



RESEARCH IN FORESTRY AND WOOD SCIENCE IN FINLAND

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PREFACE

Forestry education and research in Finland came into being soon after the middle of the 19th century. Their inception at this point in history is not surprising, for there were already, particularly in Western Europe, powerful forces at work that obviously stimulated interest and emphasized the importance of the forest resources, even in Finland. We need to call attention to only a few of them here. For example, there was the industrial revolution which generated intense economic development, including an especially great increase in building activity; there was the emergence of a more liberal economic policy which eliminated many highly protective tariffs; there was the rapid technical evolution in transport facilities; and there were immense improvements and expansion in saw-milling, followed later by similar developments in other wood-using industries.

In Finland, these developments first meant the rapid rise of saw-milling and, later, of other industries depending on wood as the primary raw material. These industries became the dominant export industries, a position that they have retained to this day. The growth of the wood-using industries and the importance of forest products as export commodities began to awaken public and government authorities to the fact that the forest resources were vital to the economic life of Finland. Coupled with this awareness was the growing concern about the capacity of the forest resources to sustain the expanding wood-using industries, and the obvious need for steps to protect, improve and maintain the productivity of the woodlands. Thus it came about that the National Board of Forestry was established in Finland in 1851, at first on a temporary basis, but perma-

nently in 1859. Among the provisions of this establishment was the education of foresters and the initiation of forestry research.

This brochure has two major objectives: (a) to trace the history and development of higher forestry education in Finland from its humble beginnings shortly after the middle of the 19th century to its present strength; and (b) to describe briefly the nature and scope of forestry research as it is reflected in the organization and spheres of activity of various institutions, all contributing to the solution of problems in forest production, wood utilization, or both.

This is the third renewed edition of the booklet.

It is to be hoped that this booklet will serve our visitors from abroad as a first-hand guide.

The Society of Forestry in Finland

STATE INSTITUTIONS

THE FACULTY OF AGRICULTURE AND FORESTRY OF THE UNIVERSITY OF HELSINKI

Initial Phases and Progress of Higher Education in Forestry in Finland

Higher education in forestry began in Finland in 1862 at a forestry school separate from the university; this school was at Evo situated about 120 kms north of Helsinki in the midst of a large forest.

Although the principal task of the school was to educate forest officers in the service of Finnish forestry, members of the teaching faculty were also able to initiate forest research. In particular, *A. G. Blomqvist*, the most outstanding teacher of the school, strove purposefully to develop forest research. He published a number of papers on the results of his studies and wrote a handbook of forest policy. In recognition of his scientific work he received the honorary degree of Doctor of Philosophy at the University of Helsinki in 1897.

A. G. Blomqvist served as a teacher at Evo during 1862–1903, and for the greatest part of this time (1870–1903) was the principal of the school. However, it became increasingly clear as the years went by that the remote location of Evo presented higher education in forestry with numerous disadvantages and hindered its scientific development. As a consequence it was decided in 1907 to move the staff and facilities of the school at Evo to the University of Helsinki, where higher education in agriculture had already been transferred from Mustiala in 1896. The transfer of higher education in agriculture had resulted in the establishment of a special Department of Agriculture in the Faculty of Philosophy in 1902. Forest

education was amalgamated with this in 1908. In 1924 the Department became the independent Faculty of Agriculture and Forestry.

At the outset two professorships in forestry were founded in this new faculty: one for Silviculture, the other for Forest Mensuration. The first professor of silviculture was A. K. Cajander who served with great vigour and distinction from 1911 to 1934. Since, however, he was appointed Director-General of the National Board of Forestry in 1918, the undergraduate teaching duties of the professorship had to be handled mainly by deputies and assistants. In addition, A. K. Cajander had to retain the professorship of forest mensuration until 1928.

The following chairs have subsequently been founded: Forest Policy (1923), Logging and Wood Technology (1930), Peatland Forestry (1937), Business Economics of Forestry (1947), Logging and Wood Technology (1948 – to be held by a professor using the Swedish language) and Forest Products Marketing (1959). Holders of the chairs of Agricultural and Forest Zoology (1921), of Plant Pathology (1921), of Plant Breeding (1968), and of Land Use Economics (1973) also serve forest education.

To facilitate the practical field training of forestry students the post of Forest Officer was founded in 1907. Until 1930 the holder of this position also taught logging and wood technology. The Forest Officer – since 1979 the associate professor in silviculture – has been responsible for giving the basic course in silviculture and conducting practical training at Hyytiälä (Korkeakoski), the Forestry Field Station of the University. This was established immediately after higher education in forestry was transferred from Evo to the University of Helsinki. A part of the Korkeakoski Forest District was then assigned as the regular outdoor laboratory and training grounds for students in silviculture and forest management. Winter training in logging has also been undertaken at Hyytiälä since 1954.

The first buildings of the Forestry Field Station were ready for occupation in 1912. A number of new buildings, including laboratories, machine halls, greenhouses, auditoriums as well as accommodation for students and members of staff, have since been added (1961–1977). Hyytiälä has thus become a modern training community which serves the practical training and research needs of most biological and technical subjects in forestry.

For the purpose of teaching forest mensuration and supervising practical field training, an associate chair of Forest Mensuration was founded in 1962. In 1967 the position of associate professor in Logging and Utilization

of Forest Products was established to take care of the general course in logging and to supervise and coordinate practical field training on various levels. In addition to the officers already mentioned, there are a number of other teachers who lecture in different basic and auxiliary subjects.

Studies and Degrees

The most recent stipulation concerning the examination requirements for forestry studies was made in 1978. According to this, successful execution of the required examinations for the Faculty of Agriculture and Forestry entitles the students to the following degrees:

Master of Science in Agriculture and Forestry
Licentiate of Science in Agriculture and Forestry
Doctor of Science in Agriculture and Forestry

The Master's degree can be earned through a great number of alternative programmes. These are grouped into master programmes and options, according to specific professional aims.

The two master programmes, the options, and the possible major subjects are as follows:

Master programme for Forestry

Option 1. Silviculture, with a major in silviculture, peatland forestry, forestry biology, forest breeding, forest pathology, or forest zoology.

Option 2. Forest Resources Planning, with a major in forest mensuration and management, forest policy, or land use economics.

Option 3. Timber Harvesting and Transport, with a major in forest technology, wood technology, or business economics of forestry.

Master programme for Marketing of Forest Products with a major in forest products marketing and/or wood technology.

The programme in Forestry is a qualification intended for those who undertake the traditional tasks of forestry (forest management, harvesting and transport, forest protection etc.). The programme in Marketing of Forest Products prepares experts for the practical and managerial aspects of trade in forest products (roundwood and forest industry products) and in machines to be used in various forestry operations.



A middle-aged Scots pine (*Pinus sylvestris*) stand which will eventually provide high-quality sawtimber.

In each programme, 160 credits are demanded, one credit corresponding to approximately 40 hours of work done by the student. The main part of the credits, amounting to 85 to 95 per cent, is obligatory. A student is

allowed from 5 to 22 credits of electives. In his major subject the student must take at least 60 credits of systematic course work, the writing of the Master's thesis being included.

For each programme the student must also have practical training of up to 30 weeks, and he must pass a language examination in English, French, German, Russian, Spanish, or some other language approved by the faculty.

A holder of the Master's degree, or the previous degree of B. Sc. in Agriculture and Forestry, may continue to study for the *Licentiate's* or *Doctor's degree*. Both degrees are taken in at least two subjects. In addition, another foreign language test and one year of post-graduate working experience are required. For a Doctor's degree a student must publicly defend a printed doctoral dissertation.

Undergraduate studies

The undergraduate course takes about four years and comprises lectures and practical training. The first year is essentially a common curriculum for every forest student. The programme consists of basic courses such as botany and chemistry, auxiliary subjects, and general courses in forestry subjects. After the first year a student chooses his main subject. This largely determines the specialized curriculum that he will follow.

In the second year, the study of general and auxiliary subjects is continued (e.g. operations research, legislation, environmental conservation) but the main stress is placed on lectures in the forestry subjects.

The third year is devoted to continued lectures and seminar training in the major subjects of the option, with auxiliary courses in administration, communication, and methodology of scientific research. In forest management and peatland forestry the students prepare a report based on practical work undertaken during the second summer.

During the fourth year the student concentrates on his major subject, the main tasks being the preparation of the Master's thesis and the final examination.

The *practical training* is of great importance. It mainly takes place in the summer, partly as joint training arranged by the University and partly



A Norway spruce (*Picea abies*) plantation growing on a fertile site.

as special training which is arranged in companies, organizations, and the National Board of Forestry.

Joint training and other field education is undertaken, with a few exceptions (e.g. training in forest mensuration during the second summer), at the University's Forestry Field Station at Hyytiälä. Summer courses are mainly concentrated in the first and second summer according to the following program:

	1st summer	2nd summer
silviculture and forest protection	4 weeks	2 weeks
peatland forestry	2 »	2 »
forest mensuration and management	4 »	5 »
logging and wood technology	3 »	3 »

Every student participates in joint training during the first summer, in the second summer, however, only those students whose programme requires additional field education. In practice, almost every student aiming to pass the master programme in Forestry is required to take part in some of the training courses of the second summer. In the Timber Harvesting and Transport option, joint training in logging is undertaken at Hyytiälä during the third academic year.

Students use the third summer for special training in their major subject. This may be taken in industrial companies, at the National Board of Forestry, forest management associations, or in corresponding organizations abroad. The length of the training period varies and depends on the option and on the major. Generally it takes two months.

Training for the Marketing of Forest Products programme is usually rather specialized. A part of this special training, which lasts six months, takes place in domestic enterprises, such as roundwood purchasing and logging organizations, wood-processing industries (saw mills, board and plywood factories, pulp and paper mills), sales and shipping offices of companies etc. Every effort is made to see that the students studying this programme have an opportunity to secure a third summer's training abroad in a country important to Finland as a buyer.

The number of students accepted for the two forestry master programmes is limited. At the present time a total of 70 new students are admitted yearly, 20 of them to Marketing of Forest Products. In recent years seven to eight times as many application have been received as there are student places. The selection of students is based on a number of specific quali-

fications. The most important qualifications taken into account in assessing the merits of each applicant are academic performance in secondary school, the quality of performance in the student's entrance examination, and the duration and quality of pre-entrance practical training.

Post-graduate Studies

Post-graduate studies are principally intended for the training of research workers, although, to an increasing degree, they are also considered as additional qualifications for advancement to senior posts. These studies lead to the degrees of Licentiate of Science in Agriculture and Forestry and Doctor of Science in Agriculture and Forestry.

The *Licentiate* course provides a thorough knowledge of a main subject in the Faculty. In addition, the examination includes at least 30 credits from supplementary studies by which a student usually obtains the highest level of the Master's degree or possesses knowledge corresponding to it in a minor subject.

A student must also present a licentiate thesis in his major subject in order to demonstrate his ability to use scientific research methods. The thesis is often the result of research work lasting about two years. The licentiate thesis is examined in a special licentiate seminar by a committee consisting of three members appointed by the Faculty. In addition to the members of the committee, others are also allowed to comment on the thesis. The higher marks in the main subject of the licentiate examination presuppose not only a first class licentiate thesis but also publishing activity. A student intending to take the licentiate examination must also pass a language test in a second foreign language and must have had at least one year's service as a Forest Officer.

In order to achieve the degree of *Doctor of Science in Agriculture and Forestry* a candidate must obtain a more thorough knowledge of his major subject, must have the same 30 credits of additional courses, pass a language test in a second foreign language, and work for at least one year as a Forest Officer. In addition, he has to prepare a dissertation which will be officially examined and, on the recommendation of the opponent or opponents, accepted by the Faculty. More recently, it has become increasingly

common for the thesis undertaken in partial fulfilment of the degree of licentiate to be expanded into a doctor's dissertation.

Graduate study involving formal course work has hitherto been relatively limited, and has consisted mainly of seminars. It is currently becoming customary for persons studying for the licentiate's and doctor's degrees to take examinations in other faculties, for example, in botany, chemistry, mathematics, commercial sciences, statistics, etc.

Research

The University's annual budget does not provide funds for research. Research at the University is therefore financed from other sources, mainly the *National Research Council for Agriculture and Forestry*. Forestry research is also sponsored by certain foundations, especially the *Foundation for Research of Natural Resources in Finland* and the *Finnish Cultural Foundation*.

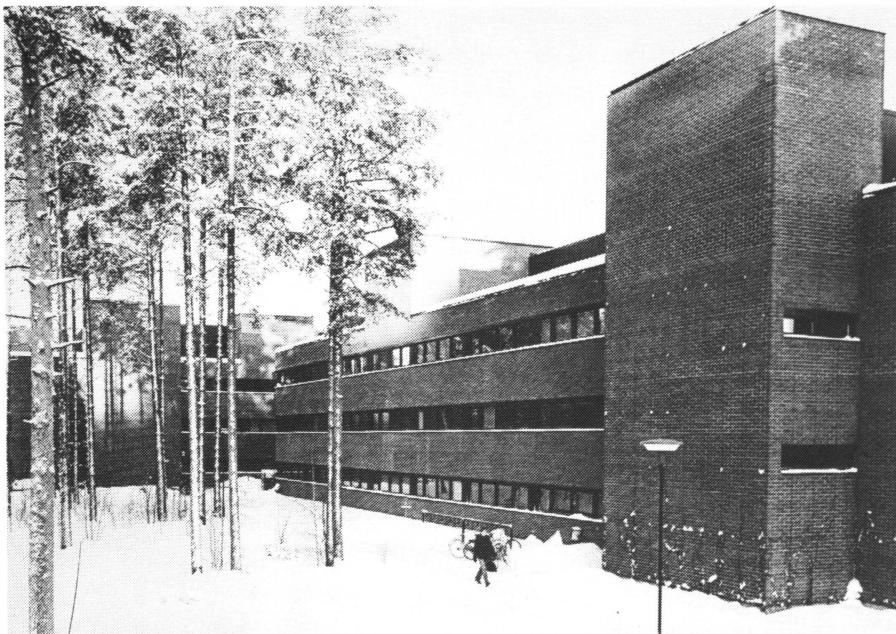
One result of the lack of sufficient continuity in financing research programs is that professors, lecturers and assistants of the University give preference to theoretical and methodological research. Programs requiring long-term experiments are performed mainly by the Finnish Forest Research Institute.

THE FACULTY OF FORESTRY OF THE UNIVERSITY OF JOENSUU

At the University of Joensuu Forestry studies were established in 1982. The education is given at the Faculty of Forestry and at Mekrijärvi Research Station in Ilomantsi. On the University campus there is also the research station of the Finnish Forest Research Institute.

Major areas in Forestry include silviculture, production of wood and peat for energy, forestry planning and forest soils. At the moment, the scope of forest soils is still undetermined.

Silviculture deals with the ecological basis of timber production and other forest products. The ecophysiology of forest trees and the structure and

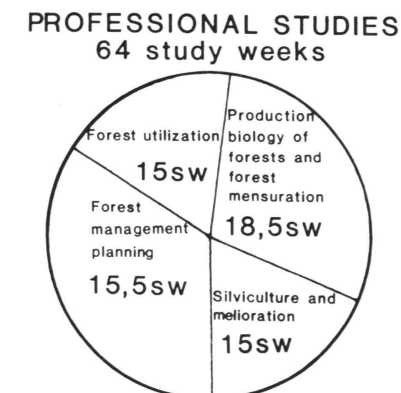
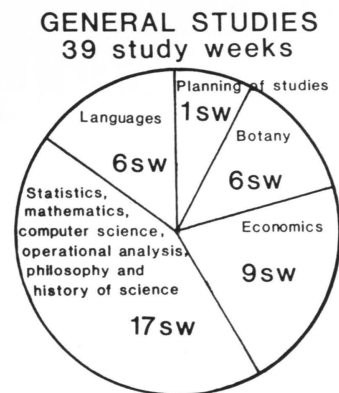


University buildings.

functioning of forest ecosystems are especially emphasized. In addition, silvicultural practices, e.g. tending of seeding stands and thinnings are dealt with.

Production of wood and peat for energy deals mainly with the ecological basis of energy plantations and integrating the production of fuel wood into traditional forestry. In addition, harvesting and distribution of energy wood and peat are emphasized in education and research.

Forestry planning deals with the acquisition and processing of the forest resource data for forestry decision making. Its basis constitutes statistics, operations analysis, production economics, automatic data processing, and the other forestry subjects. Forest inventory and growth forecast methods, including the data processing, are the central subjects of the forestry planning studies.



Structure of forestry studies.

Structure of Forestry studies

The study programme in Forestry takes 4–5 years, i.e. 160 study weeks (a study week is equal to a 40-hour study period). The study programme consists of three phases, i.e. general studies, professional studies and scientific studies.

General studies take about 40 study weeks. General studies consists of, for example, botany, mathematics, economics and foreign languages, and they form the general basis for the forestry studies.

Professional studies last for 60 study weeks. They concentrate on several aspects of forestry and forestry practices including forest ecology, forest conservation, forest mensuration, silviculture, forest technology, business economics of forestry, and social economics on forestry. Professional studies are further deepened by *scientific studies* specializing in a selected main subject, i.e. silviculture, production of wood and peat for energy, forestry planning or forest soils. The main part of the scientific studies consists of the preparation of the thesis, which may also deal with the scientific treatment of a selected problem of practical forestry.

THE FINNISH FOREST RESEARCH INSTITUTE

Brief History

Towards the end of the 19th century representations were made by practising foresters for the establishment of a special forest research institute. The interest in such an institute stemmed from the conviction that progress in forestry was required and must be based on systematic research work. An additional factor that spurred interest at the end of the 19th century was the establishment of corresponding research institutes in a number of European countries.

In 1906 the Finnish Government (Senate) commissioned A. K. Cajander to study forest research institutes and their activity in European countries,



Forestry House, home of the Forestry Departments of the University of Helsinki, and of the Finnish Forest Research Institute.

and to work out a proposal for Finland. Cajander visited institutes in Germany, Austria, Switzerland, France, Denmark and Sweden and in 1909 put forward a detailed proposal for the establishment of a Finnish forestry experimental institute. Cajander's proposal was instrumental in the formation of a State committee whose report recommended establishment of a forest research institute. This was founded through a Senate decree of October 24th, 1917, only a few weeks prior to the date (December 6th, 1917) of Finland's Declaration of Independence. The Institute started its activities on 1st July, 1918.

The Forest Research Institute is subordinated to the Ministry of Agriculture and Forestry. Originally it comprised the Departments of Silviculture, Forest Inventory and Yield, and Forest Soils. The following additional departments were established at later dates:

Department of Forest Economics and Department of Peatland Forestry in 1928.

Department of Forest Technology in 1931.

Department of Forest Biology in 1953 (the professorship of Forest Biology was originally founded in 1938 in the Department of Silviculture).

Department of Mathematics and Department of Forest Zoology in 1967.

Department of Forest Genetics in 1968.

In 1972 the Departments of Forest Biology and Forest Zoology were combined to form the Department of Forest Protection.

Research Organization

The actual research organization of the Forest Research Institute consists mainly of these nine research departments. General co-ordination of the work of the Institute rests with its Director, a post founded in 1962 and carrying the academic title of Professor. The primary tasks of the different departments are as follows:

The Department of Soil Science studies the silvicultural utilization of soil, its physical and chemical properties, its development and its improvement by various methods, as well as the microbiology of mineral soils.

The Department of Peatland Forestry studies the silvicultural utilization of peatlands including suitability for draining and afforestation, ecology

of peatland forests, the microbiology and hydrology of peatlands, the effect of various measures on the development of peatland forests, and drainage and other peatland cultivation techniques.

The Department of Silviculture studies natural and artificial forest regeneration, afforestation, factors related to seed crops, nursery production of planting stock and silvicultural methods used in forestry. It also investigates the physiology of forest regeneration and that of forest growth.

The Department of Forest Genetics studies the genetic structure of forest trees, the morphology of forest tree species and methods of forest tree breeding as well as carries out breeding experiments. A national central register of all tree breeding material is kept by the Department.

The Department of Forest Protection studies the biology and occurrence of animals, fungi, bacteria and viruses injurious to forests, and the damage done by them as well as possibilities for their control. The Department also makes prognoses of the extent of widespread pest outbreaks. The research activity in the Department is headed by two professors, one for forest zoology and the other for forest pathology.

The Department of Forest Inventory and Yield studies the methods of forest mensuration, the structure, growth, yield and development of tree stands, and the principles of forest management. It also carries out national forest inventories. A special professorship for yield studies was founded in 1969 to head the newly created forest yield section of the Department.

The Department of Forest Technology studies wood properties, wood as an industrial raw material, measurement of roundwood, and mechanization in logging and silvicultural operations. A special professorship for forest operations was founded in 1972.

The Department of Forest Economics studies social economics, business and marketing questions in forestry, conducts surveys of total drain and wood use, and performs forest balance studies. In the Department there is a special section for studies in business economics and marketing headed by a professor since 1971.

The Department of Mathematics studies and develops mathematical and statistical methods applicable in forest research, consults with research workers in applying these methods, maintains and develops the data

processing system of the Institute, publishes an annual yearbook of Forest Statistics and provides yearly the basic data for forest taxation.

Each department is headed by a professor who participates in active research work. He is assisted by a permanent body of technicians and graduate foresters and by auxiliary help as needed.

Since the 1930's the Institute has also been authorized to engage senior research specialists to study specific problems, and since 1963 several posts for senior research specialists have been established. Currently, there are ten such posts, two in the Department of Silviculture, two in the Department of Forest Technology and one each in the Departments of Soil Science, Forest Protection, Forest Inventory and Yield, Forest Economics, Forest Genetics, and Peatland Forestry.

Originally, research work was undertaken solely by the various research departments. Since 1961 regional *Forest Research Stations* have been in operation. For the time being the Institute operates eight research stations. Each station has a permanent academic research staff numbering from four to sixteen. They contribute to research work by concentrating on certain regional problems, for example, forest drainage (in Parkano and Muhos), genetics on the northern limits of forest growth (in Kolari) and forest regeneration in the arctic conditions of Lapland (in Rovaniemi). Suonenjoki Research Station concentrates on forest regeneration studies in central and southern Finland. It also includes a research nursery. Since 1982-83 there have been research stations in Joensuu, Kannus and Punkaharju. They concentrate on studies on forest regeneration, multiple use of forests, wood as energy source and tree breeding.

In addition, the Institute has two field stations. While the research stations function on a regional basis, the field stations concentrate solely on specific and restricted questions. Ruotsinkylä Field Station is specialised in forest tree breeding and Ojajoki Field Station, in forest zoological research.

All researchers working at a research station or a field station also belong to one of the nine research departments and their research activity is guided and coordinated by the respective professor.

In 1982 the permanent research staff at the Forest Research Institute comprised thirteen professors, ten senior research specialists and 163



A high-quality birch (*Betula pendula*) stand after the first thinning.

research officers. The total research personnel numbered 511. In addition, 37 persons were engaged in general administration and 43 in the administration of experimental forests. The Institute's appropriation in the State Budget for 1983 amounted to approximately 68 mill. Fmk (12 million US dollars).

Administration

The highest decision-making body of the Institute is its Administrative Board. It consists of the Director as president, a vice president and five other members appointed by the Government for a period of three years at a time. Two of the members are professors of the Institute, one representing natural sciences and the other technical sciences and economics. One member is a head of a research station. The research staff is also represented by one member.

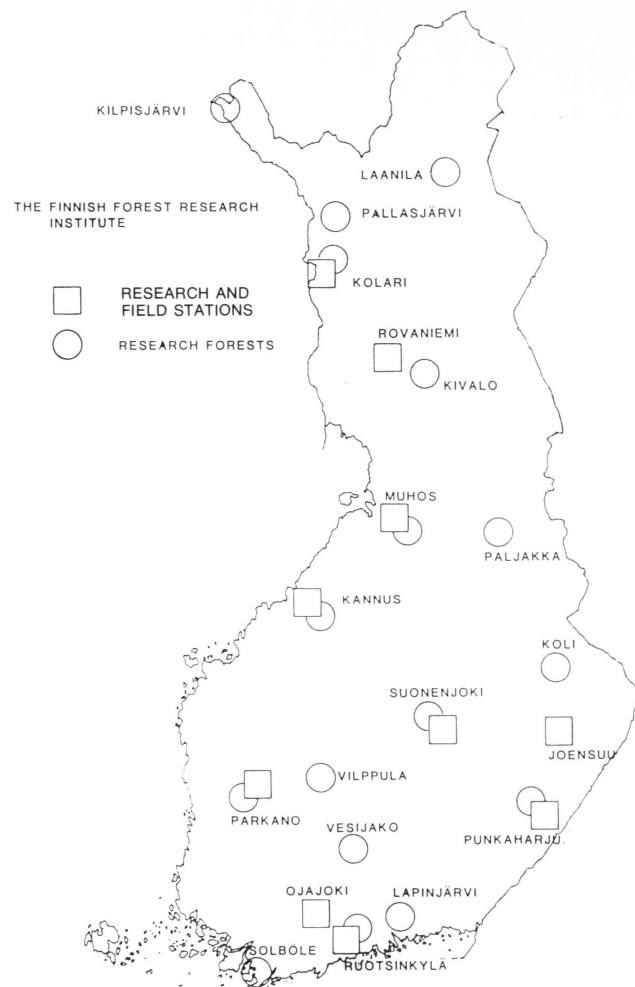
Besides the Administrative Board there is also a Negotiating Board, whose function is to suggest new investigations and ways of improving the research activities. The Board is a link between the Institute and the representatives of forestry, in which the Institute is represented by the Director, one professor and a representative of other research staff. The rest of the members, ten at the most, are appointed for a period of three years at a time by the Ministry of Agriculture and Forestry. They are to represent the Ministry of Agriculture and Forestry, the Ministry of Finance, the University of Helsinki, the National Board of Forestry, the Central Forestry Associations, the Agricultural Research Centre and other fields of forestry.

The Institute has two offices to handle practical and administrative matters. The Administrative Office deals with accounting and general administration. The Experimental Forest Office administers the experimental forests and the conservation areas controlled by the Institute.

Experimental Forests

Experimental forests form an important adjunct to the Forest Research Institute. Reservation of experimental areas for the use of the Institute was included in the proposal presented by A. K. Cajander and the first experimental forests were established in 1923–24, only a few years after the founding of the Institute. The total area of experimental forests has subsequently been increased. At present they cover a good 80 000 hectares, distributed fairly evenly throughout the country.

The experimental forests, which are under the direct control of the Forest Research Institute, offer opportunities for permanent experiments with



Research forests and research and field stations of the Finnish Forest Research Institute.

a minimum of red tape and generally ensure the possibility of carrying through long-term investigations.

The Experimental Forest Office (headed by the Chief Forest Officer) is responsible for the administration of the experimental forests. Regionally, they are divided into two forest districts, both headed by a district forest

officer. The districts are further divided into 17 smaller units which are headed by a forestry technician or a foreman. Every researcher at the Institute has the right to set up experiments in the experimental areas. Beginning in 1939 national parks and nature conservation areas have been established on state-owned land. Some of them are administered by the Forest Research Institute.

At present the Forest Research Institute controls two national parks as well as five large and five small conservation areas, totalling approximately 62 000 hectares. Strict nature reserves, areas completely reserved and protected, except for research purposes, are important subjects for forest studies and some are therefore also under the jurisdiction of the Forest Research Institute; the remaining national parks, nature reserves and nature conservation areas are administered by the National Board of Forestry.

Long-term experiments of the Forest Research Institute are also carried out to some extent in forests other than those of the Institute. In particular, there has been long-standing research collaboration with the National Board of Forestry. Bilateral agreements have also been made with some wood-using companies regarding the use of certain areas for experimental purposes. It has become possible, through these arrangements, to fill certain gaps in the network of the Institute's experimental forests.

Publication Activity

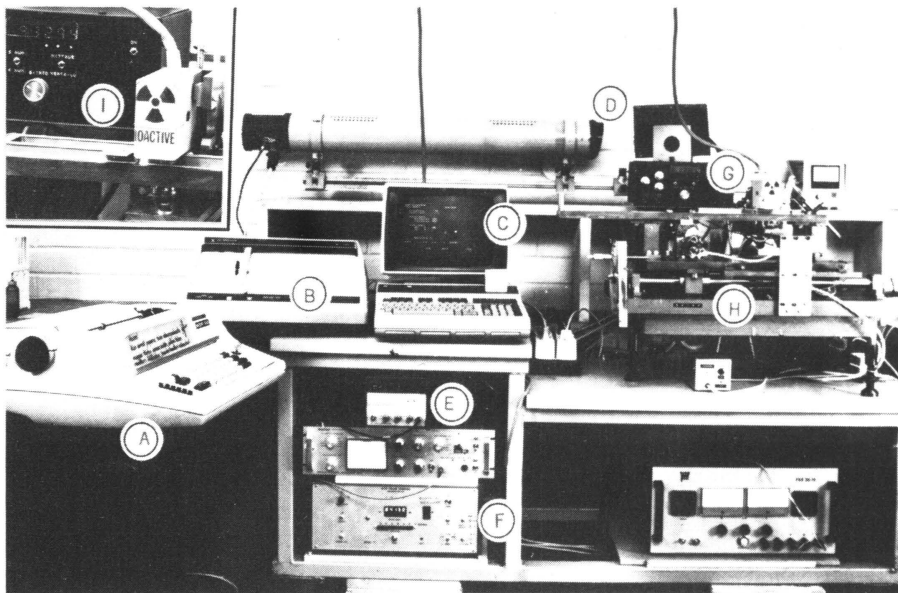
The results of the research work carried out by the Forest Research Institute have been published right from the beginning in a special series entitled, *Communicationes Institute Forestalis Fenniae*. By the end of 1982, over 100 volumes have been published, covering nearly 600 separate studies.

In order to facilitate rapid publication of the more important findings and topical results the Institute introduced *Folia Forestalia* in 1963. By the end of 1982, 540 volumes of *Folia Forestalia* have been published. Both series are distributed at present to 60 foreign countries in all parts of the world. Furthermore, a third series, *Metsäntutkimuslaitoksen tiedonantoja* (Bulletins of the Finnish Forest Research Institute), has been published since 1981. The articles in this series are usually in Finnish only and have a very limited circulation.

HELSINKI UNIVERSITY OF TECHNOLOGY

Education in technology commenced in Finland in 1849, at the beginning on a rather modest scale. However, the decree concerning the foundation of the Helsinki University of Technology was not issued until 1908. Higher education in wood science and wood processing is now mainly given at the Department of Forest Products established in 1942, which has professorships in the following subjects:

- mechanical wood technology
- paper technology
- printing technology
- wood chemistry
- pulping technology



Apparatus for measuring paper formation coaxially with light and beta-radiation

A - printer; B - X-Y plotter; C - HP 9835A calculator; D - illuminator (laser and quartz-halogen lamp); E - pulse amplifier and counter; F - specimen movement controller; G - light transmittance meter; H - specimen holding and moving system; I - insert showing the specimen clamp, measuring head and light transmittance meter.

General courses in forestry and wood-material science are also included in the curriculum of the Department of Forest Products. Each professorship contains also a corresponding laboratory.

In addition to teaching leading to the specific M.Sc. degrees of the various laboratories, a varying amount of research work is also carried out. This research work consists mainly of the M.Sc. and Doctoral thesis of the ordinary and postgraduate studies. The topics of the M.Sc. thesis are mostly industrial research and development tasks provided by the Finnish forest and printing industries. Some contract research is also carried out by the staff of the Department.

The postgraduate studies of the Department deal with more fundamental topics related to processes and properties of the various products of the Finnish forest and printing industries. Since only a modest sum of money for this type of research is provided in the Annual State Budget, the postgraduate students receive scholarships from various foundations and from the Finland Academy of Sciences.

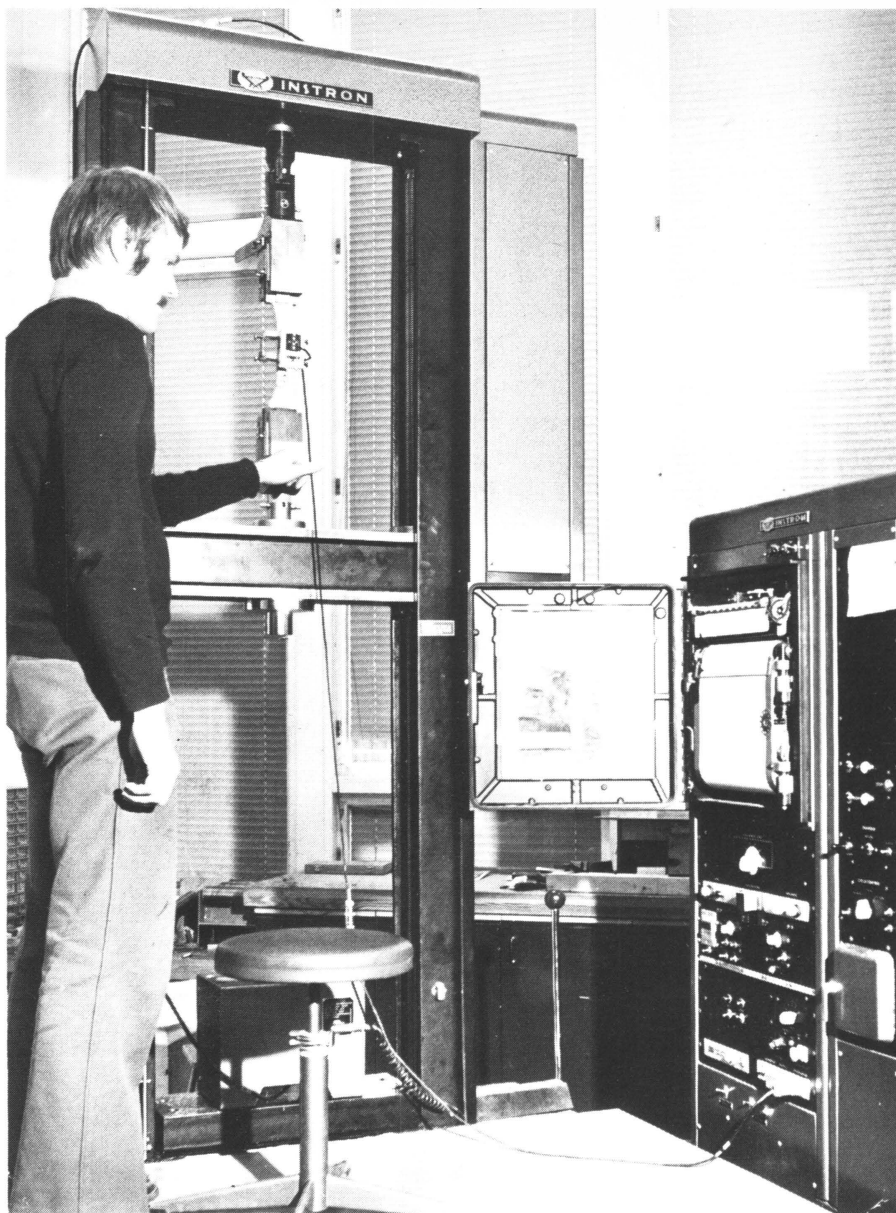
The Helsinki University of Technology has its own campus at Otaniemi in the town of Espoo, ten kilometers west of the centre of Helsinki.

TECHNICAL RESEARCH CENTRE OF FINLAND

The Technical Research Centre of Finland was founded in 1942 (the former name was the State Institute for Technical Research) to carry out basic and applied research and material testing as required by various authorities, private organizations and firms.

The activities of the Research Centre are supervised and guided by a Council. The Director General and the Board of the Research Centre, which consists of the Director General, the directors of the divisions and the Administration Director, are the executive organ of the Research Centre. The Technical Research Centre of Finland is subordinated to the Ministry of Commerce and Industry. The Research Centre works in cooperation with the Helsinki University of Technology.

The Research Centre now comprises 30 laboratories or main research fields, which are organized into six divisions. Each laboratory has an



Using electronic measuring devices the determination of different strength and elasticity characteristics of wood and wood products is fast and accurate. This illustration shows how the stress-strain diagram of a plywood specimen in a tension test is automatically recorded during the progress of the test.

Advisory Committee composed of experts in the particular field of research and activity.

The Forest Products Laboratory is engaged in the research field of wood and wood products and their mechanical processing. Its field of activity comprises the structure of wood and its properties as well as the technology related to the raw material, manufacture, properties, further processing, and use of wood products, thus covering the whole mechanical wood processing industry. The activities of the laboratory consist of research, testing, and product development. Research and product development work can be either self-initiated with financing allocated from the State Budget or commissioned investigations financed by the customer. Testing, mainly consisting of quality control, is totally commissioned.

The research and testing work of the Forest Products Laboratory is directed at the following fields:

- sawn timber
- plywood
- particle board
- fibreboard
- joinery products and furniture
- gluing of wood
- preservation of wood
- use of wood products

At the end of 1983 the staff of the laboratory totalled 81 persons. 31 of whom were graduated research officers.

The results of the research work are published in various periodicals or in the Research Centre's own series: *Technical Research Centre of Finland*, *research reports* and *Technical Research Centre of Finland, research notes* generally written in Finnish. The Research Centre is situated in Otaniemi, in the town of Espoo, near Helsinki.



Measuring stand growth in an experimental stand.

THE NATIONAL RESEARCH COUNCIL FOR AGRICULTURE AND FORESTRY

The Academy of Finland was established in its present form in 1969 by the Law concerning the Organizations of Scientific Research. In its capacity as the central governmental organ for research administration in Finland it consists of the Central Board of Science, seven National Research Councils and the Administrative Office, which is divided into three Bureaux: the Administrative Bureau, the Economic Bureau and the Planning Bureau. The Academy of Finland is subordinated to the Ministry of Education.

The National Research Council for Agriculture and Forestry, being one of the seven Research Councils of the Academy, has the following duties:

- to promote scientific research work in the fields of agriculture, forestry, home economics, food science and other connected disciplines

- to distribute grants and fellowships and make contracts for long term research projects

- to act as an expert body for government officials

- to promote cooperation in different fields of research and between research councils and institutes.

The Council employs research workers: senior and junior fellows and research assistants, appointing them for a period of one to three years. The younger fellows are allowed to hold a position for a maximum of seven years and the assistants for six years. The posts of research assistants are mainly intended to serve as starting points to those who have passed an academic examination and would like to proceed in their scientific career to the doctor's degree. The number of research employees in 1983 was 41. Fourteen of the research officers are working in the field of forestry.

The Council has no laboratories or institutes. Its researchers carry out their work either in research institutes or in the various departments of the universities. The grants distributed by the Council are intended for the employment of assistants to research staff, for equipment, travel expenses etc. A certain amount of money is granted annually from the State Budget for this purpose. The State's financial support to scientific societies is also distributed on the basis of recommendations made by the Council.

The members of the Council are appointed by the Government from among the specialists in relevant fields for a period of three years. The chairman of each Council is appointed by the President of the Republic. The present National Research Council for Agriculture and Forestry consists of a chairman and fourteen members, who have been appointed for the period 1983–85.

PRIVATE INSTITUTIONS

THE SOCIETY OF FORESTRY IN FINLAND

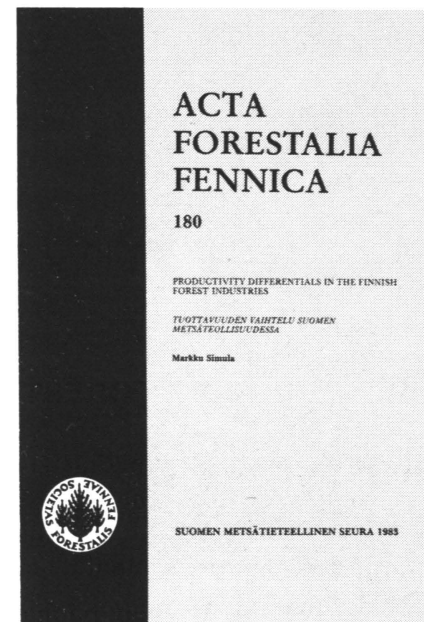
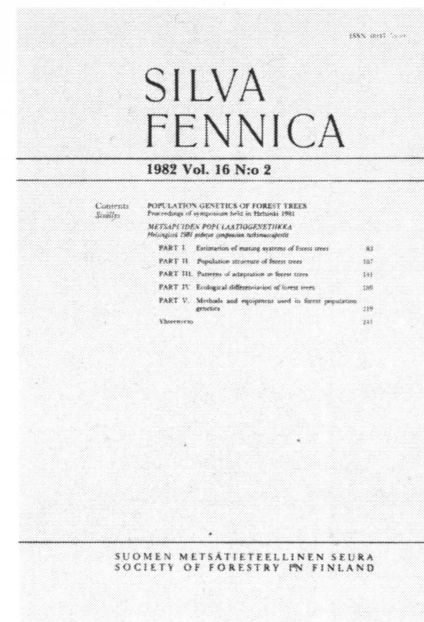
The Society of Forestry in Finland was established in 1909 on the initiative of A. K. Cajander to promote forestry research in Finland and to serve as a link among those who devote themselves to the study of forestry. The Society endeavours to attain its objects principally by:

- issuing and exchanging publications
- holding meetings
- granting financial support for research from its yearly income and funds
- taking part in international activities in forestry research

The Society started to publish *Acta Forestalia Fennica* in 1913 and *Silva Fennica* in 1926. By the end of 1983 a total of 185 volumes of *Acta Forestalia Fennica* had been published containing 585 separate studies. For *Silva Fennica*, since 1967 a quarterly journal, the figures are 120 + 17 volumes. Publication activities are probably the most important functions of the Society. The main part of the investigations conducted outside the Forest Research Institute are published in *Acta Forestalia Fennica* and *Silva Fennica*.

Over a thousand publications from all over the world arrive each year at the Society's library, as a result of the exchange agreements with foreign libraries, research institutions and seats of higher learning. The library of the Society, which is situated in the Forestry Library of the University of Helsinki, is open to all interested parties.

The ordinary meetings of the Society are held every month from September to May, inclusive. The meetings are devoted chiefly to scientific



Publications of the Society of Forestry in Finland: *Silva Fennica* and *Acta Forestalia Fennica*.

lectures containing reports from recently completed investigations. It is a commonly established practice that the results of major investigations in forestry are reported to the Society before publication.

The Society's possibilities for granting financial support for research are rather limited. The grants available are mainly used to encourage young, promising graduates to take up careers in forestry research. The Society takes part in international activities in forestry research and invites foreign forest scientists to address its meetings. It is one of the Finnish members of IUFRO.

The membership of the Society consists mainly of ordinary members who are Finnish citizens working in forestry and related research. In 1983 ordinary members numbered 470.

Distinguished foreign scientists in the sphere of forestry and related sciences may be elected as foreign members.

The administration of the Society is carried out by a Council consisting of the president, vice-president, retiring president, secretary, and three other members elected by the annual meeting. The president is elected for a term of one year. He is not eligible for immediate re-election. The secretary and other officers are elected for a period of three years and they may be re-elected.

The Society receives regular financial support from the Academy of Finland.

METSÄTEHO, THE FOREST WORK STUDY SECTION OF THE CENTRAL ASSOCIATION OF FINNISH FOREST INDUSTRIES

Metsäteho is a research institute established in 1945 and maintained by the Finnish forest industries. The function of Metsäteho is to provide services that develop and make more effective the logging and production of wood raw material. This it does through investigations and experiments and by disseminating information.

Its membership consists of 36 forest industry and wood procurement companies that belong to the Central Association of Finnish Forest Industries. The work is financed chiefly through membership fees. The membership fee is fixed on the basis of the quantity of timber logged by each member. Metsäteho's activities are managed and supervised by an 8-member Board of Directors elected yearly by the Central Association of Finnish Forest Industries.

In order to maintain close cooperation between the members and Metsäteho, permanent expert organs formed of representatives of the members have been established. These organs are the Committee for Information and Training, the Committee for Silvicultural Work, the Technical Committee and the Data-Processing Committee. The committees help in directing Metsäteho's activities along the lines of practical requirements. In addition to the permanent committees, supporting field-expert groups are set up, when needed, for different research projects.

The staff comprises the Managing Director, three section heads and 16 research and information officers. The total number of the staff is 36.



Metsäteho also participates in the development of harvesting machines and equipment. To lighten the work of manual bunching in thinnings long-reach loaders which can be used on medium-sized forwarders have been developed.

Studies associated with the wage bases of cutting, forest haulage and the long-distance transportation of timber have been on Metsäteho's programme from its inception and still continue. Metsäteho's studies constitute the bases of the currently applied wages and tariffs for the cutting, haulage and transportation of timber by truck. The number of studies aimed at the development of forest operations has increased steadily. The main emphasis in research and experimental activity today is on investigating the suitability of new methods and machines and on laying a foundation for the development of new methods and machines. A significant feature of the programme is the development of and experimentation with planning methods aimed at minimising wood procurement costs and control methods for the effective use of machines and employees. The studies cover the whole harvesting process from stump to mill. Since 1971, the programme has also included studies on the mechanization and wage bases of silvicultural work and the dissemination of information about them.



Truck transport and bundle floating are the most important forms of long-distance timber transport in Finland.

The studies and experiments are conducted on actual work sites in close cooperation with the members. In activities aimed at the development of machines, close cooperation exists with their manufacturers. Metsäteho has close contacts with other domestic and foreign research institutions, especially in Scandinavia. Nordic cooperation comprises joint research projects, in addition to the exchange of information.

Metsäteho reports its investigation results in *Metsätehon tiedotus – Metsäteho Report* (5–10 reports yearly) and *Metsätehon katsaus – Metsäteho Review* (approx. 20 reviews yearly). The Reports have an English summary and the Reviews contain a brief description of the contents in English. Practical work instructions are published in manuals. Films and series of slides are prepared and hired out as auxiliary material for the training of members, and for educational and other forestry institutions. To make investigation results and other knowledge available for practical use Metsäteho also organizes training courses and provides lecturers.

WORK EFFICIENCY ASSOCIATION (Työtehoseura)

Työtehoseura, the Work Efficiency Association, (founded in 1924) is a registered private association enjoying State support. The Association aims at the rationalization of agriculture, forestry and home economics. It carries into effect its objectives by performing research, experiments, product development and educational work, and by publishing the results.

The Forestry Department of the Work Efficiency Association was founded in 1942. At present the forestry sector consists of the forestry department in Helsinki and at Rajamäki (fifty kilometers north of Helsinki), which is also the location of the forest experimental station.

Research work was initially directed towards harvesting methods and tools, and subsequently towards the development of various types of silvicultural and logging machinery. In the 1960's economic, organizational,



Wood harvesting methods based on the use of farm tractors are studied by the Work Efficiency Association.

and sociological problems of small-scale forestry, such as the behaviour and cooperation of forest owners, were included in the research program. At present, the main emphasis is on harvesting and utilization of wood and peat for energy and the development of wood harvesting methods and machines for small-scale forestry. Much attention has also been paid to ergonomic problems and the harmful aspects of increasing mechanization. Research work is carried out in close cooperation with other Finnish and Scandinavian institutions.

In the field of silviculture, the development of soil-preparation machines is carried out at the forest experiment station. A number of the machines developed by the Work Efficiency Association are exported to foreign countries.

Investigation results are published in the *Publication-series* and *Forest Reports of Work Efficiency Association*, in the *Teho-Periodical*, and in other professional reviews.



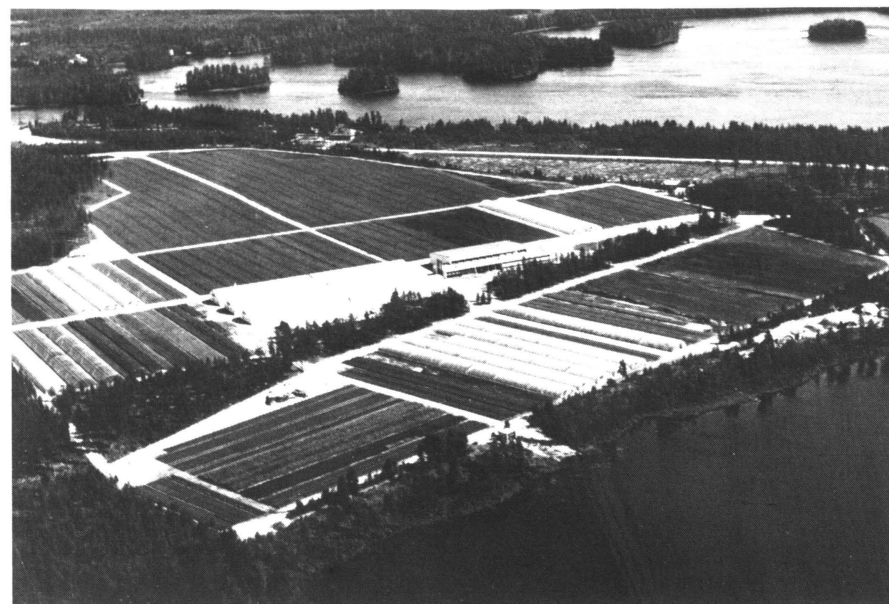
Hydraulically loaded TTS-disk tiller.

THE FOUNDATION FOR FOREST TREE BREEDING (Metsänjalostussäätiö)

The Foundation was established in 1947 by the main Finnish forestry organizations. At the present time it runs a tree-breeding centre at Haapastensyrjä, a nursery at Röykkä (both in southern Finland), a nursey in western Finland (Keuruu) and a nursey in eastern Finland (Pieksämäki). The head office of the Foundation is situated in Helsinki.

Its main objectives are:

- to select and maintain exceptionally valuable trees, plus trees and plus stands, for breeding purposes
- to supply genetically good or superior seeds and plants for forest regeneration
- to apply the results of scientific research to forest tree breeding
- to co-operate with interested parties in Finland and other countries
- to supply information relating to forest tree breeding.



Pieksämäki nursery owned by the Foundation for Forest Tree Breeding.



A birch (*Betula pendula*) seed orchard No. 336 was established in a plastic greenhouse in 1978–79. The seed is used in Central Finland. There are 125 grafted birches in this seed orchard. Tree selection was based on good growth performance in progeny tests and high quality characteristics.

So far, the Foundation has, together with other institutions, selected and marked over 12 000 plus trees and 6 000 hectares of plus stands for seed collection. The Foundation has collected about 5 000 kilograms of good seed from standing trees, sold more than 300 million seedlings originating from plus trees and produced two million grafts. 3 400 hectares of seed orchards have been established which means 1 200 000 living grafts. These seed orchards will produce all the Scots pine seed required by nurseries by about 1984, and some five years later all the Scots pine seed needed in the country, including the needs of direct sowing in forest cultivation areas. Norway spruce seed orchards total 300 hectares; their seed crop will probably not meet the requirements until the late 1980's. Birch (*Betula pendula*) breeding has advanced very rapidly in recent years. In 1974–78 a birch seedling seed orchard grown in a plastic greenhouse produced

about 200 kilograms or 300–400 million genetically and physiologically good seeds. The production of seed orchard No. 336 for the Central Finland area and the bi-clonal seed orchard in plastic greenhouses has been about 20 kilograms per year. Further breeding is going on within several breeding schemes.

The first seed orchard of *Betula pubescens* was established in 1982. The aim of *Betula pubescens* breeding is the growing of new high-producing cultivars especially for drained peatlands and utilizing short-rotation-forestry and coppice-silviculture.

The second National Breeding Programme for the years 1976–85 is under way, which means an intensification of the breeding work of the Foundation. A considerable part of the pollen and seed production, hybridization, cutting production and other breeding work will be done in controlled environmental conditions in greenhouses, all furnished with equipment for increasing the carbon dioxide level and some with artificial heating and lighting etc. These techniques are designed to shorten the breeding cycles and to develop vegetative propagation by cuttings. Using these techniques the Foundation has succeeded in shortening the breeding cycle of birch to 8 months. This means that from sowing the seed of good birch plustrees the next generation seed was harvested only 8 months later. The Foundation publishes an annual report »*Metsänjalostussäätiö – The Foundation for Forest Tree Breeding*» in Finnish with an English summary and *Information Leaflets*.

THE FINNISH PULP AND PAPER RESEARCH INSTITUTE (Oy Keskuslaboratorio – Centrallaboratorium Ab)

The Finnish Pulp and Paper Research Institute, founded in 1916, is the central research institute of the Finnish pulp, paper and paperboard industry.

The principal function of the Institute is to satisfy the need for joint research in the Finnish pulp, paper and paperboard industries. In addition to this, the Institute engages in contract research on a non-profit basis.

The research concerns the whole field of pulp and paper manufacturing, from the fibre raw material supplied to the mill right up to the final con-



The Finnish Pulp and Paper Research Institute, Tapiola.

verted product. Research is also conducted into the chemical products that can be obtained from both biomass raw materials and pulp process by-products.

Organization

The Finnish Pulp and Paper Research Institute is a joint stock company, the shares of which are owned by 25 Finnish companies producing pulp, paper and paperboard. All of these are represented on the Institute's Board, which approves the annual research programme and the budget.

The President is responsible for the Institute's activities. In addition to the President, the Managing Group of the Institute comprises the Vice Presidents who are the heads of the different research sections.

Research is divided into four sections: Chemical By-Products, Pulp and Paper Processes, Paper and Board, and Technical Service. These sections are divided into a total of 14 research departments.

Of the 300 employees, 90 are graduated in technical or natural sciences.

Financing

In 1983 the income available for Institute activities will amount to FIM 46 million; 68 % of this is provided by grants from industry, 20 % comes from contract research for industry, about 3 % from contract research for the Ministry of Trade and Industry, and 9 % from other sources.

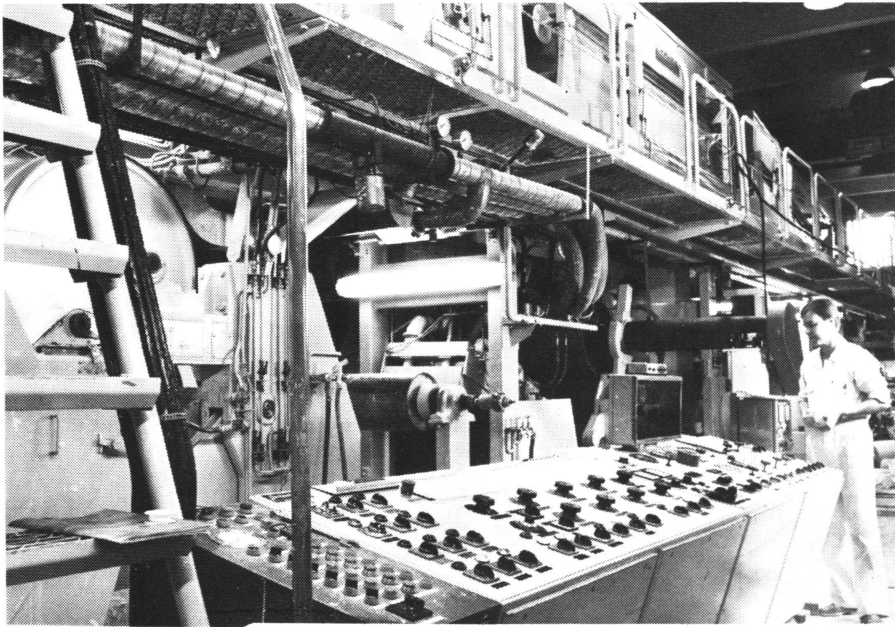
Research programme

The Institute's programme research, which serves the joint interests of the industry, is mainly concerned with technical research and development work. This type of research accounts for about one half of the Institute's research capacity. The objective is to provide the industry with the technical and scientific information it needs for optimizing forest exploitation from wood raw material through manufacturing processes to finished products. Aspects of environmental protection and energy consumption are considered in all process and product development work.

Twenty-five per cent of the research capacity is reserved for exploratory research, notably target-oriented basic research, which is also intended to produce new research ideas. The remaining 25 % consists of contract research done either for member companies or for other domestic and foreign customers.

Pilot Plant

The Institute has a well-equipped pilot plant for semi-technical investigations. The pulping plant includes a thermomechanical and chemimechanical pulping station with a 4 m³ digester and a 1,500 kW double disk



The pilot-plant coating machine.

refiner, a bleachery, a screening station, three pulpers, and 13 pulp chests with a total capacity exceeding 200 m³. For papermaking and for conversion of paper and board, the pilot plant facilities include an experimental paper machine, an experimental coater equipped with four different coating units, a ten-roll supercalander, and a corrugated board machine.

For developing the production of chemical wood products from the components of spent pulping liquors, the pilot plant includes apparatus for ultrafiltration, hyperfiltration and invert osmosis, an evaporator and a sprayer unit.

Pilot plant facilities are also available for the purification of waste water originating in the plant, and in research concerned with the purification of mill effluents transported to the Institute.

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Abbreviations:

D.F.	Doctor of Agriculture and Forestry
D.Agr.	— » —
L.F.	Licentiate of Agriculture and Forestry
M.F.	Master of Agriculture and Forestry
F.Tech.	Forest Technician
Ph.D.	Doctor of Philosophy
Ph.L.	Licentiate of Philosophy
D.Sc.	Doctor of Science
L.Sc.	Licentiate of Science
M.Sc.	Master of Science
B.Sc.	Bachelor of Science
D.Tech.	Doctor of Technology
L.Tech.	Licentiate of Technology
D.Pol.Sc.	Doctor of Political Science
L.Pol.Sc.	Licentiate of Political Science
M.Pol.Sc.	Master of Political Science
LL.M.	Master of Laws
(Econ.)	Economics
(Eng.)	Engineering
(Phys.)	Physics
(Soc.)	Social sciences

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