest consolidation of administrative functions virtually duplicates the situation that existed prior to 1957 when most of the forestry activities were under the Ministry of Timber Industry. The recent change suggests that the U.S.S.R. is still searching for an efficient way to administer its forest resources and industry.

Research Responsibilities

Both the Ministry of Agriculture and the State Planning Commission, mentioned earlier, have responsibilities for directing research institutions. As far as we know, these have not been changed. The U.S.S.R. Academy of Agricultural Sciences coordinates the work of many but not all research organizations. It performs this function for some 80 agricultural and forestry research centers and conducts research through a system of its own experiment stations. Some forestry research, of course, is performed by forestry schools, and individual republics may have research institutes.

Typical of a forestry research institute coming directly under the Ministry of Agriculture is the Leningrad Forest Research Institute. This institute operates three field stations.

The State Planning Commisssion has two

principal research institutes, both of which deal with the timber harvesting or processing phases. The Central Research Institute of Mechanization and Energetics of Forest Industry, near Moscow, has five branches as far apart as Archangel (above the Arctic Circle) and Krasnoyarsk (south central Siberia). The institute also operates two experimental logging camps as pilot test areas for mechanical logging activities. The other major research unit under the commission is the Central Research Institute of Timber Floating at Leningrad. This institute investigates all problems connected with moving forest products by water.

The U.S.S.R. Academy of Agricultural Sciences, in addition to its coordinating function, operates the All-Union Research Institute of Forestry and Forest Mechanization at Pushkino (near Moscow); the All-Union Scientific Research Institute for Agro-Forestry Amelioration, at Stalingrad; and the All-Union Institute of Plant Protection at Leningrad.

Considerable forestry research is underway at forestry schools as part of the overall academic program. For example, the Leningrad Forest Technical Academy has a substantial research program. This institution is under the Ministry of Higher Education.

The foregoing is believed to be a fairly accurate though incomplete picture of research organization. The U.S. Forestry Delegation undoubtedly missed some features of organization. For example, in Leningrad, we heard of but did not visit the newly created Central Institute for Pulp and Paper Research under the direction of the All-Union Central Science Committee attached to the Cabinet of Ministers. This institute was reported to have 300 scientists working on pulp and paper research. Additional details and descriptions of the various institutes visited by the delegation are given in the Appendix.

Educational Functions

Forestry education is primarily the responsibility of the Ministry of Higher Education, which has 11 Forest Technical Academies or Institutes under its direction. The Ministry of Agriculture, however, directs the programs of 12 faculties or departments in the agricultural academies. In addition, there are 26 subprofessional forestry schools and 19 one- or two-year ranger schools. The three principal forestry schools under the Ministry of Higher Education are the Leningrad Forest Technical Academy, the Moscow Forest Technical Institute, and the Voronezh Forest Technical Institute.

As of 1957, there were 10,150 forestry students at the higher institutions, 11,900 in the subprofessional schools, and 11,400 in the ranger schools.

Forest Protection in the U.S.S.R.

Forest Fire Protection

Uncontrolled forest fires plague Soviet foresters just as they do those of other countries who wish to practice forest management. Long hours of sunlight during the summers in latitudes of the 50's and the 60's, typical of much of the Soviet Union, produce conditions favoring fire. In the coniferous forests around Moscow (56° N. lat.) and farther north, the fire season lasts from April to October. Eighty to 85 percent of the fires occur during the period May to August. As would be expected, cutovers with accumulations of lightweight fuels exposed to sun and wind constitute the greatest hazard.

Most fires are man-caused and of these half are attributed to carelessness. The classification of fires by cause and frequency of occurrence is as follows:

	Percent
Carelessness	50
Brush burning	20
Agricultural	15
Railroads	10
Lightning	4
Incendiary	1

We were unable to obtain up-to-date statistics on burned area. Buchholz (*5*) cites data from *Lesnoe Khoziastvo*, No. 5, 1940, as follows:

	Burned area (thousand acres) by years		
	1937	*1938*	*1939*
Section of U.S.S.R.:			
North and northwest	1, 133	526	59
West and East Siberia	605	1, 685	2, 314
Other regions	398	600	305
Total	2, 136	2, 811	2, 678

The acreage losses shown pertain to forests then administered by the Ministry of Timber Industry and therefore represent only part of the losses for the U.S.S.R.

Prevention

Considerable emphasis is placed on fire prevention by the Soviet foresters. We saw a number of educational posters and were shown examples of other fire prevention materials. There are laws prohibiting careless use of fire, but we were unable to find out what penalties are imposed.

The removal of whole trees in logging, including the tops, is a practice that is increasing and is partly justified on the basis of fire prevention. On other areas where logging slash accumulates, piling and burning is practiced, at least in the coniferous types. Firelines are plowed through some areas of extensive young coniferous growth (fig. 5).

Detection

Airplane detection is commonly used, although ground systems are the backbone of detection in the U.S.S.R., as in the United States. Lookout towers vary in design, one of the most unusual being a single guyed mast about 115 feet in height (fig. 6). The mast is equipped with handspikes and the climber is aided by a counterbalancing weight on a wire rope. The small platform at the top is about 4 feet square.

Fire Control

A fire danger rating system, apparently patterned after several early types tried in the United States, is in use throughout the U.S.S.R. The system combines temperature, wind, and moisture deficit (based on precipitation and days since rain) into an index rating. The ratings are in three principal groups, as follows:

Below 300	No appreciable danger.
301 to 1,500	Medium danger.
1,501 and higher	High danger.

FIGURE 5.—Firebreak in young even-aged Scotch pine, Drazhinski Forest Management Unit, Karelia.

FIGURE 6.—Lookout mast about 115 feet in height on the Syversky Experimental Forest near Leningrad. The lookout climbs to the 4-foot-square "crow's nest" on handspikes. His ascent and descent are accelerated by a counterweight on one end of a wire rope that passes through a pulley at the top of the mast. The other end is attached to the climber's belt.

Presuppression activities such as aerial patrol are adjusted to the ratings obtained from a network of fire weather stations. Danger maps for the forested portions of the country are issued together with 30-day forecasts of fire danger, for which the Soviet foresters claim a high degree of accuracy. The forecasts are, however, revised every few days.

Fire suppression is accomplished primarily by means of handtools, water, and mechanized fireplows. The variety of hand equipment includes straight-handled shovels, rakes resembling Council tools (serrated hoes), saws, and axes. The trombone hand water pump is standard equipment. The backpack water container is of black rubber, weighs approximately 10 pounds when empty, and holds about 3 gallons.

Gasoline-powered firepumps are heavy and not well designed for easy handling and rough use. They are not compactly built and do not compare favorably with standards of manufacture in the United States. The nozzles we saw are not as versatile as the equipment available to the average forest fire protection organization in the United States. Cotton-jacket rubber hose is standard—no linen or lightweight nylon hose is used. Hose washing and drying equipment is primitive. Fire trucks are sturdy 1½- or 2-ton vehicles, usually with a 200- or 300-gallon water or chemical tank. Some trucks are equipped with power takeoff pumps or auxiliary pumps, mounted on the front end with suction hose to pump from a surface water supply.

The extent to which mechanized fireplows are used was not determined, although a great number of sizes and models were seen. Judging by the emphasis placed on power equipment, and its general availability, the chances are that tractor-drawn plows are used considerably in firefighting. Among the crews we saw mopping up one fire were a number of women.

Chemicals, primarily a 70–30 percent mixture of calcium chloride and carbon tetrachloride, are used both from the air and by ground application. Monoammonium phosphate is another commonly used chemical fire retardant, we were told. Numerous devices for delivering chemicals from the air have been tried, including glass "bombs," parachutes, and paper bags. These have been discarded as impractical. The Soviet foresters do not "cascade" chemicals in free falls from planes and declare this to be impractical because too much dispersion of liquid occurs from the 300-foot minimum flying altitude prescribed. High explosives dropped from planes have been tried and are termed "successful."

The Soviets began smokejumping in 1934 and in 1936 several fires were controlled by jumpers, the delegation was told. We did not see any jumping gear and were informed that other than chutes, helmet, and heavy shoes, no special equipment is needed. Helicopters are now used extensively in the delivery and pickup of men combating fires. The U.S.S.R. maintains 11 smokejumper centers.

General Evaluation

The impression was gained that fire control units in the U.S.S.R. are not as well organized and well equipped as in the United States. Fire losses are reported as high—higher than insect and disease losses. This concerns the U.S.S.R. foresters and, given the opportunity, they could undoubtedly improve equipment and methods to the extent necessary to eliminate fire as a major threat to intensive management.

Forest Insect and Disease Control

On numerous occasions the importance of forest insects and diseases was brought to the attention of the delegation. However, we were unable to get specific data on losses caused by these pests. Insect and disease research is featured at all of the major institutes visited. This indicates the importance assigned to the problem.

Insect outbreaks are detected and their development followed by ground and aerial surveys. About 80 percent of the forested area is covered by an aerial detection system. We were told that insect outbreaks are being predicted on the basis of "climatic conditions and other meteorological measurements." Prediction of hazardous forest disease outbreaks has been less successful.

In the pest control programs considerable emphasis is given to protection of young stands and plantations. DDT is used in aerial application for defoliators. The Soviets reported that a system of using three airplanes in squadron formation to lay down chemicals eliminates the necessity of ground marking. Just how this works was not made clear. Helicopters were said to be too costly for insect spraying and hence are used sparingly.

The Soviet foresters expressed a keen interest in biological control efforts in the United States and said that this activity was only in the initial stages in the Soviet Union. They have tried to control an insect attacking Siberian cedar with an introduced predaceous insect, but success has been spotty and predators were difficult to get in large numbers. A bacterium (*Bacillus dendrolium*), effective on the sawfly, has been tried.

Some efforts have been made to reduce insect and disease depredations through cultural practices. Mixed shelterbelts, for example, are favored since they are more resistant to widespread pest damage. If oak and basswood are mixed with pine, sawfly damage is reduced. It is claimed that damage from soil-inhabiting insects which attack oak roots is greatly lessened if yellow acacia is introduced into the oak stands.

A large number of insect and disease pests were mentioned at one time or another in various localities as being troublesome. Some of these are listed here with brief explanatory notes.

Common Insects

Dendrolimus sibiricus (Tshtv.)—a serious defoliator.

Melolontha hippocastani F.—an important root-destroying insect, controllable with benzine hexachloride or DDT.

European sawfly (*Diprion pini* (L.).)—airplane spraying with DDT is used.

Almost all hardwoods are attacked by *Altica saliceti* (Weise). Scotch pine is attacked commonly by *Ips* and *Dendroctonus* bark beetles.

Common Diseases

Lophodermium pinastri—a foliage disease of pine seedlings. Control in the nursery is said to be possible by growing pine and spruce in 50–50 mixture in the seedbeds.

Ophiostoma cubanicum—a fungus very similar to *Ceratocystis fagaccarum* (Bretz) Hunt, the oak wilt fungus found in the United States. It occurs primarily in the Caucasus and on Soviet borders near Roumania and Bulgaria.

A "*black rot*" *fungus* attacks the root collar of cork oak in the Caucasus. The disease is controlled by grafting cork oak scions to native oak root stocks.

Dutch elm disease is found widely in the U.S.S.R. Research workers at the All-Union Institute of Plant Protection believe that the fungus causing the Dutch elm disease and oak wilt may be one and the same. We were told that they have evidence that the fungi differ only in the conidial stage and this may be due to environmental influences.

Heart rots are common in aspen and to some extent in spruce and pine. We were told the common fungi are *Fomes fomentarius* and *Fomes igniarius* on the aspen and *Trametes pini* on the conifers.

Chestnut blight (*Endothia parasitica*) is common in the Caucasus but does only minor damage.

The shoestring fungus (*Armillari mellea*) is present but not a serious pest. Stem rots are the main problem with the oaks.

Timber Crops Production and Management

The U.S. Forestry Delegation received two strong and important impressions of Soviet timber-growing activities. First, the whole approach to silviculture, genetics, and other biological aspects of forestry is strongly influenced by biological philosophy and concepts unlike our own. Second, the policymakers in the U.S.S.R. are apparently preoccupied, at least currently, with the engineering or extractive phases of timber production. Certainly the proportion of time, energy, money, and brains that is being directed to the mechanization of logging and related transportation and processing activities appears to be out of balance with that devoted to silvicultural and forest management problems.

We feel these two basic impressions are important to an understanding of current and future timber production in the U.S.S.R. For this reason, we shall present some background information on biological theory and the problem of exploitation versus management.

Biological Philosophy

The New Soviet Biology

To the Western visitor, one of the most striking and enigmatic features of silviculture in the U.S.S.R. is the biology on which it is based. Although much has been written, chiefly by geneticists, in the past two decades on this subject, most foresters in the United States are unaware that a very marked schism exists between the biological philosophies of the Communist and non-Communist worlds. This new biology has an important impact on silviculture and management practices in Soviet forestry. Following is a short history and summary of its principal tenets.

The fundamental points of divergence in Soviet biology from "classical" biology are in genetic theory, but these differences have been extended into all biological disciplines with the result that a distinctive plant and animal physiology, ecology, silvics, etc., have emerged. The related applied sciences, such as agronomy, horticulture, and forestry have been altered to conform to the principles of the new biology.

Tenets of the new biology are based chiefly on the writings of I. V. Michurin, a self-taught practical plant breeder and nurseryman who lived 1855–1935. Soviet "Michurinists" point out that the counterpart of Michurin in the United States was Luther Burbank. Indeed, Burbank (often called the "American Michurin") and Charles Darwin are the only non-Soviets recognized as "authorities" in the new biology.

Michurin's contributions to Soviet horticulture were undoubtedly considerable, for he introduced wild and improved varieties of many fruit plants on a large scale, hybridized them with native varieties, and selected hardy and otherwise desirable individuals from the segregating progenies. Unfortunately, however, as Zirkle (*36*) points out, Michurin was a true scientific innocent, for the interpretations of his uncontrolled experiments were largely *post hoc* and in some cases extremely naive. He claimed, for example, that he could "teach" winter hardiness to his plants but that only a few seedlings in each progeny were capable of learning "the trick." He confused graft chimeras (which he termed "graft hybrids" or "vegetable hybrids") with true hybrids and originated the "pollen mixture" technique of effecting difficult crosses. His own explanation of this method follows:

> In dealing with interspecific crosses definitely known to be difficult, I have often achieved some success by adding a very small amount of pollen from the maternal parent to the pollen of the male parent (*18*).

Michurin's principal claims to biological fame, however, are doubtless based on his support of the philosophy of dialectical materialism, the doctrine of environmentalism, and the Lamarckian concept that acquired characters are inherited. He was an outspoken critic of Mendelian genetics.

The principal current proponent of Michurin biology is T. D. Lysenko, head of the Chair of Agronomy at the Timiryazev Academy in Moscow. Lysenko's main contribution to the new biology is the concept of phasic development. According to this concept, Cook (*11*) explains that living matter is assumed to act out its inevitably conflicting dualism in a continuing spiral of thesis (birth), antithesis (death), and synthesis (the organism). Lysenko calls these opposed forces "senescence and rejuvenation." This struggle results in a "phasic development of a plant as one or the other tendency happens to prevail." The trick in developing new forms is to "destabilize," "shake," or "shatter" the heredity at a critical phase. In Lysenko's words:

> The practical value of organisms with a destabilized heredity is obvious. Such organ-

> isms become particularly susceptible to change and serve as excellent plastic material for creating forms of plants with the needed hereditary properties (*16, p. 299*).

Although Darwin is honored as one of the authorities of the new biology, his acceptance of Malthusian ideas on population growth and control, which Darwin used to explain natural selection, has been repeatedly repudiated by Communist philosophers. Lysenko denies that intraspecific competition of any kind exists in nature:

> Intraspecific competition does not exist in nature and there is no reason for fabricating it in science. A keen struggle of ideas is in progress and the new always meets with resistence from the old. But here in the Soviet Union the new always wins (*16, p. 514*).

Lysenko's severest condemnation of the biology of the West is directed most virulently and frequently at "Mendelist-Morganist" genetics:

> The laws that govern heredity, the laws of life of organisms, can be understood only from the standpoint of the theory of development. This explains why in bourgeois society biological science is the most backward branch of science. Recognition of the theory of development is detrimental to, is incompatible with, the interests of the decaying capitalist system (*16, p. 284*).

Lysenko, in the following statement, and in numerous others, easily disposes of the chromosome theory:

> Thus experiments in vegetable hybridization provide unmistakable proof that any particle of a living body, even the plastic substances, even the sap exchanged between scion and stock, possesses hereditary qualities.
> Does that detract from the role of the chromosomes? Not in the least. Is heredity transmitted through the chromosomes in the sexual process? Of course it is.
> We recognize the chromosomes. We do not deny their existence. But we do not recognize the chromosome theory of heredity. We do not recognize Mendelism-Morganism (*16, p. 547-548*).

At the meeting of the Lenin All-Union Academy of Agricultural Sciences in Moscow, July 31–August 7, 1948, Michurinism was formally accepted as the state biology of the U.S.S.R. In more recent years, there have been efforts to revive Mendelian genetics in the Soviet Union. Published work in the field of forest genetics indicated a gradual but distinct deemphasis of Michurinism from about 1950 to 1957. The review of "Newer Russian literature in forest tree breeding and forest seed investigations," published in 1953 by Buchholz (*6*), contains many quotations from Soviet papers published in 1951. In these papers, anti-Mendelian feeling clearly runs high. In contrast is the report by Nekrasov (*20*) on the "Conference on Problems of Forest Selection," held in Moscow in 1957, which was attended exclusively by scientists from 39 organizations scattered throughout the U.S.S.R. This report indicates a strong swing toward classical biological concepts. However, something clearly must have happened in late 1957 or in 1958; the United States Forestry Delegation saw or heard nothing that would support the conclusion that Michurinism was on the decline in the U.S.S.R. in 1959. We did, however, hear a comment that a new laboratory was being established in Siberia for the study of "Mendelist-Morganist" genetics.

Under the conditions now prevailing, we would expect progress in Soviet biology to be hampered. The extent to which young scientists will be attracted to biological fields is something of a question. The situation is much different in the engineering and utilization fields of forestry. The "hard" sciences such as mathematics, chemistry, physics, astronomy, and the related applied fields are free of philosophical restrictions. Clearly they are strong, and apparently getting stronger.

Concepts in Silvics

The language barrier and especially the limitations imposed by time made it often difficult or impossible for our delegation to obtain detailed information on biological questions and related silvicultural and management problems. We were, however, fortunate in having the company of Professor V. G. Nesterov, Head of the Chair of Forestry at the Timiryazev Academy, for about half the period of our visit in the U.S.S.R. Professor Nesterov, an ardent supporter of Michurinist doctrine, is generally recognized as the current leading authority on silviculture in the Soviet Union. His book, *General Silviculture* (*21*), is a widely used text in the forestry schools of the U.S.S.R. and satellite countries. Copies of this book were kindly presented to the delegation by the author.

Prior to 1948, when Michurinism was formally accepted as the basis of U.S.S.R. biology, the two most widely consulted modern works on Soviet silviculture were Morosov's *Theory of The Forest* (1914) and E. M. Tkachenko's *General Silviculture* (1939). Tkachenko, a student of Morosov, was a celebrated teacher at the Leningrad (Kirov) Forest Technical Academy (1919–50), and enjoyed the international respect of contemporaries in his field. Tkachenko died in 1950; in 1952 a revised second edition of his book was published (*28*). This version is brought up to date ideologically by incorporating the tenets of Michurinism and revision of the bibliography in favor of old and new

Russian authors. Relics of Tkachenko's ideas still persist, however, in the new edition.[7]

The following paragraphs illustrate how some basic silvical concepts differ between East and West as expressed by Nesterov (*21*). Some of these differences are doubtless negligible and exert little influence in forestry practice; others apparently do profoundly influence certain silvicultural and management policies and practices in the Soviet Union. Although emphasis here is placed on differences, the fact is that there are many broad areas of general agreement between the Soviet and non-Soviet versions of silvics. Abundant evidence exists that much of Soviet silviculture was profoundly influenced by the work in Germany, Finland, and the Scandinavian countries during Czarist times and much of the post-revolutionary period. Conversely, many Russian foresters such as Morosov, Tkachenko, and others made important contributions to development of forestry in the West. Although Nesterov speaks for the currently official biological thinking in the U.S.S.R., undoubtedly many individual Soviet scientists subscribe privately to more classical concepts.

An previously noted, one of the important tenets of Marxian biology is the insistence that population pressure plays no selective role in evolution. Lysenko in his *Agrobiology* and Nesterov in his *General Silvicvlture* repeatedly emphasize that no intraspecific competition can or does exist in nature. But the natural thinning which is typical of pure stands of forest trees and other plants, and which cannot conveniently be ignored, is not by Marxian standards an example of intraspecific competition. Lysenko explains the situation in the following manner:

> Wild plants, particularly various species of forest trees, possess the biologically useful property of self-thinning. The property of self-thinning consists in the ability of dense sprouts of a particular species by reason of their mass to successfully withstand other species and at the same time not to interfere, to compete, with each other. The reason why this happens is that as the young trees grow, fewer woody plants than those that exist can provide the requisite contiguity of crowns (branches); therefore a number of trees normally are eliminated, die off. When the growth of trees is dense, a process of differentiation, as practical foresters call it, separating the trees into an upper, intermediate, and lower layer, goes on within each species. Trees of the lower layer have outlived their usefulness and wither away while those of the intermediate layer pass on to the lower or upper layer as circumstances may determine. Wild plants, particularly forest trees, as has already been stated, possess the property of timely self-thinning in so well-expressed a form that even experimentally they cannot be sown so densely as to cause the kind of tree (species) in question to perish on that account in the given area. Quite the opposite; the more densely the species in question is sown, the greater the probability of its favourable development in the particular area (*16, pp. 562–563*).

By non-Soviet standards, this statement is a perfectly acceptable explanation of self-thinning in forestry or of natural selection in evolution. The observation that species extinction is not threatened in the area concerned—which is apparently the point of Lysenko's argument—is irrelevant.

Nesterov's principal contribution to the new Soviet silvics is a Michurinized version of the Kraft tree classification system, which he applies to all tree species. The idea of dominance is replaced by growth and development, in line with Lysenko's phasic development theory. According to this system, the trees in the forest are divided into five growth classes, and each of these in turn is divided into three development classes.

Nesterov makes reference to the work of the Soviet scientist Tokin, who is credited with the discovery that some forest plants give off volatile antibiotics that are capable of killing bacteria and fungi. Such antibiotics are said to be produced by birch, *Prunus padus*, juniper, and species of garlic and onion. They are credited with the ability to destroy the causal organisms of such diseases as tuberculosis, typhus, cholera, diphtheria, and others. According to Nesterov, "the forest is the best air purifier, ozonizer, and pasteurizer" (*21, ch. 5*).

The bioelectrical potential exhibited by trees may be used, says Nesterov, to determine their state of health. Bioelectrical potential is measured with a sensitive voltmeter, both contacts being placed in the cambium. A "plus" reading indicates healthy conditions, whereas a "minus" reading shows the presence of disease. The bioelectrical potential is also said to change with phasic development. The bioelectrical potential is believed to be related to atmospheric electricity. Nesterov states that "as is known, corn and tobacco when grown under a wire mesh grow poorly. There are some [Soviet] experiments which indicate that the interaction between the electrical field of the forest and that of the atmos-

[7] English-speaking foresters may profitably consult the "Origin and Propagation of Forestry Ideas" by Tkachenko (or Tkatchenko) in the *Journal of Forestry* 28: 595–617. 1930.

phere has an influence on growth but this has been little investigated" (*21, ch. 5*).

According to Nesterov, a strong periodicity in seed years does not occur in the forest trees of the Soviet Union, since this would be "idealistic" (*21, ch. 7*).

Nesterov observes that seed weight is of great importance; big seeds give big plants. This is cited as "another example of the infallibility of the Michurin-Lysenko theory" (*21, ch. 7*).

Exploitation Versus Forest Management

The second major impression the U.S. Forestry Delegation received in the area of timber crops production was the degree to which forest exploitation dominates forest management. This situation represents a fundamental defect of timber growing in the Soviet Union and appears to be traceable to the inherent weakness of the administrative system employed, at least up to October 1959. Until then, the responsibility of tending, regenerating, and protecting the forests rested with the management units (leskhozi), under direction of the Ministry of Agriculture, but the responsibility for logging rested with the so-called exploitation units (lespromkhozi) subordinated to the Councils of People's Economy (sovnarkhoz). In some logging operations, such as the Shoujsko-Vidansky lumber camp in the province of Karelia, the logging is apparently carried on in an essentially independent manner. Such an arrangement is probably typical of most management units in the group 3 forests, i.e., the primarily industrial forests in the North European and Siberian forest regions.

But even in the group 2, or sustained-yield forests, where the allowable cut should not exceed growth, complications have arisen as noted by Pronin (*24*):

> A great disadvantage, which Soviet forestry and forest industry faces, is the very low priority it is given as a producer of consumer goods. . . . Logs are often left in the woods for the lack of hauling equipment. . . . This helps to explain the following information given during a forestry conference in Moscow, by B. Perepechin, Soviet Vice Minister of Agriculture [Izvestia, Jan. 21, 1959, Moscow]. He states that there has been a great over-cutting of the timber supply according to the management plans, and a great amount of cut timber has been left in the forests to rot. In 1956, this over-cutting reached 670 million cu. ft., and in 1957, it was close to 953 million cu. ft. Since more than 812 million cu. ft. of cut timber was left in the woods in 1957, it is difficult to call these conditions of forest exploitation anything other than chaotic.
>
> In the forest-deficient zones, logging has become a devastation practice rather than scientific forest management. During the Moscow meeting previously mentioned, the deputy director of the Kiev Province Forest Office reported that wood allotted to the year 1977 was being cut at that time—in other words, 20 years too soon. V. Solouhin [Vladimir Solouhin, "Vladimirskie Proselki," Young Guard Publishing House, Moscow, 1958] reveals in his book that in Vladimir Province (oblast), 150 miles east of Moscow, the central authorities ordered cutting that exceeded the annual growth by 30 per cent. Cutting was also ordered in the protection forests, which are located in 1.5 mile wide belts, along river courses.

Our delegation spent a day inspecting the cutting operation at the Krestzy timber production unit (lespromkhoz), in company with its director, G. I. Mastobayev. He, with coauthor Sin'gov, has expressed concern with the management-exploitation problem in a paper (*17*) which says in part:

> Practice has shown that in 15 to 20 years logging enterprises exhaust the available forest resources and have to discontinue their operations. With such relatively short cycles, large capital investments in mechanized forest exploitation remain unamortized. As an example, Krestzy lespromkhoz can be cited as having forest resources in the Novgorod region of about 2.5 million m.^{3} of mature timber. The lespromkhoz and other producers cut every year more than 300,000 m.^{3} of timber. With the existing system of forest exploitation, the available mature timber in the Krestzy lespromkhoz will apparently be liquidated in 7 or 8 years. . . . This situation is a result of an incorrect, one-sided approach to the control of the timber supply on which timber exploitation enterprises depend, but this situation cannot be considered unavoidable. . . . At the present time organizations engaged in forest exploitation are not interested in the questions of forest regeneration, improvement in forest productivity or in the possibilities of sustained yield. At the same time, forest managers are quite unconcerned about the questions of rational organization of forest exploitation and more effective utilization of forest products.
>
> At the present time forest exploitation in the forest regions of the second class [i.e., group 2 forests] is carried out in the same manner as in the northern and eastern regions of the third class [i.e., group 3 forests], and thus the economic advantages of the forests of the second class are largely unrealized. The main obstacle to solving the pressing problem of modifying forest exploitation practices is the organizational separation of the forest products industries and forest management.

> Between the two exists a departmental barrier which has an equally negative effect on forest exploitation and on forest regeneration and improvement of forest productivity.

B. Osipov (*23*) commenting on a report by N. S. Khrushchev on "Control Figures of Development of the Economy of the U.S.S.R. in the years 1959–1960," states:

> There must be only one boss in the forests, responsible for management and exploitation of forest resources; such is the opinion of all managers and scientific workers.
>
> In the Ukraine Republic, with the present rate of cutting, the supply of mature timber will be exhausted in the near future, even in the Carpathian region. The remaining exploitable forest resources in the Ukraine Republic do not exceed 25 percent. Denuded areas are increasing. At the same time it should be noted that the forest exploitation operations in the Ukraine are over-blown. For 1 million cubic meters of harvested forest products there are 700 specialists and (office) employees. . . .
>
> In the interest of further development of forestry in the Ukraine it is necessary to liquidate all of the forest exploitation groups (lespromkhozi) and to entrust forest exploitation to the forest management units (leskhozi). The central figure in the forests must become a forester. Compensation for the work of specialist foresters must not be less than that of specialists in forest exploitation.

The change in responsibility for forest management announced in the fall of 1959 is undoubtedly made to help solve the question of exploitation versus management. It will be interesting to see the extent to which an organizational shift can relieve problems that have troubled Soviet officials for many years, even though the change is in the opposite direction from that recommended by Osipov.

Reforestation Program and Methods

Planting

Data on nursery production and planting in the U.S.S.R. are especially difficult to obtain and those which are available appear to be of doubtful accuracy. The figures cited by Nesterov (*21*), for example, are presented in such a manner that one is inclined to feel that they have more political than biological significance. In the introduction of his book, Nesterov declares:

> In the last 50 years the U.S.A. has devastated their forests, creating 25 million ha. [62 million acres] of forest deserts. . . . It has planted in all its history only 1 million ha. [2.5 million acres]. In the last 35 years the Soviet Union has planted 5 million ha. [12 million acres], but [under the czars] only 1 million ha. were planted. Annually, before the Great Fatherland's war, the U.S.S.R. planted 300,000 ha. [740,000 acres] of new forests.

In the final chapter of his book Nesterov (*21, ch. 19*) makes the following statements:

> After the victory of the war forests are being grown like never before [in the Soviet Union. . . . From 1949–1952, 2.6 million ha. [6.4 million acres] of new protection forests were seeded and planted. That is more than the plantations of all capitalistic countries together.

Similarly, in the post-mortem revision (i.e., the 1952 edition) of Tkachenko's book (*28*) the following data are presented:

> According to Marx, capitalism is not interested in reforestation but forest devastation through logging. A typical example is the U.S.A. Fires and exploitation have destroyed there 540 million ha. [1,335 million acres], but only 756,840 ha. [1,870,000 acres] or 1/700th has been replanted. . . . In Minnesota in 20 years, from 1909 to 1928, hundreds of sawmills were closed and only 3 percent of the virgin forest remains. The present reforestation program will get the state self-supporting again only after 7,000 years. . . . The anarchistic nature of the capitalistic system is not able to carry through a program [in forestry]. . . .
>
> The annual reforestation program in the U.S.A. is 2,350 ha. [5,800 acres]—40-year average on afforested federal land; in Sweden 5,200 ha. [13,000 acres]—30-year average; in Great Britain 6,784 ha. [17,000 acres]—1920 to 1934; in the U.S.S.R. 88,567 ha. [220,000 acres]—1927 to 1938.
>
> The U.S.S.R. has planted 165 times more shelterbelts than has Canada. According to the Stalin plan for the steppes, in the period 1949 to 1965, 5,709,000 ha. [14 million acres] of forest should be planted, plus 320,000 ha. [800,000 acres] of sand dunes during the period 1949 to 1955. From 1951 to 1955, in the U.S.S.R., 2,500,000 ha. [6,250,000 acres] will be planted in kolkhozes [collective farms] and 2,500,000 ha. in federal forests.

Since the above data were released (1952) plans for reforestation have expanded materially. We were informed at the Ministry of Agriculture that the seven-year plan calls for reforesting 27,180,000 acres. About 247,000 acres of the total are to be planted each year for shelterbelts and in erosion control or sand dune fixation. The planting program comes under the Agronomical Forest Project in the Ministry of Agriculture.

Data on area "planted" in the U.S.S.R. clearly combine, as is the custom in that country, both planting of nursery-grown stock and areas direct seeded. Almost certainly the latter kind of artificial regeneration, especially in the group 3 forests of "industrial significance," accounts for a large percentage of the area claimed to have been planted. It also appears not unlikely that areas where special seedbed preparation has been done, such as scarification treatments of various kinds in connection with logging operations, might be given "planted" status. We were told, for example, that in 1958 approximately "1,400,000 ha. [3,460,000 acres] were reforested, half of this through natural regeneration."

We had difficulty obtaining information on quantity and quality of forest tree nursery stock produced in the U.S.S.R. We visited several small experimental or demonstration nurseries (Exhibitions of Economic Achievement in Moscow and Kiev and at the arboretum in Pushkino) but only two that could be classed as actively engaged in the production of forest nursery stock. One was located at the Syversky Mechanized Leskhoz near Leningrad, the other at the Zhitomir Forest State Farm (west of Kiev). Both were relatively small, 12.5 and 11 acres respectively, but the neatness with which they were maintained was impressive.

The Zhitomir nursery produces principally 1–0 pine and 2–0 spruce, some larch, walnut (*Juglans manshurica*), and poplar. The production per acre of nursery is reckoned at 1 million for pine, 800,000 for spruce, 400,000 for larch, 245,000 for walnut, and 200,000 for poplar.

The Zhitomir Board of Forest Management (Ukrainian SSR) informed us that of the 395,000 acres of land reforested in their region since 1945, 98 percent was planted with seedlings and only the remaining 2 percent was direct seeded. This forest is in the group 2 category. In any event, the total area planted is of little biological importance unless survival meets acceptable stocking levels. No data at all on survival were made available to our delegation and it is doubtful if reliable information on the national level is available to many foresters in the U.S.S.R. Nesterov (*22*) does concede that there "were many failures in the steppe plantations between 1949–52 because of the use of seed from regions not suited and also to inadequate care of the plantations."

Although there may be some reasonable doubt as to claims of acreage planted, there is no doubt that planting efforts are being greatly intensified in certain regions, especially in the group 1 forests of some watersheds and in the steppes.

As noted previously, 395,000 acres of plantations have been established since 1945 in the approximately 2,470,000-acre forest area supervised by the Zhitomir Board of Forest Management. The current 7-year plan calls for the planting of an additional 247,000 acres, 40 percent on new areas, and 60 percent on cutover lands.

Plantations in this area are normally established at the rate of 4,000 to 4,900 plants per acre and thinned at the age of 12 to 3,200 per acre. We were told that close spacing, achieved by planting trees 12 to 18 inches apart in rows 6 feet apart, is used because it simulates natural forest conditions. Planting stock is 1–0 for pine and 2–0 for spruce. No transplants are used. We observed the preparation of an oak cutover site in the Zhitomir region where furrows were being plowed about 10 feet apart, preparatory to planting larch (fig. 7). The soil was deep and rich; while pine would probably do well here, strong competition from oak stump sprouts could be expected.

Direct Seeding

We saw several large-scale examples of direct seeding. One of these was with Scotch pine in the Drazhinski forest management unit in Karelia. clear-cut in 1948. Although four single seed trees per acre had been left, inadequate reproduction had occurred. In 1951, the area was direct seeded in spots about 16 inches square, with approximately 1,600 spots per acre. Twenty-five to 30 seeds were planted in each spot. The "take" in all spots was good and an excellent young stand of pine covered an area several hundred acres in extent (fig. 8). Dense clumps of pine in each spot were showing good height differentiation at the present age of 8 years, but the Soviet foresters were uncertain whether the spots should be thinned.

An experimental direct seeding of Norway spruce was observed at Mostovaya, about 190 miles west of Moscow. The clear-cut area had been prepared by plowing strips 3 feet wide and 18 feet apart to reduce competition from dense aspen sucker stands. Ten to 20 seeds were planted in the strips in spots at 3-foot intervals. Good germination and initial survival was observed, but competition from aspen will be severe. The Soviet foresters plan to cultivate the area periodically to keep competing growth in check.

We were told of promising results from direct seeding in the Krestzy area (Novgorod region), where precipitation averages 20 inches annually. The sowing rate for Norway spruce is 1.3 to 1.8 pounds per acre.

Shelterbelt Establishment

The most spectacular tree-planting projects in the U.S.S.R. are those in the forest steppe, steppe, and semidesert zones of the Russian Soviet of Federated Socialist Republics (R.S.F.S.R.) and the Ukrainian S.S.R. Our delegation observed several demonstration shelterbelt plantings at the *Exhibition of Progressive Experience and Its Application in the Practical Work of the Ukrainian*

FIGURE 7.—Preparation of an oak cutover site for the planting of Siberian larch on Zhitomir State Forest and Management Unit near Zhitomir, Ukrainian S.S.R. Cost of site preparation in this area averages $15 per acre.

Republic, at Kiev. At Stalingrad, however, we spent the greater part of 1 day visiting various segments of the "green belt" that is being established around the city (fig. 9), and state shelterbelts that extend for hundreds of miles in a north-south direction.

In the Ukraine, shelterbelts cover about 710,000 acres. In 1958, 24,700 acres were planted to shelterbelts, and it is estimated that 261,000 acres will be planted under the 7-year plan.

Shelterbelts with five rows (about 30 feet wide) are recommended in the forest steppe zone of the Ukraine, but six, seven, and eight rows are considered satisfactory. Belts wider than this do not do well in this region. One-row belts do not grow well either: average heights at age 22 are 10 to 15 feet less than the heights of trees in multiple rows. Oaks do not grow as fast as poplar and birch; the latter are considered best for the forest steppe zone in the Ukraine. Farther south, honeylocust, black locust, and species of oak are favored. The oak is planted as 1–0 stock or is direct seeded (three acorns per hole).

Some belts observed in the Ukraine were of the following composition:

1. Center row basswood with various oaks in other rows.
2. Rows of oak, maple, basswood, mulberry, ironwood, apple and pear, with shrubs in the outside rows.
3. Rows of oak and rows with honeylocust and maple alternating.
4. Rows of black walnut. These are used in forest zones and the northern part of the forest steppe zone.
5. Center rows of various poplar hybrids and birch with outside rows of wild cherry and silver maple.

The Soviet foresters believe that shelterbelts improve soil properties on sandy soils by increasing the organic matter content of the A_1 horizon. They stated that a 20-year-old planting increases the depth of incorporated organic matter by 1 or 2 inches.

Great emphasis is being given to the establishment of shelterbelts in the Stalingrad area. Stalingrad is located in a semidesert steppe zone

FIGURE 8.—Direct seeding was used to reproduce this clear-cut area on the Drazhinski Forest Management Unit after attempts to obtain natural reproduction by seed trees failed.

FIGURE 9.—Part of the Stalingrad "green belt." The principal species planted on better soils is *Quercus pedunculata*, shown here.

where the annual precipitation averages about 12–14 inches, 50 percent of which is in the form of rain. Primary objectives of the shelterbelt are to reduce wind velocities and thus reduce water loss by evaporation, physical damage to crops, and wind erosion. The latter problems are especially acute in areas of sandy soil, where wind velocities must be reduced to less than 8.5 m.p.h. to prevent damage to crops and soil.

Planting of the Stalingrad green belt was started before World War II, but the 7,400 acres planted before the war were practically eliminated during the German siege of the city. Present plans for the green belt call for a total planting of 18,500 acres. Postwar planting started in 1957 and about one-half of the proposed area is now said to be planted.

Intensive cultural methods characterize shelterbelt establishment in the Stalingrad area. Site preparation includes plowing to a depth of 20 inches, and after planting the soil is cultivated frequently to control weeds and maintain a dust mulch for water conservation. Irrigation is seldom feasible and is little used except where surface water is readily available. Depending on site and species involved, one-way row cultivation is applied 5 to 7 times a year and may be continued for as long as 7 years. In some cases, two-way cultivation is used.

Planting and cultivation are mechanized. We saw a four-way row cultivator designed for this purpose in operation (fig. 10). A conventional two-row cultivator was equipped with an outrigger on each side, each of the latter being manned. The crew, with tractor driver, thus consisted of three men (or women).

Although the design may vary, most of the shelterbelts in the Stalingrad area consist of three planted strips, each about 200 feet in width. Each strip is separated from the adjoining strip or strips by an unplanted zone, 1,000 feet wide. Thus the total width of the belt is 2,600 feet.

The strips are machine-planted in rows, the usual distance between rows being 10 feet. Spacing between plants within rows is usually 28 inches. One-way cultivation is used in such strips. We observed one belt in which the plants were spaced 12 x 12 feet within the strips and two-way cultivation was being used. In the absence of machine cultivation, prewar plantings were in rows 5 feet apart within strips.

Species composition used in the Stalingrad green belt varies from locality to locality, depending on previous experience with plantings on the soils concerned.

On heavy chestnut soils, the following trees and shrubs are commonly used: *Ulmus turkistana*, *Fraxinus pennsylvanica*, *Fraxinus viridis*, *Robinia pseudoacacia*, *Eleagnus angustifolia*, *Caragana arborescens*, and species of *Malus*, *Rhus*, and *Ribes*. On better soils (chernozems), the native *Quercus pedunculata* is widely used. On sandier sites

FIGURE 10.—Four-row cultivator in the Stalingrad "green belt."

Pinus sylvestris, species of *Populus*, and black locust are substituted for oak.

All stock, except oak, is nursery grown for 1 or 2 years. The oak (*Quercus pedunculata*) is normally direct seeded at the rate of 4 or 5 acorns per spot at intervals of 28 inches in the row. Apparently excellent survival is obtained by this method. The seed is obtained locally from small native stands that typically occur in ravines or gullies.

We discussed the effect of shelterbelts on crop yields with the staff of the All-Union Scientific Research Institute for Agro-Forest Amelioration in Stalingrad, which has done considerable research on the subject. Ameliorating effects of windbreaks around grain fields are said to increase yields from 175 to 350 pounds per acre. In another example given, the yield of wheat from an unprotected field was 2,000 pounds per acre while nearby protected fields produced 2,500 pounds. On this farm the protected fields were 250 to 275 acres in size and about 3 percent of the land was in shelterbelts.

Tree Improvement

The possibilities of extensive tree improvement through the eugenic application of mass selection practices in intermediate and reproductive cuttings are apparently generally accepted in Soviet forestry circles. Aljbenski (*1*), for example, devotes the first chapter of his book to silvicultural selection.

Tree improvement activities of a more intensive nature have, on the basis of the Soviet literature, been carried on in the U.S.S.R. for many years. Major interest appears to have centered on the introduction and "acclimatization" of exotics, and hybridization. Since most of such work since 1948 has by necessity been carried on according to Michurinist doctrine, it is difficult to separate fact from flummery. Reference to the use of "graft hybridization," the "pollen mixture method" of effecting difficult crosses, treatments to "destabilize" the heredity, etc., are typical of reports in this area; and it is often difficult to know if such statements are inserted for camouflage or if the techniques were in fact employed.

The work in "acclimatization" is particularly abundant and apparently productive. It is of special interest that most of such work is said to be based on Michurin's concept that some young, recently emerged seedlings when planted in a hostile environment are able to alter their "nature" and thus become acclimatized. In the next generation, more of the offspring of such plants will be adapted to the new environment. This explanation, of course, supports the Lamarckian hypothesis that changes in characteristics of an organism may be induced by the environment and are heritable. Such acclimatization is interpreted on a Mendelian basis as the result of selection among individuals of a genetically diverse population. Whether such work is carried on under the banner of socialism or capitalism, however, makes little difference, for the results in either case may be beneficial. By this method acclimatized forms have been developed through seed collections from surviving trees in old plantings of various exotic species in the U.S.S.R.

Nekrasov's report (*20*) of the "Conference on Problems of Forest Selection," held in Moscow in 1957, gave evidence of increasing interest in problems of ecotypic diversity of species native of the U.S.S.R. as well as exotics. Problems associated with the selection of "plus" trees and their testing and establishment in seed orchards were also discussed, as were the usually controversial subjects of polyploidy and the use of ionizing radiations as methods of improvement. In general, this conference appears to have been strikingly open and characterized by a free exchange of ideas, thus suggesting that the restrictions imposed by Michurinist doctrine were being relaxed. But as previously mentioned, Michurinism was found in full bloom in the summer of 1959.

Although much reference is made to "graft hybrids" in the Soviet literature, there is little indication that such activity is seriously pursued by most workers other than for propaganda purposes. Similarly, the purported use of "pollen mixtures" is likely cited by many workers for other than biological reasons. Aljbenski (*1, ch. 5*) indicates his Michurinist solidarity when he recommends the addition of a dash of pollen of the mother-tree species to that of the male species when especially difficult interspecific crosses are attempted. But is it doubtful if any serious tree hybridizer in the Soviet Union would willingly contaminate one of his controlled crosses.

Our delegation was shown several examples of so-called interspecific "graft hybrids." With the exception of one that appeared to be a chimera, the stocks and scions concerned appeared morphologically typical for their species. We were informed in one instance that the evidence of "hybridity" was based on the "heterosis" exhibited by the scion when compared with the growth rate it exhibited on its own root system. Several interspecific (even intergeneric) "hybrids," purportedly derived from the use of pollen mixtures, are on display at the U.S.S.R. Exhibition of Economic Achievement in Moscow. These plants all appear to fall well within the range of variation for the mother species.

Despite an obvious effort to give Michurinism strong support in the literature, much sound basic work in controlled hybridization is undoubtedly being done in the Soviet Union. Available reports show that controlled hybridization within and between species of the following genera has been carried on for a number of years: *Pinus*, *Picea*, *Larix*, *Abies*, *Betula*, *Populus*, *Quercus*, *Juglans*, *Fraxinus*, *Tilia*, *Ulmus*, and *Acer* (*1*, *20*).

Nesterov (*21*, *ch. 9*), as previously noted, has stated that through selection, hybridization, breeding of new forms, and improved cultural methods "the scope of forest improvement and production increase has reached dimensions in the U.S.S.R. which have never been seen before." If this is true, the evidence was concealed from our delegation. We saw no examples of even putatively improved forest trees, other than possible promising introductions, that had been outplanted other than for testing purposes. This situation struck our delegation as particularly anomalous in view of the enormous annual planting program that is reportedly carried on in the U.S.S.R. and the great potential usefulness that even the most minor improvements could provide.

Silviculture and Management Practices

The impressions of silviculture and management reported here are based on field observations in the area west of Moscow and north of Petrozavodsk, with additional limited observations in the forested steppe region of the Ukraine. Evaluation of the extent of various silvicultural and management practices has been influenced not only by what we saw and were told in the U.S.S.R. but by what we have since read in numerous Soviet publications, most notably that by Nesterov (*21*). Statistical data on the extent of various practices was difficult to get and often conflicting.

Forest Improvement or Intermediate Utilization Cuts

The term "improvement cuts" or "intermediate utilization cuts" in the U.S.S.R. is apparently roughly equivalent to the term "tending" in British terminology or "intermediate cuttings" as used in American silviculture, i.e., all treatments of the stand during the portion of the rotation not included in the period of regeneration, including cleanings, liberation cuttings, weedings, and thinnings.

According to Nesterov (*21*, *ch. 14*) improvement cutting should be done in conformity with the Michurin-Lysenko theory of phasic development of trees. Before the Revolution, improvement cuts were carried out on only 198,000 acres. In 1950, however, "2.2 mill. ha. (5.4 million acres) were cut for improvement, from which was obtained 33.5 mill. m.^{3} (1,180 million cu. ft.)."

The improvement cutting methods termed "thinning from below" and "thinning from above" were, according to Nesterov (*21*), Soviet innovations, as were also various combinations or modifications of them. The method most widely used so far in the U.S.S.R. is said to be thinning from above, but with the advent of Michurinist biology "radical improvements in forest improvement cuts have been made possible." In 1950, Nesterov worked out "new methods based upon the theory by Michurin-Lysenko on plant growth and development." The new methods are the "physiological rejuvenation method" and "liberation method."

The "rejuvenation method" is said to be usable in pine, spruce, aspen, birch, alder, linden, and oak pure stands. According to this method, the "physiologically or phasically young trees" are left and the "phasically old" trees are cut.

The "liberation method" is recommended for mixed stands. By this method, the best trees of the principal species are left, but secondary species and otherwise undesirable trees are cut with due consideration to tree physiological conditions, "phasic development," vigor, productivity, and quality. This method is applied in the early age of the stand.

In closing his chapter on improvement cuts, Nesterov emphasizes the basic absence of intraspecific competition: "From Lysenko's works it follows that improvement cuts are not necessary to lessen the competition between individuals of the same species, because there is no overpopulation in the forest; however, improvement cuts are necessary to serve the interests of man."

Unfortunately, our delegation did not have the opportunity to observe the several improvement cuts used in the Soviet Union in any detail. We were shown one experimental pine-spruce stand on the Drazhinski Forest Management Unit near Petrozavodsk on which the suppressed trees, all less than about 4 inches d.b.h., had been cut. This was said to be a thinning to increase nutrients and available water for the remaining trees and also to improve soil conditions. Our impression was that improvement or intermediate cuts in this area where the forests belong to the group 3 category having "industrial significance" are rare and of an experimental or demonstration nature.

Principal "Utilization Cuts"

The term "utilization cuts" corresponds to the term "reproduction methods of cutting" as usually employed by American silviculturists.

Three principal utilization cuts are employed in the U.S.S.R.: (1) Selection cuts; (2) shelterwood cuts; and (3) clear cuts. (The frequency of use, however, is in the reverse order.)

As employed in the Soviet Union, *selection cuts* may be of three kinds: (1) Selection of quality trees; (2) diameter limit cut; and (3) regulated selection cut. "Selection of quality trees" apparently is equivalent to the term "selective logging" in the United States (a high-grading method). "Diameter limit cut," another high-grading system, is evidently equivalent to American usage of the same term. The third type of selection cut, "regulated selection cut," is equivalent to the "selection method of reproduction" as used in the American literature.

Since selection cuts are ill adapted to the extensive even-aged forests of group 3, and to mechanization, their use is restricted to protection forests in the mountains, other watersheds, and resort areas.

We observed no selection cutting operations, but on a trip to Lake Ritsa in the Caucasus Mountains we saw many truckloads of what appeared to be very high quality beech (*Fagus orientalis*) and fir (*Abies nordmanniana*) logs being transported down the Pzyp river valley. According to our hosts, only sanitation or salvage cuttings are permitted in these protection forests.

The shelterwood system as a type of "utilization cut," according to Nesterov (*21*), is a Soviet "first" and was widely used in the past. Its use is evidently restricted now to the "nonindustrial" forests, since it is not well suited for mechanized logging methods.

Clear cuts in various forms are the utilization cuts most widely used in the group 2 and group 3 forests, the latter alone representing 85 percent of the commercial forest area. Distinguished mainly by the width of the strip or block cut, three general types of clear cutting are recognized: (1) Common clear cuts (width usually 330 feet, but may be as little as 80 feet, or as great as 800 feet); (2) concentrated clear cuts (widths from 1,700 to 3,300 feet and up to 6,600 feet in length); and (3) limited clear cuts (which take out 60 to 90 percent of the timber volume and are probably similar to so-called "commercial clear cuts" in the United States).

The "limited clear cut" has been largely abandoned because it is unsuited to mechanization. In recent years the wider "common clear cuts" and "concentrated clear cuts" have been used more. In these systems, seed trees are left singly or in groups and, if necessary, direct seeding is sometimes practiced.

Nesterov (*21*) contends that when the cutting width is reduced from 3,300 feet to 800 feet, the expense of securing natural reproduction is increased to 380–560 rubles per ha. ($95 to $140 per acre); whereas the cost of artificial reproduction (by direct seeding) on 3,300-foot clear cuts, is in the order of 250–375 rubles per ha. ($62 to $94 per acre.)

At the Mostovaya mechanized logging operation, in a spruce-aspen-birch type, blocks or "patches" 330 by 1,700 feet were being clear cut. The adjacent areas, we were told, would be clear cut in 3 or 4 years. Some effort had been made to avoid damage to advance spruce reproduction. It appeared doubtful, however, that these suppressed plants would survive.

We observed that the basic clear-cut unit at the Krestzy lespromkhoz (timber production unit) was 1,700 feet in width and 3,300 feet in length (roughly ⅓ x ⅔ mile), i.e., a "concentrated clear cut." This enterprise, located about midway between Moscow and Leningrad in the Novgorod region, is in the group 2 forest category. The Krestzy lespromkhoz has an area of about 1,000,000 acres. Twelve logging units are normally in operation at all times. Seed trees are typically left in groups. We were told that 20 percent of the clear-cut areas will usually reproduce naturally. Of the remainder, 98 percent is direct seeded and 2 percent is planted with 1–0 pine or 2–0 spruce stock. Although this operation has been active for at least 15 years, artificial reproduction has been used only for the past 2 years.

Mastobayev and Sin'gov (*17*) attribute the deficiencies in forest cultural work on the Krestzy forest to a shortage of qualified specialists and, apparently, a lack of interest in such activities:

> A considerable obstacle to carrying out forest cultural work experienced by the lespromkhozi is the scarcity of qualified specialists. At the same time in the Krestzy leskhoz [forest management unit], the talents of experienced forest specialists are not employed to full extent because of the limited scope of the forest cultural work in the leskhoz.
>
> In the 1958 year the Krestzy leskhoz planted and sowed only 90 hectares [220 acres] and carried out other regeneration work on 300 hectares [740 acres]. They could not do any

FIGURE 11.—Natural reproduction of Scotch pine by seed-tree method on Syversky Experimental Forest near Leningrad. The area was cut about 25 years ago. Seed trees have not been harvested.

more, since they have no mechanized equipment and only four workers.

At the Syversky Experimental Forest (administered by the Leningrad Research Institute of Forestry), we were shown several experimental pine clear cuts of different ages. The oldest appeared to have been cut 25 to 30 years ago (fig. 11). Most of the clear cuts had seed trees which were still standing. All of the areas were well stocked and the experiments were clearly successful.

Similar well-stocked pine clear cuts of various ages (up to about 25 years) were observed on the Drazhinski Forest Management Unit near Petrozavodsk in Karelia. On one well-stocked clear cut, made in 1937, four seed trees per acre were left. The seed trees, still standing, were to be removed in 1960. Workers on this unit are still undecided on the question of single seed trees vs. groups.

Some of the poorest clear-cut operations observed in the U.S.S.R. were those conducted by the Shoujsko-Vidansky lumber camp, operating in predominantly spruce forests. Headquarters of the camp are at Chelna, about 12 miles west of Petrozavodsk. The logging operation visited was 25 miles from Chelna. We traveled to the operation by narrow-gage railroad and thus had an opportunity to observe previous clear cuts in the area. Stocking was extremely poor in all observed areas (fig. 12). Most clear cuts conducted by these loggers are said to be in strips 800 feet in width and 3,300 feet in length. Seed trees are left in groups about 300 feet square. The poor reproduction in this area appears to be traceable to at least three factors: (1) The area is in the group 3 forest category, i.e., forests of primarily industrial significance; (2) poor fire control; and (3) no foresters on the staff. Also, an "incentive" or "bonus" system of production described later may have stimulated "production at all costs."

FIGURE 12.—Shoujsko-Vidansky logging operation, Karelia. The predominantly spruce forests are clear cut in strips about 800 feet wide and 3,300 feet long. Seed trees are left in groups about 300 feet square.

Other Forest Uses

Unlike the United States, where harmonized multiple uses of forest lands is a well-recognized principle, the U.S.S.R. offers little evidence of conscious effort to develop such objectives. Of course, timber production is the principal use of the forest and watershed protection is recognized in many areas as the dominant value of good forest cover. Production of big game and furbearing animals is recognized as requiring forest lands. However, we did not observe any substantial programs aimed at dual purpose management for timber and wildlife. One minor exception where multiple use is a planned objective of forestry is in parts of the shelterbelt region. For example, near Stalingrad, some shelterbelts are being established and specifically designed for future timber production, as well as for protection and recreational purposes.

Watershed Management

Recognition by the Soviet foresters of the importance of watershed management is evident because substantial forest acreages have protection as their primary function. These forests are not used for industry and the only utilization of material is from salvage and sanitation cuts. All shelterbelts, which help protect the land against wind and drought, also are included in this category. To improve composition in the protection forests, undesirable species are cut and desirable ones planted. Work of this nature has been done on 110 million acres so far. Although this is a relatively small part of the total forest land, the management of protection forests is considered significant.

In the Ukraine near Zhitomir, a 150-year-old oak stand covers about 24,000 acres. This forest is maintained in an uncut condition, primarily for esthetic reasons—although it also functions as a protection forest for a nearby river system. The forest is on nearly level steppe land with deep soil (fig. 13). Careful timber harvesting would not have damaged the watershed values but would have provided useful wood products in a timber-scarce region.

On the other hand, accelerated erosion is a severe menace in many parts of the U.S.S.R. The right bank of the Dnieper river is an example of this problem. We were told of a gully reforestation station in one of the towns on this river, where special machinery has been developed for gully-control work.

The delegation was informed that large areas in the Caucasus Mountains, on the eastern end of the Black Sea, are maintained as protection forests. To preserve the watershed values, only sanitation cuttings are permitted in these forests. As noted previously, however, some of the higher quality logs being hauled from this area did not appear to come from sanitation cuts. It was stated that all logging is done with horses and suspended cableways in the protection forests of the Caucasus.

The beneficial aspects of planting mixed conifer-hardwood stands were described to the delegation at several places, but no examples of such plantings were seen. The Soviet foresters believe that pine and basswood make a good combination to maintain and improve soil properties, watershed values, and growth, because the root system of basswood is said to stimulate the growth of pine roots.

Considerable attention is being given to wetland drainage, and research as well as general application of drainage practice is underway. For example, at the Syversky Experimental Forest, south of Leningrad, large-scale drainage work in peat soils was seen. Ditches are several feet deep and 3 to 4 feet wide, spaced about 150 feet apart.

Figure 13.—Oak (*Quercus robur*) protection forest, 150 years of age, on Zhitomir State Forest and Management Unit near Zhitomir, Ukrainian S.S.R. Understory plants are chiefly Norway maple, European hornbeam (*Carpinus betulus*), basswood, and hazel.

In some instances, extremely massive ditching equipment is used (fig. 14). Soviet foresters estimate, on 15 years' data, that ditching increases height growth about 30 to 35 feet in 100 years in this area. They consider the expenditure of 180 rubles ($45) per acre for this drainage program to be a good investment.

Forest Recreation

The people of the U.S.S.R. like the out-of-doors and many kinds of recreation were observed by the delegation. Fishing, boating, swimming, picnicking, and hiking are common. As is true the world over, water has a great attraction for recreationists.

At Kiev, a large public recreation area is under development on the Dnieper River with special facilities for handling crowds of swimmers, boaters, and picnickers. Tremendous numbers of vacationers visit the Black Sea resorts, where swimming, boating, and hiking seem to be the principal diversions. These forms of recreation are not properly classed as forest recreation but they do influence forest and park activities. For example, near Yalta and Sochi, very fine dendrological gardens are maintained by the Ministry of Agriculture. These areas receive heavy use by the vacationing masses along the Black Sea. The Yew-Boxwood Grove near Sochi gets a heavy use by sightseers and hikers from the resort areas. Along the major highways in the forest regions are some improved roadside picnic spots. One we visited had no tables, benches, or sanitary facilities, but did have a roofed shelter.

The United States Forestry Delegation members were told that big game is abundant in some regions. Small upland game, including birds, was reported in some areas. Hunting is permitted in season and the bag limits are carefully controlled, we were informed. We visited excellent wildlife museums at two institutions where some biological research on the animals is underway. We saw no examples of wildlife habitat management or research.

Grazing

The United States Forestry Delegation did not visit those parts of the U.S.S.R. reported to be the primary regions where forest grazing is important, such as the Turkmen, Tadzhik, and Kazakh Union Republics, The Urals, and West Siberia. In fact, we observed only occasional use of forest or associated rangelands for grazing. Goats are reported to be a problem in some areas in spite of regulations against allowing goats access to the forest. Principal damage was said to be in the timber stands adjacent to collective and state farms. On the natural rangelands near Stalingrad, we saw several large bands of sheep on badly overused range. We were told this degree of overgrazing was tolerated near the larger cities but was recognized as bad practice.

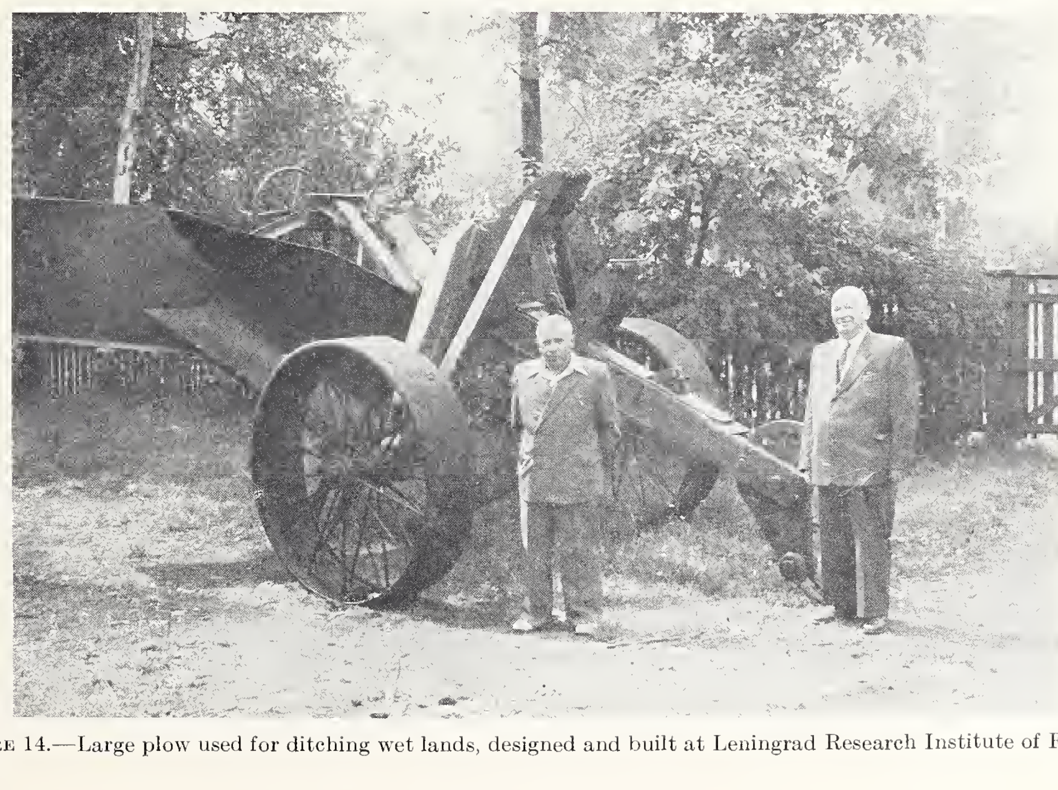

FIGURE 14.—Large plow used for ditching wet lands, designed and built at Leningrad Research Institute of Forestry.

Timber Harvesting

For the past 10 or 12 years, the Soviet logging industry has been undergoing some marked changes. Historically it has been a highly seasonal enterprise characterized by low worker output. However, in recent years the government has frequently reorganized the direction and control of timber harvesting in an effort to increase production per worker, stabilize the industry, provide for easier planning and control of logging, and perhaps to make social and political gains.

Recent reports by visitors to the U.S.S.R., and published accounts in the Soviet Union, all stress the many changes in the industry. Instead of a seasonal labor force recruited from the collective farms during the slack season, "permanent" logging enterprises (lespromkhozi) are now being established. These are complete villages with homes, schools, hospitals, and other facilities for a logging and timber handling enterprise. Reports differ, however, on the extent to which the lespromkhozi have solved many problems of the Soviet timber industry.

A strong trend toward mechanization of logging, timber transport, and timber processing has been described by every forestry group that has visited the U.S.S.R. Koroleff (*13, 14*) has reported in detail on many of the newer types of logging machines. We were told at the Ministry of Agriculture that (1) 90 percent of timber felling is by gasoline and electric chain saws; (2) logging-to-shipping-point operations are 90 percent mechanized; (3) woods transportation to lower yards [8] is 60 percent by trucks, 30 percent by narrow-gage railroads, and 10 percent by tractors; and (4) supplemental shipping to mills or other users is 50 percent by water, 30 percent by mainline railroads, and 20 percent by other means.

One characteristic of the trend toward mechanization in the U.S.S.R. is the high degree to which use of standardized but unproved equipment is adopted "by edict." In 1957, for example, it was reported that electric chain saws for timber felling, electric-powered winches and tractors for skidding and loading, producer-gas operated tractors, and floodlighted night logging operations were standard. Our delegation found most of these practices and equipment abandoned or on the way out. The changeover from the reported 136,000 electric felling saws in use in 1957 to a gasoline model, for example, is now said to be virtually complete.

[8] *Lower yards*, as will be explained more fully later, are merely concentration points where logs or trees are delivered from the woods for further sorting and processing.

Logging

We visited three logging enterprises: (1) Mostovaya—a tractor and truck operation about 190 miles west of Moscow; (2) Krestzy—a narrow-gage railroad, winch and cable logging enterprise near Novgorod; and (3) the Shoujsko-Vidansky operation near Petrozavodsk. We also saw some logging areas and equipment at Syversky, south of Leningrad; and at Zhitomir, near Kiev. The observations reported here probably represent the better logging operations of the Soviet Union, since it is unlikely that we would have been shown others. Mostovaya and Krestzy are pilot test areas for the newer logging equipment and practices developed by the Central Scientific Research Institute of Mechanization and Energetics of Forest Industry.

Felling and Limbing

Timber is felled with the "Druzhba" portable gasoline chain saw. The Druzhba weighs approximately 27 pounds, has a 3-h.p. engine, and 24-inch maximum chain. A stand-up frame permits the operator to work erect and use the knee to exert pressure on the cut (fig. 15). Recent models have rubber shock absorbers on the handles. Detachable starters and rotating blades are standard. We were also shown a hydraulic felling wedge, powered by the saw engine (fig. 16).

The older style electric chain saws were not being used in felling on the operations we visited, although we saw them at the landings. The usual model was the K–6, a 220-volt, 200-cycle, 1.7 k.w. capacity unit with 20-inch cutting bar. It weighs about 20 pounds.

On clear-cutting operations in mixed forests of spruce, pine, birch, and aspen averaging 30 to 40 cords per acre, one timber faller with a Druzhba gasoline chain saw could cut 6 to 8 trees, 8 to 20 inches in diameter, in 10 minutes. However, a conservative daily average would probably be 120 to 125 trees. The fallers usually had time to help in limbing or perform other tasks. Even so, there appeared to be much idle time for the fallers in most situations.

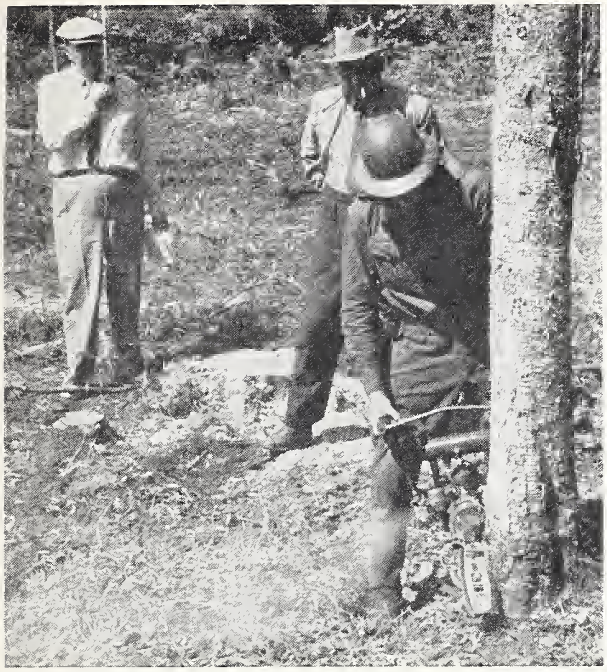

FIGURE 15.—Druzhba gasoline chain saw in operation, showing the "stand-up" frame.

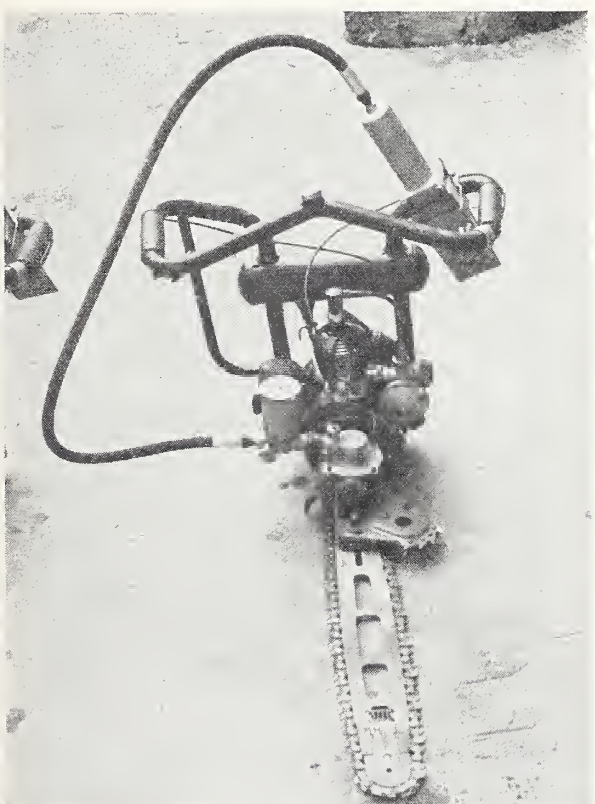

FIGURE 16.—Druzhba gasoline chain saw with hydraulic wedge.

Tree-length logging was standard on the operations we visited. Sometimes trees were removed with tops intact. Where trees were limbed, the workmen used 3-pound, short-handled, single-bit axes with wide blades. Tractor drivers sometimes helped in the limbing.

On the landings, a portable electric circular limbing saw was sometimes used. A number of models were seen, but a common type was equipped with a 15-inch thin circular saw on a 45-inch aluminum handle. The device weighs about 17 pounds (fig. 17).

Skidding

As already mentioned, we visited operations with tractor and cable skidding systems. Quite a variety of methods and machines were observed, some of them experimental.

TDT–40 and TDT–60 Crawler Tractors. These machines are good pieces of equipment and widely used. The TDT–40 is a cab over radiator model, with tilting deck apron, power winch behind the cab, and an A-frame fairlead mounted on the apron. The tractor has a 16-inch wide track approximately 15 feet long, with four large steel track wheels and front idler and driving sprockets. The front idler and driving sprockets are set up from the ground to enable the tractor to climb over snow, ice, and earth. The TDT–60 is almost identical in appearance but is a larger, more powerful machine (fig. 18).

TDT–60 Special Crawler Tractor, equipped with a Hiabob loading boom, is similar to a machine widely used in Scandinavian countries, Canada, and the United States. The boom has a cable lift and hydraulically controlled side swinging gears. A rubber-tired roadless trailer is attached to a center plate over the tractor transmission. In operation the machine is driven close to the standing trees. A timber cutter fells a tree across the trailer reach pole, and a tractor driver using a pike pole guides the direction of fall. The operator rights the tree on the tractor and trailer bunks, and moves the load to the next tree to be felled. The complete load of whole trees is hauled to the nearby improved road, where the trailer is transferred to a highway truck tractor unit for the trip to the lower landing.

"Super Tractor" Experimental Tree Harvesting Machine. This piece of special equipment, still experimental, is built on a crawler tractor of about 100 to 120 h.p. It fells, loads, and hauls whole trees from stump to landing. A heavy front-end knee action claw grasps the tree to be felled 8 or 9 feet above the ground and fastens a cable at this point. A 30-inch hydraulically driven and controlled circular power saw, operating horizontally on a knee-action steel arm, severs the tree (fig. 19). The machine has a rear-end winch with cable to pull the tree over on

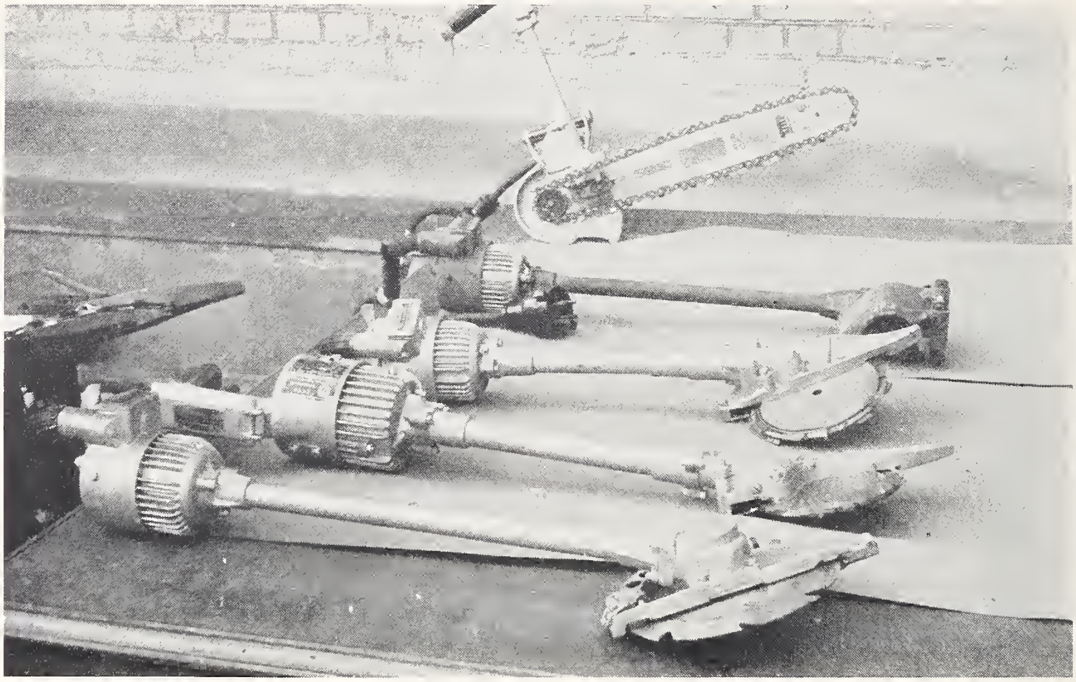

FIGURE 17.—Electric-powered equipment used in lower yards. In foreground are three limbing saws, then a portable concave-head barker, and a chain saw.

FIGURE 18.—Model TDT–60 tractor taking on load.

FIGURE 19.—Experimental tree harvesting machine. This is a TDT–90 crawler tractor with 30-inch hydraulic-powered circular saw, steel knee-action claw to grasp tree about 8 feet above the ground, and rear-end winch to pull tree over and bind it to the top of the tractor.

top of the tractor, where it rests in a toothed log cradle or bunk. The machine moves from tree to tree and makes up its load of 10 to 12 trees before hauling them to the loading station. The saw arms and winch are powered with two 30 h.p. hydraulic pump motors. The operator is protected from tree trunks and branches by a heavy steel canopy. We thought this machine was ingenious but considering machine cost, operation, and labor, it seems inconceivable that such a device could be a competitive unit even under optimum conditions.

A large crawler tractor with wide yoke was viewed at an exhibition in Moscow but not seen in operation. A TDT–90 with a wide yoke over the tractor had an arm extending on each side to an overall width of about 20 feet. Two cable winches were used to bunch logs to either arm. The unit was designed to operate on a road and skid the logs or trees in the ditch line, but its utility was not made clear to us.

A rubber-tired all-purpose tractor was seen in operation and appeared to be quite similar to the Caterpillar W–2, Michigan, Hough, or Le Tourneau rubber-tired units. This machine (fig. 20) had four 18- x 54-inch tires, two towing winches, and a 140 h.p. engine. It was equipped with an A-frame for skidding and a center plate hitch for hooking to a rubber-tired logging trailer. We were told the operator could inflate or deflate all tires from the cab, varying the pressure between 8 and 37 pounds, depending on ground conditions. This machine was undoubtedly one of the best we saw and on fairly good ground or unimproved roads would be a useful and flexible unit.

A high-lead logging winch, TL–5, was observed at Krestzy. This machine, about 125 h.p., was diesel powered and had three winch drums for skidding and two for loading. An electric generator supplied power for lights and for bucking and limbing saws. The logging operation, on level ground, had a 50-foot high-lead spar tree and in effect was a ground-lead yarding system. The yarder reached out a maximum of 800 to 850 feet. On one crew a walkie-talkie signal transmitter was used by the choker-setter to communicate with the winch operator.

Loading

Most loading was performed by skidding tractors towing a cable or using a winch to "parbuckle" the trees up an inclined skidway to the trucks. In another commonly used system, the tractor or winch pulled two cables rigged to gin poles, lifting the load for the truck to back underneath. The TL–5 winch was used to load whole trees onto railroad cars. Two 50-foot spar poles, supporting a 250-foot cableway span, were rigged

FIGURE 20.—The rubber-tired all-purpose tractor.

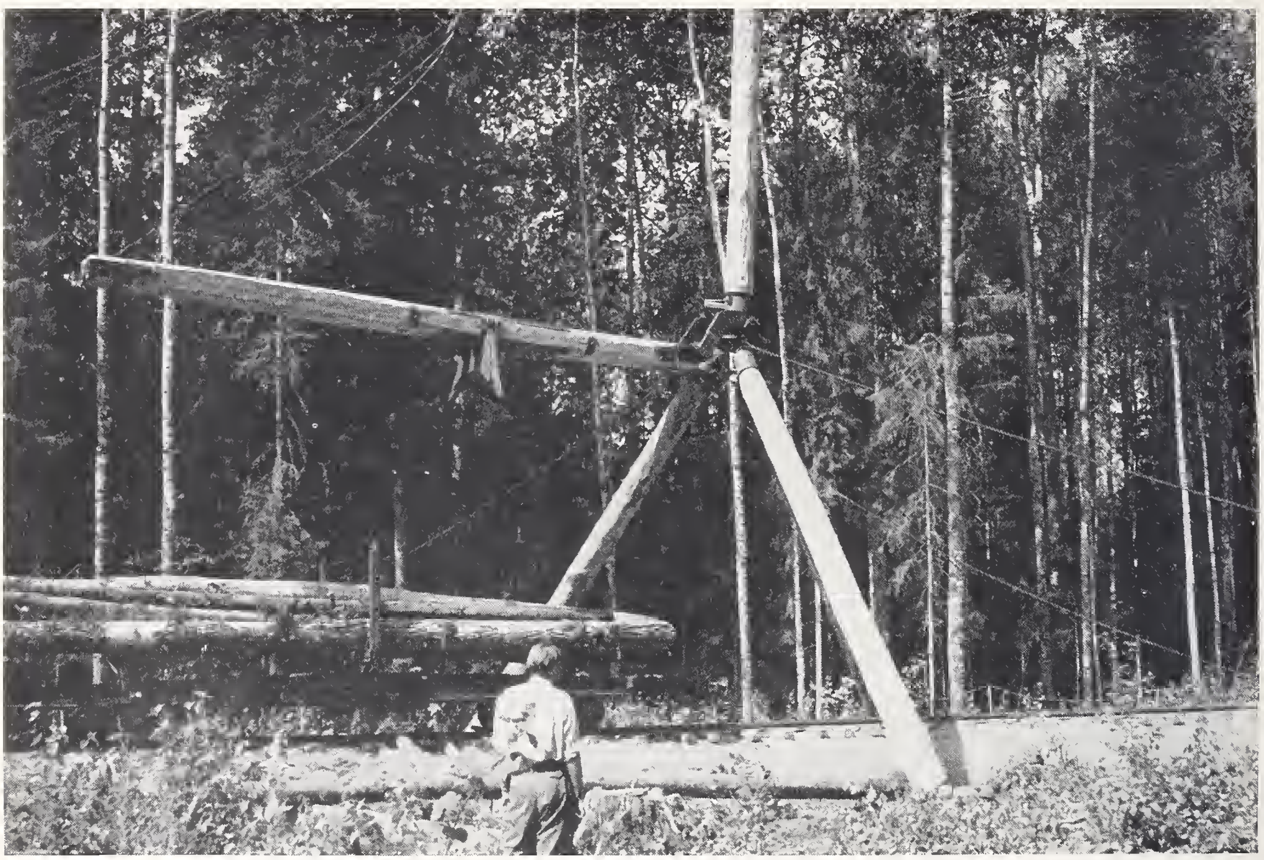

FIGURE 21.—Closeup view of tripod spar pole and loading boom.

with a Tyler system to carry the trees from the yards to the cars. Another cable unit, similar to the TL–5, was used in connection with a tripod spar tree and McLean loading boom (fig. 21). Railroad cars were run under the tripod. Similar equipment has been used for many years in the Pacific Northwest but for the most part has been discarded as being too slow. The operation we observed was typically slow.

Log Transportation

Logging Roads and Trucks

The European parts of the U.S.S.R. we visited had no serious problems in building logging roads. In fact, so much of the terrain was ideal for road construction that the engineers' preoccupation with construction of off-road hauling equipment was puzzling.

About 87 percent of the logging truck roads are said to be surfaced, usually with glacial sand and gravel but occasionally crushed rock. Twelve percent are dirt surfaced, and 1 percent are planked. We saw a few test sections surfaced with 3- x 10-foot reinforced concrete slabs with underside ribs to serve as anchors. These slabs were used to form the wheel tracks for main logging roads and were salvaged and moved to new locations as needed. We saw experiments underway in which resins and Portland cement were being mixed with native sand and gravel soils to form a hard-surfaced road. Logging roads vary between class III and class IV (U.S. Forest Service) standards, and are 14 to 20 feet wide with easy grades and curves. Soils were generally good for roadbuilding in the areas we visited, were well drained, and contained no hard rock, except an occasional boulder.

Special machinery seemed to be used very little in roadbuilding. We saw no modern super-tractors, power-wheeled scrapers, rock forks, front-end loaders, portable truck-mounted concrete mixers, or other advanced road construction equipment. Where power equipment was used, it generally consisted of power shovels and dump trucks. Occasionally an old model tractor and elementary type of bulldozer were seen on a logging road project. Patrol graders were used to maintain the roads.

We were told that ballasted main logging truck roads cost 90 to 120 thousand rubles per kilometer or $36,000 to $48,000 per mile. Costs based on converted rubles are not always meaningful without knowledge of many other factors. However, some cost and labor data are given below for the U.S.S.R. together with estimates made by the U.S. delegation for comparable roads built in America.

Type of road	U.S.S.R.		U.S.A.	
	Costs per mile	Labor per mile	Costs per mile	Labor per mile
	Thousand dollars	*Man-days*	*Thousand dollars*	*Man-days*
Logging truck roads:				
Ballasted main road	36 to 48	1,300 to 1,610	6 to 9	124 to 186
Unballasted temporary road	8 to 32	320 to 1,130	2 to 3	41 to 62
Narrow logging railroad:				
Ballasted main line	28 to 32	1,610 to 2,260	7 to 10	146 to 209
Unballasted temporary railroad	20 to 32	640 to 1,050	3 to 4	62 to 84

The engineers of the Soviet Union have placed much emphasis on designing and building a good rubber-tired, heavy-duty log truck and trailer for use on unimproved roads "to reduce roadbuilding and log transportation costs." This objective may be worthwhile but grossly inefficient in country such as we visited where good roads can be built at low cost. The following three principal logging trucks are currently most widely used:

Model	*Fuel*	*Axles driven (number)*	*Empty weight (pounds)*	*Load capacity (tons)*
Z-1-S-51	Gasoline	3	12, 000	4½
MAZ-200	Diesel	1	14, 000	5
MAZ-501	do	2	17, 000	5

Reports as recent as 1957 indicated that large numbers of producer-gas trucks were in use. We saw none on the logging operations we visited in 1959.

A number of experimental special trucks were described to us. One of these we saw in operation at Mostovaya looked like a Soviet adaptation of the Le Tourneau electric wheel. This machine was a conventional logging truck with an added drive shaft operating a D.C. electric generator which, in turn, supplied power to a pair of D.C. electric-driven (motor in hub) wheels (fig. 22). These wheels were mounted on a "bogey" between the truck unit and trailer to give added traction on roadless terrain or soft ground. Since the truck was underpowered, it seemed like a waste of power to generate electricity and supply it to an extra set of wheels.

FIGURE 22.—A roadless logging truck with electric-driven bogey. The electric generator driven by the truck engine can be seen behind cab.

Narrow-Gage Railroads

The Krestzy and Shoujsko-Vidansky lespromkhozi are narrow-gage (30-inch) railroad operations combined with high-lead or ground cable skidding systems. Track construction on the level or gently rolling terrain is simple. Track-laying machines are used to lay 30-foot sections with 7- to 8-foot round or hewn ties. The machine (fig. 23) is very similar to those used in the United States 50 years ago.

Full-length trees averaging 80 feet long are placed on two cars, each car having one bunk. Cars run on 30-pound rails with sixteen 24-inch wheels under each load. In past years, logging railroad cars were of wooden frame construction; more recently a simple, efficient all-steel car has been developed.

The 8- to 15-ton logging railroad locomotives are powered by either gasoline or diesel engines and equipped with hydraulic transmissions and airbrakes.

The Krestzy operation serves as a pilot test area for railroad logging equipment. The Central Scientific Research Institute of Mechanization and Energetics has a mobile laboratory in two railroad cars. These are well instrumented for study of all aspects of railroad logging.

Water Transportation

We were told that 100,000 miles of waterways are utilized to transport logs in various stages of delivery from woods to mill. As would be expected, timber is moved in various combinations of road, rail, and water. A rough estimate given us for 1958 was that one-third of total wood transportation was by water.

However, the practical problems of economical log transportation by water are not simple. First of all, the fresh-water courses are frozen for about two-thirds of the year. Water transportation involves long routes to deliver the logs and forest products to western U.S.S.R. and the markets of Central Europe. The logs are relatively small and many pieces must be handled per unit of volume. Larch makes up much of the volume to be transportated in Siberia. Logs of this species sometimes sink readily so that they cannot be floated alone. Either they must be bundled securely with other "good floating" logs or loaded aboard barges or ships. Shipping requires dry-deck tree-length grading, knotting, bucking, sorting, storing, and loading on barge or ship for transportation to the distant mills nearer to the populous areas or markets.

Good-floating species are frequently cut into 16-foot saw logs or cordwood lengths and are driven down the rivers to the mills. However, the large volumes of small-sized logs literally block whole river channels. During spring floods, problems of catching the logs at the proper place and reclaiming those which go high and dry along the shores and beaches become serious.

Log transportation by water is reported to be 7 percent by ship or barge, 28 percent in loose

Figure 23.—Railroad track-laying machine.

bag booms, and 65 percent in rafts of various kinds. Bundle rafts are made of different sizes, depending on the water depth, raft form, and the distances the logs are to be towed. We were told that some rafts (of U.S. Davis type) on the Kama and Volga Rivers have a maximum length of 1,300 feet and width of 236 feet. They contain up to 10,000 cords or approximately 5 million feet board measure (U.S. Scribner Scale). Such rafts would have a draft of approximately 6½ to 13 feet. Ocean rafts have been made larger than river rafts, but these are being replaced by barges and boats.

The Central Scientific Research Institute for Timber Floating at Leningrad studies all aspects of water transportation for logs and lumber. It is equipped to do many types of research in hydraulics, and modeling studies of streamflow, raft and barge design and behavior, and similar research. Several branch stations are located on lakes and rivers of the U.S.S.R.

Production Factors

Crew Organization

Logging crew organization varied somewhat from job to job. At Mostovaya, a truck-tractor operation, woods crews worked in units of five men as follows: (a) Tractor operator who not only drives the tractor but helps set chokers, swamp, limb, and handle loading cables—by far the hardest working crew member; (b) one faller who helps the driver set chokers and usually has 50 to 60 percent idle time; (c) two limbers who also do some swamping; (d) one landing man who unhooks chokers, lays out loading cables, and generally helps in loading.

We were told that such a five-man crew produces 25 to 32 cords per day, loaded on the truck.

At Krestzy, where a ground-lead yarding system was used, a five-man crew consisted of one faller; one choker-setter who handles three chokers and signal flag; one landing unhook man who also hooked logs for loading; a loader who spotted logs on the cars and cut tops as necessary; and the winch operator. Trees were loaded while the choker-setter put on the three chokers. Loading stopped while the trees were being yarded. Production was about 4 carloads, or 30 to 32 cords per day.

The Shoujsko-Vidansky operation, the largest one visited, was a full production unit, not at all experimental as were the others. The operation consisted of 12 foremen camps, each with two logging sides with three yarding tractors, and a total of 72 operating machines (plus 24 spare tractors). About 1,320 people were employed in the woods end of the operation. Woods crews consisted of six-man units: Tractor operator, faller, three limbers and swampers, and a man on the landing to trim tops. One additional man did the loading for three crews and three tractors. Scalers and foremen were in addition to the crew makeup given.

Workers generally spend 8 hours per day on the job in the woods with 1 hour for lunch. Including travel time to and from the cutting site, these men were away from town 12 hours per day.

Worker Output

The widespread use of machines of all kinds has not substantially increased output per man-day. According to *Statistical Handbook* (*32*) the production of an average worker had increased from 0.34 cords in 1940 to 0.36 in 1955. In explaining this remarkably small gain, Bowles (*4*) suggests it may be due to high labor turnover (in spite of establishment of lespromkhozi), low priority granted the logging industry, and required diversion of workers to such activities as logging slash disposal and regeneration of cutover areas. The constant shifts from one type of machine to another would not speed unit output because workers would not become used to each new machine. In a number of instances Soviet officials admitted to a shortage of skilled machine operators.

Our observations suggested that lack of good woods organization is an important cause of low output. Hand and machine labor was often mixed. Tractor drivers helped with swamping while the machine was idle. Cable skidding speeds were slow by United States standards. Machines were often used for two jobs such as loading and skidding, with resulting idle crew time.

The Shoujsko-Vidansky operation had the best output of any we visited. The "norm" established for piecework pay was 46 cords for 18 men, or about 2½ cords per man-day. This rate covered the woods work from stump through the loading operation.

A comparison of worker output in the U.S.S.R. with that in the United States is not fully significant because of the dissimilarity of conditions. However, the following tabulation may be of interest and it is based on conditions at least roughly similar. The U.S. data are for a prelogging operation in the Pacific Northwest where volumes not to exceed 35 cords per acre in trees 17 inches or smaller were removed. Stands being cut at the Shoujsko-Vidansky operation average 33 cords per acre with trees generally less than 18 inches. The figures for the U.S. operation were adjusted so that they apply to a production volume equivalent to the U.S.S.R. operation. Both sets of data cover the entire operation, including woods labor, roadbuilding, machinery operation and maintenance, supervision, and technical forestry.

	Shoujsko-Vidansky operation, U.S.S.R., 1958	*U.S. logging operation, Pacific Northwest, 1959*
Average number employees daily	1, 320	643
Average number days worked per year	285	185
Hours worked per week	46	40
Total man-hours worked per year	2, 884, 200	951, 640
Production in cords	310, 000	310, 000
Man-hours per cord produced	9. 3	3. 1
Production per 8-hour day, cords	0. 86	2. 6

Production in the U.S. logging camp is three times that of the U.S.S.R. operation. Because a more intensive road system was built in the U.S. operation, skidding distances were shorter and production correspondingly higher. We believe, however, that better organization, planning, and supervision of the job and greatly superior quality, speed, power, and maintenance of logging machinery afforded large advantages to the U.S. operation and are significant factors in the greater output in the example given.

Worker Income and Compensation

Complete published information is not available on the wages and salaries paid workers in woods operations. Reasonably accurate assumptions may be made, however, from fragmentary data we obtained, along with some published statements.

Except for certain permanent salaried woods jobs such as forest guards, all the workers in the forest products industry are paid on a piecework basis. A government agency sets the work quota for each task, as well as the base pay. If this quota is met a bonus is paid. An additional bonus is paid if the base quota is overfulfilled by an individual, the crew, or the entire production unit.

An example of how this system works was given to the delegation at one logging operation. Assuming that a certain number of cubic meters of timber cut per day for a six-man crew is the base work quota, each man then receives a 20 percent bonus if this quota has been met. For every additional cubic meter of timber produced, the crew receives 1½ times the base rate. In addition, if the monthly production quota for the entire camp has been met, a further bonus is paid to every worker in the camp. A still further bonus is possible. This is paid to the camp which rates first among comparable units in the region in any given quarter of the year. An additional 112,000 rubles ($28,000) for instance, had been received by this particular camp, for being first in production for the second quarter of the year.

Pyramiding of bonus payments makes it difficult to arrive at a real wage scale for any given classification of labor. The earnings of every worker are subject to wide fluctuation, since in most instances his take-home pay depends not only on his personal performance but on that of his crew and the entire working unit. The picture is complicated by the fact that the workers may also share in the profits made by the camp or the plant at which they work. A government agency again sets the base price for a given item produced or manufactured. If a "profit" is made, that is, a margin between value of product at the base price and the operational cost, a percent of it goes into the director's "discretionary fund." A part of this fund is used for the workers' vacations, medical care, recreational facilities, and similar benefits, while the rest, generally about 25 percent, may be used for housing for the workers, in addition to the amount usually allotted for this purpose.

We were told that this system of compensation increases labor productivity by stimulating competition and bringing about technological improvements devised by the workers. But it was also pointed out that if a working unit consistently overproduces a base quota by a large enough percent, then a higher norm is established before any bonus is paid. The widely expressed concern about the low productivity of labor in the forest products industries may justify some doubt as to the effectiveness of this incentive payment system.

Differential pay scales for the workers of a five-man crew were as follows, in percentage of the base rate per unit of production: Tractor driver, 26 percent; faller, 22 percent; each of two limbers or swampers, 17 percent; landing worker, 18 percent.

According to the Ministry of Agriculture,[9] in spite of improved rate of pay, the earnings of the woods workers remain lower than the average pay of industrial workers. A recently established seniority pay scale allows additional payments, up to a maximum of 340 to 500 rubles ($85 to $125) a month, depending on the area. Higher pay is allowed for the Siberian, Far Eastern, and Far Northern regions. From examples given and information supplied by the Ministry of Agriculture, it may be concluded that the average pay for the wood workers seldom exceeds 6,000 rubles ($1,500) per year. With 1940 as a 100 percent base, the 1956 average earnings of such labor had increased to 290 percent.

Only a few examples of the earnings of industrial workers in the forest products field were obtained. It appears that earnings range from 6,000 rubles ($1,500) or less a year for unskilled labor to as high as 20,000 rubles ($5,000) a year for skilled, including bonuses. The technical and the supervisory personnel at the plants visited received salaries of 1,000 to 2,000 rubles ($250 to $500) a month and bonuses. We were told that women receive the same rate of pay as men for the same type of work.

Low rent and free medical care may be considered as compensating factors for the relatively low earnings of the workers in the forest products industries. On the other hand, the cost of food, clothing, and home furnishings appears to be considerably higher than that in the United States.

Living and Working Conditions

In most places visited by the delegation, the workers lived in "company type" settlements with their families. Housing appeared to be of substantial construction, generally wooden frame (fig. 24). Two families lived in a dwelling of this type. The allowable living space, which excludes kitchens and storage areas, is from 65 to 75 square feet per person. Homes of the woods workers had electricity but usually no running water. Wood was used for heating and cooking. A cord of wood cost the worker approximately one week's wages. Houses were frugally furnished but neat and clean. It is possible for the worker with a family to build his own or to buy a company home. In some cases the director's discretionary bonus fund is used to assist the workers in acquiring their own homes.

The logging villages we visited were reasonably clean and tidy. Roads were unsurfaced but there were board walks for pedestrians. The village had its own schools, community recreation hall, and hospital.

The leaders of the Soviet logging camps are safety conscious but never did we see the same care and emphasis on safety that typifies the U.S. logging industry. We were told that the U.S.S.R. logging camp accident frequency was 70 per 1,000 employees per year and that 70 percent of all accidents were minor. A comparison of logging accident frequencies per million man-hours in the U.S.S.R. and in the Pacific Northwest is as follows:

	1958	*1959*
A large company in Pacific Northwest (logging on hazardous rough terrain)	15. 71	14. 90
Pacific Northwest Loggers Assn. (Average of 35 companies)	40. 94	42. 75
Average logging in U.S.S.R	32. 00	-----

We were informed that woods workers and the technical people have a right to leave an organization at will. Further discussion revealed that in practice it is extremely difficult for individuals, except the specialist, to move of their own volition because of a scarcity of living quarters. Unless the worker is assured of a place to live by another organization, the absence of unoccupied living space prevents quite effectively any unauthorized

[9] Lesnoe Khozaystro, S.S.S.R. [Forest Enterprise in U.S.S.R.], pp. 207 and 257. 1958.

labor migration. Furthermore, since the pay scale for a comparable job is substantially the same throughout the country, and the worker has to stand the cost of moving, there is little incentive for leaving one job for another.

Evidently the same basic considerations tend to freeze the technical and supervisory personnel in the lower ranks. Only the recognized specialists experienced little trouble in changing occupations—they are highly sought after by the various enterprises, which evidently are free to bid for such talent.

FIGURE 24.—The Krestzy logging village. These houses are built by the logging enterprise (lespromkhoz) and rented to the workers. Most houses are occupied by two families on the basis of 70 square feet of living space per person.

Forest Products Utilization

The objectives of the 1959–1965 7-year plan for the Soviet Union call for increase in output of the heavy industries by 82 to 85 percent and of the consumer industries by 62 to 65 percent. Among the latter, considerable attention is given to the growth of the wood conversion industries. The projected 7-year capital outlay for the forest operations, pulp and paper, and woodworking industries is estimated at 60 billion rubles ($15 billion), of which 60 percent is earmarked for industries engaged in wood utilization. In contrast, in the past 7 years, because of the pressures of industrialization and postwar reconstruction, the emphasis in capital outlay in forestry and forest products industries was on extraction of forest products. Consequently, 64.3 percent of the total amount of money spent on this phase of economy was allotted to forest management and logging, while all other branches of the forest products industries, including pulp and paper, received only 35.7 percent.

Available published figures indicating the production goals for various branches of the forest products industry differ considerably, as do other statistical data. For the present purposes, it is adequate to indicate the percentage increases expected under the 7-year plan. These are given in table 2. The FAO Yearbook (*12*) is the source of most 1958 figures, but the percentage production increases anticipated by 1965 are gleaned from several sources. The authors do not vouch for the accuracy of these data, but at least the data show the relative trends expected in timber production.

TABLE 2.—*Indicated expansion of the basic branches of the U.S.S.R. forest products industries, 1958–65*

Branch of industry	1958 production [1]	Expected increase by 1965
		(Percent)
Total wood production	376 mil. m.[3]	[2] 16
Industrial wood	252 mil. m.[3]	
Fuelwood	124 mil. m.[3]	
Lumber	87 mil. m.[3]	[2] 36
Plywood	1,229,000 m.[3]	[3] 103
Total wood pulp	2,896,000 metric tons	[4] 171
Total paper	2,237,000 metric tons	[4] 95
Paperboard	720,000 metric tons	[4] 402
Fiberboard	111,000 metric tons	[3] 750
Furniture production	7.5 bil. rubles [3]	[3] 140
Prefabricated houses	5.5 mil. sq. m.[3]	[3] 264

[1] Source: FAO Yearbook (*12*) unless otherwise noted.
[2] Bowles (*3*).
[3] Vasilyev (*34*).
[4] Pulp, Paper, and Board Mills, U.S.S.R. Report by American Paper and Pulp Association, April 1959.

As much as 50 to 75 percent of the increase in production is expected to come from the modernization of the existing plant facilities and from increase in labor productivity. The control figures for the 7-year plan anticipate an increase in labor productivity of 45 to 50 percent based on the 1958 production figures.

The U.S. Forestry Delegation had only limited opportunities to visit wood conversion plants. All of these were located in the European parts of the Soviet Union. A small sampling of the wood manufacturing facilities is in itself insufficient for a detailed appraisal of the status of the Soviet wood conversion industry. An effort was therefore made to supplement personal impressions with information from the current Soviet technical literature. Recent literature shows that at least three of the woodworking plants visited by the delegation—Ust-Izhorsky plywood plant, near Leningrad; Solominsk sawmill at Petrozavodsk; and Bozhenko Furniture Plant in Kiev—have been repeatedly cited as examples of operations with highly advanced technology in their respective fields, worthy of wide acclamation and imitation by other technologically less advanced plants (fig. 25). Hence, it is reasoned that the general level of technology in the forest products industry in the Soviet Union can be fairly judged by assuming that the plants visited represent at least better than average conditions for the entire country. Support for this conclusion can also be found in the references cited elsewhere in this report.

Woodworking Industries

The Impact of the Exploitation Policy

One of the basic problems confronting the Soviet forest products industries has been the division of planning and control responsibilities between the forest products industries and forest management. As constituted in most of the republics, forest enterprises, i.e., logging camps and forest products industries, are controlled by the Council of Peoples Economy (Sovnarkhoz). Prior to October 1959, management of the forest resources was under the supervision of the Ministry of Agriculture. The effect of this separation on forest management practices was discussed on

FIGURE 25.—Landscaped alley lined with posters at the Bozhenko Furniture Plant (Kiev). Sign on the far left reads, "A leader of communist labor, Alexandra Ivanova, took responsibility for fulfilling the 7-year plan in 4.5 years. Every day overfulfilled the norm by 180 percent. Workers of the Bozhenko factory, follow the example of Alexandra Ivanova." The next sign is the honor board with photographs of the workers who have overfulfilled their quotas Similar "honor boards" were seen by the delegates at other plants.

FIGURE 26.—General view of the lower yard at the Shoujsko-Vidanski operation. Electric chain saws are used for bucking logs.

pages 16 and 17. Even though some organizational changes have been made, the extractive parts of the industry are likely to be committed to a policy of timber exploitation for some time to come.

In the short 15- to 20-year "cut-out period" permitted on the areas assigned to the logging camps, the capital investments in mechanization, roadbuilding, and concentration yards cannot be completely amortized. As a consequence, it is estimated (*17*) that in the group 2 forests alone the loss due to incomplete amortization of such capital outlay will amount, in the next 10 to 15 years, to somewhere between 2 and 3 billion rubles ($500 to $750 million).

Because of their remote location, camps, logging and concentration yard facilities, and living quarters of the workers and the supervisory personnel cannot be effectively utilized for any other purpose after the lespromkhoz is liquidated. For instance, capital outlay at the Krestzy camp is about 50 million rubles ($12.5 million), of which amount production buildings and facilities represent an investment of 20 million rubles ($5 million) and living quarters and cultural projects 10 million rubles ($2.5 million). Most of these facilities will have to be abandoned when logging operations cease, which is expected to happen in the next 6 to 7 year (*17*).

This consideration, no doubt, affects the thinking of the planners and has an adverse effect not only on the efficiency of the logging operations but on the degree of utilization of the available timber. Finally, liquidation of the logging operations affects the consuming industries, which are forced to go longer distances for their raw materials.

Lower Yards and Integrated Operations

As a result of the prevailing practice of tree-length logging, the Soviet logging industry has developed concentration places, called *lower yards*. These usually are no more than concentration points to which tree-length stems are delivered either by rail or by trucks and where they are reduced to lengths which are determined by the intended utilization, species, and quality (fig. 26). If electric power is available, electrically powered portable saws are used. Women are employed in all phases of work at the yard, including handling of pulpwood size sticks and working on log decks (fig. 27). Relatively little mechanical handling equipment is in evidence, except on an experimental basis. One log-sorting conveyor was used to separate logs by species, size, and end use. By means of 40 electronic control pushbuttons, the operator directed each log or cant to its proper compartment (fig. 28). A number of similar units are in use in Finland and Sweden and one is being developed in the United States. An efficient end-clamp grapple was used with a bridge crane at one lower yard to move logs to a storage yard or onto railroad cars. This device would pick up a load of 16 to 24 logs of uniform length.

The vast majority of the logging operations in the Soviet Union have no direct tie with the manufacturing plants and are merely suppliers of raw forest products. It is recognized, however, that integration of logging and wood conversion industries is essential if greater efficiency in forest products utilization is to be achieved. A determined attempt is made to integrate such operations, but it is admitted that to date progress has been slow and in many instances unsatisfactory.

The type of integration proposed may consist of only partial conversion of round timber at the lower yards into lumber, box shook, and other primary and secondary wood manufacture, with the residues utilized for generating electric power, for manufacture of wood particle boards, and for production of wood distillation chemicals. The more sophisticated approach visualizes complete utilization of timber at the associated plants engaged in production of prefabricated houses and the component parts for homes built of local materials.

Great emphasis is placed on self-sufficiency, carried to such extremes as converting conifer needles into pulverized meal for feeding poultry and cattle, production of silicate binders from the local sand, and manufacture of crude wood particle boards and building blocks from branches and culls. Destructive distillation of wood residues is considered another possibility. Although mainly in the experimental stage, such extreme forms of utilization are justified on the basis that self-sufficiency is the key to successful wood utilization in the remote parts of the country.

On a more conservative basis, some of the following advantages of integration of logging and wood manufacturing operations have been suggested by Urkin (*29*):

1. Experience has shown that integration of logging with sawmilling and some form of manufacturing results in 5 to 30 percent additional yield of usable wood. For instance, whenever manufacturing facilities are available, defective logs, which otherwise are rated as culls, can be converted into sawed materials which can be profitably utilized at an integrated operation, such as for box shook and certain items of millwork. Also, logs otherwise suitable only for firewood can be converted into box boards. For instance, at Krestzy lower yard, this practice has resulted in a 4 to 5 percent increase in yield of industrial wood.
2. Most of the active forest enterprises are situated at considerable distances from the government sources of electric power and are, therefore, forced to create their own sources of energy. The integrated forest enterprises have sufficient quantities of wood

Figure 27.—Women stacking pulpwood from a conveyor at the Shoujsko-Vidanski lower yard.

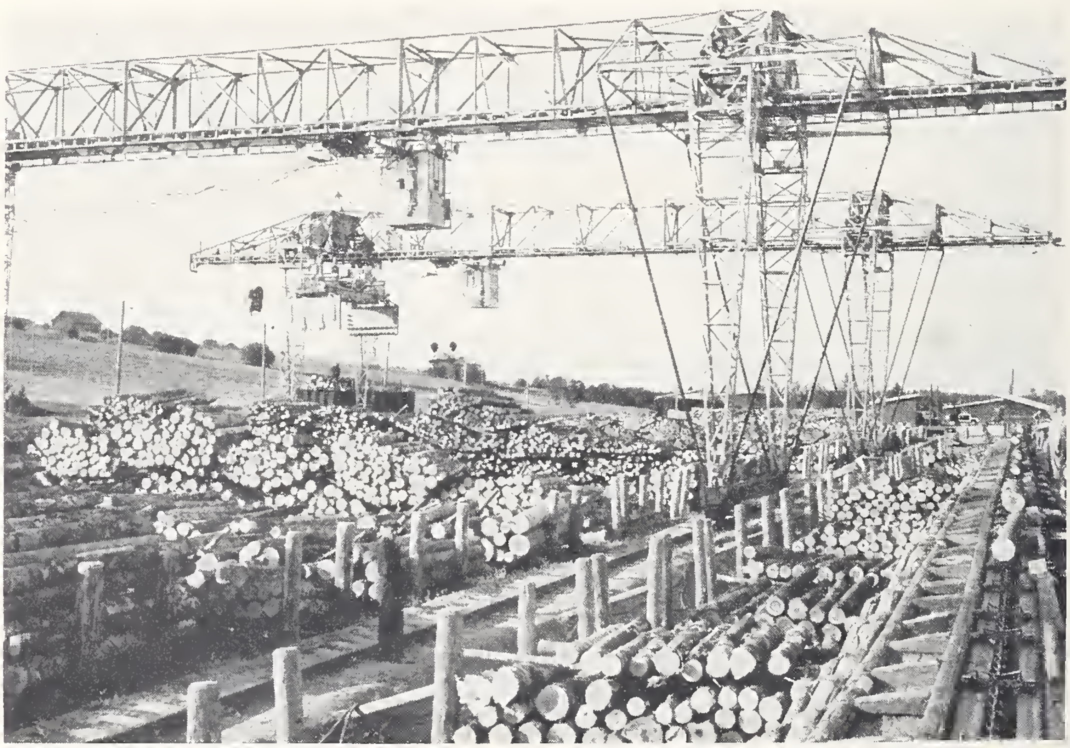

Figure 28.—Log sorting chain (right) equipped with an automatic kicking device and crane for loading logs into railroad gondolas at Mostovaya. Logs are sorted by species, quality, and intended use.

residues to generate electric power in amounts adequate not only for their own use but for the needs of the worker's settlements. It is stated that the average cost per kilowatt hour, if the power generating plant is operated on wood residues, is 30 to 40 percent less than that of purchased power from the government-operated utilities. If, however, the plant is operated on fuelwood, as will be the case at a non-integrated yard, then the cost of electricity per kilowatt-hour is 47 percent higher than the price of purchased current.

3. Experience at integrated operations has also shown that the cost of raw materials to the associated plants may be reduced by as much as 25 percent, cost of transportation decreased by 2 to 10 percent, labor productivity increased by 10 to 15 percent in the logging operations, and by 10 percent in the manufacturing plant.
4. Considerable reduction in the shutdown time can be expected. In 1956, the shutdown time averaged 21.1 percent of the total working time for all the sash gang mills under the jurisdiction of the Ministry of Timber Production (the responsible agency at that time). Eighty-three percent of the total shutdown time of the mills has been from lack of raw material. At some sawmills, removed from the logging operations, shutdown time due to this cause alone has been as high as 51 percent of the total working time. It is assumed that with better planning and a greater diversity of operations, the shutdown time need not be as high at the integrated plants.
5. A compelling reason for integration is the high cost of transportation of round timber from the forest regions to the manufacturing centers. With the gradual relocation of logging operations into the eastern (Siberian) regions of the country, the average distance for transporting round material by rail has increased from 550 miles in 1940 to more than 900 miles by 1957. If this material could be sawed at the source, the savings, based on the present transportation costs of 37 rubles per cubic meter (about 25 cents per cubic foot), of round timber, would equal 20 rubles per cubic meter (14 cents per cubic foot), for sawed green material and 25 rubles (18 cents) for the air-seasoned product, or a reduction in cost of transportation of 54 percent for the former, and 70 percent for the latter.
6. Even more substantial savings could be achieved through reduction in the capital investment in the integrated enterprises, compared to the individually operated units of equal size. Though it is admitted that no such savings are possible through mere consolidation of the existing facilities, table 3 purports to show the possibilities for new construction. It shows comparative figures for an integrated and an alternate, nonintegrated plan for the Ermilovsky Forest Operation. The greatest savings, ruble-wise, are in the consolidation of living quarters, which amount to more than half of the total cost of construction and are estimated to average 14 to 15 thousand rubles ($3,500 to $3,750) per workman, for the entire country.
7. A further stated benefit of integration of the woods and manufacturing operations is the greater opportunities it offers for employment of women. Employment of several members of a family not only creates a more favorable living climate, but also results in reduction in the total space requirement for the working force. Comparative costs of integrated and nonintegrated operations are shown in table 3.

TABLE 3.—*Comparative capital costs of integrated and nonintegrated lumbering operations (from Urkin, 29)*

Items of cost	Integrated operation	Nonintegrated operation			Reduction in cost
		Logging	Manufacturing plants	Total	
	Thousand rubles	*Thousand rubles*	*Thousand rubles*	*Thousand rubles*	*Percent*
Area preparation	679	550	229	779	12. 8
Lower yard	2, 860	1, 740	1, 200	2, 940	2. 5
Maintenance shops	823	720	703	1, 423	42. 3
Electric power station	8, 307	2, 850	7, 877	10, 727	22. 4
Transport	877	800	627	1, 427	38. 5
Water and sewers	2, 700	1, 040	2, 250	3, 290	18. 0
Construction of houses	29, 415	15, 735	17, 925	33, 660	12. 6
Overhead	12, 470	240	8, 636	13, 876	10. 0

TABLE 4.—*Expenditure and income from forest operations, 1947–58* [1]

[In million rubles]

Year	Expenditures				Gross income				Net income	Percent of total expenditures
	Operational field	Capital	Administration	Total	Forest income	Resources of leskhozi applied to operational expenditures	Other	Total		
1947	874.8	29.7	30.6	935.1	795.0	293.6	54.0	1142.6	207.5	22.2
1948	1317.9	63.6	60.9	1442.4	1149.1	430.9	63.4	1643.4	201.0	13.9
1949	1593.1	302.9	67.8	1963.8	2400.7	589.3	113.5	3103.5	1139.7	58.0
1950	1939.9	688.3	73.7	2701.9	2174.7	702.8	124.3	3001.8	299.9	11.1
1951	2108.7	436.0	79.5	2624.2	1560.7	634.2	137.2	2332.1	−292.1	−11.1
1952	2231.5	352.7	81.0	2665.2	1546.0	574.6	131.8	2252.4	−412.8	−15.5
1953	1899.5	167.0	57.0	2123.5	1602.3	571.9	118.9	2293.1	169.6	7.9
1954	1920.1	152.3	50.0	2122.4	1763.3	609.3	173.9	2546.5	424.1	20.6
1955	1967.3	87.8	45.0	2100.1	1903.7	561.8	248.6	2714.1	614.0	29.0
1956	2028.2	93.2	40.0	2161.4	1870.2	778.8	284.2	2933.2	771.8	35.5
1958 [2]				2450.0				3400.0	950.0	38.8

[1] From U.S.S.R. Ministry of Agriculture (*30*).
[2] Figures for 1958 as given to the U.S. Forestry Delegation by A. I. Bovin, U.S.S.R., Ministry of Agriculture, Moscow.

Income From Forest Operations

The total forest operation—logging, handling timber through the lower yard, reforestation, and protection—is reported to be a profitable undertaking in most years. Although cost accounting methods used in the Soviet Union are not easily understood by western foresters, table 4 is of interest in comparing expenditures and income. In all but two of the 11 years in the period 1947 to 1958, income exceeded total costs. The data given have not been converted from rubles to dollars because they are primarily of comparative value.

Sawmilling

Since the U.S.S.R. has about half of the softwood inventory of the world and the 7-year plan calls for a substantial increase in production of lumber, we were particularly interested in appraising Soviet manufacturing facilities. We saw several small sawmills, both U.S.-built circular mills and limited-cut gang mills. Most interesting, however, were two large volume production plants, one near Petrozavodsk, Karelia, and the other one at Stalingrad. The installation at Stalingrad consisted of two separate sawmills at the one location.

Present annual output of the three mills was reported to be:

Solominski sawmill, Petrozavodsk 30 million feet, board measure
Stalingrad sawmills 77 million feet, board measure

We were unable to get any meaningful cost data but did obtain production information to compare with U.S. sawmill output.

Logs were delivered to the mills by rail, water, truck, or to a minor extent, by tractor. Rail-delivered logs were generally presorted as to species and size but waterborne logs were mixed in the rafts or on the barges. Sawlogs brought to the mill by truck or tractor were sometimes sorted by size classes and species. Thirteen 2-centimeter (about 0.8-inch) top diameter classes were recognized. Log lengths varied from 10 to 24 feet. At the mills we visited, sorting was done manually while the logs were in the water.

With critically severe winters, log storage at the mill and moving logs into the mill becomes a problem. If logs are stored in the water, they must be made into large bundles so that some of the logs are above the ice. Another solution is to heat or agitate the pond to prevent freezing. At the mills we visited, the logs were stored in large piles on the shore and moved as needed with mobile gas- or diesel-powered crawler cranes.

The Solominski and Stalingrad mills had three and four log slips, respectively, and were equipped with gangsaws. At Stalingrad the logs were moved approximately one-fourth mile from the water to the yard or mill deck by bull chains and rollers.

Each mill had a log storage deck that would hold 12 to 16 logs ahead of the saws. Even though the logs had been well limbed in the woods or at the lower yards, they were meticulously knotted again on the mill deck. We did not see any log barkers at the Soviet plants as are commonly used in many U.S. sawmills. Logs were loaded onto the carriages by steam or air kickers.

Saws were either of Swedish or Finnish manufacture or, if Russian-made, were modeled after Scandinavian-type units. Gangsaws had 30-inch vertical openings, ran 500 to 600 sash strokes per minute, had 300 r.p.m. crankshaft speeds, and a maximum feed of 30 feet per minute. The carriage operator clamps the logs with front end tongs and positions it to ride "free" as he feeds it into the saw (fig. 29). Operators of log gangsaws commonly have difficulty when logs are sent into the saw frame butt end first. Two serious problems arise—one, to raise the log pressure rolls over the swelled butt, and the other, to keep the heavy slabs from falling and striking the saw blades. In the Soviet mills, these problems have been solved by providing special pneumatic lifts for the pressure rolls. Also, two women offbearers control the heavy, short, wedge-shaped slabs with pickaroons when swell-butted logs are put through butt end first.

Heavy timbers faced on two sides were usually resawed (fig. 30). In some cases, the cants were reduced by gangsaws into two outer slabs and rough-sawn boards. An alternative was to feed the cants into a wide edger where circular saws were positioned to cut 3-, 4-, and 6-inch widths. Feather edges of slabs were trimmed by means of double saws behind the log gangsaws. However, at the Stalingrad mills, boards or slabs were not edged. Wancy-edged boards went directly to a local furniture, door, and window-sash factory after drying where they were resawed to the sizes needed.

Gang trimmers were not used in the mills we visited. Slabs, boards, and small dimension stock were trimmed by a manually operated, power swing or jump saw. Heavier cants were trimmed on the green chain by staggered saws mounted on either side. First one end of the cant was trimmed, and after the piece moved forward, the other end was trimmed to the proper merchantable length. Defects were cut out with jump saws as timbers and boards moved down the green chain.

Lumber did not flow through the sawmills with

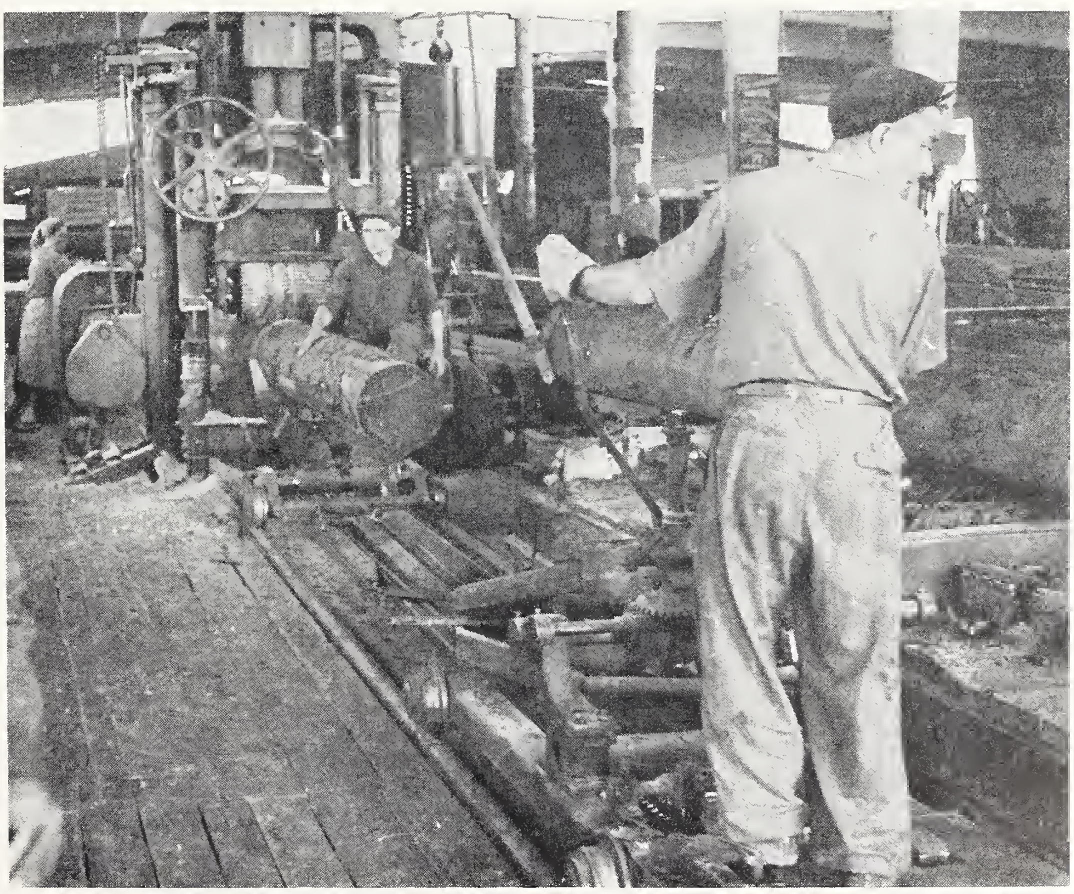

Figure 29.—Gang sawmill at Stalingrad. Gang mills are used exclusively as headsaws throughout the U.S.S.R.

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FIGURE 30.—Cants developed by the headsaws. These are resawed into the final products by gang mills, one of which is shown in the right upper corner of the photograph. Stalingrad.

precision. Generally, narrow leather or composition belts were used to carry slabs to the resaw. Belts and drags conveyed sawdust and refuse to the mill hog. Cants were removed from the green chain by hand and automatic or machine sorting was entirely absent. In fact, a great deal of hand labor was used in all mill operations. The carriage and saw operators and mechanics were men but at least 40 percent of the sawmill employees were women.

In the lumber yards, most handling of material was manual. A few lift and straddle trucks were seen. Women lumber pilers constituted most of the labor force in the yards. Export lumber was generally packaged and strapped for dock and ship handling.

The output of lumber per man-day in the U.S.S.R. mills visited was only about one-tenth that of a modern mill in the United States. It should be remembered, however, that man-day production by itself may not be the whole story. As previously stated, we obtained no cost data and comparative unit production costs are not available.

More favorable log size works to the advantage of U.S. production. Nevertheless, there is no question but that poor organization, excessive hand labor, and lack of versatile automatic equipment accounts for the relatively poor production of the Soviet mills. Table 5 gives production data at three U.S.S.R. mills and that of a typical sawmill in the Pacific Northwest.

Seasoning

One of the pressing problems of the Soviet wood industry is the status of wood seasoning. According to Burkov (*9*):

> From the total quantity of sawed materials only 15 to 20 percent are subjected to either air seasoning or artificial drying, as a result of which the building industry and wood working plants receive green sawed products of a lower quality and the railroads are forced to transport green heavy materials. Furthermore, in the course of transportation green sawed products become stained and molded, warped and checked.
>
> Lack of attention to protection of forest products leads to about 20 percent of construction lumber being used unproductively for repair of recently constructed buildings and installations.

One of the principal aims of the seven-year plan is to create new kiln-drying capacity. Particular attention will be paid to the development of high-temperature drying equipment, to intrumentation and modernization of the existing drying facilities, and to the more extensive use of air seasoning as a preliminary step to artificial drying. A greater use of mechanical sorting and piling

TABLE 5.—*Comparison of production of log gang sawmills: U.S.S.R., 1958, and Pacific Northwest, 1959*

Item	Unit	U.S.S.R. sawmills		Mill in U.S.A., Pacific Northwest
		Solominski	Stalingrad	
Log gangsaws	Number	3	8 (2 mills with 4 each)	2
Cant gangsaws	do	1	5	1
Heavy-duty edgers	do	3	None	1
Light slab edgers	do	3	8	2
Size of logs cut (average)	Board feet	140	140	190
Shifts operated daily	Number	3 of 7½ hr.	2 of 8 hr.	2 of 8 hr.
Persons on payroll (total)	do	1,000	1,100	192
Days operated yearly	do	285	285	240
Man-days (8 hr.) worked in each plant yearly.	do	273,125	300,437	46,080
Lumber cut yearly	Thousand board feet	29,835	77,350	55,000
Lumber cut per man-day of 8 hours	Board feet	109	257	1,194

equipment, to replace hand labor, is also considered essential. It is estimated that more careful attention to proper seasoning may bring about yearly savings in excess of $750 million.

Good hand-piling methods were observed at the Solominsk sawmill. At this mill, specializing in cutting lumber for the export trade, a number of pieces of mechanical equipment, such as the straddler type lumber carriers, were in use. Elsewhere lumber piling for air seasoning was of rather poor quality. The only instance of kiln-drying encountered by the group was at the Kuybishev sawmill at Stalingrad. This revealed the use of natural-circulation kilns, in which the drying conditions are determined by wet- and dry-bulb hand hygrometers. Pine and spruce lumber was dried on a 6-day schedule and hardwoods (birch, aspen, and basswood) on a 30-day schedule.

Veneer and Plywood

Plywood production is one of the major branches of the Soviet forest products industry. The 1958 production was said to be 1,230 million cubic feet, second in volume only to the United States, and it is expected to approximately double by 1965 under the seven-year plan. Sixty-eight percent of this increase in production is expected to be achieved by new construction, and 32 percent through modernization and intensification of production in existing plants. The new plants now under consideration will range from 880,000 to 3,700,000 cubic-foot yearly capacity. We were told that all new plywood plants of these capacities will have integrated flake board manufacturing facilities, ranging from 880 to 1,760 thousand cubic feet of board, or about half of the rated plywood production capacity.

Also being planned are a number of smaller plywood plants and specialized veneer mills intended primarily for furniture manufacture. The smaller plywood plants are to have a rated capacity of 530,000 to 635,000 cubic feet of plywood and 70,000 to 105,000 cubic feet of veneer. Specialized veneer mills, planned for production of dry veneer, will have a yearly capacity of 175,000 to 350,000 cubic feet.

Most of the veneer and plywood now produced in the Soviet Union is birch. Small amounts of other hardwoods, largely oak, beech, and walnut, are also produced. In spite of the predominance of softwood species, practically no softwood veneer is currently being made, but it is anticipated that appreciable quantities will be produced in the future. Judging by the complaints from the furniture plants, dry face veneers of good quality are in short supply.

The problems of the Soviet plywood industry are identified as follows (*26, 8*):

1. The present level of mechanization even in the technologically most advanced plants is only 61 percent. The greatest shortcoming is the complete absence of conveyors and other means for mechanical handling of veneers and plywood in all stages of manufacture.
2. Prevalence of obsolete methods of technology and obsolescense of production equipment.
3. Low labor productivity. The Soviet experts estimate it to be one-fifth that in the United States plywood plants.
4. Low rate of new equipment production. While the seven-year expansion plan for the plywood industry calls for 2,500 units of new equipment, only 180 pieces were made in 1958 at the Proletarskaya Svoboda (Proletyan Freedom) plant, responsible for production of this equipment.

The main objectives for the seven-year period call for improvement in the level of mechanization and automation, introduction of improved models of production equipment, and improvements in technology, especially in preparation of veneer logs, in cutting and drying of veneers, and in gluing. One of the goals of the seven-year plan is to increase utilization of urea and other synthetic adhesives to about 60 percent, from the present level of less than 20 percent. Other major objectives include more complete utilization of residues and an increase in labor productivity from about 2,000 cubic feet of plywood per 8-hour shift, per worker, to 2,650 cubic feet. Responsibility for technological improvements in the plywood industry rests with the Central Research Institute of Plywood and Furniture.

The U.S. Delegation was fortunate in visiting the Ust-Izhorskii Plywood Plant near Leningrad, considered to be the model plywood plant in the Soviet Union. This plant has been in operation since 1907. It was considerably enlarged in 1935, when it became the largest plywood plant in the Soviet Union. It was severely damaged during the war and has been completely rebuilt and modernized since 1948. The plant is now a part of the Leningrad Forest and Furniture Combine.

The major product of this plant is hot-pressed birch plywood. Rotary veneer is cut on five lathes and is dried in calender rollers heated by steam and hot air. The yield of veneer is about 44 percent, or 35 cubic feet, of veneers per 80 cubic feet of logs. About 50 percent of the plywood is bonded with casein and soya bean adhesives, about 35 percent with urea glues, and 15 percent with phenol. A special grade of "decorative" plywood is produced with selected birch face veneers or with decal imitations of other fancy woods, bonded with urea-melamine glue films, and underlaid with metal foil. Total production of this plant was reported to be 2,200,000 cubic feet of plywood per year. The veneer logs, in multiples of 6.4 feet with an average diameter of about 8 inches, are received by rail or by barge. After conditioning in hot water vats, the logs are debarked and rounded on two lathes. Veneer blocks are worked down to 3- to 4-inch diameters.

In addition to flat plywood, this plant produces convolute-wound plywood pipes in 2- to 12-inch diameters, approximately 16 to 24 feet in length with walls ¼ to ½ inch in thickness, and pipe sleeves. These pipes are designed to withstand pressures of 3 to 12 atmospheres, depending on the wall thickness and the inside diameter. They find ready acceptance in the chemical industry, in place of the nonferrous metals and stainless steel. The yearly production of this division is about 1.3 million lineal feet of pipe.

Separate divisions of this plant produce furniture parts, such as tabletops and headboards for beds, television set cases and suitcases. This plant also produces high-quality densified phenolic wood plastics comparable to American "compreg," compressed wood particle material, and a flakeboard, all described later.

House Prefabrication

Because of the critical shortage of living space, prefabrication of houses and of the component parts of homes, apparently including millwork items such as doors and windows, is considered to be one of the major objectives of the 7-year plan. The 1958 production of prefabricated housing is rated at 60 million square feet. It is expected to reach 107,500,000 square feet in 1959, and 215,000,000 square feet by 1965. At the same time, the production of other component parts (such as millwork) is expected to reach 107,500,000 square feet by 1965.

The prefabricated houses appear to be of two major types—all frame and of squared log construction. They range in size from the single-family type to multiple apartment houses. Such homes will be produced by all larger sawmills, as well as by specially integrated sawmill-manufacturing units, at which the entire production will be devoted to prefabrication. Prefabricated wood houses are intended primarily for villages, small towns, and out of town summer residences (dachas). They are expected to play a very important part in the opening up of new areas, such as new forest areas in Siberia. No all-wood, single residence homes are expected to be constructed in the large cities, where new residential construction is entirely of the precast concrete and masonry type.

Unfortunately, the U.S. Delegation had no opportunity to inspect any of the house prefabrication operations. Their personal observations were confined to a visit to a single-occupancy frame home exhibited at the U.S.S.R. Exhibition of Economic Achievement in Moscow. This house was found to be quite adequate in design and space but, by American standards, of rather low quality on the basis of materials used and workmanship (fig. 31).

Furniture and Millwork

The 7-year plan calls for production of furniture valued at $4.5 billion by 1965, to meet the requirements of the extensive new residential and institutional construction. This will be 2.4 times the value of furniture on the basis of the 1958 production. The prevailing practice of planning furniture production on the basis of ruble value, however, does little to stimulate quantitative production, since this system of accounting creates interest in the smaller output of higher priced items. In 1957 a 15-percent value increase in furniture production brought only 9-percent increase in the number of chairs, 6 percent in wardrobes, 11 percent in tables, and 5 percent in sideboards. According to Varaksin, Baranov, and Kisin (*33*), this system of planning constitutes a definite brake on the introduction of mass-production techniques in the manufacture of inexpensive furniture suitable for the furnishing of new dwellings and apartments.

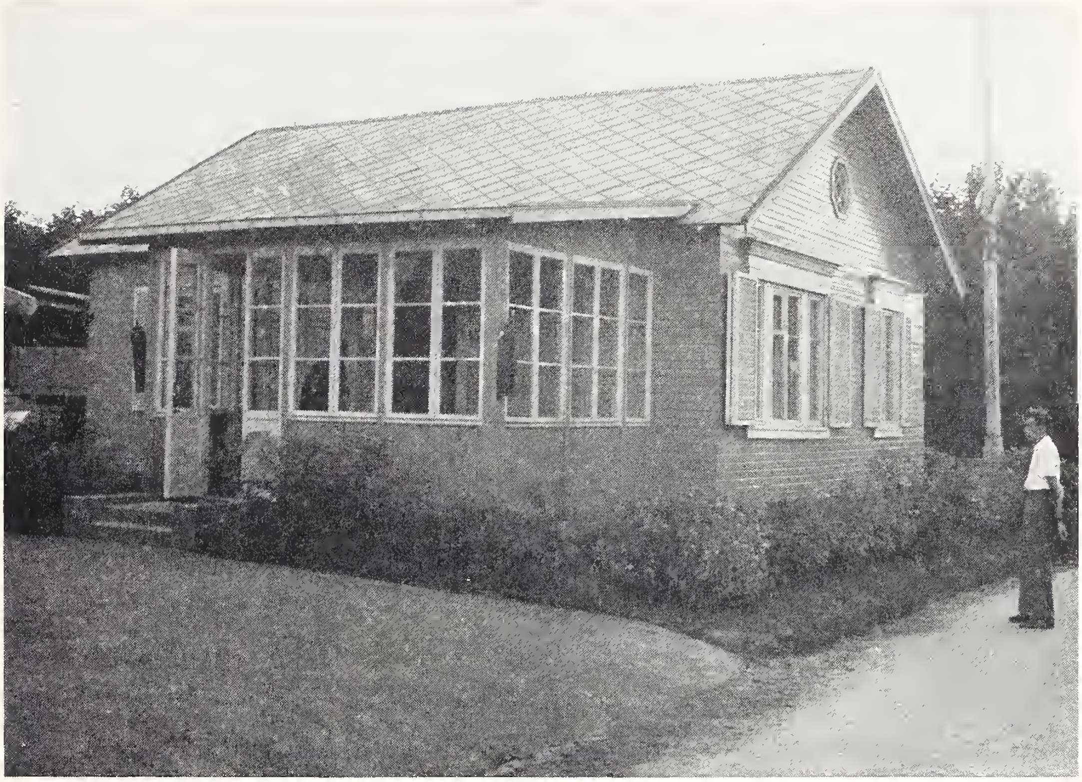

FIGURE 31.—Prefabricated house at the U.S.S.R. Exhibition of Economic Achievement in Moscow.

It is estimated that in the years to come, more than 75 percent of new furniture will be utilized for furnishing the newly constructed living quarters and only 25 percent for replacement and additions in the now-occupied dwellings. Since more than 60 percent of the new quarters will consist of two-room apartments and the remainder of one- and three-room quarters, emphasis will be placed on the types of furniture most suitable for the two-room dwellings.

The relatively small size of the living area, 100 square feet or less per person, coupled with the now universally adopted ceiling height of 8 feet 2 inches makes currently produced designs too cumbersome, since such furniture occupies about 50 percent of the available space. Furthermore, furniture of that design is not suitable for mass production techniques.

On the basis of these considerations and the All-Union competition in furniture design held in 1958, recommendations were made to concentrate on production of sectionalized furniture, convertible sofa-and-chair-bed items, and lighter weight bent and molded wood and upholstered chairs. Great emphasis in planning is placed on the possibility of prefabrication of parts and installation of assembly lines in the furniture plants. Advantages of the more extensive use of plywood and various types of wood particle boards are also stressed. Rather surprisingly, considering the prevailing type of apartment house construction, little mention is made of the possibilities of built-in features, except for kitchens for which "stationary" sectional furniture is recommended.

From personal observations of the members of the delegation, supported by statements in the technical Soviet literature, it appears that the stated objectives for the Soviet furniture industry are not being realized. Major contributing factors to this lack of accomplishment can be summed up as follows:

1. Unwillingness of some managers to abandon the out-dated techniques in favor of mass production techniques.
2. Failure on the part of research organizations and the machine building industry to develop and manufacture new production equipment in quantity. Introduction of untried machines which are either unsuited for the intended purpose or require extensive modifications and adjustments, is also a common complaint.
3. Low labor productivity, partially due to scarcity of labor-saving devices, such as conveyor systems, and partially to the scarcity of properly trained machine operators and other skilled labor.

4. Incomplete utilization of the available production space and equipment.
5. Shortage of materials, particularly dry face veneers, plywood, and properly dried lumber.
6. Unnecessary and costly duplication of manufacturing facilities and proliferation of styles.

The personal judgment of the U.S. Forestry Delegation was based on the inspection of the Bozhenko Furniture Plant in Kiev and the millwork plant at Stalingrad. The Bozhenko Furniture Plant was awarded a special certificate of recognition for technical innovations, and it is cited in the literature as an example of automation in furniture production. A brief description of this operation, therefore, may be in order.

The plant produces daily 800 chairs, 200 wardrobes, 90 sideboards, and a small amount of bedroom furniture and miscellaneous items of "high grade" furniture. Seventy percent of the entire output is sent out in a knockdown condition and 30 percent is assembled for the local trade. Beech and pine are used for the solid parts; considerable quantities of plywood, mostly birch, are also utilized. The plant consists of a large receiving yard, dry kilns, a planing mill, a cut-up mill, parts manufacturing division, and a number of assembly and finishing divisions, some of which are conveyorized. More than half of the plant's 1,600 employees are women. Sixty of the 104 technical people also employed by the plant have university degrees.

Most of the machines are old and too light for mass production. Much handwork was in evidence, even on the conveyorized assembly lines. On the line producing sideboards, two men were using hand chisels to cut recesses for door hinges; dowels were driven by hammer. In some departments, no apparent orderly flow of component parts could be detected. There was considerable duplication of facilities, especially in the finishing departments. Because of inadequate exhaust systems and generally poor housekeeping (fig. 32), extreme health and fire hazards prevailed throughout the plant. Some of the stain spraying was done outdoors to reduce fire hazards (fig. 33).

All furniture was either finished "natural" with two or three coats of lacquer or stained with gray-brown (walnut) or reddish-brown (mahogany) stains and finished with lacquer. The lacquer, with 18 percent solids, is applied hot. Rubbing and polishing on flat surfaces was done with a belt polisher, followed by hand rubbing (fig. 34).

Furniture seen at the time of the visit was of a massive and unimaginative styling, quite at variance with the expressed objectives of the 7-year plan. The overall quality of construction and workmanship was uniformly poor, even in the "high grade" department, where walnut face veneers of high quality were used.

FIGURE 32.—Yard of the Bozhenko Furniture Plant. A high fire hazard exists due to poor housekeeping. No mechanical means are used for transporting furniture parts between the buildings.

FIGURE 33.—Spraying stain outdoors at the Bozhenko Furniture Plant in Kiev.

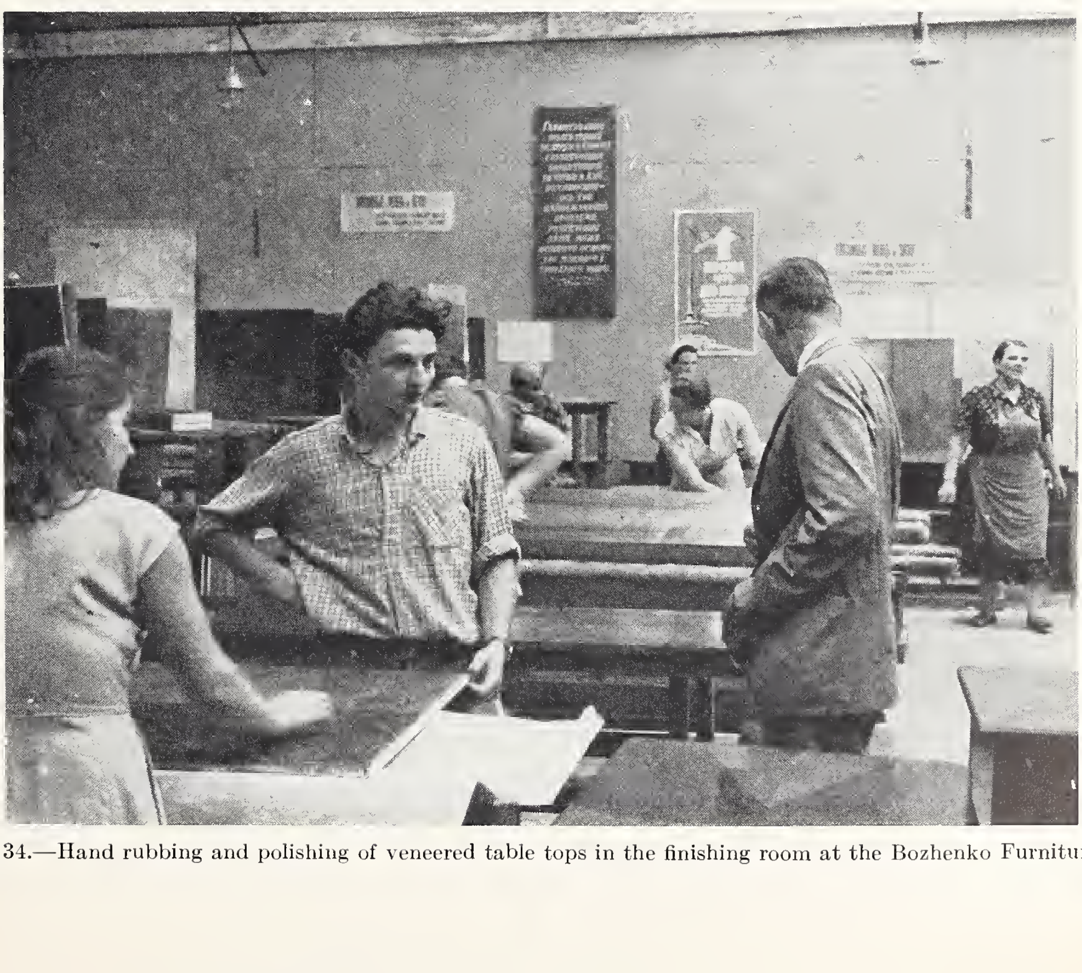

FIGURE 34.—Hand rubbing and polishing of veneered table tops in the finishing room at the Bozhenko Furniture Plant.

An interesting attempt to utilize wood waste was found in production of wood particle cores for the furniture doors. The screened sawdust and shavings were dried in a revolving drum, mixed with a urea resin, and conveyed to a lower floor where the mix was placed in frames built of pine, with low-grade birch veneers for the top and the bottom. Each step, including spreading of the mix, was done by hand. The panels were pressed in a steam-heated press for 20 minutes, under pressure of 285 pounds per square inch and at 135° C.

The Stalingrad millwork plant, operated in conjunction with two sawmills, produces windows and doors for residential and industrial construction. This plant is poorly equipped and although partially conveyorized, uses too much labor for the volume of production. The final quality of product was extremely low by American standards.

The Stalingrad plant also produces wood flour from kiln-dried coniferous shavings and sawdust. Stone grinding equipment and standard rotary driers are used. Two grades of flour, 460 and 635 mesh per square inch, are produced. The flour is packaged into 35-pound paper sacks and shipped to the plastic manufacturing plants.

In spite of the obvious shortcomings of the Soviet woodworking industries, there is no sound reason for thinking that these could not be overcome in time. Efficient assembly-line wood manufacturing plants are now in the design stage and some of them should be in operation soon. But preoccupation with mass production techniques and standardization, coupled with the obvious shortage of skilled labor, machine operators, and supervisory personnel, may be the principal deterrents to achieving quantity and quality production goals for some time to come.

An example of ambitious planning is the Bratsky Forest Products Combine which will consist of a viscose pulp mill, a carton mill, a sawmill with a yearly capacity of 350 million board feet of round wood, a planing mill with a capacity of 42 million board feet of lumber, and a furniture factory. The mill residues and low-grade timber will be converted into particle board.

Fuelwood

Although the use of round timber as a major industrial fuel is declining, the use of fuelwood for domestic and industrial uses is still considerable. The 1958 estimates place the amount of timber used for wood fuel at 33 million standard cords. This figure does not include fuelwood produced by small local operators for their own use or for the local markets, or wood produced in the forests controlled by the collective farms. It may be safely assumed that somewhere between 35 and 40 percent of the total annual timber cut is used as fuelwood. The projected 1965 production figures indicate no anticipated reduction in this type of wood utilization by the end of the 7-year period (fig. 35).

This extensive use of wood for fuel is of considerable concern to the industrial managers and planners in the U.S.S.R. Attempts are being made at the integrated lower yards to convert the better grades of timber, formerly cut into fuelwood, into some industrial products, such as box shook (fig. 36). The quality of fuelwood observed at several yards was extremely low, containing much decayed wood and species of low specific gravity, such as aspen. Fuelwood was sold to the consumers in a green condition.

FIGURE 35.—Handling fuelwood with pallets at the Mostovaya lower yard. Most of the wood is low-grade aspen.

FIGURE 36.—Box shook mill at Krestzy. Some of the low-grade aspen logs, formerly cut into firewood, are now converted into box shook.

Effective use of wood residues for generating electric power was observed at several lower yard locations.

Pulp and Paper Industries

On the basis of the limited visits which the U.S. Delegation made to pulp and paper establishments and associated agencies, it is difficult to provide a balanced description of the pulp and paper industry. The most significant developments or prospects are embodied in the present 7-year plan, rather than in achievements of the past. Apparently the Soviet industrial planners have now recognized to a much greater degree the importance of wood cellulose products to their economy. In the total plan for expansion of forest industries, the greatest emphasis and capital investment is envisaged in the field of fibers and chemical processing, particularly in the pulp and paper industry. The paper mills visited on this mission gave evidence of considerable progress and achievement in pulp and paper manufacture.

Present and Future Production

In spite of the expressed interest in pulp and paper in the U.S.S.R., the industry is and will remain much smaller than its American counterpart for many years. This is illustrated by the following tabulation of per capita consumption of paper and board as reported by the American Paper and Pulp Association (APPA):

Year	*U.S.S.R. consumption of paper & board per capita (pounds)*	*United States consumption of paper & board per capita (pounds)*
1933	6. 0	178. 0 (1934)
1940	12. 1	255. 0
1953	23. 0	393. 0
1956	27. 7	434. 1
1958	31. 5	405. 4
1960 (proposed)	35. 0	------------
1965 (proposed)	45. 0	------------

In 1958, the production of paper and board in all of the Soviet Union was only about 10 percent of United States production, or 3,183,600 short tons for the U.S.S.R., as compared to 30,797,000 tons for the United States. According to reports by the APPA[10] the 7-year plan (1959–65) will provide for about 25 new combined cellulose and paper plants, plus installation and modernization of about 100 paper machines. On the assumption that all of this is achieved, the pattern of paper use in the U.S.S.R., even as projected for some years ahead, will be well below that of the United States. The extensive 7-year development plan calls for expansion from the 1958 production of

[10] "Pulp, Paper, and Board Mills, Union of Soviet Socialist Republics," report by American Paper and Pulp Association, 122 East 42d St., New York 17, N.Y. April 1959.

TABLE 6.—*U.S.S.R. production of woodpulp, paper, and board, 1913–58; proposed expansion of woodpulp, paper, and board, 1960–65; and apparent estimated per capita consumption of paper and board 1913–58 and 1960–65*

Year	Chemical woodpulp	Groundwood pulp	Paper	Board	Apparent consumption paper and board [1]
	Short tons	*Short tons*	*Short tons*	*Short tons*	*Lbs./capita*
1913	47, 300	41, 800	216, 700	22, 000	2. 2
1923	38, 500	42, 900	118, 580	20, 350	1. 5
1933	227, 700	308, 000	556, 710	86, 900	6. 0
1940	520, 300	430, 100	893, 200	121, 000	12. 1
1946	330, 000	220, 000	580, 800	55, 000	14. 0
1953	1, 210, 000	1, 100, 000	1, 769, 000	605, 000	23. 0
1955	1, 200, 000	1, 100, 000	2, 214, 300	605, 000	28. 6
1956	1, 826, 000	789, 800	2, 035, 000	586, 300	27. 7
1957	2, 163, 700	974, 700	2, 337, 500	[1] 680, 000	29. 8
1958	[2] 2, 224, 200	[1] 1, 134, 000	2, 411, 800	771, 800	31. 5
1960 (proposed)	[3] 3, 190, 000	1, 294, 700	2, 994, 200	1, 348, 600	35. 0
1965 (proposed)	[4] 5, 280, 000	[1] 1, 900, 000	3, 858, 900	3, 087, 000	45. 0

Source: APPA, based on United States and Soviet Government data.

[1] Estimated, APPA.
[2] Includes rayon pulp—180,000 tons.
[3] Includes rayon pulp—297,000 tons.
[4] Includes rayon pulp—638,000 tons.

3,183,600 tons to more than 6.9 million short tons. Detailed information on the various types of paper and pulp was not obtained by the Delegation. However, some perspective on volume of production by major categories is found in table 6, compiled by the APPA.

If the production capacity goals apply to all of the Soviet Union, as presumably they do, it is interesting to isolate the portion of the total which originates in the Island of Sakhalein, an area which was part of Japan prior to late 1945. Two reports [11] prepared by the Natural Resources Section, GHQ, SCAP, in Tokyo show that Japan lost over 50 percent of its wood supply and about 40 percent of its pulp and paper capacity to the U.S.S.R. at that time. The mills in the Sakhalein area, nine in number, were built by the Oji Paper Manufacturing Company of Japan. Total capacity at the end of 1945 was 1,277,000 tons (American Paper and Pulp Association, see footnote 10). It would therefore appear that a significant portion of total production came from the mills in this area.

Analysis of the history of the pulp and paper industry in the U.S.S.R. shows no growth pattern of strength and diversity, such as characterizes the American industry. However, the seven-year plan has recognized some of the shortcomings and provided for a much accelerated development. Plants visited showed clearly the progress that is now taking place and the vigor with which expansion is being pursued. Much capital for expansion is scheduled for resource-rich areas in the North, the Urals, West Siberia, and especially East Siberia. Another feature of the plan is to provide much greater mechanization and more highly integrated utilization, which in turn will put the forest economy and forest products industries in better balance.

Objectives of the 7-year plan include construction of several large integrated centers, producing sawn wood products, particle and fiber boards, pulp and paper, chemical cellulose, and wood chemicals. Unfortunately, time and other travel demands did not permit a visit to such a center, if such a complete unit is in fact in operation at present. The paper plants which we visited did not show such complete integration, but rather gave the impression of concentration on a few simple products at the expense of complete utilization. However, better utilization is probably planned for these plants, and they were visited before it could be achieved. For example, the newsprint mill of the Kondopozhsky Pulp Combine used very high-quality wood for mechanical and sulfite pulp, with no special provision for use of lower grade wood, a variety of species, or for higher yield processes in the pulping operation. Ethyl alcohol manufacturing facilities were to be installed later.

It is difficult to comment with confidence on the various grades of paper produced in the U.S.S.R. without specific data on the quantities of each, and without test data on these papers. However,

[11] Reports by Robert J. Seidl, Natural Resources Section, GHQ, SCAP, Tokyo, April 1946 as follows: Estimate of Pulpwood Situation in Japan, Rpt. 28; The Wood Pulp Industry of Japan, Rpt. 56.

the varieties of paper available are few and quality is, with a few exceptions, mediocre. An examination of the papers available to the public at various stops in the country showed the paper to be average to poor in quality, small in variety, and scarce in quantity, by United States standards. The observation about quantity would be obvious from the per capita production figures. Some writings indicate that if goals of the 7-year plan are achieved, the needs of the population for paper will be met. However, this presupposes no widespread development in food packaging, unit containers, sanitary papers, magazines, or larger newspapers, all of which would require much more paper than is presently planned.

Although the quality and scope of the present industry is not great, much progress is evident in mechanization and plant expansion to produce greater tonnages of a few basic papers. This was dramatized at the Kondopozhsky plant near Petrozavodsk, where expansion from 70,000 short tons per year to 335,000 tons was scheduled during the 1959–65 period. This expansion apparently will be achieved somewhat ahead of this schedule. Although three new paper machines and all accessory equipment were being installed, there were no unique or notable features other than size and the scope of the expansion (fig. 37).

In contrast to the newsprint mill, the Kommunar mill near Leningrad is a good example of an old mill that produces a low tonnage of excellent quality papers. It has an average daily output of about 30 tons. Pulp used in the manufacture of these papers comes from the Leningrad and Volga regions.

The mill has six paper machines, four producing condenser and other fine papers, and two producing drawing and copy paper. Thin papers from 5 to 12 microns in thickness are also produced. These papers were well-formed and clean, and their production is of a highly technical nature. To improve quality, process water is sand-filtered, and minerals removed by ion-exchange. Glass pipes are used for transporting pulp in some parts of the process. Instrumentation is good, including such items as temperature control on each dryer and automatic tension control on this very fragile paper. Control of quality is monitored by three laboratories: one for control of refining, one for chemical testing, and one for mechanical and electrical tests. The latter laboratory has a device for a continuous measure of dielectric strength.

The entire mill left a good impression of an old mill well-maintained and definitely improved. Production increased 300 percent in 7 years. The crew, numbering 700, was pleasant and intelligent

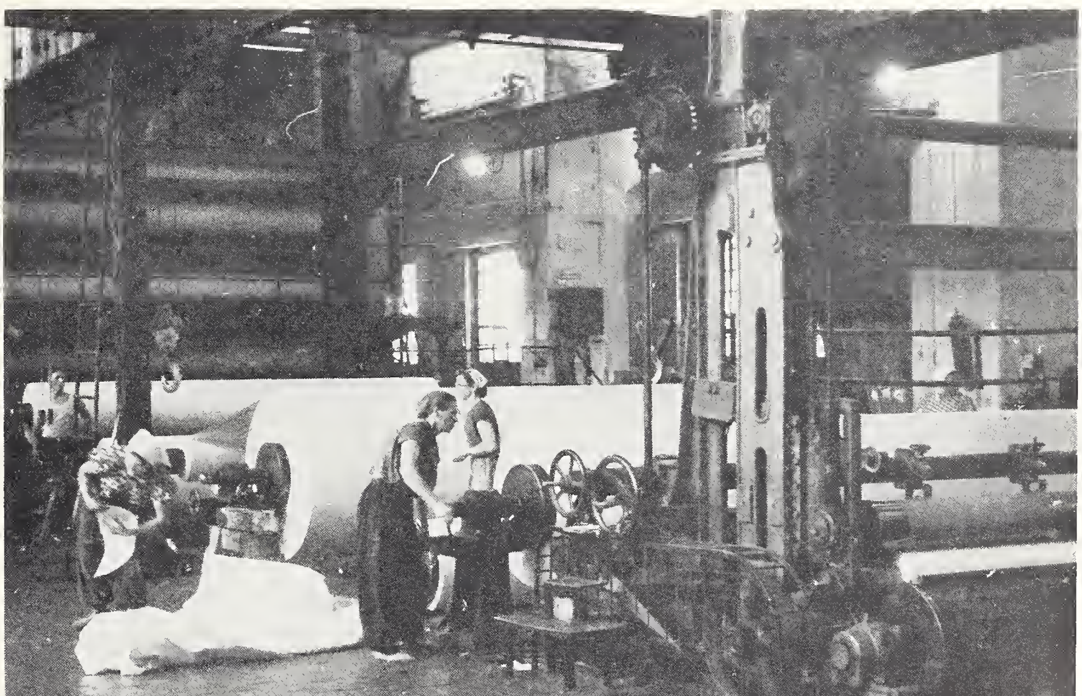

Figure 37.—Reels and rewinders at the Kondopozhsky paper mill.

FIGURE 38.—A pulpwood barker of the cambium-shear type at the Shoujsko-Vidanski lower yard. With the exception of men operating the barker and the cut-off saw, all manual labor is performed by women.

and took pride in its work. This plant and its record is also a testimony to the emphasis given by the government to highly technical products required for electronic and other electrical devices.

An interesting development is the projection of plants for using a reed as the raw material for corrugating board. The semichemical pulping process will be used. Some of the equipment for this operation will come from England.

Type of Machinery

No unusual paper-making machinery was apparent in the mills visited. Machinery from Germany, England, Sweden, Finland, France, and the United States was in use. However, much paper-making machinery is also built in the U.S.S.R., some in the Leningrad area. The U.S.S.R. is also building a large central works for paper machinery in the Ural region, but this machinery probably will not be exported, since so much is needed within the country. An interest was expressed in the greater purchase of machinery from the United States.

An effective mechanical wood-barking machine was observed at the Shoujsko-Vidansky Logging Camp near Petrozavodsk. The machine was designated as "O.K. 1," made at a plant called Volna Revolutsii. It was of the cambium-shear type, with three shoes which were apparently held against the log by centrifugal force. The shoes had a sharp taper on the entering end so they could "climb" up on the log. Speed was about 10 to 33 feet per minute, on logs of 3 to 12 inches in diameter (fig. 38). The good quality barking was at least partly due to the uniform size and excellent condition of the Norway spruce being peeled.

Particle Board and Fiberboard

Present and Future Products

No detailed data on particle board and fiberboard production were obtained, which would accurately reflect the position of these products on a national basis. However, without doubt, the State Planning Commission and the regional Councils for Peoples' Economy are planning a heavy emphasis on expansion in these fields.[12] Products of this type are presently produced by the furniture and pulp combines, such as the Leningrad Forest and Furniture Combine which we visited.

Reports by the Ministry of Agriculture indicate that a new special branch of the paper and cellulose industry is to be established to manufacture fiberboard and particle board. By 1965, the intent is to produce 2,955,000 cubic meters of particle board (1,670 million square feet, ¾-inch basis)

[12] The West German firm of Himmelheber has a contract to install several plants based on the Behr process, with 50 to 100 tons per day capacity. All of these plants will be located in the Western European sections of the U.S.S.R.

and 500 million square meters of fiberboard (5,350 million square feet).[13] Achievement of these goals is doubtful. United States production of these items for 1959 is approximately as follows:

	Thousand square feet
Hardboard	1,639,000 (⅛-inch basis)
Insulation board	2,803,000 (½-inch basis)
Particle board	250,000 (¾-inch basis)

These products are scheduled for large expansion for several reasons: (1) The demand for prefabricated houses and the desire for greater mechanization of the building and furniture industries requires wood products of this type; (2) the Soviet producers recognize that complete utilization and integrated utilization depend upon the use of wood in fiber and particle form; (3) there is a scarcity of structural plywood which might otherwise relieve pressure on building boards; and (4) the use of particle and fiber boards is in keeping with a universal trend toward the greater use of sheet materials.

Examples of Operations

Only two operating particle board plants were visited by the U.S. Forestry Delegation. One was at the Bozhenko furniture plant near Kiev, in which particle board was being integrally formed as panels for furniture and doors. This operation has been described earlier in the report. It is difficult to judge the reasons favoring such an operation in which particle board was fabricated on a furniture production line. It would be much more efficient to produce the board on large-scale machinery and work with cut panels in the furniture factory.

As already mentioned, the Delegation visited the particle-board operation at the Ust-Izhorsky Plant near Leningrad, which was operated as part of the Leningrad Forest and Furniture Combine. The plant was new and impressive and was well integrated for making plywood, compreg, and other items at the same site. Birch residues from the plywood operation were used for these products. Other plants were reported to be making softwood boards. Flakes were cut on four machines manufactured by F. Meyer and Schwabedissen (Germany), and dried to about 5-percent moisture in four pneumatic flake dryers. The flakes were blended with 7 percent of urea resin, which was obtained from a modern glue plant adjoining the machine. Glue at 52-percent solids was blended with flakes and particles. The board was formed on an English Bartrev press, a machine which compresses a preheated (by high-frequency energy) mat continuously between metal belts. This machine was installed and started by English personnel, who left only recently. The board machine was about 4.4 feet wide, and speed varied from 9 to 20 feet per minute. A new sander was being installed at the time of our visit. While the product appeared to be reasonably good, only 60 percent was said to be of first quality. The board was destined for use in furniture (70 percent) and housing (30 percent). Most of it was ½ to ¾ inch thick, although some of ¼-inch thickness was also made. Present production of this plant was reported to be 22,000 cubic meters per year (18,640,000 square feet at ½-inch average thickness).

The Ust-Izhorsky particle-board operation was modern and well-built and housed in a new brick building with steel roof trusses, covered with precast concrete roof slabs. The adjoining glue plant was well-designed and orderly. Although the equipment and process were largely foreign, it was reported that Soviet processes now under development would be coming into widespread use under the new expansion program.

A product related to flake board, but of a much more specialized nature, is a compressed and impregnated wood flake plastic, which was also made near the Bartrev particle-board operation. It was reported that this product has been produced in the Soviet Union for about 5 years. It is similar to a United States product known as "Flapreg," developed at Washington State University. Small flakes and particles are soaked in phenolic resin, dried, and compression-molded to yield a dense and strong plastic. Resin content was said to be about 70 percent. The treated flakes were also molded directly into specific shapes, such as bearings, widely used on trams and trains. They serve as a substitute for nonferrous metals and afford a saving of oil, since they can be water lubricated.

A companion product produced at the same factory is a densified wood veneer plastic, comparable to compreg which was developed by the U.S. Forest Service at the Forest Products Laboratory. Thin birch veneers in racks were mechanically lowered into tanks of phenolic resin for impregnation until the resin content was about 50 percent. Impregnated veneer was dried, and the veneers assembled and pressed in a six-opening press. The product could also be made in a Baldwin press, 17 feet by 4.4 feet in size and of 9.5 thousand ton capacity, which reached the U.S.S.R. under the lend-lease program. The product was used for gears, bearings, and electrical parts. For special uses, it was made with plies rotated at 30° angles. Some were made with as many as 193 plies, compressed to 2¼-inch thickness. Some plastic was as thin as ⅛ inch. Total plastic production was given as 2,500 tons per year, large for this type of product.

[13] Another report (34) gives the production estimate for 1965 as 277 million square meters (2,975 million square feet) of fiberboard.

Wood Chemicals and Byproducts

Because there is still a large demand for fuelwood which offers a good outlet for mill residues, the need for chemical utilization as a final step in complete utilization may not be so acute in the Soviet Union as in some other countries. On the other hand, sources of sugar are scarce, and the making of ethyl alcohol as a byproduct of sulfite pulping is quite practical. We were told that there are a number—perhaps 10 to 15—wood saccharification plants. This type of chemical conversion of wood has not yet proved economical in the United States, although the technology is well known.

The basic desire for complete utilization is widely recognized at wood-using centers in the U.S.S.R., and this philosophy is expressed repeatedly as part of the present 7-year plan. In spite of these pronouncements, effective large-scale chemical utilization (other than pulp) will probably await solution of more pressing problems, and it is doubtful that the research and technological basis exists at present for any advanced integrated wood chemical industry. At any rate, no evidence of advanced wood-chemical utilization or research on the subject was found. At wood-sorting and wood-using centers, such as the lower yards at Krestzy and Mostovaya, serious attempts were made to utilize forest and mill wastes for byproducts. While much of this effort seems somewhat misdirected at present, some of it may bear fruit. In contrast to the usual careful research approach in the United States to this complicated problem, the Soviet technicians were attempting direct application of various methods on a fairly large pilot-plant scale.

A typical example of the Soviet approach was found in a small laboratory in which experiments were conducted on products that could be made from sawdust, particles, and binders. One mixture contained coarsely hogged wood and branches with 5-percent silicate binder which could be compressed into a rigid material, weighing about 60 pounds per cubic foot. It is unlikely that this product is very water resistant. A special oven had been built for making sodium silicate on an experimental basis. This unusual operation was an attempt to make the plant self-sufficient in binder production. The silicate in some cases was also mixed with sodium flurosilicate to make a more water-resistant mixture. For demonstration purposes, some of this product was used to build a house wall section. The outer surface was a silicate woodwaste board of ¾-inch thickness, with a colored modified silicate coating. This board was fastened to a stud of about 5-inch thickness. The stud was covered with an asphalt paper, then a thinner woodwaste board, and then wallpaper. A so-called "sandwich panel" wall was also displayed, having a core of the silicate wood mixture and dry wall surfaces. Both of these constructions were heavy and not very durable.

At this laboratory, experimental building blocks were being made of ordinary sand, powdered sand, silicate, and sawdust. They were hollow in the manner of a cement block, but very heavy for their size of 1.3 by 0.6 by 0.6 feet. They were cured by oven-baking at 150° C. It was not clear how these would perform. In spite of the fact that these products were seemingly so far from being thoroughly developed, we were told that a production plant was being planned for the near future.

At the Krestzy timber operation, a wood chemical plant utilized branches, needles, sawdust, and other waste. Part of this raw material was also used for boiler fuel, generator gas for combustion engines, and silicate-bonded board products. The chemical plant was of the continuous destructive distillation type, with a continuous gas generator, a separator for acetic acid and other materials, a centrifugal separator, and a gas-cleaning unit. The gas was pumped to combustion engines. The solution containing acetic acid was neutralized with milk of lime to make calcium acetate, which was sent elsewhere for recovery of usable acetic acid. A small amount of methanol was also produced. Tne tars produced were used as binders. Thirty-five cubic feet of wood waste was said to yield 1,300 calories of gas, 80 pounds of rosin, and 57 pounds of raw material for acetic acid. However, these figures could not be accurate, since no distinction was made between needles, branches, sawdust, or wood species in the mixture.

The raw material for the various products was in various forms, including branches and needles from the whole tree logging operation. Branches were reduced in a drum chipper, about 2 feet in diameter, with six knives. It was fed by a series of toothed drums, apparently all power driven. Three small drums were on the bottom with a larger one on each side. The top drum carried its own motor, and was free to lift up and down as the load changed. This feeding mechanism was very effective.

At the lower yard area of the Shoujsko-Vidansky Logging Camp, a small production plant had been built to make useful products from needles. Crowns of the trees were brought in with the main stem of the tree and this had stimulated the search for needle products. The branches were hand-fed to a special hammermill that stripped them of needles without also reducing the branch. Needles were then ground, passed over shaker-screens, reground, and bagged. The product was proposed for poultry or cattle food. Although it was only pulverized spruce needles, it was reported to be high in minerals and to contain 1.5 times more carotene than cod liver oil. Similar ground needles of Norway spruce and Scotch pine in Poland have been found to be rich in many important elements and to be valuable food supplements for domestic fowl and pigs.[14]

Branches remaining from this process were hogged and proposed for future use in particle board. It was planned to build a plant to make a lower density insulation-type board from branch material. Since so much residual wood for chipping existed at this site, it seemed preferable to compact the branch material for fuel, and use the present fuelwood for the building board.

Although specific plants were not visited, the wood hydrolysis process is reported to be widely used, operating on sawmill waste in the North, in the Urals, and Eastern Siberia. End products are ethyl alcohol, feed yeast, and furfural.

Most of the products described in this category do not seem presently very important, but they do reflect the policy and the desire of the Soviet leaders for more complete utilization of woody substance, from the forest itself to process-plant residuals. Under the United States system, it is doubtful that the products could be considered economic. The same is probably true under the Soviet system. Nevertheless, the numerous attempts to find processes and products that will be useful and improve utilization must certainly find at least limited success. Perhaps the greatest limitation to this approach is the lack of fundamental understanding of the chemistry involved.

Forest Products Utilization at Forest Management Units (Leskhozi) and on Collective Farms (Kolkhozi)

To round out the picture of forest products utilization, we should mention that considerable quantities of material are removed in the forest cultural operations by the labor employed at the forest management units and on the collective farms. In 1956 the value of products so obtained was estimated to be in excess of $250 million. More significant than the monetary value of these products is the fact that these operations create a stabilizing effect of employment by providing year-round work for the woods labor.

The main products of this utilization are box and cooperage shook, parts for horse-drawn carts and sleighs, agricultural implements, simple items of cabinet work and furniture, and a great variety of handicraft, ranging from baskets to wooden toys and novelties. More than 80 different kinds of woodcraft, for instance, were made in the shops and at homes at the Syversky Experimental Forest near Leningrad. In recent years, some of the forest management units were equipped with small sash-gang sawmills and wood-working shops capable of producing structural material and millwork for local residences and operational buildings. By 1957 there were some 250 such sawmills, which produced more than 420 million board feet of sawed products, and about 1,000 woodworking shops, equipped with power machinery. Most items produced by the forest management units are examples of individual handicraft.

In addition to the items made of wood, some forest units also produce crude wood tar and rosin, charcoal, meal from coniferous needles, pressed wood particle board, and similar products already described. In most instances, workers employed at the forest management units (leskhozi) are also engaged in raising agricultural products for their own consumption. Such gardening is not permitted on the agricultural lands, but only on the small clearings and meadow lands within the forest.

The collective farms (kolkhozi) in the Soviet Union control about 97 million acres of forest land. Forest cutting on these acres is controlled by the farm management. Substantial volumes are cut for fuelwood and for materials suitable for farm buildings and residences. Some collective farms operate small sawmills as well as woodworking shops, in which a variety of items essential to farm operation are made in the slack season.

There is strong evidence that in many areas of the European Soviet Union, forests controlled by the collective farms are heavily overcut, primarily for fuelwood. In 1955, 7 percent of the total cut came from collective farms which make up less than 4 percent of the forest area of the country. Ninety-two percent of the farm cut was for fuel.

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[14] "Vitamin flour from needles of pine (*Pinus sylvestris*) and spruce (*Picea excelsa*) as addition to the fodders for the domestic animals birds and pigs." Konstanty Szezerbakow, Main School of Rural Husbandry, Warsaw, Poland. (An unpublished office report.)

Forestry Research

As the engineering and mechanical aspects of forestry dominate land management, so does research in these areas take precedence over the biological in the U.S.S.R. This conclusion of the U.S. Forestry Delegation is based on visits to numerous research institutions. Our impression was that the Soviet forestry research programs in general tend to emphasize the applied approach without adequate basic information available. For example, pilot-plant tests figure prominently in the early stages of many experiments.

Forestry research is carried on at 12 universities, 15 specialized research centers, and hundreds of laboratories in industrial plants, experiment stations, and forests. It is not possible here to describe completely the program of each research establishment visited. Rather, general reactions are set forth with examples to illustrate the kind of research under way. Additional descriptive material for a number of experiment stations is given in the appendix.

Collection of Resource Data—The All-Union Forest Project (Lesproekt)

The All-Union Forest Project is a coordinating agency in the Ministry of Agriculture, responsible for the national forest survey and for collecting other information basic to planning forest protection, timber exploitation, regeneration, and to some extent forest recreation. Headquartered in Moscow, the Forest Project develops survey techniques, makes inventories, analyzes data, prepares reports, and coordinates surveys done by other groups.

More than 5,000 engineers and technicians are employed on the Forest Project. A great many basic records were lost in World War II, but since 1947 the organization has completed the initial survey of the entire 2.8 billion acres of forest land. In the last 12 years, 2 billion acres have been covered with extensive aerial surveys and 0.8 billion acres by more exact methods, that is, by combining the better aerial techniques with ground surveys.

For the more extensive surveys, aerial photos at the scale of 1:25,000 are used. A new "spectrozonal" method recently adopted uses a two-emulsion film—one layer is sensitive to infrared, the other is a regular emulsion for the normal color spectrum. The prints used in photointerpreting are excellent with this technique. After preliminary photo interpreting in the office for species, age, and density, flights are made to check the type lines, stocking estimates, tree diameters, and tree heights on the photographs. No growth rates are determined.

The intensive surveys make the same preliminary determinations from the aerial photos, but ground crews check type and condition class estimates. Ground surveys are usually on a 2- to 3-percent intensity. Tree diameter and height information is obtained on temporary 0.02-acre circular plots having approximately a 16-foot radius. In forest areas where types and condition classes are complex, more intensive sampling of 8 to 10 percent may be employed. Growth data are obtained from separate permanent plots. On the more intensive surveys, information is also obtained on soil type, topography, insect and disease damage, fuel type, and deterioration rate of timber stand. A newly adopted device for "plotless cruising" was described. It consisted of a simple hand-held angle gage as developed by Bitterlich. Although it differs from the prism method used in parts of the United States, it apparently accomplishes the same purpose.

Analysis of field data appears to be very complete, and electronic data processing methods are used "for the most important data," a not-too-exact description. Elaborate sets of maps are prepared from the processed data for selected areas. These areas usually either lie close to the larger cities or are the areas where most intensive protection, management, and utilization of the forest is contemplated. At least eight principal types of maps are prepared, on a scale of 1:300,000 as follows:

1. Timber type and age class.
2. Insect and disease distribution map showing major pests of the area.
3. Fuel type map of special value for fire preplanning.
4. Life expectancy or timber deterioration maps.
5. Landscape evaluation or esthetic values map (ordinarily prepared only around large cities where recreation values are high).
6. Silvicultural practices map, showing areas in need of thinning, weeding, or other cultural measures in the 10 years ahead.
7. Maps of forest plantations and of areas in need of planning.
8. Soil map showing texture, parent material, and moisture-holding capacity.

Only 5 copies of the 11-album sets of survey data and maps are prepared for each survey unit. No reports are published in quantity.

Up to now, about 175 to 185 million acres have been mapped by this intensive method. The 7-year plan calls for an additional 500 million acres to be so covered. The expected average forest survey interval is 10 years, or 5 years for selected zones of great importance. During the interval between surveys, records are kept up-to-date by adjusting them from reports of cutting, fires, or other changes.

Research in Protection and Management

Research in the protection and management fields is emphasized at educational institutions as well as at special research institutes. The Delegation observed that investigations at academies were variable from the standpoint of facilities and apparent support. The overall picture was unimpressive by comparison with present forestry research at United States forestry schools and agricultural experiment stations.

Members of the Delegation received the impression that the Soviet scientists are doing some good work on insect and disease problems, particularly at the research institutes. Strong emphasis is placed on studies of life histories of pests, placing the field of research into a somewhat more basic category than much of the rest. Interests center strongly on chemical control and, according to the scientists with whom we talked, little progress has been made yet on biological control. The All-Union Institute of Plant Protection, in Leningrad, has one of the most impressive programs. While the attention of this research group is directed primarily to pest problems of agricultural crops, the Institute conducts a comprehensive program on shelterbelt insect and disease problems. We were impressed by the technical skill used in motion pictures depicting forest insect development.

Forest Fire Research receives major attention at the Leningrad Research Institute of Forestry, where emphasis is being given to development of fire control machines and equipment. We saw one of two fire research laboratory rooms where basic research on combustion and on fire retardants was underway. The laboratory visited, said to be the poorer of the two, was indeed poorly equipped. The research equipment and techniques used in modeling test fires were crude. It is doubtful if satisfactory experimental control could be obtained. Research on fire danger rating was said to be underway here.

Research programs in the general area of regeneration and silviculture and the phases basic to timber growing problems, cover the usual laboratory and field approaches. Most of the research establishments visited had plant physiology research programs. Work underway included tree nutrition and fertilization, translocation, water relations, and similar studies. We were shown extremely modest experiments involving use of radioactive material to follow the movements of phosphorous in spruce seedlings. We visited one well-equipped radioisotope laboratory at Timiryazev Academy where tree fertilization was being studied. We were surprised at the absence of controlled environmental facilities and greenhouses at all institutions visited. If these were available, we did not see them.

Seed research programs are underway at the All-Union Institute of Forestry and Forest Mechanization at Pushkino. This institution supervises a seed certification program for the Soviet Union. The U.S. Forest Service has been actively exchanging material with this group for a number of years. The director of the Pushkino station observed, however, that the seed certification program still has much room for improvement.

We saw few well-designed field experiments. Studies of weed control in nursery seedbeds at Syversky were presumably set up in randomized block design, but the amount of replication used was not clear. At this same location we saw a large-scale randomized block design used in a Scotch pine seed-production experiment. One phase of this experiment related stand density to seed production. A 25-acre area was divided into 40 plots (about ⅓ acre per plot), with 5 stand densities being compared. It was reported that a density of 120 trees per acre increased seed yield 8 times over the control. One may wonder whether Lysenko's philosophy of biology, discussed earlier, is responsible for the absence of designed experiments. In essence, he claims that statistical studies of variation are unnecessary under Michurinism because biology, as Soviet scientists view it, is not governed by chance.

At the Timiryazev Academy's experimental forest, we saw numerous field experiments on growth, thinning, and stand composition involving larch, pine, spruce, and basswood. Study plots were not replicated and were small—usually 80 feet square but not over 150. A questionable practice of permanently marking plot boundaries consisted of digging a foot-deep ditch on the plot line, severing plot tree roots in the process. No isolation strips were used on these plots.

Little equipment was observed at the soils laboratories visited. All forestry soil-moisture work is done by gravimetric sampling, although we were told that for agricultural soils electrical resistance and nuclear scattering methods are used. Soils studies underway include moisture in relation to stand density, changes in infiltration rate as stands mature, and effect of liming on tree growth.

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Research in Forest Mechanization

As mentioned, development of machines for all types of forestry operations takes top priority in the U.S.S.R. We felt that the Soviet research and development in this area was imaginative and, for the most part, highly successful. When it is realized that the program of mechanization in forestry has been underway only 25 years, and only 10 to 15 years at an accelerated pace, the progress is appreciable. We had no way of judging the relative expenditures for mechanization versus biological research, but the difference must be substantial. For example, the annual budget of the Central Scientific Research Institute of Mechanization and Energetics of Forest Industry is $3.5 million. Incidentally, income to the Institute from "experimental" logging operations under its control is about $3.25 million.

Practically every research institute we visited had as its major division a unit studying mechanization. The two principal institutes are the Central Scientific Research Institute of Mechanization just mentioned, and the Central Scientific Research Institute for Timber Floating. The programs at both institutes are well housed and well equipped, the former in a new building in Moscow where 430 scientists, engineers, and technicians are employed. Considerable basic research is included in the programs. Work is underway on principles of power application to harvesting and transport problems, hydraulics of streamflow in relation to timber floating, and similar fundamental engineering problems.

Laboratories for engineering research are well equipped at all institutions visited, and often scale-modeling techniques are used extensively. This was true of the Institute for Timber Floating where models of stream channels were being used to study effect of currents, volume of flow, obstructions, and other problems on log and raft movements. At the Leningrad Research Institute of Forestry, a large "department of mechanization of forest management" is concerned with the design and testing of machines for logging, planting, direct seeding, pest control, firefighting, and naval stores production. Scale model tests of various plows, as for swamp drainage, were demonstrated. All major institutes have mobile laboratories to study performance of trucks, narrow-gage railroad equipment, and other machines in use.

Research and Development in Pulp and Paper

Research and development in pulp and paper did not appear to be extensive or unusual in any respect. More extensive research on chemical aspects of wood pulp and paper might better be conducted at institutions not directly concerned with forestry matters. For example, there is a newly created Central Institute for Pulp and Paper Research in Leningrad which employs about 300 people, about 20 percent having scientific degrees. Although this Institute was not visited, it is reported to have various laboratories for studies of sulfite, sulfate, semichemical, and mechanical pulping, and dissolving pulps. The Institute is also responsible for the detailed planning of specific plants that are projected by the State Planning Commission. The impression was gained that much of the work of this Institute related to practical mechanical aspects of pulp and paper manufacture. This Institute was under the jurisdiction of the All-Union Central Scientific Committee, under the Cabinet of Ministers. The Institute was said to have branches in other cities.

Evidence of progress in mechanical and chemical engineering research is given in a report by Albert Wilson, editor of *Pulp and Paper* magazine in the July 1959 issue. Mr. Wilson visited the Central Institute for Pulp and Paper Research in Leningrad. He described a "dry process" for making paper. This product is similar to what are often called "nonwoven" fabrics in the United States. In the Soviet process, fibers are dispersed in air in a glass enclosure and are vacuum-formed on a wire screen to give a web which is bonded by means of a double "sizing" bath. The machine runs at 85 feet per minute, and a new model is to run at three times that speed. About six machines were said to be in commercial use. Glass or other fibers are used for special technical papers, where high temperature and dielectric resistance are required. Emphasis given to research on such a process, coupled with the care exercised in making condenser paper as observed in the Kommunar mill, illustrate that Soviet research on technical papers for industry has priority over research on paper for consumer use.

Part of the research program on pulp and paper at the Leningrad Forest Technical Academy is supported by cooperative grants from industry. About 20 people work under this arrangement, and some of them are studying for postgraduate degrees. The work of this laboratory is closely coordinated with that of the Central Institute for Pulp and Paper Research.

Compared with other research establishments visited by the Delegation, the Leningrad Forest Technical Academy has fairly extensive pulp and paper laboratory facilities for use in its education program. This program, like that of the Academy in general, is under the Ministry of Higher Education. Research in pulp and paper is under the Chemical Processing faculty, which last year graduated about 75 students. The paper-testing laboratory was large and was well equipped with German instruments, but was not maintained at a constant relative humidity. The pulping laboratory had about 10 small digesters, for alkaline or acid pulping, with external liquor circulation and electric heat. There seemed to be no special facilities for high-yield or semichemical pulping.

Experiments were being conducted on prehydrolysis sulfate pulping, although no such large plant exists in the Soviet Union at present. Most work was concentrated on larch, the most abundant forest tree in the U.S.S.R. Interesting experiments were being conducted on the single-stage bleaching of alkaline pulp by direct addition of oxygen gas to pulp in an autoclave. It was reported that the pulp, in a hot and slightly alkaline condition and with a trace of chlorine dioxide added, could be brought to a brightness of 89 percent (G.E. equivalent) and to an alpha-cellulose content of 94 percent, with a 2 percent addition of oxygen gas. The economics of this process are not yet clear.[15]

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[15] The process is described in "Data of the Conference on Chemistry and Technology of Lignin," Edition No. 75, pp. 145–155. Leningrad Forest Tech. Acad. 1956. (In Russian.)

Education in Forestry

This report on forestry education in the U.S.S.R. is based on visits to a limited sample of institutions in the European part of the Soviet Union by the U.S. Forestry Delegation. Specific contacts were made at two technical forestry institutes or academies (Moscow and Leningrad) and two forestry faculties in agricultural academies (Moscow and Kiev). Some supplementary information was gathered at a number of research institutions, forestry enterprises, and other agencies, especially as regards nonresident higher education (correspondence courses) and subprofessional training.

The information gathered on the ground has been augmented by a number of published reports (*25, 2, 10, 19, 27, 30, 31*), and by brochures in English published by the Leningrad Forest Technical Academy and Timiryazev Academy. It is further strengthened by the evident standardization of curricula, policies with reference to faculty and student matters, and many other facets of higher education throughout the Soviet Union.

General Education Program

The basic universal education law in the Soviet Union was passed in 1930, making 4 years of education compulsory. In 1947, the requirement was raised to 7 years and, in 1951, "in conformity with the sixth 5-year plan," 10 years of education was to become obligatory for the country as a whole by 1960. This 10-year program is comprised of three stages: primary school (grades 1–4), beginning at age 7; intermediate or "incomplete secondary school" (grades 5–7); and upper or "complete secondary school" (grades 8–10).

At the end of the seventh year, students may enroll in the specialized technical schools (technicums). These are 4-year vocational or subprofessional institutions that provide instruction in both general and specialized subjects. They are operated by the major industrial ministries of the Soviet Union, including the U.S.S.R. Ministry of Agriculture. Chuvahin (*10*) states that the graduates of these technical schools acquire both a general education comparable to that in the 10-year complete secondary schools and a specialized training which equips them to work "as technicians in industry, as agronomists in agriculture, and as assistant physicians in medicine, without any other special training." According to Shirley (*25*), the extension of compulsory education to 10 years was to be accompanied by an increase in the number of technical schools to develop more skilled workers, artisans, technicians, and foremen. The students who complete the full 10 years of secondary schooling either terminate their education at that point, enroll in the technicums which they can complete in 2 years, or go on to the universities and institutes of higher education.

Higher education in the U.S.S.R. is centered in the universities, polytechnic institutes, and specialized technical institutes such as those which train men and women for work in forestry and the forest industries. The polytechnic institutes have many different faculties and train people in a variety of specialties, in contrast to the specialized institutes that generally train their students for one particular branch of the national economy. Except for the agricultural academies, which are responsible to the Ministry of Agriculture, all three of the indicated types of institution come under the direction of the U.S.S.R. Ministry of Higher Education. The Ministry has supervision over the curricula, establishes methods of teaching, and selects the textbooks. As reported by Timoshenko (*27*), it controls the expansion of institutional facilities, sets enrollment quotas, and plans the placement of graduates.

Admission to the higher educational institutions is reputedly not affected by the student's nationality, race, religion, sex, social origin, or property status. Every Soviet citizen from 17 to 35 years of age has the right to higher education, by his own free choice, after the required preliminary preparation and, with certain exceptions to be noted later, provided he can pass the competitive entrance examinations.

A general outline of forestry education in the U.S.S.R. is diagramed in figure 39.

Specialized Education in Forestry

Two major classes of higher educational institutions are concerned with specialized education in forestry. Most important from the enrollment standpoint is the forest technical institute or academy, which is somewhat comparable in scope and administrative organization to the American forestry school or college. Eleven such institutions were reported in 1958 (*30*) to be training specialists for employment in forestry and the forest industries. These are:

(1) Leningrad Forest Technical Academy, founded in 1803 as the Tsars Forestry School.

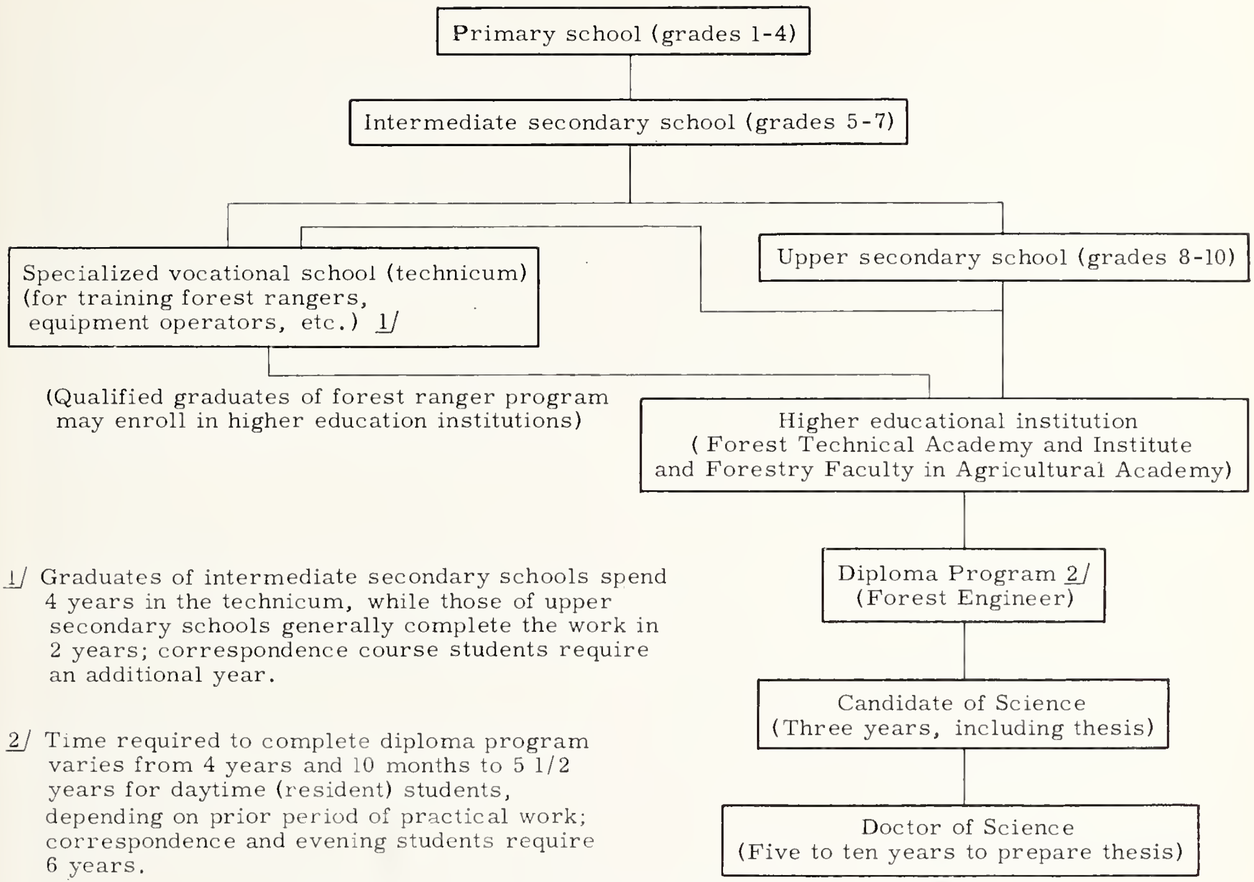

FIGURE 39.—General outline of forestry education in the U.S.S.R.

(2) Ukraine Forestry Academy in Kiev, reorganized in 1954 from the Kiev Forestry Institute and Novo Alexandrovsky Forestry Institute of Kharkov.

(3) Voronezh Forest Technical Institute, renamed for the second time in 1955. This institute is stated to be the largest center in the U.S.S.R. for training forest management specialists, with a 1957 enrollment of 1,000 students in this field alone.

(4) Povolozhsky Forest Technical Institute in Ioshkar-Ola.

(5) Siberian Forest Technical Institute in Krasnoyarsk, the only such institution in the Asiatic U.S.S.R.

(6) Ural Forest Technical Institute in Sverdlovsk.

(7) Archangel Forest Technical Institute.

(8) Beloruski Forest Technical Institute, which was transferred in 1946 from Gomel to Minsk.

(9) Moscow Forest Technical Institute.

(10) Bryanski Forest Technical Institute in Bryansk.

(11) Lvov Forest Technical Institute.

The number of forest technical academies and institutes listed above is somewhat at variance with information available from other sources. A total of eight such schools were reported to the delegation at its initial conference at the Ministry of Agriculture, while Shirley (*25*) lists only seven by name. In the latter cases, the difference may be in possible misunderstanding as to whether the forestry programs at some locations are offered in forestry or agricultural institutes.

The second class of higher educational institution is the forestry department in the agricultural academy, with somewhat more limited curricula than the technical institute. A total of 12 such departments were in existence in 1957 (*30*).

In addition to the above institutions, there were in 1957 some 26 forest technical schools, at a grade below the institutes and the departments in the agricultural academies. Almost all the Councils of Peoples' Economy are reported to operate such schools. At a still lower level are the 19 subprofessional institutions, apparently somewhat comparable to the American "ranger school," which provide 1 or 2 years of training for forestry foremen. Completing the educational program are the special "in service" courses provided for workers in forest industry plants. These are of 3 to 12 months duration, according to the specialty involved, and are intended to train workers to operate the equipment they use

Statistics on enrollments in forestry appear to be somewhat at variance. As reported by the U.S.S.R. Ministry of Agriculture (*30*), in 1957 there were a total of 10,150 students in the higher institutes and academies, 11,900 in the technical schools, and 11,400 in the ranger schools. The figure for the higher institutions is far below the 1958 enrollment of approximately 18,700 students indicated by Shirley (*25*) for only seven of the forestry technical institutes. Furthermore, information given to the Forestry Delegation indicated a total of 9,500 students enrolled in 1959 at 2 of the larger institutions (Leningrad and Moscow); this compares with Shirley's 1958 figure of 7,000 for these same 2 institutions. While these statistics would appear to imply a notable increase in higher forestry enrollment over the past 2 years, such a development is open to considerable doubt in view of the seeming tendency for the Soviet government to limit enrollment to conform to controlled employment opportunities. It was not indicated to the Delegation that any such increase had occurred. In any event, the number of students in U.S.S.R. forest technical institutes and academies is considerably greater than in our American forestry schools.

The Forest Technical Institutes and Academies

These higher educational institutions of forestry are generally comparable to our American forestry schools in organization. Like the similar institutions in agriculture, engineering, and other U.S.S.R. professions, the forestry institutions afford three separate course programs, involving (1) daytime resident instruction on a full-time basis, (2) correspondence courses, and (3) evening courses. In the past, the time required to complete the daytime program has been 4 years and 10 months of study; for the correspondence and evening courses, 6 years.

In keeping with the present emphasis on actual work experience for students, a somewhat revised program was scheduled to go into effect on September 1, 1959. Daytime resident students must now have 2 years of practical work as a prerequisite to entering on the 4-year and 10-month higher education program. However, in some departments enrolled students may take this practical work at the start of the program at a school forest or a wood-processing plant, thereby increasing the course to 5½ years. Since the correspondence and evening-course students are all gainfully employed in management, utilization, or allied forestry jobs while enrolled in the higher institutes and academies, the new emphasis on practical work does not lengthen their established 6-year period of study.

Upon completion of their daytime, correspondence, or evening courses, the students receive a qualifying diploma designating them as foresters or forest engineers. It is not a scientific degree, but some students enter graduate study, leading to the Candidate of Science degree, as described later in this report.

Student Factors

We were told at one of the institutions that about 30 percent of the students who complete the secondary education program enter higher education, but no corroborating information was obtained for the Soviet Union as a whole. The State Planning Committee determines the number of students to be admitted to each academy each year, presumably on the basis of estimated employment needs.

Admission to the higher technical institutes and academies is reputedly on a merit basis. Prospective students are given competitive examinations which are administered by commissions composed of instructors in the institution. As indicated for the Moscow Technical Forestry Institute (*31*), there are three general categories of admissions, which may be presumed to be standard for comparable institutions throughout the U.S.S.R. The first of these, made *without entrance examinations*, is restricted to participants of the "Great National War," who hold certificates with commendation from the secondary schools or received gold or silver medals for "outstanding achievements and exemplary behavior" on the completion of secondary school programs.

The second category of admissions involves applicants who have had at least 2 years of practical work in the industrial or agricultural enterprises, or in other areas of the national economy, culture, or government; also participants in the Great National War and men and women demobilized from the Soviet Army and Navy. Preference is given to applicants receiving the highest marks on the entrance examinations and who have practical experience in the chosen specialization.

The third category, which involves at least 20 percent of the enrollment vacancies, is filled by applicants receiving the highest marks on the entrance examinations. Preference is given to those who received gold and silver medals on completion of the secondary school program, and to students who ranked in the upper 5 percent of the specialized technical school (technicum) graduates.

In the two categories of admission for which entrance examinations are required, the specific subjects covered in the examinations at the Moscow Technical Forest Institute (and presumably at the other higher forestry institutions) will differ somewhat according to the particular faculty in which the prospective student plans to enroll (*31*). Admission to the mechanical technology and processing, mechanization, or forest economics faculty involves examinations in mathematics (oral and written), physics (oral), Russian language and literature (written), and a foreign language (oral); the foreign language may be English, French, or German. The examination for the forest management or forest engineering faculty omits the foreign language requirements from the above list, while examination for the chemical technology faculty substitutes an oral test in chemistry for the written part of the mathematics examination and retains the foreign language requirement.

To be eligible for the entrance examinations, the applicant must be between 17 and 35 years of age and must have successfully completed either the 10 years of preliminary general schooling, or a subprofessional program in forestry with a supplementary 2 years of practical experience. Shirley (*25*) estimates that only about one out of four applicants gain admission, although those who fail the examination may then work for 2 years in the forest or industry and reapply. When students are successful in passing the examination on the second try, they are given priority over those without such work experience. Further evidence of the importance attached to practical work experience was noted at the Ukraine Agricultural Academy at Kiev, where 80 percent of the entering students were reported to have completed the 2-year work period. The other 20 percent were those who had achieved high standing in secondary school and high grades on the entrance examinations to the Academy.

Women are admitted to the institutes and academies on the same basis as men, and comprise 25 to 30 percent of all forestry students. They may enter any of the available curricula, but appear to prefer those in forest economics, mechanical processing and technology, and chemical technology of wood. In these fields women may make up 60 to 70 percent of the student body (*25*).

Students attending the daytime programs receive a stipend that is intended to cover the costs of board, lodging, clothing, and other essential expenses. This is a graduated payment, ranging from $75 per month during the first year at the school to $100 at Timiryazev and $120 at Ukraine, during the final (fifth) year. In addition to the base stipend, we were told that an added 25 percent is paid to students who pass all examinations with an excellent rating. While on required practical work assignments, students receive from $75 to $100 per month, depending on the kind and amount of work they do. They also receive a stipend during their summer vacation. At Timiryazev Academy a number of "personal" stipends amounting to $175 to $250 per month were available for the most promising students.

Student stipends and expenses varied from one institution to another. For example, at Timiryazev Academy the room rent amounted to $3.75 per month and board $2.25 to $2.50 per day. At the Ukraine Agricultural Academy, these charges were $5.25 for room and $1.50 to $2.00 for board. The institutional libraries usually have adequate copies of required textbooks, which can be borrowed by students. However, the cost of textbooks is quite low and they are frequently purchased by students in the more advanced and specialized courses.

About 90 to 95 percent of the students who enter the forestry institutes and academies are said to graduate, less than 2 percent being dismissed for low scholarship. Students are motivated by social and family pressures to apply themselves industriously to their studies, and because of the monthly stipends, economic pressure is not a significant cause of withdrawals.

There is some exchange of students in connection with foreign study in Scandinavia, East Germany, Finland, Czechoslovakia, and certain other countries. Soviet students enrolled at foreign higher educational institutions can apply such study to their diploma requirements in the U.S.S.R.

Admission to the higher educational institutions is so regulated that all students can be placed in jobs upon receiving their diplomas. Such placement is often in the same location in which the students carried on their practical work. The graduates of curricula related to forest management generally find employment in areas which are the responsibility of the Ministry of Agriculture; those concerned with forest engineering or mechanization in jobs controlled by the Councils of Peoples' Economy. Pulp and paper technologists naturally enter the pulp and paper industry.

Curricula

In generalizing on the training of engineers in the higher technical institutions, Chuvahin (*10*) states that 8 percent of the curriculum is devoted to social sciences and economics, 32 to 35 percent to theoretical subjects, 35 to 40 percent to general engineering subjects, and 20 to 25 percent to special subjects related to the future specialty of the student. He says:

> A number of subjects, such as mathematics, physics, chemistry, drawing, technology of metals, social and economic sciences, and a foreign language, are obligatory for all students of the institute. A choice of other subjects, particularly those relating to some narrow specialties, entirely depends on what profession the student has chosen. Besides that, special courses are read at the technical institute which are not obligatory and are taken by the student only if he wishes.

Following is a listing, by subjects and associated study hours, of the 1955 Forest Management curriculum at the Leningrad Forest Technical Academy, modified slightly from the translation by the U.S. Forest Service of the catalog of that institution. It is noted that this is in substantial agreement with the 1958 curriculum breakdown listed by Shirley (*25*). Similar listings for the other five curricula at the Leningrad Academy are included in the appendix to this report.

Subject	Number of hours
1. Marxism-Leninism principles	250
2. Political economy	140
3. Advanced mathematics and mathematical statistics	182
4. Foreign language	142
5. Physics	156
6. General chemistry, analytical, colloidal	156
7. Organic chemistry	90
8. Botany	140
9. Plant physiology and basic microbiology	140
10. Principles of descriptive geometry and drawing	72
11. Surveying and topographic drawing	150
12. Meteorology and climatology	54
13. Soil Science and geology	178
14. Agriculture	54
15. Technical mechanics	82
16. Genetics and selection of tree species	72
17. Dendrology	134
18. Silviculture	170
19. Forest planting	195
20. Forest mensuration	144
21. Forest pathology	72
22. Forest entomology and basic zoology	108
23. Biology of forest animals and birds	54
24. Mechanization of silviculture and forestry work	154
25. Hydrotechnical improvement (timber flotation)	80
26. Construction	78
27. Economics and organization in forest economy	128
28. Safety and fire control technique	40
29. Physical culture and sports	124
30. Specialized courses:	
a. forestry	
or b. forest improvement (amelioration)	
or c. landscape forestry	380
Total	3, 919

Chuvahin comments further:

> The main forms of instruction are lectures, laboratory work, preparing yearly projects and diploma projects, practical work in industry, consultations, and independent research work. About 40 to 50 percent of the entire curriculum is devoted to lectures. Every encouragement is given to independent scientific research conducted by the students. . . .
>
> To graduate from a higher technical establishment, a student must defend his diploma project. This project is presented before the State Examination Commission, headed by one of the leading scientists in the given field, and composed of the dean of the faculty, heads of chairs, professors and teachers, and representatives of the corresponding ministries and industrial enterprises.

Each student is required to devote the final 4 or 5 months of his program to actual work in the forest or a wood-using industry, culminating in the preparation of a thesis or report on the operation to which he or she was assigned, including proposals for its improvement. This is the report that must be defended before the State Examination Commission prior to the award of the diploma.

A complete technical forestry program of higher education is made up of seven separate faculties, providing instruction in six distinct subject matter curricula, plus the correspondence course program which deals with all the six curricula. Such complete instruction is available at the Moscow Forest Technical Institute and the Leningrad Forest Technical Academy and possibly at other establishments in the U.S.S.R., but not all of the 11 forestry institutions are yet able to offer the full complement of curricula.

The terminology used in designating the six faculties and corresponding subject matter curricula appears to be somewhat confusing, at least in translation, and the following designation of curricula is based on seemingly comparable American organization.

1. *Forest management*, including forest amelioration and park and landscape forestry. The forest amelioration option covers the fields of shelterbelt planting and care, drainage of wetlands, and soil improvement measures.

2. *Forest engineering*, including logging. The program deals with mechanization of woods operations, including land transportation and timber floating, and with the organization and management of logging operations.

3. *Mechanical technology and processing* (wood technology and utilization). Separate chairs in this faculty cover the fields of sawmilling and planing; wood-working (industrial organization and processing of wood working, including woodworking machinery, gluing, plywood and particle boards, and wood finishing); wood-moisture relations (all aspects of seasoning); machinery and instrumentation (plant layouts and theory of wood cutting); and wood technology (structure and properties of wood, and defects in wood).

4. *Chemical technology of wood* (chemical processing). This curriculum is concerned with pulp and paper and other fiber products, wood hydrolysis, plastics, wood distillation, and other chemical products, including naval stores.

5. *Mechanization.* This program deals with machinery operation and maintenance, including power requirements. It also includes design and construction of logging and roadbuilding equipment and machinery for wood-processing plants, as well as plant layout and installation.

6. *Forest economics*, as related to forest management, mechanical processing, and the timber industry. This program deals with such matters

as the national forest resources in relation to the location, organization, and development of the forest industries, and also includes the productivity norms for forest workers under different degrees of operating difficulty.

Facilities

With a few notable exceptions, the facilities for instruction in the institutions visited were generally inferior by American standards. The buildings were predominantly old, and the classroom, lecture, and laboratory facilities in even the newer structures were not considered adequate for effective instruction.

The observed equipment used for instruction and associated research varied considerably between institutions and especially within the individual schools, depending upon the faculty or department involved. The best equipped laboratories appeared to be those devoted to the development, operation, and maintenance of equipment, and other aspects of mechanization; to pulp and paper studies and related chemical facilities; and to certain aspects of woodworking (fabrication) including an operating sawmill at one academy. At several institutions, museums provided supplemental material of value in study programs (fig. 40). In general, the facilities for instruction appeared particularly inadequate in most areas of forest biology and wood technology. In the latter field of instruction and in the various aspects of utilization, it was emphasized that the students received much of their applied training through actual work assignments in the pertinent industries. It was also indicated that the forest properties controlled by the institutions provided their main facilities for supplementary instruction purposes in forest biology and allied phases of forestry.

Except for some educational films, audio-visual aids appear to be quite limited and mostly in the form of charts and display samples. One excellent color film on the life history of defoliating insects and bark beetles was seen by the Forestry Delegation, and Shirley (*25*) reports seeing three others concerned with: (1) The development of plows for planting, fire fighting and drainage, (2) mechanized skidding equipment, and (3) automation in a furniture plant.

Library facilities were outstanding in the institutions visited, the Moscow Technical Forest Institute claiming more than 200,000 volumes and the Leningrad Forest Technical Academy some 800,000 items. The latter library, which employs some 23 people, reported an annual acquisition in the order of 45,000 volumes (including 25,000 books) and an annual increment of 25,000 cards for cataloged articles.

Each of the institutions visited controlled considerable areas of experimental or school forest,

FIGURE 40.—The Williams Soil Museum at the Timirazyev Agricultural Academy in Moscow. The museum is a valuable facility for study at the academy.

used both for research and as training areas for students. These tracts provide practical field training in specific areas of study, ranging from the growth, protection, and management of forests to the harvesting of timber, including the use and maintenance of power saws, tractors, and other items of logging equipment.

Correspondence Course

Illustrative of the correspondence course program at the higher education level is that conducted at the Ust-Izhorsky Plywood Factory near Leningrad, where a branch of the Leningrad Technical Forest Academy is maintained for the purpose of training engineers for the plywood industry. In the summer of 1959, 43 students were enrolled in this program which requires 6 years to complete and leads to the same diploma received by resident daytime students at the Academy. Most of the lectures and applied study is given at the plant, with the instruction provided by engineers employed at the plant and by lecturers from the Academy.

Students enrolled in the factory institute go to classes in the morning or evening, and work an 8-hour day. In addition, they have 1 day off each week with pay for study, or 4 consecutive days per month if the plant director agrees. Winter and spring they are allowed 30 days off from their jobs so they may go to the Academy for special laboratory work for which facilities are not available at the plant, and for final examinations. While studying, these men and women are employed as laborers, foremen assistants, or foremen, depending on their progress in the program. The aim is to give students experience in every department at the plant.

It is reported that 99 percent of these engineers stay at the Ust-Izhorsky Plywood Factory upon graduating from the plant institute and receiving their diplomas from the Forest Academy.

Graduate Study

The forestry technical institutes and academies, like those in engineering and other fields, also administer the postgraduate programs leading to the Candidate of Science and the Doctor of Science degrees. Admission to the Candidates of Science programs, which involves 3 years of advanced study, is by special examination. The number of admissions to a given institution and the distribution among the several specialties is approved by the Ministry of Higher Education. Generally, no more than five such graduates will study under a given faculty adviser. The adviser receives an extra stipend for each candidate studying under his direction.

Students working for the Candidate of Science degree generally take no specific course program but are required to carry on research in some area and publish the results. They are also required to pass two examinations in subjects pertinent to their specialty, plus one in Communist philosophy and one in a foreign language. The third year is devoted to preparation of a thesis, but this may be submitted and defended at a later date, if it is not completed before the end of the 3-year term. In the thesis, "the young scientist must reveal his knowledge of the theory of a particular science, his general scientific erudition, and his capacity for independent research work" (*10*). The student presents his thesis before an open meeting of the Scientific Council of the institution in which he is enrolled, and this group then takes a secret vote with reference to the award of the scientific degree.

Students studying for the Candidate of Science degree may devote their full time to resident study at the higher educational institutions or at scientific research institutes where postgraduate work is available. Or they may carry on some of their research and special study in a nonresident status, while working at a research institution, experiment station, industrial plant, or other suitable place of employment. If this nonresident work is considered adequate, such students can become Candidates of Science without the full 3 years of residence in the institute or academy. Students devoting full time to graduate study are apparently eligible for financial aid, in the form of special stipends or scholarships.

Men and women receiving the Candidate of Science degree find employment in teaching at a higher educational institution in their field of interest, in research institutions or experiment stations, or in factories where they have been engaged in production or development work.

Admission to study for the Doctor of Science degree is limited to men and women who already have the Candidate of Science award. To qualify for the doctorate these people must prepare "a dissertation which is a new independent contribution to science, solving some scientific problem or giving a theoretical generalization of new scientific problems" (*10*). No prerequisite courses or other resident study or examinations are involved in this program, but the standards for the dissertation are high. There is no stated time for completion of the doctoral requirements, but it usually takes 5 to 10 years to get the necessary experimental data, analyze them, and write the dissertation. The data may be collected by members of the staffs of educational or research institutions or by men and women working with forest management units or other aspects of forestry or in the forest industries in connection with their employment.

The dissertation is presented to and defended in open discussion before the Scientific Council of the institution involved, composed of professors in the given faculty and representatives of industrial concerns in the particular field. Recommendation with regard to the award of the degree is by secret vote of the Council, with approval required of two-thirds of those voting. Final decision on the award rests with the Higher Attestation Committee of the Commission of Higher Education in the U.S.S.R., composed of the most eminent scientists in the Soviet Union.

Timoshenko (*27*), in comparing the levels of graduate study in Soviet and American Engineering schools, concludes that the Candidate of Science degree is about equivalent to the American Ph. D., with the Doctor of Science degree at a somewhat higher level. He also comments that the Doctor of Science is generally awarded to persons who are already recognized for their scientific or engineering contributions.

The Agricultural Academies

Forestry education in the agricultural academies in the U.S.S.R. appears to have a status somewhat comparable to that in American agricultural colleges, the instruction being offered in one or more faculties or departments in the academy organization. Diploma-level work is offered in some 12 agricultural institutes or academies. Graduate instruction is offered at Timiryazev Academy (Moscow) and possibly elsewhere for training teachers of forestry for the "middle education" technical schools.

None of the agricultural academies has all six specialized curricula which constitute the educational pattern of the more fully developed technical forestry institutes and academies. That at Kiev, for example, has in its 10 faculties 3 that are concerned with general forestry (forest management), forest engineering (logging), and wood technology and utilization. In addition to instruction leading to a diploma, and involving both daytime (resident) and correspondence courses, the Scientific Council of the Academy also considers theses written for the doctorate. The agricultural academies also offer short courses of 3 to 6 months for specialists, designed to improve the technical skills of employed men and women, who wish to keep abreast of developments in science and allied fields. About 15 to 20 percent of the students in the three branches of forestry offered at Kiev are women.

The organization of the agricultural academies is uniform throughout the U.S.S.R., as are the individual curricula. In organizing the curricula, climatic factors and other local conditions are taken into consideration by varying the amount of time devoted to given courses. Any curriculum changes proposed by any faculty are considered by representatives of all the Republics. The content of specific courses, as pertains to the detail of theories and other subject matter, was reported as being determined by the instructor giving the course. The time to be devoted to specific topics is worked out with the dean of the faculty. Teaching at the Ukraine Academy (Kiev) is done in part by people from research institutes and the forest enterprises, who give lectures and conduct seminars. A foreign language is a specific requirement of the curriculum at the agricultural academy; at Kiev about 80 percent of the "undergraduate" students are reported to study English to meet this requirement, while postgraduate students are required to prepare a paper in English.

At present more attention is being devoted to practical knowledge and the development of practical skills for jobs. Students spend 40 to 45 percent of their time in practical work, exclusive of a 1½-month vacation. The academies maintain experimental forest areas where such practical work is carried on under faculty direction.

As at the technical forestry institutes, the faculties at the agricultural academies are responsible for research as well as teaching, with students participating in the investigative work. The professors and scientific workers (postgraduate students) at the academy conduct research at associated institutes and experiment stations, as well as at the academy itself.

The agricultural academies are responsible to the Ministry of Agriculture, which determines the number of students admitted and the funds available to the individual academies, and coordinates the curricula. The personnel of the academies also report to the Ministry of Agriculture on the students' research work. Graduates of the five-year "undergraduate" program are employed through the Ministry of Agriculture, a list of available jobs being sent to the academy before the students graduate. Students with "marked" diplomas (*cum laude*) have the first choice of jobs, as well as the opportunity to stay at the academy for advanced specialized work. From 8 to 10 percent of academy graduates are reported to go into teaching and research.

Subprofessional Training

The information in this section is largely that reported by Shirley (*25*), since our Delegation did not get detailed firsthand information regarding the U.S.S.R. system of education at the subprofessional level. According to official statistics for 1957 (*30*), the Soviet Union operated 26 schools (technicums) with 2- to 4-year programs for training technicians for forestry work, as well as 19 1-year "forester ranger" schools. Shirley visited the largest of these subprofessional institutions, at Tchuguev, near Kharkov, which in 1958 reported an enrollment of 660 resident students and 560 correspondence students, 25 to 30 percent of the total being women. The student ages ranged from 14 to 30 years.

The school at Tchuguev provides three curricula; forest ranger, forest and farm machinery, and bookkeeping for agriculture. Students enroll in the forest ranger curriculum after 7 years of prior schooling and passing the entrance examination. They must spend 4 years in residence to complete the program of this ranger school rather than the customary single year. The other two programs required 10 years of preliminary education and 2½ years of resident study. Students enrolled in the correspondence program require an additional year of study in order to graduate, and must spend 1 month each year at the school before taking examinations. At Tchuguev, approximately 36 percent of the resident students and 71 percent of those studying by correspondence were enrolled as forest ranger students.

The course work of these subprofessional schools is established by the Ministry of Higher Education, with some latitude permitted in the fourth year of the forest ranger program to provide instruction particularly pertinent to the region in which the school is located and in which the graduates will presumably be employed. According to Shirley (*25*):

> The [forest ranger] curriculum includes general subjects—history, literature, foreign languages, mathematics, physics, and chemistry for a total of 1,500 hours. Special subjects are: botany; soils; surveying; dendrology; planting; drainage; protection against insects, diseases, and fire; mensuration; logging; light construction; and forest management, totaling 2,178 hours, of which 775 are spent in laboratories.
>
> Field study covers 155 days additional of eight-hours each in the special subject fields of forestry. In addition, 102 days of work experience in forestry are required. Graduates may then take the state examinations in forestry and dendrology, silviculture, logging, and forest management for a state certificate.

The graduates of this forest ranger program are reported to constitute an important source of students for the technical forest institutes and academies. Approximately half of those from Tchuguev continue their education to qualify for the forest engineer diploma. Those men and women who have taken the forest ranger program as resident students are required to spend an intervening period of 2 years in forestry employment before embarking on the advanced study, but the correspondence graduates may enter the higher institutions directly from the subprofessional schools.

The Forestry Delegation was informed of a somewhat different type of subprofessional training at the Ust-Izhorsky Plywood Factory, near Leningrad, which operates a technical school at a lower level than the diploma-qualifying institute program it also maintains. The technical school is intended for training foremen at the plant and had 86 students enrolled in the summer of 1959. If they have had 7 years of preparatory education, enrollees spend 5 years in the technical school at the plant, whereas with 10 years of prior schooling they can complete the program in a 3-year period. All instructors for this school are from the plant personnel.

Administrative and Faculty Organization

Each higher education institution is headed by a director (rector) who has three administrative assistants (prorectors), one each in charge of teaching, research, and the general business management. The director has full responsibility for the affairs and operation of the school, including the budget, plans for expansion of faculty and facilities, relations with government officials and the timber industry, and other duties pertinent to the operation of the institute and the welfare of its faculty and students. In the discharge of some of his duties he is assisted by the Scientific Council of the Institute, of which he is chairman. This is an advisory group, usually selected from the staff, and concerned chiefly with teaching methods, programs, and scientific activities of the organization. It also recommends candidates for the Candidate of Science and Doctor of Science degrees, and appoints the professors to the institute staff. The director and his deputies are appointed by the Ministry of Higher Education, or by the Ministry of Agriculture in the case of the agricultural academies, on recommendation of the Commission on Higher Education. The latter is a board representing all the technical institutes. These administrative personnel have no definite term of appointment.

Each faculty (department) in the institute or academy is headed by a dean, appointed from the professors teaching the main subjects in that department, who has the responsibility of general supervision of the work of the faculty and the specific curriculum in which the department offers instruction. The faculty, in turn, is comprised of a number of chairs, each uniting a group of professors and other teachers in a specific field and people working in research in that field. Each chair may be headed by a professor or a docent (associate professor). In addition to the chairs in the several faculties, which come under the guidance of the deans, there are other chairs under the direct guidance of the director of the institution. At the Leningrad Forest Technical Academy, for example, there are five such chairs, concerned with dialectic and historical materialism, the history of the CPSU, political economy, the Russian language, and physical training and sports.

Women obviously play an important role in higher education in the Soviet Union, as indicated by the fact that they comprised 40 percent of the teaching staff at Timiryazev Academy.

The faculty comprises four grades of teachers, as follows:

(1) Professors, who must have the Doctor of Science degree to attain that rank. They receive a base salary of $1,000 to $1,250 per month. If a professor is also head of a chair, he receives $125 per month additional. Further income may be received for publications and for the number of graduate students the professor has under his direction, as well as from consulting fees. He receives his expenses for travel on official work. Upon retirement (60-year minimum), a professor receives $600 per month.

If he conducts research work for a forest enterprise, a professor gets additional pay equivalent to half his base salary. However, he must meet his primary teaching and research commitments, and is allowed to spend not more than half his time on outside work involving additional income. Some professors are elected as members (lifetime) of the Academy of Science, for which they receive $875 per month additional. Corresponding members of the Academy receive half this sum. In either case, as full or corresponding members of the Academy, they retain their titles and associated stipends after retirement.

(2) Docents (associate professors) must have the Candidate of Science degree, and may have the doctorate. They receive a base salary of $625 to $800 per month, plus an added $125 if they are also heads of chairs. Like the professor, the docent receives payment for publications, for consulting work, and for the number of graduate students working under his direction, as well as up to half his base salary if he conducts research for an enterprise.

(3) Senior teachers, who fill the general education chairs, receive salaries of $375 to $500 per month, depending on whether or not they have a science degree and also upon their experience.

(4) Assistants, who may be postgraduate students or may already have the Candidate of Science degree, are paid $260 to $375 per month, or up to $435 if they have the science degree.

Professors are appointed by secret ballot of the Scientific Council of the institute concerned, on the basis of reports made on the candidates by a special commission of five or six people. Each appointment is made for a 5-year term, at the end of which a vacancy is declared. While this is considered to be filled on a competitive basis, the usual procedure is to reappoint the incumbent, provided his teaching and philosophy are considered acceptable. If an incumbent is not reappointed he has three alternatives: being retired, applying to another institute, or taking a lower position if one is made available to him.

Timoshenko (*27*) reports that in the selection of a new professor, the emphasis is on his scientific production, with much less concern for teaching ability or administrative competence. Seniority has little or no bearing in connection with promotion.

People below the rank of professor are reported to go through the same appointment procedure every 5 years, but a professor apparently has definite influence in the selection of the other people in his chair. The indicated system of 5-year appointments applies to all higher education institutions in the U.S.S.R.

The student-faculty ratio is about 10 or 11 to 1 in the higher educational institutions. The number of professors in a given institute or academy (*27*) is independent of the number of students enrolled and hence reasonably constant, whereas the recent growth in student population has resulted in a definite increase in docents and assistants. The proportion of professors on the staff is accordingly low, amounting to about 6 percent in some cases.

Educational Concepts

The following statement of educational philosophy, as it relates to the objectives of the higher technical institutes in the U.S.S.R., is that presented by Dimitri S. Chuvahin (*10*), Soviet Ambassador to Canada:

> The curriculum in the Soviet higher technical establishments is made up in such a way as to equip the student with a certain amount of theoretical and practical knowledge, to teach him to work independently in the future in order to broaden his knowledge, and to inculcate in him the capacity for creative work. In training engineers, we completely reject superficial universities, on the one hand, and too-narrow specialization, on the other. The main principle in the training of our engineers is broad specialization on the basis of a profound knowledge of the scientific principles in a given branch of production.

In the opinion formed by the U.S. Forestry Delegation, as a consequence of discussions with faculty personnel, the objectives expressed in the above quotation seem to have been lost sight of in the current educational pattern in forestry with its marked emphasis on practical training. Based on our general observations, the current Soviet concept of higher education at the level leading to the diploma is primarily that of training men and women for specific applied work, with conspicuous attention to immediate productivity. The entire program at this level appears to be concerned with vocational training rather than professional education.

With this stress on practical work, the Soviet forester is far better equipped on graduation than his American counterpart (the B.S. graduate) to fulfill the requirements of any practical jobs to which he may be assigned. It is doubtful, however, that the Soviet type of education is as effective for training the future leaders in forestry and the forest industries as is the American system, where emphasis on basic education is concerned with scientific principles and their application to all aspects of forestry and utilization.

Summary

The visit of the U.S. Forestry Delegation to the European part of the U.S.S.R. provided an opportunity for an evaluation of Soviet forest land management practices, forest industry, research, and education. Principal impressions were:

1. The U.S.S.R. contains a large forest resource and a forest industry that is being developed rapidly as part of the seven-year plan (1959–65).
2. Exploitation of timber is so essential to the development of the country that heavy cutting to the detriment of good forest management is the rule, especially in densely populated areas.
3. Protection of forests from fire, insects, and diseases is not well developed. Fire control especially lags behind United States standards.
4. Biological theories are dominated by Marxian philosophies to the detriment of sound scientific advancement, in the opinion of the U.S. Delegation. Persistence in adhering to these doctrines can only have a deleterious effect on progress in Soviet forest biology.
5. Cultural practices are for the most part passive in application, but 7-year goals are said to call for substantial acceleration in these activities. Shelterbelt planting and culture is clearly the most advanced and successful element of Soviet forestry.
6. Multiple use of forest lands does not seem to be a dominant feature of U.S.S.R. forestry. Watershed protection is recognized in many areas but is not correlated with timber use. Multiple use is more incidental than planned.
7. Along with the emphasis on timber extraction is a strong effort to mechanize all phases of timber production. A number of good machines have been developed and are in general use, although the organization of logging and handling of cut products is often inefficient.
8. Wood processing and fabrication plants, including sawmills, pulpmills, plywood plants, furniture factories, and other industrial units are generally inefficient with great amounts of hand labor employed. However, some well-managed plants were seen. The 7-year plan calls for major improvements and expansion.
9. Forestry research in the biological fields is not being pushed to the extent that engineering and mechanization research are being emphasized.
10. Education in forestry is standardized to a high degree at the major institutes. The number of forestry graduates tops the United States by a substantial margin. The educational program is well developed to train subprofessionals but is below American standards in its emphasis on basic education concerned with scientific principles.
11. Responsibility for forest land management and protection was split organizationally from timber harvesting and manufacturing prior to October 1959. This division between two major branches of the government has been one basic reason for lack of progress in forest management. The recent changes may improve this situation.
12. In spite of the tremendous forestry resources of the U.S.S.R. and the rapid growth of its forestry industry, the country will be hard pressed for a long while to meet the demands of its own economy for wood. Without substantial government subsidy, it appears unlikely that the U.S.S.R. can establish a dominant position in the world's timber trade, although present limited foreign markets undoubtedly will be substantially enlarged.
13. In spite of the many features of Soviet forestry and forest industry that do not compare favorably with practices in the United States, substantial progress has been made in recent years in the U.S.S.R. and the rate of improvement is outstanding in some activities.
14. For the most part, Soviet foresters make up a dedicated, hardworking, and sincere professional group. They are friendly and desirous of strengthening professional ties with foresters in the United States.

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Appendix

Conversion Factors [16]

*1 cubic meter sawed lumber	=424 bd. ft.
*1 cubic meter roundwood	=221 bd. ft. (6.25 bd. ft. per cu. ft.)
1 cubic meter per hectare	=14.2913 cu. ft. per acre
1 cubic meter per hectare	=89.32 bd. ft. per acre
1 cubic meter per hectare	=0.1588 cord per acre (roughly 1/6)
1 cubic meter (solid volume)	=35.3145 cu. ft.=0.3924 cord
*1 cubic meter (German festmeter)	=0.6 metric ton (air dry)
*1 stere (German raummeter)	=1 cubic meter or 0.276 cord (128 cu. ft.) of stacked roundwood
1 cubic foot	=0.02832 cubic meter
1 cubic foot per acre	=0.06997 cubic meter per hectare
1 cord of 90 cu. ft. solid wood content	=2.549 cubic meters
1 U.S. cord (4′4′x8′)	=90 cu. ft. of wood on the average for conversion purposes (84 is suitable for unpeeled wood, 80 to 105 for peeled wood)
1 cubic ton (England)	=50 cu. ft. or 1.416 cubic meters (roundwood volume)
1 hectare	=2.471 acres
1 acre	=0.4047 hectare
1 meter	=39.37 inches or 3.28 feet
1 kilometer	=0.621 mile
1 sq. meter	=10.7584 sq. ft.
1 sq. ft. basal area per acre	=0.2296 sq. meter per hectare
1 sq. meter basal area per hectare	=4.356 sq. ft. per acre
1 inch	=2.54 centimeters or 25.4 millimeters
1 kilogram (kg.)	=2.2046 pounds (lbs.)
1 metric ton	=2,204.6 pounds (lbs.)
1 pound (lb.)	=0.4536 kilogram (kg.)
1 pound per acre	=1.1208 kilograms per hectare
1 kilogram per hectare	=0.8922 pounds per acre
1 kilogram per sq. cm.	=14.2 pounds per sq. inch
1 liter	=1,000 cubic centimeters or 1.0567 qts.

[16] The usage of cubic meter in connection with yields per hectare usually refers to volume in the entire standing tree. It must be reduced by about 10 percent to obtain merchantable volume in terms of cubic feet of merchantable material by U.S. utilization standards. FAO factors approved by two International Conferences in 1947 are shown by an asterisk.

Principal Resource Statistics

TABLE 1a.—*Forest land in the U.S.S.R.*

Heading	Unit	Total for U.S.S.R.	Subtotal	
			European	Asiatic
Total area of U.S.S.R	Million acres	5, 536. 0	1, 376. 3	4, 159. 7
Population	Million	208. 8	162. 3	46. 5
Total forest land, gross	Million acres	2, 794. 9	543. 8	2, 251. 1
State forest land [1]	do	2, 679. 3	478. 6	2, 200. 7
Community reserves [1]	do	18. 8	13. 8	5. 0
Forests on collective farms	do	96. 8	51. 4	45. 4
Stocked forest land	do	1, 784. 8	403. 5	1, 381. 3
Coniferous	do	1, 392. 2	268. 4	1, 123. 8
Broadleaves	do	392. 6	135. 1	257. 5
Nonstocked forest land (cutovers, burns, glades, etc.)	do	281. 2	45. 2	236. 0
Productive forest land	do	2, 066. 0	448. 7	1, 617. 3
Nonproductive forest land (lakes and water courses, ravines, steep slopes, stony soil, bogs, etc.)	do	728. 9	95. 1	633. 8
Productive forest land per capita	Acres	9. 93	2. 77	34. 64
Stocked forest land per capita	do	8. 52	2. 42	29. 71

[1] Forests were classified in 1923 as being of "general" importance, or "local" importance. The latter, called here "community reserves," are assigned to villages and towns for local use.

TABLE 2a.—*Distribution of the U.S.S.R. forests by union republics*

Republic	Total area	Population	Total area of forest land	Forest land percent of total area	Stocked area	Stocked area per capita	Stocked area percent of total area
	Million acres	*Million*	*Million acres*	*Percent*	*Million acres*	*Acres*	*Percent*
Russian Fed. S. Republic	4, 219. 0	117. 5	2, 617. 0	62. 0	1, 667. 0	14. 20	39. 5
European portion	1, 046. 2	93. 9	477. 4	45. 6	349. 4	3. 73	33. 7
Asiatic portion	3, 172. 8	23. 6	2, 139. 6	67. 4	1, 317. 6	56. 09	41. 7
Ukrainian S.S.R	148. 5	41. 9	20. 5	13. 8	16. 8	. 40	12. 5
Belorussian S.S.R	51. 4	8. 1	18. 3	35. 6	15. 8	1. 95	30. 6
Uzbek S.S.R	98. 6	8. 1	17. 1	17. 3	11. 6	1. 43	11. 5
Kazakh S.S.R	683. 5	9. 3	64. 7	9. 5	35. 3	3. 81	5. 2
Georgian S.S.R	17. 8	4. 0	6. 4	36. 1	5. 9	1. 46	31. 2
Azerbaidzhan S.S.R	21. 5	3. 7	2. 7	12. 6	2. 2	. 59	10. 7
Lithuanian S.S.R	16. 1	2. 7	4. 2	26. 2	3. 7	1. 36	22. 1
Moldavian S.S.R	8. 4	2. 9	. 5	5. 9	. 5	. 17	6. 2
Latvian S.S.R	15. 8	2. 1	6. 4	40. 6	5. 2	2. 62	32. 4
Kirgiz S.S.R	48. 9	2. 1	6. 7	13. 6	1. 7	. 84	3. 5
Armenian S.S.R	7. 4	1. 8	1. 0	13. 3	. 8	. 42	9. 1
Tadzhik S.S.R	35. 1	1. 9	3. 7	10. 5	. 5	. 30	1. 6
Turkmen S.S.R	120. 6	1. 5	21. 3	17. 8	14. 6	9. 59	12. 2
Estonian S.S.R	11. 1	1. 2	4. 4	40. 0	3. 2	2. 69	27. 6
Total for U.S.S.R	[1] 5, 503. 7	208. 8	2, 794. 9	50. 5	1, 784. 8	8. 52	32. 4

[1] Total slightly at variance with comparable figure in table 1a.

TABLE 3a.—*Growing stock and annual growth of U.S.S.R. forests*

Heading	Unit	Total in U.S.S.R.	Subtotal	
			European	Asiatic
Total growing stock	Million cu. ft	2, 812, 023	651, 199	2, 160, 824
Coniferous	do	2, 419, 043	477, 310	1, 941, 733
Broadleaved	do	392, 980	173, 889	219, 091
Volume on productive forest land	Cu. ft. per acre	1, 358	1, 458	1, 329
Volume of stocked area	do	1572/1844	1, 615	1, 558
Coniferous forests	do	1744/1929	1, 786	1, 715
Broadleaved forests	do	1000/1543	1, 272	857
Total annual growth	Million cu. ft	31, 960	9, 782	22, 178
Average annual growth on productive forest land	Cu. ft. per acre	15. 7	22. 9	12. 9
Average annual growth of stocked area	do	17. 86	25. 01	15. 72
Total volume of wood per capita	Cu. ft	13, 525	3, 991	46, 403
Annual growth per capita	do	151. 9	60. 0	476. 7

TABLE 4a.—*Averages of growing stock and annual growth by regions of important U.S.S.R. forests*

Economic regions	Average volume of stocked area per acre	Average annual increment per acre	
		Stocked area	Total productive forest area
	Cubic feet	*Cubic feet*	*Cubic feet*
European U.S.S.R	1, 615	25. 01	22. 9
Northern region	1, 458	14. 29	12. 9
Northwestern region	1, 486	17. 15	15. 7
Central region	1, 701	40. 02	37. 2
Western region	1, 686	34. 30	32. 9
Ural region	1, 901	28. 58	25. 7
Volga region	1, 386	40. 02	34. 3
Southern region	1, 186	44. 30	40. 0
North Caucasus region	2, 472	38. 59	34. 3
Transcaucasus region	857	24. 30	22. 9
Asiatic U.S.S.R	1, 558	15. 72	12. 9
West Siberia region	1, 715	20. 01	18. 6
East Siberia region	1, 629	15. 72	14. 3
Far East region	1, 572	14. 29	11. 4
Central Asia & Kazakhstan	157	4. 29	2. 9
Total, U.S.S.R	1, 572	21. 44	15. 7

Table 5a.—*Distribution of stocked area and volume, by species*

Species	Stocked area	Percent	Volume	Percent
	Million acres		*Million cu. ft.*	
Pine (Scotch)	270. 6	16. 0	531, 130	20. 0
Spruce	178. 2	10. 6	373, 592	14. 0
Fir	57. 1	3. 4	147, 685	5. 6
Larch	677. 8	40. 5	1, 004, 698	38. 0
Siberian stone pine	79. 3	4. 7	206, 060	7. 7
Juniper	1. 7	. 1	565	
Japanese stone pine	48. 4	2. 8	17, 445	. 6
Total coniferous	[1] 1, 313. 1	78. 1	2, 281, 175	85. 9
Mountain oak	8. 4	. 5	12, 254	. 5
Plains oak	12. 6	. 7	12, 607	. 5
Ash	1. 5	. 1	2, 260	. 1
Maple	1. 2	. 1	1, 271	. 1
Hornbeam	2. 2	. 1	3, 426	. 1
Beech	6. 2	. 3	18, 258	. 7
Elm	1. 2	. 1	1, 766	. 1
Birch	226. 8	13. 5	239, 715	9. 0
Aspen	35. 8	2. 1	57, 563	2. 1
Alder	4. 9	. 3	5, 438	. 3
Linden	4. 7	. 3	7, 416	. 2
Poplar	3. 2	. 2	4, 167	. 2
Saksaul (*Holoxylon aphyllum jijim*)	48. 9	2. 9	1, 236	. 1
Other broadleaved	12. 1	. 7	3, 037	. 1
Total broadleaved	[1] 369. 7	21. 9	370, 414	14. 1
Grand total	[1] 1, 682. 8	100. 0	2, 651, 589	100. 0

[1] Total slightly at variance with comparable figure in table 1a.

Table 6a.—*Exploitation of the U.S.S.R. forests*

Method	Total in U.S.S.R.	Subtotal	
		European	Asiatic
	Million cu. ft.	*Million cu. ft.*	*Million cu. ft.*
Total annual cut	13, 408. 9	8, 652. 0	4, 756. 9
Cut on State forests	12, 420. 1	7, 627. 9	4, 792. 2
Final harvest cut (mostly clearcutting)	10, 718. 0	6, 695. 6	4, 022. 4
Improvement and sanitation cutting	822. 8	603. 9	218. 9
Regeneration cutting (shelterwood mostly)	416. 7	328. 4	88. 3
Other cuttings	462. 6	423. 8	38. 8
Cutting on collective farm forests	988. 8	600. 3	388. 5
	Cu. ft.	*Cu. ft.*	*Cu. ft.*
Per capita cut	63. 57	50. 50	111. 24

Principal Institutes, Schools, and Other Units Visited in the U.S.S.R.

Timiryazev Agricultural Academy and Williams Soil Museum, Moscow [17]

This Agricultural Academy, organized in 1865, is designed for the twofold purpose of training technical specialists in various fields of agriculture, and conducting research work on ten associated experimental areas, including an experimental forest. There are six faculties (departments) at the institution: Agronomy (field crops and farm engineering), animal husbandry, soils and agricultural chemistry, horticulture, agricultural economics and statistics, and agricultural education (including postgraduate study).

The Academy earlier had a *faculty of forestry*, but this was transferred to the Moscow Forest Technical Institute when the Institute was created. However, the Academy still maintains a chair of forestry in the soils and agricultural chemistry faculty, and this has the responsibility of training foresters at the postgraduate level for teaching in the "middle education" technical schools which offer instruction in forestry. The chair also provides instruction in forestry which is required of students in the other specialties covered at the Academy.

About 3,000 regular undergraduate students are enrolled at the Academy, 60 percent of them men. Postgraduate students number approximately 300, including 25 forestry students in residence in 1959. In addition, some 700 men and women attend the 3- to 6-month courses offered for specialists during the fall and winter. It was reported that about 600 people receive their diplomas each year, on completion of the 5-year "undergraduate" course.

Timiryazev Academy has a total of 55 chairs and some 530 professional members in its six faculties. Their staff consists of 350 teachers (including 64 professors) and 180 other technical people. About 40 percent of the members of this staff are women, including 6 professors. In addition to the professional personnel, the Academy is served by approximately 500 other workers, these being graduates of the "middle education" technical schools and laborers.

The Academy library contains about 1,500,000 volumes, but the Delegation received no information as to the size of the forestry section. The headquarters of the forestry chair, which comprises two professors and two candidates of science who lecture, are in a separate Forestry Building, one of the oldest structures at the institution, which provides the necessary offices, classrooms, and laboratories.

About one-third of the 1,800-acre campus or farm area is occupied by the forestry research station, with its 625-acre experimental forest and allied facilities. The Experimental Forestry Plot, from which the present experimental forest was developed, actually antedates the Academy itself, having been founded in 1862. A number of the existing plantations are more than 75 years old.

Also associated with the forestry program of the Academy is the Schroder Dendrological Garden, begun in 1863, which now contains about 1,000 species and varieties of coniferous and broad-leaved trees.

In addition to the farm and forest land directly connected with the Academy, there are six other tracts at different locations under control of the institution. The total area involved is about 39,000 acres, about two-thirds of which is arable. The rest is meadow and forest land. Much of the practical work required of the students is conducted on these holdings.

The Williams Soil Museum, named for Academician V. R. Williams (1863–1939), at the Timiryazev Academy in Moscow contains exhibits of the soils of the U.S.S.R. The 3,500 monoliths, each about 8 inches wide and 3 feet long, are arranged by major soil groups (tundra, podzol, chernozems, etc.) and show both natural and cropped conditions. However, the exposed faces of the profiles have been smoothed so it is difficult to identify the structure of the material. The profiles would be of more value to foresters if the vegetation and surface organic layers had not been removed.

Each group of monoliths is accompanied by maps showing their distribution and the more important climatic factors which influence soil formation. Approximately 50,000 samples of soils and parent material from which the soils are formed, and displays of both natural and planted vegetation grown on the soils make the displays complete. An herbarium of 20,000 plant specimens is also maintained.

Moscow Forest Technical Institute, Stroitel (Near Moscow, R.S.F.S.R.)

This Institute was established in 1919, and in 1923 the faculty of Forestry from Timiryazev Agricultural Academy was transferred to the new institution. In 1925, because of inadequate facilities, Moscow Forest Technical Institute was transferred to Leningrad and combined with the Leningrad Forest Institute. In 1930 it was reconstituted as the Forest Technical Institute of Mechanical Processing of Hardwoods. It continued as such until 1936 when it was again closed

[17] In addition to the direct information acquired by the American Forestry Delegation, the following two publications dealing with the Academy were consulted: (1) Kantorovich, Alexander: Timiryazev Academy. Moscow. 1957, and (2) Monthey, L. G.: Ag. College—Soviet Style. Agronomy News, Sept.–Oct. 1959, p. 2.

and operations transferred back to the Leningrad Forest Technical Academy. As a result of the growing demand for forest engineers, the Moscow Forest Technical Institute was reopened in 1943, this time in its present location in Stroitel. The instruction and research was expanded to its present scope and now includes six day faculties, three evening faculties, and one correspondence faculty as follows: (Day faculties) forest engineering, forest mechanical, mechanical, technology of wood, forest mensuration, exploitation, and forest economics; (evening faculties) forest mechanical, mechanical technology of wood, and forest management. The nature of instruction by the correspondence faculty was not determined. The daytime, evening, and correspondence study courses lead to an engineering diploma in an indicated field of forestry. The Institute also administers the Candidate of Science and Doctor of Science programs.

Up to 1,000 students are admitted to the Institute each year in all faculties. About 22 to 25 percent of the students are women. The total undergraduate enrollment was reported as about 5,000 in 1959, comprising 2,500 men and women in the daytime, 500 in the evening courses, and 2,000 in the correspondence courses. In addition, there were about 100 postgraduate students in residence. The largest representation of students (35 percent) was indicated for the forest engineering (logging) curriculum, the lowest for the forest economics and wood technology faculties (9 and 4 percent, respectively). The forest management, mechanical technology and processing, and mechanization faculties each attracted about 17 percent of the total number of students.

The Institute granted the diploma to 842 students in 1959, 500 in the daytime program and the balance in the evening and correspondence courses. The average number of recipients of the Candidate of Science degree is 10 to 15 per year.

The library facilities at the Institute are extensive, with an indicated accumulation of 200,000 volumes. No detailed information was received as regards annual rate of acquisition, breakdown by categories, or library personnel.

Among the laboratories visited were those for seed testing, radioactive tracer work, forest protection (entomology, pathology, and zoology), forest soils, and various aspects of mechanical technology. Actually, very little laboratory equipment was in evidence in most of these sections, and the members of the institute did not seem particularly interested in showing it.

Much of the instruction in the forest management and forest engineering curricula involves practical fieldwork that is carried on in the Institute's experimental forest. This is a tract of 27,500 acres, located about 19 miles from Stroitel. At the tract work is carried on in forest protection, nursery practice, planting, and other silvicultural and management activities. Students are in residence on the forest from the first of May to the middle of July.

Students in the faculties concerned with various aspects of forest exploitation and processing get their practical training chiefly in industrial plants which cooperate with the Institute in this regard.

Leningrad Forest Technical Academy [18]

This is the oldest higher education institution devoted to forestry in the Soviet Union, having been established as a forest school in 1803, in what is now Pushkin. The school was transferred to St. Petersburg in 1811 and renamed as a Forest Institute, subsequently going through a series of name changes, to Forest and Land-Surveying Institute (1837), Agricultural Institute (1864), and back to Forest Institute (1877). In 1929, in connection with the industrialization of the timber industry, it was reorganized into the Leningrad Forest Technical Academy, with the responsibility for training men and women in all aspects of forestry and forest utilization.

Today, the Academy has the full complement of seven faculties, administering the six major curricula and the correspondence program. The number of chairs in the faculties administering the 6 curricula totals 44, with an additional 5 chairs directly responsible to the director of the institution. These latter chairs are concerned with dialectic and historic materialism, history of the CPSU, political economy, Russian language, and physical training and sports.

During the 114-year period preceding the Revolution, the Leningrad Forest Academy (under its various designations) is reported to have trained approximately 4,000 specialists in forest management and engineering. This compares with the 13,000 men and women said to have been trained from 1917 to 1959 in management, forest engineering, mechanical technology and processing, chemical technology, mechanization, and forest economics. As reported to the Forestry Delegation, the normal enrollment for the Academy is 4,000, but in 1959 there were approximately 4,500 undergraduates and 150 postgraduate students registered.

The Academy is housed in three main buildings and several smaller supplementary quarters. These accommodate the various offices, lecture rooms, library and reading rooms, workshops, and

[18] In preparing this section, the following sources of information were drawn upon, in addition to the information supplied directly to the United States Forestry Delegation: (1) U.S.S.R. Ministry of Higher Education: The Leningrad Kirov Order, Lenin Forest Technical Academy (in English), 1959; and (2) U.S. Forest Service: Translation of 1956 Leningrad Forest Academy catalog, 1958.

a large number of laboratories. The library is quite impressive, housing some 800,000 volumes and employing 23 people. Its annual acquisition is said to amount to about 45,000 volumes, including 25,000 books, and the yearly increment of cataloged articles is of the order of 75,000 cards. A motion picture laboratory at the Academy is engaged in making scientific and educational films. Already produced are films on floating and driving, woodworking machines and tools, utilization of timber waste, and plant pests, the latter a noteworthy color movie.

Among the more extensive laboratories are those devoted to teaching the various aspects of mechanization and maintenance of equipment, including metallurgy, metal treatments, X-ray study of metals, and internal combustion engines. Also included are a machine shop and a shop for vulcanizing tires. The chemistry laboratories are concerned with basic chemistry, wood chemistry, and pulp and paper studies. The timber-testing laboratory is well equipped, with a variety of machines, indicated as used for purposes of instruction only. A woodworking (fabrication) laboratory is also available for student use.

A sawmill associated with the Academy is used for student instruction. This is a gangsaw operation, cutting logs which are provided by associated groups. The Academy retains for its own use 40 percent of the lumber produced, and also charges the customers for the remaining 60 percent of the cut.

The Academy has a separate laboratory for research in pulp and paper, with some 20 people at work, some of them studying for the Candidate of Science degree.[19] Research is also carried on in a flotation laboratory, aimed at developing various systems of floating logs; in a woodworking laboratory, involving basic studies of energy consumption on different cutting factors in the operation of circular cutoff saws; and in a fabrication laboratory, for automation in chair manufacture. The Academy claimed to have two electron microscopes and plans to acquire a third, all for research on plastics, but none was seen by the Delegation. The institution issues a "Scientific Proceedings," published since 1886, which reports on the research work of its staff.

Part of the Academy grounds is occupied by a dendrological park of 165 acres, originally laid out in 1833. The park contains over 1,600 different trees and shrubs, both native and exotic. A meteorological station in the park has been used in making scientific weather observations since 1890.

[19] There is a separate pulp and paper institute in Leningrad, operating under the direction of the All-Union Central Science Committee. This institute, which also has branches in other cities, has some 300 people in the Leningrad branch, some of them graduate students.

The Academy maintains an experimental forest of 2,500 acres at Lisino, about 40 miles from Leningrad, for research and practical training for forestry students in the use of saws, tractors, and other logging equipment. This tract, which was a former hunting area of the emperors, has been under Academy management for over 150 years. The former palace of the czars at Lisino is used to house the students during the 1½ winter months they are in residence on the forest each year. An annual cut of approximately 17 million board feet or 15,700 cords is made on the forest.

Ukraine Academy of Agricultural Science at Kiev

This Academy combines research and education in agriculture and forestry. There are 10 faculties of which 3—Forest Management, Wood Technology and Utilization, and Forest Engineering—deal with forestry subjects. About 7,000 students are enrolled at the Academy, divided about evenly between day and correspondence students. Of the total number of students, in 1959, 1,625 were enrolled in the forestry faculties as follows: 375 day and 625 correspondence students in forest management, 250 day students in wood technology, and 375 day students in the forest engineering department. From 15 to 20 percent of the students in forestry are women.

The term of study, commencing with the fall term of 1959, will be 5½ years, of which time 40 to 45 percent will be spent on practical work. The calendar year also includes 1½ months of vacation. Practical work is obtained either on a 50,000-acre Experimental Forestry Farm or by working with the organizations cooperating with the Academy. In the latter case, students are frequently accompanied by a teaching staff member.

About 20 percent of the entering students are accepted without prior practical experience. Selection is based on performance in the entrance examinations. Otherwise, preference is given to those with 2 years or more of practical experience. All students receive a stipend, with ranges from $75 a month for the first year students, to $125 for the graduating class.

The undergraduate curriculum in all areas of study is standard for the entire country, but course content is varied somewhat according to the local conditions. The emphasis in this Academy, as in other Soviet technical institutions, is on applied training for specific jobs.

Postgraduate work for a degree of Candidate of Science and Doctor of Science is conducted on the same basis as in other similar institutions in the U.S.S.R.

The faculty organization at the Academy is also comparable to that of other technical institutions of higher learning. A faculty member can engage up to half of his total working time in outside professional activities for pay. Those assuming responsibility for developing new or assisting existing enterprises, can be relieved from regular duties at the Academy and then receive additional remuneration equal to half of their regular pay. A faculty man elected to the Ukraine Academy of Science receives an additional stipend for life.

All-Union Research Institute of Forestry and Forest Mechanization, Pushkino (Near Moscow), R.S.F.S.R.

The Institute, under the Ministry of Agriculture, is a branch of the Lenin Academy of the Agricultural Sciences. It was established in 1956 as a result of reorganization and consolidation of the biological section of the All-Union Wood Research Institute, the Moscow Research Institute of Forest Management, and the All-Union Research Institute of Forest Management. As part of the Academy of Agricultural Sciences, it coordinates research on the biological, engineering, and economic problems of forest management.

The Institute consists of the following eight departments:

(1) Forestry Department, with a fire protection laboratory. This section deals with the evaluation of different cutting systems, problems of natural forest regeneration, succession of species, and improvement of forest productivity. It is also concerned with the questions of forest fire prevention and methods of forest firefighting.

(2) Department of Forest Propagation. This unit deals with the techniques of forest regeneration and establishment of new forest growth.

(3) The Department of Tree Selection and Production of Seed. Genetics, selection and acclimation of forest tree species, and the problems of seed production are handled by this unit.

(4) The Department of Forest Economics and Organization. This department deals with the economics and organizational problems of forest management and is concerned with developing a scientific approach to current and projected forest management planning.

(5) Department of Mechanization of Forest Operations, with shops and special construction bureau. This unit is engaged in development and construction of new types of machines and improvement of existing models of machines and tools employed in forestry work.

(6) The Department of Forest Protection. New methods of control of forest insects and disease are developed by this department.

(7) Technical Laboratory of Woods Waste Utilization. This branch studies the physical properties of wood and develops processes for mechanical and chemical utilization of woods waste by the forest management units (leskhozi).

(8) Department of Hunting, with a laboratory for testing firearms and hunting equipment. This department is concerned with the theory and practice of wildlife management and licensing. Development and testing of hunting equipment is the responsibility of the associated laboratory.

Three special laboratories are operated separately from the eight departments:

(1) Hydrology Laboratory, with the Istrinsk testing grounds, is engaged in studies of the hydrological effects of forested compared with non-forested areas, effect of drainage, microclimate of the forest, and the effects of meteorological conditions on forest growth.

(2) The Physiological Laboratory is working on the problems of physiology and ecology of forest species and the effect of herbicides and fertilizers on forest vegetation.

(3) The Forest Soils Laboratory is concerned with all aspects of forest soil management and soil preparation in forest operations.

The Institute also maintains a bureau primarily interested in developing methods of forecasting epidemic attacks of insects and diseases. The bureau also prepares current predictions of the incidence and spread of pests.

Each of the departments has branch stations which carry on work on specific problems under its jurisdiction. The Institute also maintains 10 regional forest experiment stations, and cooperates with other institutions, such as Forest Technical Institutes and Academies, in conducting forestry research.

Leningrad Research Institute of Forestry

This Institute, in the Ministry of Agriculture, has as its principal field of interest research on problems of the swampy, coniferous northern forest (taiga). The headquarters laboratories are located in Leningrad, but the Institute works at three experimental substations and has its own experimental forest at Syversky, 45 miles south of Leningrad.

The program of the Institute is under a director who has a deputy in charge of research and one handling administrative matters. There are six departments and three laboratories:

(1) Economics and Organization. This unit deals with economic problems of forest management and timber production, inventory methodology and photogrammetry, and plans and programs.

(2) Silviculture. This department does research on timber-cutting systems, cultural operations, and natural regeneration.
(3) Forest Crops and Seed Production. The program of this group relates to artificial reforestation, introduction of species, and seed production.
(4) Protection against Forest Insects and Diseases. This department handles research on insect and disease pests of trees and cut products, but not of processed wood. It also handles pest detection surveys for the northern forests.
(5) Forest Fire Control. Prediction of fire danger, fire suppression (including chemical control), and fire detection are studied.
(6) Mechanization of Forest Management. This department, one of the largest at the Institute, handles research on mechanization, including equipment for swamp drainage, planting, direct seeding, and fire suppression.
(7) Soil Science Laboratory. The staff of this laboratory assists other departments, as on regeneration problems, and does no basic or independent research.
(8) Physiology and Naval Stores Laboratory. This unit studies anatomy and physiology of trees and does naval stores research.
(9) Silvicide and Herbicide Laboratory. Chemical control of undesirable plants is the primary assignment of this group.

The Institute's program is developed by periodic meetings of a Scientific Council composed of scientists from other institutes, universities, representatives of industry, the ministry, and the Institute itself.

Approximately one-third of the Institute's staff are engineers and technicians and two-thirds are biologists, chemists, physiologists, and foresters. The director is a chemist and specialist in naval stores. Monthly salaries for scientists range from 2,500 to 5,000 rubles ($625 to $1,250) but we were told that outstanding scientists have an "unlimited bank account" on which to draw.

All-Union Scientific Research Institute for Plant Protection

This Institute, administered by the U.S.S.R. Academy of Agricultural Sciences, has 18 field stations in the Soviet Union. At the Leningrad headquarters, there are 15 laboratories: Systematic entomology, ecology of economic insects and diseases, shelterbelt pests, pest outbreak prediction, chemical control, biological control, microbiological control, herbicides, chemistry and biochemistry, immunization, plant taxonomy, mycology, zoology, pathology, and mechanization.

The Institute concentrates its efforts on the most important insect and disease problems in the country. Similar work is carried on by many other organizations in the U.S.S.R.

Most of the work is on agricultural crops with only about 10 percent of the effort devoted to shelterbelt and forest problems. Some basic research is underway. However, most of the work is concerned with applied aspects.

For example, the Institute is interested in finding shelterbelts most resistant to diseases and insects but is not primarily concerned with the resistance of an individual or a species. Attention is directed to the whole complex growing on the site. After studies of the microclimate and other microphases of the environment, the Soviet scientists claim they can now recommend definite mixtures of forest trees which will eliminate the spread of insect attacks in shelterbelts. No breeding for disease or insect resistance is carried on at the Institute.

The Institute is compiling a description of all insects in the U.S.S.R., the crops they attack, and a list of all references in the literature. This work, which is published by the U.S.S.R. Academy of Sciences, has covered 6,000 species to date.

The Mycology Laboratory, established in 1907, has a woman scientist in charge. Most of the work at this laboratory concerns the identification of fungi attacking agricultural crops. Some work on forest problems is included in the program. For example, they have studied a disease of acorns and are presently investigating oak wilt and Dutch elm disease.

All-Union Scientific Research Institute for Agro-Forest Amelioration

This Institute was located in Moscow until 1958 when it was moved to its present location in Stalingrad in order to better carry on research in semidesert steppe problems. The Institute operates 10 substations in different parts of the U.S.S.R. For example, there is one in Rostov and one in Siberia. All of these stations have their own farms where agriculture, horticulture, and forestry practices developed for shelterbelt areas are tested.

At the Stalingrad headquarters, the Institute has the following departments and laboratories: Shelterbelts, economics of shelterbelts, soil erosion control, reforestation and sand fixation, vineyards and horticulture, mechanization, plant breeding and seed production, disease and insects, soils, and plant physiology. In 1959 the scientific staff numbered 100.

The Institute is presently located in temporary housing at one of the old field stations. A new site is under development on which 18 buildings will be constructed.

The Institute controls about 5,000 acres. However, work by the 100 scientific and technical personnel is conducted on collective and State farms, as well as on the Institute's own land.

Considerable shelterbelt research is underway. Control methods for water erosion of soil include such practices as terracing, methods of cultivation, tree planting, and orchard planting on slopes. Sand fixation is studied in areas where agricultural enterprises might be possible.

Central Scientific Research Institute of Mechanization and Energetics of the Forest Industry

This Institute, located at Khimki, near Moscow, is one of the two principal research units of the State Planning Commission. It was founded in 1932 for the purpose of assisting the forest industries to raise production through introduction of machines, reduction of costs, establishment of production norms, and introduction of safety standards. The principal emphasis of research is on logging equipment, road construction, and transportation. Minor effort is going into research on utilization of logging residues.

The Institute's program is organized in six divisions: (1) Timber harvesting, (2) road construction, (3) power supply, (4) equipment maintenance, (5) design and construction of forestry camps (buildings), and (6) economics and organization of forestry enterprises. Each division has two or more laboratories with a total of 23 at the Institute. In addition to the main program at Moscow, there are five affiliated substations: The Northern (Archangel), the Karelian (Petrozavodsk), the Caucasian (Krasnodar), the Urals, and the Siberian (Krasnoyarsk). The Institute operates three experimental forest enterprises (logging camps and lower yards) where all new forms of equipment and forms of work organizations are tested. Of these, Mostovaya is a truck operation and Krestzy a narrow-gage railroad operation.

The Institute attempts to be self-supporting and receives the income from its logging operations to finance research. Expense and income for 2 recent years was reported as:

	1957	*1958*
Expenses	$3, 212, 500	$3, 475, 750
Income	2, 478, 750	3, 236, 500

The Central Institute is located in a new four-story building with other adjacent structures housing heavy-machine research programs. Approximately 430 engineers, scientists, and laboratory technicians are employed at the Moscow center.

Central Scientific Research Institute for Timber Floating

This Institute, near Leningrad, is the primary research organization that develops equipment, techniques, and systems of moving timber by water. It designs and tests channel dredges, log-handling cranes, log-bundling machines and raft-holding devices. It also designs, tests, and recommends for specific situations dikes, revetments, canals, dams, and other improvements and controls related to the movement of logs by water.

The Institute consists of six research departments, two hydraulic laboratories, and two experimental machine shops (one in Leningrad and one on the Volga River). Modeling studies are conducted at the main headquarters in Leningrad. Here are located three large water tanks in which simulated streams can be built. Studies are made of the hydraulics of river flow, behavior of rafts of various design, boat and barge design, effect of channel barriers and dams, and similar problems.

Much of the research work is done in the field away from Leningrad at numerous seasonal stations on lakes and rivers. The Institute is under the direction of the State Planning Commission of the U.S.S.R.

Syversky Experimental Mechanized Leskhoz

This experimental forest management unit is located 45 miles south of Leningrad. It has served as a field research and management demonstration area for the Leningrad Forest Research Institute since 1927. The forest covers about 56,000 acres, made up of 36 percent Scotch pine, 29 percent birch, 21 percent Norway spruce, 12 percent aspen, and 2 percent other species. The area is divided into five subunits for management purposes.

Practical scale timber harvesting is carried out under the four classical silvicultural systems: (1) Seed tree, (2) 2- or 3-stage shelterwood, (3) group selection, and (4) individual tree selection. The latest mechanical methods of timber cutting are tested. Since a large part of the forest is swampy, extensive tests of swamp drainage and ditching equipment have been made.

A wide range of field experiments are reported to be underway—500 different studies in all—including research on silvicultural systems, thinning, drainage, hardwood control by silvicides, nursery studies, fire protection, seed production, naval stores, and a number of tests of mechanical equipment. The forest has three experimental nurseries, a small seed extraction plant, and a forest fire control museum.

In addition to experimental and large-scale demonstrations of timber management, the Syversky Leskhoz operates a wood utilization plant where 230 people are employed. The workers are chiefly off-season woods workers, but a small permanent labor force is also maintained. The principal aim of this operation is to intensify utilization. About 80 different types of small wooden products are manufactured. These include tongue depressors, shopping baskets, wooden pails, and other small woodenware. The average annual gross return from the operation is $625,000, which is about $11 per acre. Net profit is figured at approximately $1.20 per acre per year.

The Nikitsky Botanical Garden

The Nikitsky Botanical Garden is located on the lower seaward slopes of the Yaila-dagh or Alpine Meadow mountains, near Yalta on the Southeast Black Sea coast of the Crimean peninsula. Although the southeastern coast region of the peninsula is at about the same latitude (45° N.) as St. Paul, Minn., the winters are mild and such exotics as magnolias (*Magnolia* L.), oleander (*Nerium oleander* L.), tulip-tree or yellow-poplar (*Liriodendron tulipifera* L.), bignonias (*Bignonia* L.), myrtle (*Myrtus communis* L.), camellias (*Camellia* L.), mimosas (*Mimosa* L.), and various tender fruit trees are hardy.

The heat of summer is moderated by on-shore breezes from the Black Sea which has made the region long famous as the site of numerous summer sea-bathing resorts. This coast, together with portions of the northeast Black Sea coast, constitute the "Russian Riviera." In prerevolution days, the Russian imperial family and Russian nobles maintained palaces in the area. These, as well as many new palatial structures, are now used as sanatoria or rest homes for workers from all parts of the U.S.S.R.

The Garden was established in 1812 for the purpose of testing the adaptability of promising exotic plants for this mild-climate area. The Garden, now under administration of the U.S.S.R. Academy of Sciences in Moscow, carries on an extensive selection and breeding program involving fruit trees, industrial crop plants, ornamental trees and shrubs, and some coniferous species of forest trees.

The Garden now occupies 585 acres and, in addition, two nurseries are operated in the steppes north of the mountains. The nurseries supply planting stock of introduced and improved varieties for the collective and state farms in the area.

Laboratories for entomology, pathology, biochemistry, physiology, cytology, and embryology have been functional for several years and a new laboratory for soil-climatic investigations is being planned. An herbarium and research library of 200,000 volumes is maintained. The latter carries an up-to-date file of many foreign botanical journals, including *Plant Breeding Abstracts*. The Garden staff consists of 60 scientific workers, 100 technical and administrative workers, and about 100 gardeners and helpers.

About 1,400 species are represented in the Garden's collections, as well as numerous cultivated varieties. The rose collection alone is said to include about 1,000 varieties. Of special interest to visitors from North America is a specimen of the giant sequoia (*Sequoia gigantea* [Lindl.] Decne.). This tree is now 62 inches in diameter and 100 feet in height. It is said to be the "greatest tree in the Garden."

Sochi Experiment Station for Forest and Park Management, Dendrological Garden, and Yew-Boxwood Grove

The Sochi Experiment Station, one of the field stations of the All-Union Institute for Forestry and Forest Mechanization (Pushkino), is located in the city of Sochi [20] at the base of the seaward slope of the Caucasus mountains on the northeast coast of the Black Sea. In aspect and principal function, the area is similar to the southeast Crimean coast, for here also are numerous sanatoria and rest homes patronized by workers throughout the U.S.S.R.

The administrative building and laboratories of the Experiment Station are located in a formal Italian style dendrological garden established in 1890. The "old area" of the garden occupies about 30 acres, but new plantings in progress and those planned for the future will increase the area to 150 acres. Approximately 750 species and varieties of woody plants, chiefly of Asian, North and South American, European, and Australian origin, are represented in the collections. The garden is meticulously maintained and is a popular rest place for guests in the neighboring sanatoria. The total number of Garden visitors annually is estimated to be almost one-half million.

The forest area under administration of the Experiment Station is a strip about 200 miles in length and 12 to 65 miles in width, paralleling the Black Sea coast from Tuapse southeastward. The area is all mountainous and the slopes are covered with luxuriant and abundant vegetation.

In the vicinity of Sochi, where the annual precipitation averages about 55 inches, the principal species from sea level to the 1,350-foot elevation are oaks (*Quercus pontica* K. Koch., *Q. sessiliflora* Salisb., *Q. robur* L., *Q. castaneaefolia* C. A. Mey, and *Q. lanuginosa* Don.); and lesser amounts of beech (*Fagus orientalis* Lipsky), blue beech (*Carpinus betulus* L. and *C. orientalis* Mill.), hornbeam (*Ostrya carpinifolia* Scop.), box (*Buxus sempervirens* L.), chestnut (*Castanea sativa* Mill.), walnut (*Juglans regia* L.), Caucasian wing-nut (*Pterocarya fraxinifolia* Spach.), lime (*Tilia cordata* Mill. and others), elm (*Ulmus foliacea* Gilib. and *U. glabra* Huds.), zelkova (*Zelkova carpinifolia* K. Koch.), pear (*Pyrus communis* L.), and willow. Yew (*Taxus baccata* L.) and the following pines

[20] Sochi is located in the southeastern part of the Krasnodar Kray of the R.S.F.S.R., and close to the boundary of the Georgian S.S.R., which lies to the southeast.

also occur in this zone: *Pinus halepensis* Mill., *P. sylvestris* L., *P. pinaster* Solander, *P. nigra* Arnold, and *P. mugo* Turr.[21]

The principal species in the zone at an elevation of 1,350 to 2,000 feet is the native chestnut but above 2,000 feet this species is replaced by beech (*Fagus orientalis*), which, to an elevation of about 3,000 feet, forms the dominant vegetation.

Between 3,000 feet and timberline (about 6,300 feet), where annual precipitation reaches 155 inches, the forest cover is chiefly fir (*Abies nordmanniana* Spach.), beech, Scotch pine (*Pinus sylvestris*), and spruce (*Picea orientalis* Carr.).

The forests administered by the Experiment Station are classified in the "group one" category, i.e., protection forests maintained for watershed protection and for esthetic value. Cutting in such forests is technically restricted to sanitation or salvage cuts. Sixty-seven percent of the trees stocking the area are said to be mature or overmature at the present time and plans are underway to develop a suitable logging method to utilize the available material. These sanitation-salvage cuts are expected to yield 70 million cubic feet annually for the next 15 years.

Research at the Sochi Experiment Station is carried on in several fields. Regeneration studies are concerned chiefly with oak, chestnut, and fir. The testing of exotics for plantation establishment also plays an important role in the research program. Interest is centered on Douglas-fir, Sitka spruce, yellow-poplar, *Cedrus* (*C. deodara* and *C. atlantica*), cork oak (*Quercus suber* L.), and hardy species of *Eucalyptus*. In this connection, the station carries on an extensive seed exchange program with cooperators inside and outside the Soviet Union. In 1958, the station shipped about 4,000 seed samples to foreign countries.

Pathological investigations are concerned chiefly with chestnut blight and several stem and root rots of oak. Inoculation studies of chestnut are said to have resulted in the isolation of blight-resistant individuals and the station is willing to exchange cuttings of these plants with interested workers. The station also maintains an entomology section. Important insects in the area are the European sawfly and several parasites of the native oaks.

In addition to selection for disease resistance in chestnut, a selection and hybridization program for the improvement of cork oak is being carried on. Selected individuals from the test plantations of this species are hybridized and such selected plants are also crossed with *Quercus variabilis* Blume and *Q. suber* var. *occidentalis* (Gay) Arcangeli. Since cork oak is especially susceptible to a root rot in the vicinity of the root collar, selected plants are typically propagated by grafting on rootstocks of native oak species. It should be noted that in this instance such grafting is not done with the objective of creating "graft hybrids," but solely for the purpose of propagation.

The Experiment Station also administers a reserve forest or natural area called the "Yew-Boxwood Grove" a few miles southeast of Sochi in the Khosta River valley, near the village of the same name. The reserve or park has graveled paths, benches, etc., and guides, if desired, are provided for visitors. The reserve is of special interest because of the specimens of yew or "redwood" (*Taxus baccata* L.) and boxwood (*Buxus sempervirens* L.) [22] it contains, and also because it provides visitors with an opportunity to see at firsthand the typically luxurious vegetation that characterizes the covelike sites at low elevations on the southern mountain slopes in this region.

The reserve includes a yew grove of about 150 acres in which the oldest trees are estimated to range in age from 1,000 to 1,500 years. One specimen has about a 75-inch breast-high diameter and a height of about 115 feet. Although highly valued as a bow wood in the middle ages, yew is now used chiefly for ornamental purposes.

Boxwood, an exceedingly slow-growing species, is abundantly represented in the reserve. One of the older trees, estimated to be about 150 years of age, was 10 inches in diameter (d.b.h.) and 80 feet in height. The wood of boxwood is hard and dense with high stability and has long been used for engraving, rulers, and other special uses.

The Reserve also contains many fine old specimens of beech (*Fagus orientalis*) and lime (*Tilia cordata*). Most of the other ligneous species native in this elevation zone are also found in the reserve.

Curricula at the Leningrad Forest Technical Academy [23]

(The details of the Forest Management curriculum are given in the section "Education in Forestry" of this report.)

Forest Engineering Curriculum

Subject	Number of hours
1. Marxism-Leninism principles	250
2. Political economics	141
3. Foreign language	132
4. Advanced mathematics	336

[21] Schenck, C. A. Fremdländische Wald und Parkbäume. Erster Band: Klimasektionen and Urwaldbiler. 615 pp., illus. Verlag von Paul Parey in Berlin. 1939.

[22] Synonym: *B. colchica*.

[23] Based on a translation of the Leningrad Forest Academy catalog, made by the U.S. Forest Service. Some modifications in terminology, as translated, have been made in an endeavor to clarify the apparent meaning of terms.

Subject	Number of hours
5. Physics	220
6. General chemistry	136
7. Descriptive geometry and drawing	204
8 Theoretical mechanics	192
9. Strength of materials and mechanics of construction	244
10. Mechanism theory, machinery parts and hoisting-transportation equipment	253
11. Metallurgy and practice in workshops	176
12. Hydraulics and hydraulic machines	90
13. General electrodynamics and electric power equipment	177
14. General thermodynamics and internal combustion engines	160
15. Surveying and topographic drawing	142
16. Industrial forest taxation and basis of forestry	64
17. Basic forest commodities and basic principles in wood pulp	60
18. Construction	114
19. Civil engineer constructions	120
20. Traction engines	120
21. Technology and mechanization in log and lumber yards	165
22. Wood transport by land	93
23. Fundamentals in water transportation system and hydrology	96
24. Economics and lumber industry organization	114
25. Safety and fire control technique	44
26. Physical culture and sports	132
27. Specialized subjects: a. lumbering technology or b. timber flotation	259
Total	4, 234

Mechanical Technology and Processing Curriculum

Subject	Number of hours
1. Marxism-Leninism principles	259
2. Political economics	147
3. Foreign language	138
4. Advanced mathematics	336
5. Physics	238
6. General chemistry	142
7. Descriptive geometry and machine-construction drawing	246
8. Metallurgy and practice in workshops	395
9. Machine-construction technology, allowance, fitting and technical dimensions	151
10. Theoretical mechanics	188
11. Strength of materials	186
12. Mechanism and machine theory	120
13. Machine parts and elevators	256
14. Hydraulics and hydraulic machinery	72
15. General thermodynamics and internal combustion engines	165
16. General electrodynamics and electric power equipment	195
17. Traction machines and rolling stock for forest roads	280
18. Repair of lumbering and forest machinery	183
19. Fundamentals in highway system and highway-building machines	98
20. Economics and organization in forest economy and logging industry	113
21. Safety and fire control technique	39
22. Physical culture and sports	138
23. Specialized courses: a. machines and mechanisms in lumbering. or b. mechanization in forest economy	296
Total	4, 380

Mechanization Curriculum

Subject	Number of hours
1. Marxism-Leninism principles	250
2. Political economics	140
3. Foreign language	140
4. Advanced mathematics	336
5. Physics	250
6. General chemistry	140
7. Descriptive geometry and machine-construction drawing	250
8. Theoretical mechanics	190
9. Strength of materials	180
10. Mechanism and machine theory	120
11. Machine parts	150
12. Hoisting machinery and pneumatic-motor-transport	100
13. Metallurgy	190
14. Workshops for metal and woodworking	220
15. Electrotechnic and electric power equipment	190
16. General thermodynamics and internal combustion installations	160
17. Hydraulics and hydraulic power transmission	70
18. Tolerance and technical dimensions	50
19. Science of staple commodities and wood fiber	90
20. Machines and tools in lumber processing	270
21. Technology and equipment for heat treatment of wood fiber	140
22. Technology in mechanical wood fiber treatment	220
23. Woodworking automation	60
24. Economics and woodworking industry organization	105
25. Safety and fire control technique	40
26. Physical culture and sports	140
27. Specialized courses: a. woodworking technology, or b. woodworking machines and equipment	300
Total	3, 491

Chemical Technology Curriculum

Subject	Number of hours for specialties I[1]	II[2]
1. Marxism-Leninism principles	250	250
2. Political economics	138	138
3. Foreign language	136	136
4. Physical culture and sports	136	136
5. Higher mathematics	328	328
6. Physics	232	232
7. Descriptive geometry and drawing	208	208
8. Metal technology	84	84
9. Theoretical mechanics	100	100
10. Strength of materials	100	100
11. Machine parts and lifting-transport of equipment	136	136
12. Inorganic chemistry	222	222
13. Analytical chemistry	290	290
14. Organic chemistry	280	272
15. Physical chemistry	246	254
16. Colloidal chemistry	72	72
17. Thermodynamics	148	148
18. Electrodynamics	132	132
19. General chemical technology	132	132
20. Chemical technology processes and apparatus	212	212
21. Automation and control of chemical products	72	72
22. Safety and fire control technique	36	36
23. Chemical industry economics and organization	100	100

[1] Wood chemical technology.
[2] Technology of cellulose-paper production.

Subject	Number of hours for specialties I[1]	II[2]
24. Basic construction and sanitation techniques	36	36
25. Wood and cellulose chemistry	190	190
26. Wood chemical technology	254	
27. Specialized courses:		
a. wood chemical production technology		
or b. technology of hydrolysis and sulfite-alcohol derivatives	156	
28. Pulp and paper technology		338
29. Equipment and interplant transportation of pulp and paper production		72
Total	4, 426	4, 426

[1] Wood chemical technology.
[2] Technology of cellulose-payer production.

Forest Economics Curriculum

Subject	Number of hours
1. Marxism-Leninism principles	225
2. Political economics	300
3. Dialectic and historical materialism	80
4. Fundamentals of civil and labor law	60
5. Economic geography of the U.S.S.R	80
6. Advanced mathematics and laws of probability and nomography	300
7. Physics	160
8. General chemistry	100
9. Descriptive geometry and drawing	120
10. Theoretical mechanics	100
11. Strength of materials	100
12. Machine, mechanism and machine-parts theory	100
13. Thermodynamics and heat economy	90
14. Electrodynamics and electric power economy	100
15. Building and estimating principles	60
16. Surveying	60
17. Foreign language	140
18. General statistics	90
19. Industrial statistics	70
20. Timber inventory practice	70
21. Industry financing	70
22. Bookkeeping and analysis of balance sheets	160
23. Forest supply organization and planning	70
24. Technical standardization	60
25. Safety and fire control technique	40
26. Physical culture and sports	140
27. Special courses (see details that follow)	1, 240
Total	4, 185

Special Courses in Forest Economics Curriculum

(I) For a major in "Economics and organization of forest economy and timber industry."

Subject	Number of hours
1. Silviculture and forest crops	180
2. Forest taxation and organization	160
3. Lumbering technology, log transport and use of traction machines	270
4. Forest economy mechanization	70
5. Timber industry economics	160
6. Forest economics	160
7. Organization and planning of enterprises:	
a. forest economy	
or b. timber industry	290
Total	1, 240

(II) For a major in "Economics and organization in woodworking and pulp and paper industry."

Subject	Number of hours
1. Inorganic, analytical chemistry	210
2. Organic chemistry	130
3. Supply department of timber industry enterprises	60
4. Technology of woodworking products	270
5. Technology of pulp and paper production	170
6. Wood chemical and hydrolysis technology	150
7. Economics of wood processing industry	160
8. Organization and planning of enterprises:	
a. woodworking industry	
or b. pulp and paper and wood chemical industry	290
Total	1, 440

U.S. GOVERNMENT PRINTING OFFICE: 1961

UNITED STATES DEPARTMENT OF AGRICULTURE

1862 1962

Growth Through Agricultural Progress