



RESEARCH IN FORESTRY AND WOOD SCIENCE IN FINLAND

1976

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RESEARCH IN FORESTRY AND WOOD SCIENCE IN FINLAND

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 here to call attention to only a few of them. For example, there was the industrial revolution generating intense economic development, including an especially great increase in building activity (i.e. construction); 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 resource was vital to the economic life of Finland. Coupled with this awareness was the growing concern about the adequacy of the forest resource 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 permanently 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 activity spheres of various institutions, all contributing to the solution of problems in forest production, wood utilization, or both.

Because of the close and continuing interdependence of research and higher education in forestry as in any field, it seems appropriate at the start to outline some highlights in the growth of higher forestry education and its relation to research as it has developed in Finland over the past one hundred years.

It is to be hoped that this booklet can serve our visitors from abroad as a first-hand orientation to Finnish forestry research.

February 1976

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

The principal task of the school was to educate forest officers in the service of Finnish forestry, but 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 results of his studies and wrote a handbook of forest policy. In recognition of his scientific work he received in 1897 the honorary degree of Doctor of Philosophy at the University of Helsinki.

A. G. Blomqvist served as 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 caused higher education in forestry to suffer 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, to where higher education in agriculture had 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, in 1918 he was appointed Director-General of the National Board of Forestry, the teaching duties of the professorship on the undergraduate level had to be handled mainly by deputies and assistants. In addition, A. K. Cajander had to fill the professorship of forest mensuration until 1928.

Subsequently the following chairs have been founded: Forest Policy (1923), Logging and Wood Technology (1930), Peatland Forestry (1937, a permanent extraordinary professorship which was converted to a full chair in 1950), 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, of Plant Pathology and of Plant Breeding also serve as associates in forest education. They devote part of their time to teaching forestry students in their particular subjects and to advising graduate students. The first of these two chairs was founded in 1921 as a permanent extraordinary professorship, but was changed in 1949 to an ordinary Chair of Agricultural and Forest Zoology. The second of the two chairs was also founded in 1921 as a permanent extraordinary chair but changed in 1948 to a full professorship of Plant Pathology. The third of these chairs was founded in 1968 as a permanent extraordinary professorship.

To facilitate the practical field training of foresters, the position of Forest Officer of the University was founded in 1907. Until 1930 he also taught logging and wood technology. Since then the Forest Officer has been responsible for giving the basic course in silviculture and conducting practical training at the Forest Training Centre of the University.

Immediately after the shifting of higher education in forestry from Evo to the University of Helsinki, a part of the Korkeakoski Forest District was 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 (Korkeakoski) since 1954. Subsequently, this whole Forest District has been dedicated for use as the Forest Training Centre of the University, though it has remained under the control of the National Board of Forestry. The first Forest Officer of the University was Dr. A. Benj. Helander.

The buildings of the Forest Training Centre were not ready for occupation until 1912, but training began in 1910 in a temporary manner. 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



A stand of pine saplings (*Pinus silvestris*)

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 offices mentioned already, there are a number of associate professors and 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 1968. According to this, successful execution of the required examinations for the Faculty of Agriculture and Forestry entitles the students to the following degrees:

1. Bachelor of Forestry
2. Master of Agriculture and Forestry
3. Licentiate of Agriculture and Forestry
4. Doctor of Agriculture and Forestry

The last degree is not obtained through a separate examination, but is

awarded when a licentiate's doctoral dissertation has been published and officially examined and approved.

The forest examination (Bachelor of Forestry) provides the qualification required by a person whose aim is to enter practical forestry, but the examination is usually also taken by persons who intend to enter a research career. According to the requirements now in force the forest examination takes two forms — the General Forest Examination and the Commercial Forest Examination. The former is a qualification for those who undertake the traditional tasks of forestry (forest management, logging, etc.); the latter prepares experts for the marketing of forest products.

There is, however, a certain specialization within the limits of the General Forest Examination. A student is required to include in his forest examination at least four of the following main subjects: business economics in forestry, forest mensuration, forest pathology, logging technology, forest zoology, marketing of forest products, peatland forestry, silviculture, social economics in forestry, and wood technology.

In each of these subjects he may take a course at three different levels. The most intensive is the *laudatur* course, the next the *cum laude* course, and the least intensive is the *approbatur* course. A student is required to pass the *laudatur* course in at least one main subject and also take at least one other main subject to the *cum laude* level. The fulfilment of a *laudatur* course requires not only a wider knowledge of literature compared with the *cum laude* and *approbatur* courses, but also more practical training and the writing of a *laudatur* thesis.

The combination of subjects is chosen by the student in collaboration with the adviser in the student's main subject, but the final program must be approved by the Faculty. Some main subjects can only be studied in combination with certain others. Thus, a student who chooses silviculture as his main subject must also include in his combination of subjects forest mensuration and peatland forestry; the fourth main subject is optional. As a result of this arrangement, specialists can be educated for every branch of forestry and combinations of subjects corresponding to the requirements in every field of activity can be taken. The main subject of the Commercial Forest Examination is the marketing of forest products. With Faculty permission a student may select a fourth major subject outside the Faculty of Agriculture and Forestry. For example, he may choose a suitable complementary subject, e.g. botany or genetics in the Faculty of Philosophy, statistics or economics in the Faculty of Political Science.

In order to secure a sufficiently broad background in general forestry a student has also to pass general courses usually of one semester's duration (i.e. courses shorter than the *approbatur* courses) in the following forestry subjects: forest mensuration, silviculture, business economics of forestry, social economics of forestry, and logging technology (also peatland forestry for the General Forest Examination). The students have also to pass examinations in the basic subjects, botany — including plant physiology — and chemistry, and in a number of auxiliary subjects which are mainly determined according to the subject schedule.

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 program 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 combination of main subjects. These largely determine the specialized curriculum that he will follow, i.e. forest management, technology, economics, etc.

In the second year, study of the basic and auxiliary subjects is continued but the main stress is placed on lectures in the main subjects.



Pine stand (*Pinus silvestris*)

The third year is devoted to continued lectures and seminar training in the main subjects, with limited study in the auxiliary subjects, and to the preparation of a report based on practical work undertaken during the second summer.

During the fourth year the student concentrates on the laudatur thesis and on the final examinations. These examinations — both written and oral — are held once a month. Under this system a student is allowed to take one subject at a time; for example, one examination in a main subject every month.

The *practical training* is of great importance. It takes place mainly in the summer, partly as joint training arranged by the University and partly as special training which is arranged in companies, organizations, and the National Board of Forestry.

Joint training is undertaken with a few exceptions (e.g. training in forest mensuration during the second summer) at the Forest Training Centre of the University at Hyytiälä where the Korkeakoski Forest District is reserved for this purpose. Training is mainly concentrated in the first and second summer according to the following program:

	1st summer	2nd summer
silviculture	4 weeks	5 weeks
peatland forestry	2 »	2 »
forest mensuration	5 »	5 »
logging	2 »	5 »

Every student participates in joint training during the first summer; but in the second summer only those students participate whose combination of subjects requires additional field education. In practice, however, almost every student aiming to pass the General Forest Examination is required to take part in the joint training of the second summer.

In addition, joint training in logging is undertaken at Hyytiälä during the third academic year (in January — February). Every student taking logging technology to the cum laude level or higher must fulfil this requirement. Students use the third summer for special training in their main subject. This may be taken in industrial companies, National Board of Forestry, forest associations, or in corresponding organizations abroad. The length of this training varies and depends on the subject and requirements of the joint training included in the combination of subjects. The length of the special training in the main subjects of the General Forest Examination varies from one to five months but generally takes about two months.

Training for the Commercial Forest Examination is executed mostly in a specialized manner. A part of this special training, which lasts six months, takes place in domestic enterprises, such as roundwood purchasing and logging operations, 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 the Commercial Forest Examination 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 to undertake study in preparation for the Forest Examination is limited. Today a total of 65 new students are admitted yearly, about one third of the candidates to study for the Commercial Forest Examination. In recent years seven to eight times as many applications are received as the number of students that can be admitted. The selection of students is based on a number of specific qualifications. The most important qualifications considered in judging 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.

Graduate Studies

Graduate studies serve principally 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 examinations of Master of Agriculture and Forestry and Licentiate of Agriculture and Forestry. A licentiate whose doctoral dissertation has been officially examined and approved will be granted the title of Doctor of Agriculture and Forestry.

The examination for *Master of Agriculture and Forestry* is comparable to the Forest Examination in general character but differs from it mainly in scope and intensity. The first difference is that there are fewer main, basic and auxiliary subjects than in the Bachelor's examination. The combination of subjects comprises at least three main subjects. The second difference is that the studies go more deeply into the main subjects (the cum laude course of the Master's examination corresponds approximately to the laudatur course of the Bachelor's examination). Also the thesis (pro gradu work) of the Master's examination is somewhat more thorough than the laudatur thesis of the Forest Examination. The Master's examination can be passed either after the Bachelor's examination or

without a preceding Forest Examination. Only a few students have recently studied for this degree.

Those who intend to enter more deeply into forest science, and especially those who intend to qualify for research work, usually proceed directly to the degree of the *Licentiate of Agriculture and Forestry* after the Forest Examination. The licentiate course requires a thorough knowledge of a main subject in the Faculty. In addition, the examination includes at least one supplementary subject in which a student has to obtain the highest level of the Master's examination or possess knowledge corresponding to it.

A student must also present a licentiate thesis in his main subject in which he shows his ability to use scientific research methods. The thesis is often the result of research work lasting from two to three 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. Cum laude and laudatur marks in the main subject of the licentiate examination presuppose not only a first class licentiate thesis but also other research publications in the field and a thorough knowledge of the literature. A student intending to take the licentiate examination must also have had at least one year's service as a Forest Officer.

In order to achieve the degree of *Doctor of Agriculture and Forestry* a candidate 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 a licentiate to be expanded into a doctor's dissertation.

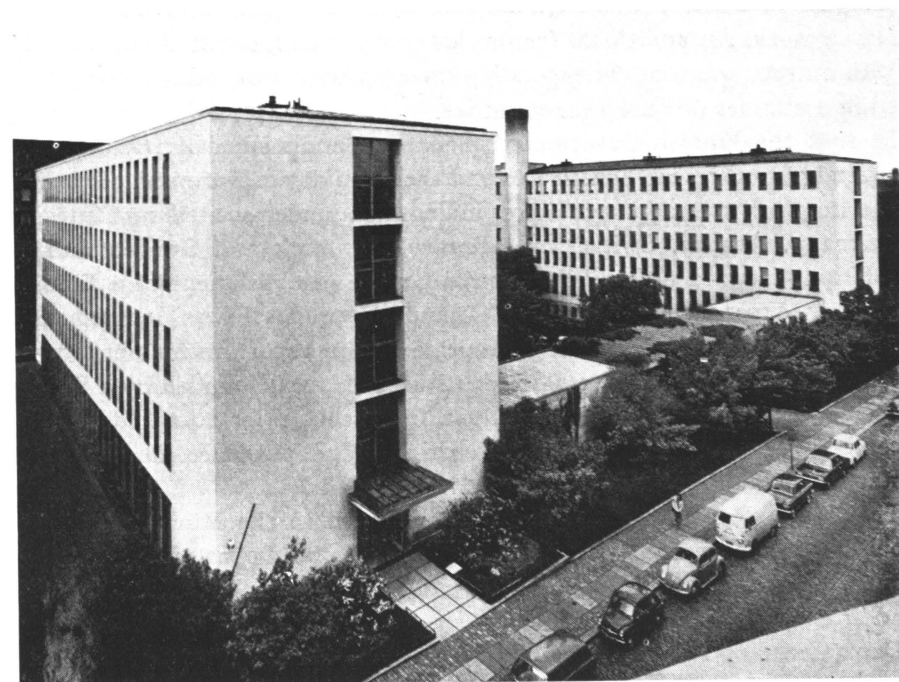
Graduate study involving formal course work has hitherto been relatively limited, and has consisted mainly of seminars. Currently, it is becoming customary for persons studying for the licentiate's and doctor's degrees to take examinations in other faculties, for example, in botany, chemistry mathematics,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



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

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 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 that corresponding research institutes had been established 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, 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 by 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 activity on the 1st of 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 Soils. At later dates the following additional departments were established:

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 united to be one Department of Forest Protection.

Research Organization

The Forest Research Institute now consists of these nine research departments and two offices: Administration Office and Experimental Forest Office. 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 microbiology of mineral soils.

The Department of Peatland Forestry studies the silvicultural utilization of swamps including suitability for draining and afforestation, ecology of swamp forests, the microbiology and hydrology of swamps, the effect of various measures on the development of swamp forests, and drainage and other swamp 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 carrying-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 Departments is headed by two professors, one for forest zoology and another 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, carries out national

forest inventories, and assists the Department of Forest Economics in forest balance studies. 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 timber, and mechanization in logging and silvicultural operations. A special professorship for forest work science 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, assisted by the Department of Inventory and Yield, 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.

Every 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 nine 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 Inventory and Yield, Forest Economics, Forest Genetics, and Peatland Forestry.

In 1976 the permanent research staff at the Forest Research Institute comprised thirteen professors, nine senior research specialists and 93 research officers.

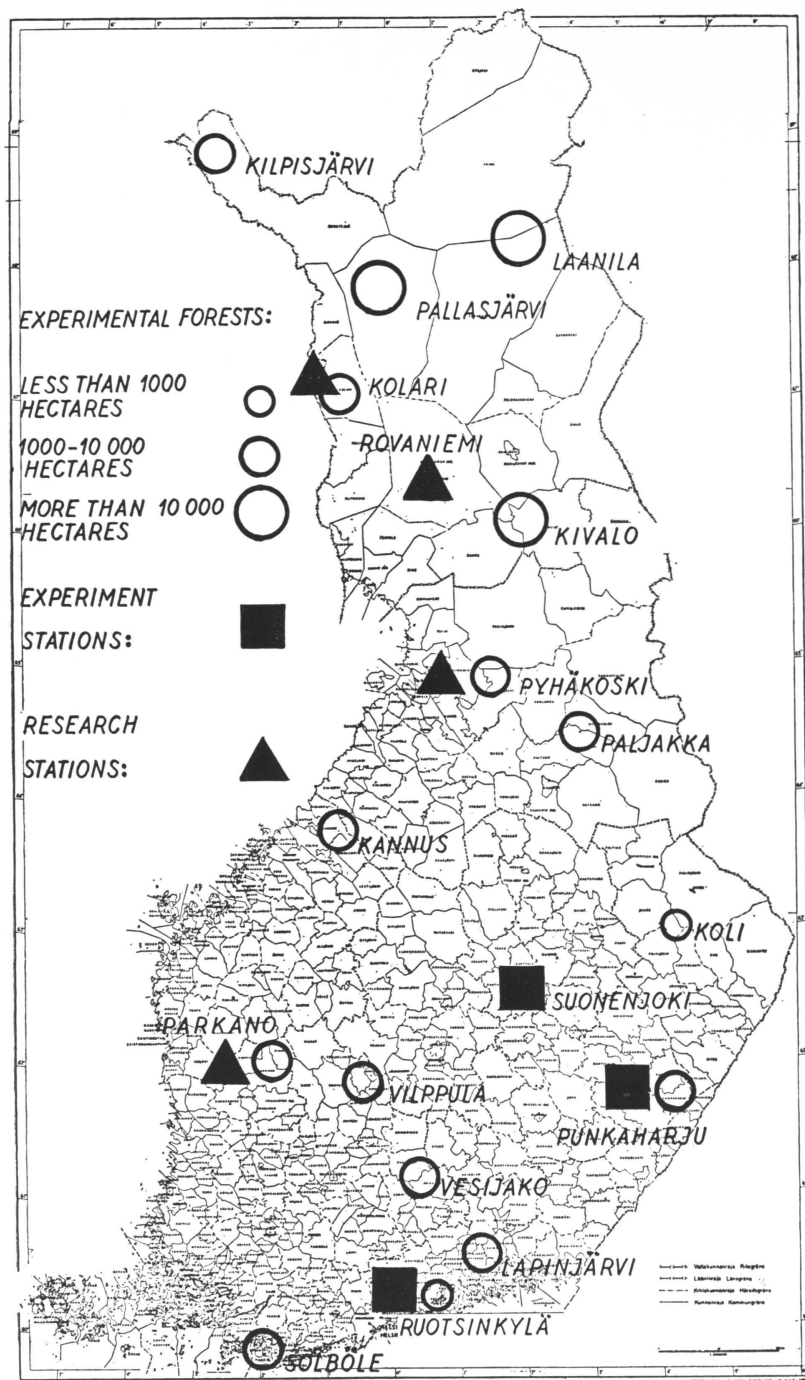
In order to promote collaboration between forestry research and practical forestry a Negotiating Board of the Forest Research Institute was established in 1953. According to the present decree it consists of the Director of the Institute, one of the professors, and eight other members representing various fields of forestry. They are nominated by the Ministry of Agriculture and Forestry. Primary responsibility of this Board is to serve in an advisory capacity pointing out problem areas which in their judgement need investigation and receiving firsthand reports on the progress of the Institute's research program. Thus, an opportunity is provid-



Artificial regeneration of forest by means of a planting machine

ed for the representatives of practical forestry to alert the research staff about critical needs and to stay informed about latest developments. Originally, actual research has been undertaken solely by the various research departments. Since 1961 regional *Forest Research Stations* have been in operation. For the time being the Institute operates four research stations. Each station has a permanent academic research staff numbering from three to ten. They contribute to research work by concentrating on certain regional problems, for example, forest drainage (in Parkano and Pyhäkoski), genetics on the northern limits of forest growth (in Kolari) and forest regeneration in the arctic conditions of Lapland (in Rovaniemi).

The researchers also have four *Experiment Stations* at their disposal. While the research stations function on a regional basis, the experiment stations solely concentrate on specific and restricted questions. The most prominent of them, Suonenjoki Experiment Station for Forest Regeneration, includes a research nursery. Two experiment stations (in Ruotsinkylä and Punkaharju) are devoted to forest tree breeding and the fourth, Ojajoki, to forest zoological research. The Institute's appropriation in the State Budget for 1976 amounts to approx. 24 mill. Fmk.



Experimental forests, forest experiment stations and research stations of the Finnish Forest Research 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 79 000 hectares, fairly evenly distributed throughout the country.

The experimental forests, which are under the direct control of the Forest Research Institute, offer opportunities for permanent experiments with a minimum of redtape 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 three forest districts, each 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.

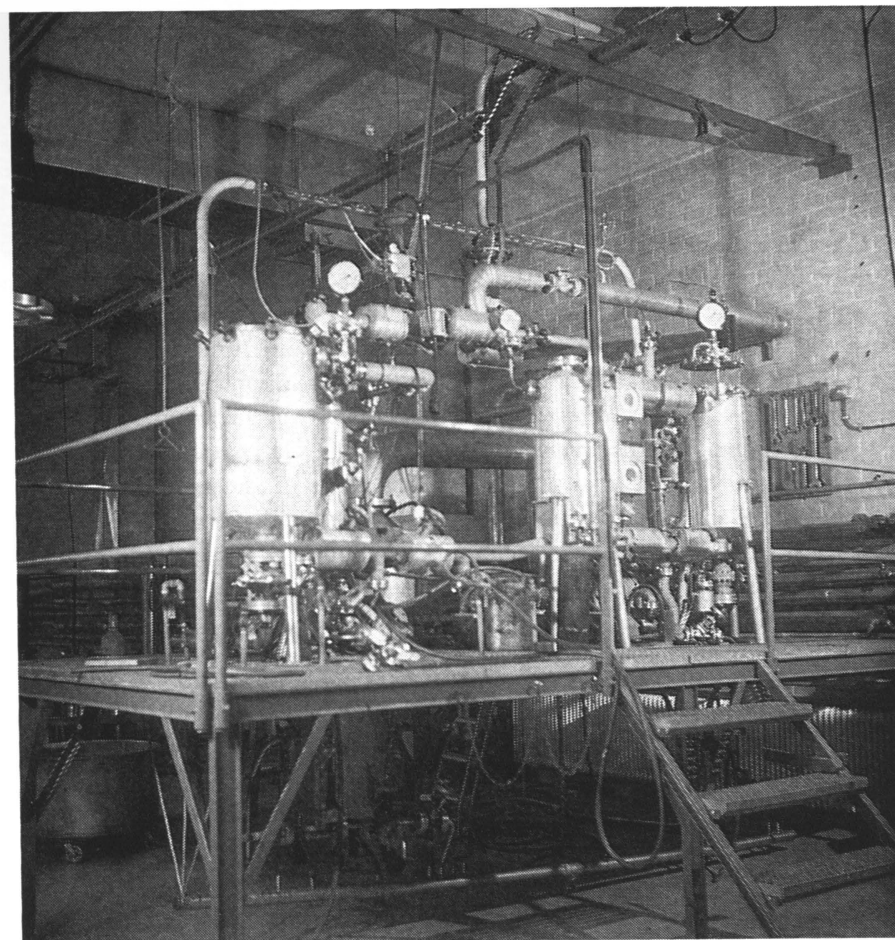
At present the Forest Research Institute controls two national parks as well as five large and five small conservation areas, totalling approximately 62 000 hectares. Strict nature reserves, areas completely reserved and protected except for research purposes, are important subjects for forest studies 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. By these arrangements it has become possible to fill certain gaps in the network of the Institute's experimental forests.

Publication Activity

The results of the research work of the Forest Research Institute have been published from the beginning in a special series entitled *Metsäntutkimuslaitoksen julkaisuja* (*Communicationes Instituti Forestalis Fenniae*). By the beginning of 1976 eighty-seven volumes had been published, covering a total of 483 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 beginning of 1976 251 volumes had been published in this series. Furthermore, the Forest Research Stations of the Institute publish Research Bulletins of their own.



A view of the pilot cooking equipments in the pilot plant hall of the Forest Products Department

HELSINKI UNIVERSITY OF TECHNOLOGY

Education in technology in Finland commenced in 1849, in the beginning on a rather modest scale, but 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 Forest Products Department, established in 1942, which has professorships in the following subjects:

mechanical wood technology
paper technology
printing technology
wood chemistry
pulp technology

General courses in forestry and wood-material science are also included in the curriculum of the Forest Products Department.

Besides teaching, the staff of the Department carries out research work in wood science and wood processing. The necessary equipment for research is available at the Department but since no funds are provided for research work in the State Budget it must be financed from various outside sources. The *National Research Council for Technology* and the *Foundation for the Advancement of Technology*, in particular, sponsor technical research in Finland. In addition, some of the members of the teaching staff are working in the Technical Research Centre of Finland. The Helsinki University of Technology occupies a special campus at Otaniemi, ten kilometres 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 is working in cooperation with the Helsinki University of Technology.

The Research Centre now comprises 32 laboratories or main research fields, which are organized into four divisions. Each laboratory or laboratory group has an Advisory Committee composed of experts in that particular field of research and activity.

In the research field of wood and wood products and their mechanical processing there are following three laboratories:

Wood Panel Products Laboratory

- General Section
- Wood Panel Section
- Plywood and Gluing Section
- Chemical Section
- Application Section

Timber Laboratory

- General Section
- Wood Working Section
- Product Research Section

Wood Preservation Laboratory

- General Section
- Research Section

At the beginning of 1976 the research staff of these laboratories consisted of 21 graduated research officers.

Research in wood chemistry is carried out in the Chemical Laboratory of the Technical Research Centre of Finland.

The results of the research work are published in various periodicals or in the Research Centre's own series:

Publications of the Technical Research Centre of Finland, (Reports of the State Institute for Technical Research: Series I-Wood and Series IV-Chemistry until 1972) and *Laboratory Reports* generally written in Finnish. The Research Centre is situated in Otaniemi, in the town of Espoo, near Helsinki.



With modern 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 tension test is automatically recorded during the progress of the test

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 the capacity of the central governmental organ for research administration in Finland it consists of the Central Board of Research Councils, six National Research Councils and the Administrative Office, which is divided in 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 six Research Councils of the Academy, has the following duties:

- to promote scientific research work in the fields of agriculture, forestry, home economics, 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 by appointing them for a period of one to three years. The 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 want to proceed in their scientific career to the doctor's degree. The number of research employees in 1976 is 36.

The Council has no laboratories or institutes. Its researchers carry out their work either in research institutes or in the various departments

in the universities. The grants distributed by the Council are intended for the employment of assistants to research staffs, for equipment, travel expenses etc. For this purpose the Council is granted annually a certain amount of money from the State Budget. Also the State's financial support to scientific societies is 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 three year period. 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 eleven members, who have been appointed for the period 1974—76.

PRIVATE INSTITUTIONS

THE SOCIETY OF FORESTRY IN FINLAND

The Society of Forestry in Finland (SFF) 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:

1. issuing and exchanging publications
2. holding meetings
3. granting financial support for research from its yearly income and funds
4. taking part in international activities in forestry research

SFF started to publish *Acta Forestalia Fennica* in 1909 and *Silva Fennica* in 1926. By the end of 1975 a total of 148 volumes of *Acta Forestalia Fennica* had been published containing 551 separate studies and comprising 40119 pages. For *Silva Fennica*, since 1967 a quarterly journal, the figures are 120 + 9 volumes and 14326 pages. 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*.

The ordinary meetings of the Society are held every month from September to May, inclusive. The meetings are devoted chiefly to scientific 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, such as exchanging publications (currently with 240 foreign institutions) and by inviting 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 1975 ordinary members numbered 425.

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.



Studies on new harvesting methods and machines have a noticeable share in the research work of Metsäteho

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 working principle 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 approximately 50 forest industry and wood procurement companies that belong to the Central Association of Finnish Forest Industries. The work is financed chiefly by membership fees. The membership fee is fixed on the basis of the quantity of timber logged by the 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.

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.

The staff comprises the Managing Director, three section heads and 16 research and information officers. The total number of the staff is 38.

Studies associated with the wage bases of cutting, forest haulage and long-distance transportation of timber have been on Metsäteho's programme from its inception and still continue. Metsäteho studies constitute the bases of the currently applied wages and tariffs for the cutting, haulage and transportation of timber by lorry. 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 costs and control methods for the effective use of machines. 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 concerning them.

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 its publications *Metsätehon tiedotus* — *Metsäteho Report* (approx. seven reports yearly) and *Metsätehon katsaus* — *Metsäteho Review* (approx. 25 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 occasions and provides lecturers.



The Research and Training Centre of The Work Efficiency Association is situated at Rajamäki, 50 kms north of Helsinki

THE WORK EFFICIENCY ASSOCIATION (Työtehoseura)

Työtehoseura, the Work Efficiency Association, is a registered private association founded in 1924 which is enjoying State support. The Association aims at the rationalization of agriculture, forestry and home economics. The Association endeavours to carry 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. The personnel of the department consists of the department head, researchers, machine experts and the necessary office staff. Research work is performed both in the office of the Work Efficiency Association in Helsinki and in the Research and Training Centre at Rajamäki

about fifty kilometres north of Helsinki. The training activity within forestry is concentrated in the School for Forest Foremen and forest machine development at the Forest Experiment Station, both at Rajamäki.

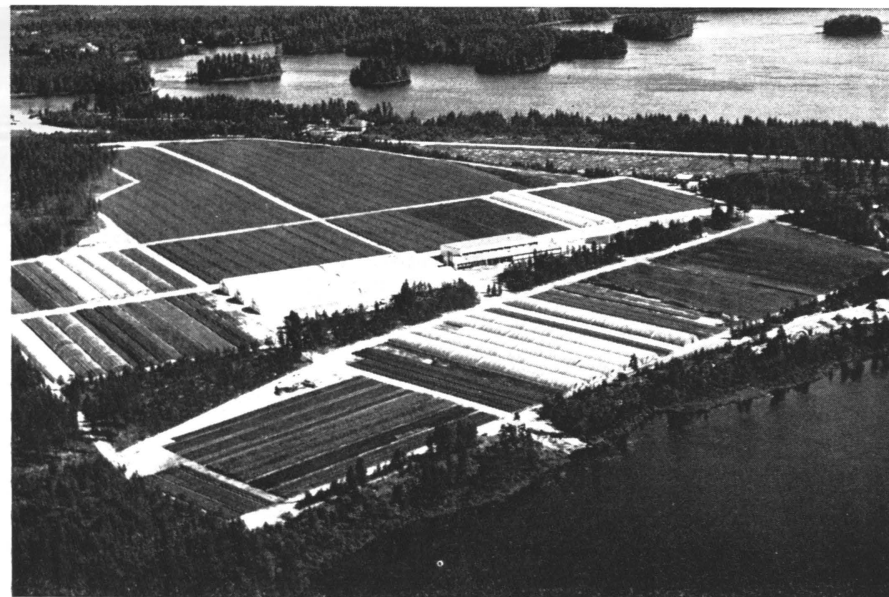
Research work was initially directed towards harvesting methods and tools, and subsequently towards the development of various types of silvicultural and logging machinery. In the past few years economic, organizational, and sociological problems of small-scale forestry, such as behaviour and cooperation of forest owners, have been included in the research program. At present, the main attention in logging concerns the development of methods and machines specially for thinnings and small-scale forestry. Since 1961, much attention has been paid to ergonomic problems. The mutual relationship between the worker and the work has attained special interest, and harmful aspects arising from increasing mechanization are investigated in cooperation with other Finnish and Scandinavian institutions.

Concerning silviculture, the development of soil-preparation and planting machines is in progress. Permanent experimental areas have been es-



Developing working methods and machines is one of the main functions within The Work Efficiency Association. TTS Disc Trencher — one of the results of this activity

established for the testing of new methods. Standardization work also belongs to the activities of the Association. Investigation results are published in the *Publication-series* and *Forest Reports of Work Efficiency Association*, in the *Teho-Periodical*, and in other professional reviews.



PIEKSÄMÄKI nursery owned by the Foundation

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 breeding station at Röykkä (both in southern Finland) and a nursery in eastern Finland (Pieksämäki). The address of the head office is: Alkutie 69, SF-00660 Helsinki 66.

Its main objectives are:

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

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 4 500 kilograms of good seed from standing trees, sold more than 200 million seedlings originating from plus trees and produced two million grafts. There is a national goal of 3550 hectares of seed orchards which means 1 420 000 living grafts. All of the grafts have been made and 95 % of the desired area has already been planted with grafts. These seed orchards will produce all the Scots pine seed required by nurseries by about 1980, 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. In Haapastensyrjä Tree Breeding Centre there are about 10 000 growing grafts.



This seed orchard of birch (*Betula verrucosa*) produced already three years after establishment one million high quality seeds per seedling, on average. The seedlings were then 4 to 7 years old. The forecast for 1976 is 90 kilograms or 180 million seeds from 125 seedlings

Birch (*Betula verrucosa*) breeding has advanced very rapidly in recent years. In 1975 a birch seedling seed orchard in plastic greenhouse produced 63 kilograms or 125 million genetically and physiologically good seeds. There are also two-clone provenance hybridization and species hybridization seed orchards in plastic greenhouses producing enough seed for experimental and breeding purposes. The aim of *Betula pubescens* breeding is the growing of new high producing cultivars especially for drained swamps and utilizing short-rotation-forestry and coppice-silviculture. Other short-rotation forestry species included in breeding work are willows (*Salix* sp.), aspen and poplar (*Populus* sp.) and alders (*Alnus* sp.). In 1976 the second National Breeding Programme for the years 1976–85 has been started, 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. The Foundation publishes an annual report *»Metsänjalostussäätio — The Foundation for Forest Tree Breeding»* in Finnish with an English summary.

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 laboratory of the Finnish pulp, paper and board industry. The aim of the Institute is to carry out technical and scientific research concerned with chemical and mechanical pulp and with the manufacture of paper and board, with a view to promoting progress of the technology in these fields. The Institute is maintained by the industry, and engages in joint technical and scientific research and development work on a non-profit basis.

The main emphasis is laid upon comprehensive project research. Furthermore, young engineers and scientists are provided with opportunities for post-graduate education through research work. The Documentation Service Department functions as a central unit in the technical and scientific information service for the Finnish paper industry. The Institute acts as an international forum in research and standardization.

Organization

Each company contributing towards the financing of the Institute's activities has one representative on the Board of the Institute as well as on the Executive Committee of the Board.

The Research Committee, which acts as an expert body on behalf of the Executive Committee with regard to research topics, has eight members appointed by the industry.

For the accomplishment of research projects, the Research Committee appoints contact groups, whose members are experts from the industry. Of the 271 employees, 86 have graduated in technical or natural sciences. Activities extend throughout 14 departments.



Finnish Pulp and Paper Research Institute, Tapiola

Financing

In 1976, the income available for Institute activities amounts to approximately 20 million Marks, proportionally provided as follows: about 76 % by grants from industry, about 18 % by contract research from industry, about 2 % by contract research from the Ministry of Commerce and Industry, and from other incomes, 4 %.

Research programme

Extensive projects, to which 50 % of the Institute's capacity is tied, are the basis of long-term research. Introductory research comprises 15 %, and has the main object of producing new and fruitful ideas. The Institute also engages in research work on the basis of private contracts. In 1975, the research capacity was divided between the different sectors as follows:

	per cent
New raw materials	6
Pulp	32
Paper and board	29
Converting of paper and board	11
Topics of general nature (such as the development of analytical methods and environmental protection)	22

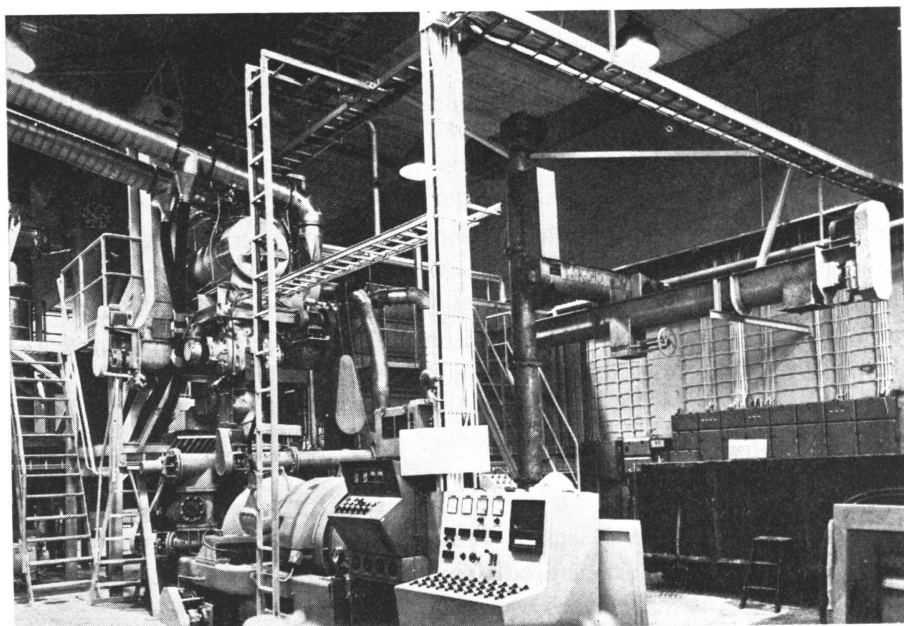
Pilot Plant

The Institute has a well equipped pilot plant for the manufacture of paper from wood and for conversion operations on both paper and board. The pulping plant includes a digester of 600-litre capacity, a thermomechanical pulping station with 1000 kW double disk refiner, a screening station, two pulpers, and 13 pulp chests with total capacity exceeding 200 cubic meters.

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 supercalender, and a corrugated board machine. Also the pilot plant facilities are available for the purification of waste water originating in the own plant, and in research concerned with the purification of mill effluents transported to the Institute.

The Institute is situated in the vicinity of the large State centre for technical education and research, some ten kilometers west of the centre of Helsinki. The total volume of the buildings is 70 000 cubic meters, of which the pilot plant comprises 28 000 cubic meters. In addition to the pilot plant which serves the needs of process research, the Institute has modern laboratory equipment for pulp, paper and package testing, and for physical and chemical research.



The thermo-mechanical pulping station, with Bauer 411 (1000 kW) double disk refiner, installed at the end of 1975

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¹⁾ Abbreviations on the last page

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Abbreviations:

D.F.	Doctor of Agriculture and Forestry
L.F.	Licentiate of Agriculture and Forestry
M.F.	Master of Agriculture and Forestry
B.F.	Bachelor of Forestry
Ph.D.	Doctor of Philosophy
Ph.L.	Licentiate of Philosophy
M.Ph.	Master of Philosophy
B.Ph.	Bachelor of Philosophy
D.Sc.	Doctor of Science
L.Sc.	Licentiate of Science
M.Sc.	Master of Science
B.Sc.	Bachelor of Science
D.Sc. (Eng.)	Doctor of Science (Engineering)
L.Sc. (Eng.)	Licentiate of Science (Engineering)
M.Sc. (Eng.)	Master of Science (Engineering)
D.V.M.	Doctor of Veterinary Medicine
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

