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Forestry and Forest-industry Education in Finland

by

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Abstract

A general overview of the school system in Finland is provided as background to a detailed description of forestry education in that country. Vocational and technical forestry education is organized and conducted by the National Board of Vocational Education. Numerous occupational diploma programs are offered at 30 forestry schools and colleges, including programs for forest workers, forest machine operators and mechanics, forest technicians, sawmill technicians, wood-based panels technicians, forest engineers, and forest-industry engineers. Short courses and refresher courses are also provided for more than 30 000 people annually. Three universities offer higher degrees in forestry: the University of Helsinki, the University of Joensuu, and the Helsinki University of Technology. International forestry is an important element of forestry education. It is addressed through a marketing degree program that emphasizes international commerce through the training of students from developing countries and through foreign-exchange programs for students, teachers and researchers. Examination of the organization and teaching of forestry subjects in Finland suggests ways in which Canadian forestry education might be improved to meet the future needs of an increasingly technical forestry sector.

Résumé

Les auteurs présentent une description détaillée des programmes d'étude en foresterie offerts en Finlande et donnent en contexte un aperçu général du système scolaire de ce pays. L'enseignement professionnel et technique en foresterie y est régi par un conseil national. 30 collèges et écoles de foresterie offrent des programmes pour l'obtention de diplômes professionnels; on y forme notamment des travailleurs forestiers, des opérateurs et mécaniciens d'équipements forestiers, des techniciens forestiers, des techniciens de scierie, des techniciens en panneaux dérivés du bois, des ingénieurs forestiers et des ingénieurs pour les industries forestières. Des cours de courte durée et des cours d'appoint sont suivis par plus de 30 000 personnes par année. Trois universités dispensent une formation de niveau plus élevé: l'Université d'Helsinki, celle de Joensuu et l'Université de technologie d'Helsinki. Les aspects internationaux sont considérés comme importants; ainsi, un programme universitaire en mercatique met l'accent sur le commerce international, des étudiants de pays en développement sont formés, et des échanges d'étudiants, de professeurs et de chercheurs sont organisés avec d'autres pays. L'examen de l'organisation et de l'enseignement de la foresterie en Finlande fournit des idées en vue de l'amélioration de l'enseignement de la foresterie au Canada, compte tenu des besoins futurs d'un secteur forestier de plus en plus technicisé.

Introduction

Finland can truly be called a 'forest nation'. With a forestry philosophy that pervades and affects the daily life of almost every member of the population, the forests of Finland are both an economic mainstay and an important part of the country's cultural heritage. Forestry in Finland is the product of a conscious national effort to use the forest resource to the fullest according to multiple-use principles (Anon. 1986). Much of the success must be ascribed to a widespread public appreciation of the importance of the forest resource and to a thorough system of forestry education that encompasses all segments of forestry activity.

With roughly one-third of its land area lying north of the Arctic Circle, and a productive forest area only 40% that of

Ontario, Finland makes full use of its forest resource, annually harvesting about 2.5 times that amount of wood harvested in Ontario. Moreover, through progressive forest legislation and a commitment to intensive forest management, the total forest growing stock is actually increasing. Forestry and forestry-related industries are the most important sectors of the Finnish economy. In 1986, forest products accounted for approximately 37% of Finnish export earnings.

Forestry practice in Finland is shaped by a predominance of private ownership and by a heavy demand for fibre and sawlogs from a large and diverse forest industry. Of a total 26.4 million ha of productive forest land, 63% is privately owned, either by farmers or by non-resident woodlot owners. There are about 280 000 private forest holdings in Finland; the average size of holding is 37 ha, and 80% of all holdings are less than 50 ha in extent. The other major forest owners

¹Forestry Canada - Ontario Region, Great Lakes Forestry Centre, Sault Ste. Marie, Ontario

are the state (24%) and the forest industry (9%). Forest policies based on the principle of sustained yield and designed to increase long-term yields provide a climate for intensive and innovative forest management in all ownership categories. Hence, in addition to a generally high level of silvicultural activity, there is a strong emphasis on tree improvement and on stand-improvement measures such as drainage, fertilization, thinning, spacing control, and so on (Vuokila 1979, Sevola 1983). Increasingly, a more integrated approach to forest management is being promoted (Räsänen 1988). Additional background information on Finnish forestry is given in recent articles by Gasbarro (1982), Haavisto and Jeglum (1984), Hirvonen (1984) and Grey (1988).

Because of the high level of activity in forestry, correspondingly high numbers of people are involved. There are about 30 000 permanent professional forestry workers, plus 10 000 to 15 000 seasonal and temporary workers (Anon. 1985). Out of a total population of about 5 million, a recent labor-force survey (Anon. 1988) showed that 47 000 people were employed in forestry in 1986. However, this survey did not include private owners, most of whom do their own forest work. It is estimated that private forest owners put in up to 6 000 person-years annually. Salaried staff in the public sector (The National Board of Forestry, the Central Board of Forestry TAPIO, Forest Management Associations, etc.) number about 10 000. These include graduate foresters, forest engineers and technicians who are responsible for forest management planning or who supervise the application of the forestry laws in state and private forests. In addition, the forest industry employs some 100 000 workers in its mills and forest operations.

The intensive nature of forestry activities in Finland demands a training system that is able to supply skilled personnel to meet the different occupational needs within the sector, whether in state or company operations or for the small private forest owner. Hence, we see not only forestry faculties in universities and colleges, but also an extensive network of vocational schools throughout the country devoted to the technical training of forest engineers, forest technicians, machine operators, and forest workers, as well as the provision of short courses for farmers, private-forest owners and others. As we begin to adopt a more intensive approach to forest management in Canada, it is salutary to examine the education and training system that has been developed in support of the forestry sector in Finland.

General Education Overview

The Finnish educational system was reorganized during the 1970s, and children now receive 9 years of general schooling, starting at age 7. The Finnish educational system is highly state-supported and the mandatory 9 years of comprehensive school, including textbooks and study materials, are free of charge. In addition, local authorities provide a free noon meal, medical and dental care, transportation, and board and lodging if the distance to school is excessive.

Comprehensive school is divided into a 6-year primary level in which all students follow the same curriculum, and a 3-year lower secondary level with streaming in selected subjects. There is strong emphasis on the basics — reading, writing, arithmetic, geography, science, history, and physical education. Two other languages are compulsory, starting at grade 3. Since Finland is officially bilingual, one of these must be the second national language, Swedish or Finnish. About 95% of the pupils choose English as their second foreign language.

After finishing comprehensive school, a student may choose to continue his studies at a vocational school or college, or may go on to upper secondary school, which leads, potentially, to college or university. A centralized system for applications and admissions regulates admission to upper secondary schools (equivalent to grades 10-12 of Canadian high schools). A good grade average in comprehensive school is essential if one is to gain admission to upper secondary school, and about 50% of students go on to attend these schools for a further 3 years. Many of the remainder (46%) choose to follow one of 25 vocational courses, which include forestry and forest-industry training, at one of the 100 vocational schools throughout Finland. Only a small proportion, 5 to 10%, enter directly into the work force after completion of comprehensive school.

For those accepted into upper secondary schools, compulsory subjects include mathematics, chemistry, biology, history, social sciences, and one foreign language, commonly English but increasingly German, French, Russian or Spanish. The overall curriculum varies depending on whether the school has a technical or an academic orientation.

It is necessary to pass a separate national matriculation examination before entering university. The competition for university placement is frequently intense. Approximately 20% of those graduating from upper secondary schools gain admission to universities and other institutions of higher education, and 40% enter vocational schools. The remaining 40% generally enter the work force, although some may have an opportunity later to continue their education either through their employment or on a part-time basis.

It generally takes from 4 to 7 years to obtain a degree at one of Finland's 21 universities and colleges. At present, more than half of university students are female. Some time during or after their full-time education, between the ages of 19 and 30 years, all males must fit in 9 to 11 months of compulsory military service. Subsequent short periods of military-reserve duty must also be served.

Vocational and Technical Forestry Education

"Training and craftsmanship are a guarantee of competence in carrying out a job in forestry and forest industry. At the same time, the viability of forest districts and remote areas is ensured." (Anon. 1987)

The National Board of Vocational Education, under the Ministry of Education, is responsible for all aspects of vocational education in Finland. This board is organized into separate offices for different occupational fields, one of which is the Bureau of Forestry Education.

The Bureau of Forestry Education directs and supervises 30 forestry schools and colleges (Fig. 1), of which two are for Swedish-speaking students (Anon. 1987). Each school usually offers several lines of study, although some concentrate on particular occupational fields (e.g., forest engineer, forest machine operator, etc.). All schools and colleges have modern dormitories and cafeterias. Instruction and full board (if a student chooses to live in residence) are free of charge.

Graduates of comprehensive schools begin their forestry training with a 1-year introductory program, offered at 40 locations throughout the country and attended annually by about 1 400 students. Here they acquire basic knowledge about forestry and the forest industry. This includes 6 weeks

Figure 1. Vocational and technical forestry schools and colleges in Finland.

of practical training, mainly in jobs associated with forest regeneration and the tending of young stands. After completion of this introductory program, students are channeled into one of nine specialized programs (see box). The 1-year introductory course is not required by matriculants from upper secondary schools. As well, forestry workers may be enrolled in some specialized vocational programs directly from the workforce under certain circumstances. However, there is usually a prerequisite for long-term forestry work experience or previous related training and experience.

The nine specialized programs in forestry, their duration, and the manner in which classroom studies alternate with practical training are illustrated in Figure 2.

Of the 30 forestry schools and colleges, 22 'forestry schools' (Fig. 1) offer the 1-year introductory program plus an additional 1 or 2 years of study for a specific trade. The numbers graduating annually within each trade are: forest workers, 700–800; forest machine operators, 200–300; and forest machine mechanics, 30–40 (von Schoultz 1979, Holopainen 1984, Anon. 1987).

Seven 'forestry colleges' (Fig. 1) offer more specialized training for supervisory, planning and managerial positions. The forest technician program takes 4 years for those who

Figure 2. The basic study lines for technical forestry occupations in Finland.

have completed comprehensive school (Fig. 2), and graduates about 170 annually. The program for forest engineer requires 5 to 6 years, and 120 students graduate each year. Practical training is an integral part of both programs. They are similar to technician and technologist programs in Canada, although the course length and level of detail are greater in Finland. It is possible for graduates from these colleges to enter university degree courses, although there are limited quotas for such students.

Four 'forestry colleges' also provide training of technical personnel for the mechanical woodworking industry — i.e., sawmilling, wood-based panel manufacture, and marketing. The annual output is about 80 industrial technicians, 20 forest-industry engineers and 40 forest engineers with the marketing option. Some of these colleges also provide training in sawing and planing for small-scale operations.

Practical training of an operational nature is an important and intensive component of all forestry training programs (Fig 2). Competitions are frequently part of this practical training, and serve to hone the skills of the students in such subjects as the estimation of stand parameters, felling, marking for thinning, orienteering, and other forest-worker skills.

Most forestry schools have their own forest, each of about 1 000 ha in extent, in which students receive practical training. In total there are 35 000 ha of school forests, most managed on a commercial basis, but the forests often contain a variety of experimental plots and demonstrations of regeneration systems, site types, stand improvements, and so on. Many of these experiments are cooperative endeavors with research organizations, thereby exposing students to research methods. School forests are managed according to multiple-use principles, and the management plan is called a 'multiple-use plan' rather than a forest-management plan (Veijola 1984).

Vocational Programs in Forestry in Finland

Forest worker: Practical training accounts for 70% of the curriculum, the emphasis being on logging, with 5 weeks of logging practice towards the end of winter. Students also learn about marking, scaling of timber, the operation of forest machines, safety, regeneration, tending of young stands, and forest improvement work.

Forest machine operator: This one-year program emphasizes the structural and maintenance aspects of forest machinery as well as its operation. The emphasis is on equipment used for felling and logging, and for forest improvement and silvicultural tasks.

Forest machine mechanic: The entrance requirement is completion of the forest machine operator's program or a related program. The program aims to develop a high level of skill in the repair and servicing of heavy forestry machinery. About 50% of the curriculum is devoted to repair and servicing, and 30% to the structure of machines.

Forest technician: Training prepares the forest technician primarily for supervisory field duties in forestry. All aspects of forestry are covered, but there is heavy emphasis on timber production and harvesting, as well as on planning and personnel management. Practical training accounts for a large part (about 1.5 years in all) of the program.

Sawmill technician and wood-based panels technician: The syllabus has a high practical content, with emphasis on the production process. The courses also cover matters related to raw materials, product transportation, and marketing. Graduates are employed in the forest industry, mainly in supervisory and marketing roles.

Forest engineer: As in the forest technician program, the syllabus is based on silviculture, timber harvesting, wood technology and forest planning. General subjects make up 25% of the total. Practical training amounts to a total of about 1.5 years. Forest engineers find employment in planning and supervisory positions with various government and forest owner organizations or the forest industry in forest research, education, conservation and recreation. Evo Forestry College offers specialization in multiple-use forestry.

Forest-industry engineer²: The syllabus covers production processes in the mechanical forest industry, raw materials and their procurement, pulp chemistry, products utilization and marketing. The sawmilling industry receives particular attention. General subjects, particularly foreign languages and mathematics, are also stressed. Graduates are employed mainly in managerial positions.

Forest engineer, trading option: This is a somewhat shorter program than for forestry-industry engineer, and covers subjects dealing with marketing, internal and external factors affecting the wood processing industry, domestic and foreign trade, wood and wood products, and production processes. Foreign languages are important. Graduates find employment in the domestic and foreign sales departments within the forest industry.

²Some technical colleges under the Bureau of Technical Education National Board of Vocational Education offer 3- to 4-year programs for technicians and engineers in joinery and carpentry, and the pulp and paper industry. The study lines (i.e., programs) are called "wood technique and process" and "laboratory technique". This training is not solely for the forest industry, but for other sectors of the economy as well (L. Hellman, personal communication).

Employment opportunities in Finland are generally good, and most forestry school graduates find a job in their own field or in a closely related one. However, currently there is a surplus of forest technicians, and course enrollments are being reduced to match the demand. There are also plans to phase out some of the training centres that now provide introductory forestry programs.

The opposite situation exists for professional forest workers, to the extent that employers are having difficulty in finding enough trained workers to fill their needs. The occupation of forest worker no longer interests many young people as much as in the past, and course enrollments have been declining for a number of years. Meanwhile, mechanization, especially of harvesting and thinning, has increased. There is still a need for skilled forest workers, and it is recognized that their training has to be adjusted to meet the demands of an increasingly technical forestry sector and to offer a more attractive career path. Employers usually give preference to those who have successfully completed training appropriate to the work involved.

Teachers in forestry schools are generally required to be educated to one level above the level they plan to teach. They are also required to take an additional year of education at a special teacher training college (at Kuru), one of seven institutes in the country designated as training schools for candidate teachers in various fields. Currently, about 15 to 30 vocational and technical forestry teachers graduate annually with a Diploma in Educational Technology.

In addition to providing full-time training, the forestry schools, together with various government forestry boards and forestry associations, offer a variety of short courses to farmers and private woodland owners throughout the country. These include both theory and practical training. After the successful completion of a sufficient number of courses, forest owners may earn a farm-forestry or tree-farmer certificate. Short courses are usually 1 to 5 days in duration. There is also a 3- to 5-month basic forestry course for tree farmers, arranged through some of the forestry schools. These courses, together with programs for young people arranged in collaboration with the Finnish 4H League, extension courses, and refresher courses for various forestry and forest industry occupational groups, attract some 30 000 participants annually. It is a reflection of the widespread interest in forestry in Finland — also exemplified by the existence of popular magazines and newspapers devoted to forest management and forestry-related issues — that many of the individuals who take these courses do so voluntarily to improve their technical skills and understanding of forestry principles.

Forestry Education in Finnish Universities

"As far as I can see, a broad consensus of opinion exists in Finland that universities should promote independent research and scientific education as well as provide higher education based on research." (Lehto 1987)

Higher education in forestry and forest-industry subjects is provided by three institutions — the University of Helsinki, the University of Joensuu in eastern Finland, and the Helsinki

University of Technology. A number of other universities also have technical faculties or departments concerned with wood processing and wood chemistry, as will be noted later.

University of Helsinki

The University of Helsinki, the largest and oldest university, will celebrate its 350th anniversary in 1990 (Lehto 1988). Its Faculty of Agriculture and Forestry includes several forestry departments — silviculture, peatland forestry, social economics in forestry, mensuration and management, land-use economics, business economics in forestry, logging and utilization of forest products, forest products marketing and farm forestry. Other departments deal with both forestry and agricultural topics, viz.: agriculture and forest zoology, plant pathology, and plant breeding (Jokelainen *et al.* 1982, Suvanto 1988). These departments are typically fairly small, usually headed by one professor accompanied by a small staff. At present there are about 40 professors, assistant professors and research associates; in addition, there are usually between 15 and 25 graduate students, most working towards higher degrees, who act as teaching assistants.

Most forestry departments of the Faculty of Agriculture and Forestry are located in 'Metsätalo' (i.e., 'Forest House') in downtown Helsinki. In the same building are the main office and a number of departments of 'Metsäntutkimuslaitos' (the Finnish Forest Research Institute), the principal state-supported forest organization in Finland. This arrangement facilitates communication between the university and research staff, and provides a stimulating working and learning environment for forestry students. The main forestry library and several other forestry organizations (e.g., Society of Forestry in Finland, International Peat Society) are located in the same building.

Three degrees are offered in forestry, viz.: Master of Science, Licentiate of Science, and Doctor of Science. In contrast with Canadian universities, the M.Sc. is the first academic degree taken at Finnish universities. It is somewhat more intensive and demanding in terms of content and requirements than the Canadian B.Sc.F. The M.Sc. program is typically from 4.5 to 5.5 years in duration, but may take up to 7 years. It varies in length because there is no set timetable for the completion of degree requirements, and because students often must work to help finance their education. Forestry students usually take loans to finance their education. Government loans of 20 000 FM (1 Canadian dollar = 3.7 FM) annually may be granted, for up to 10 years. Of this amount, 7 000 FM is forgivable, and the interest on the balance is only 3%. Payback begins 2 years after full-time employment begins, with a payback period of 15 to 20 years. As indicated above, most forestry students must work in addition to taking loans because they have to pay for summer field courses during the first 2 years of the forestry program.

There is heavy competition for student places in forestry; 8 to 10 times as many students apply for entrance as are accepted, and consequently, the quality of student is high. About 70 students enter the M.Sc. program annually. Of these, 50 take the main forestry program and 20 take the trading program option.

There are four study options in the main undergraduate program: (1) forest biology and silviculture, (2) forest management and planning, (3) timber harvesting and transport, and (4) a marketing program. The same first-year courses are common to all options. A detailed list of the course require-

ments in silviculture has been given by Leikola (1987).

Field courses, led by faculty members, play an important part in the curricula (Figs. 3 to 5). For example, during the first summer in the silviculture program, students take 13 weeks of practical training at the University Forestry

Figure 3. Students receiving instruction in peatland forestry. Peatlands cover one-third of the land area of Finland.

Figure 4. Field lessons in silviculture during a summer course at the University of Helsinki forestry Station at Hyytiälä.

Figure 5. Students learning the correct application of the TTS disc trencher for site preparation in a pine seed-tree area. (Photo courtesy of Paavo Haataja, Työtehoseura).

Station at Hyytiälä near Tampere (Leikola 1987). The main topics covered are silviculture, forest protection, peatland forestry, forest mensuration and mapping. The following January, a 4-week practical course in logging is given. An additional 4 weeks of field courses are given in the second summer, plus a further 3 weeks in the third summer. This heavy emphasis on field work and practical training is in stark contrast with the situation in Ontario. For example, at the University of Toronto, students take a 1-week field trip and a 2-week spring camp in their first year, followed by a 1-week silvicultural tour in their second year. Although these field trips may be supplemented by trips of one to several days on an occasional basis, the point is that Finnish students benefit from much more intensive and detailed practical training.

In addition to field courses taken in their first academic years, Finnish forestry students usually find summer employment in industry or government during their third and fourth years. This gives them practical exposure to the types of work they will encounter after graduation. Students may work for the National Board of Forestry, the Central Board of Forestry TAPIO, one of the Forest Management Associations (the district level organization of forest owners and salaried foresters), or private industry.

The marketing program option is divided into two further options — marketing of forest and wood-industry machinery, and marketing of forest products (Leikola 1987). Students follow a specialized program, similar to cooperative education programs in Ontario, in which 6 months are spent gaining work experience in commercial enterprises in Finland. In addition, students may obtain their summer work experience in countries to which Finland exports forest products or forest machinery.

Undergraduate programs require a detailed thesis, for which the student receives credit for 25 study weeks. The thesis frequently deals with some aspect of the student's summer work, and may well be conducted for the benefit of and in cooperation with the employer. The study may also be conducted in association with a university professor or research fellow in relation to his/her research program. The student is usually paid for this work and may be employed by the same agency after graduation. We have the impression that this undergraduate thesis is substantially stronger, and entails more in-depth scientific work over a longer period, than the typical B.Sc.F. thesis in Ontario.

Post-graduate studies are intended mainly for the training of research workers, although increasingly, they are considered an additional qualification for senior posts (Anon. 1984). The Licentiate program requires additional credits for supplementary studies, plus a thesis to demonstrate the candidate's ability to use scientific research methods. The research work lasts for about 2 years, and the thesis is examined and graded by a committee of three members appointed by the Faculty. The Licentiate candidate must also pass a language test in a second foreign language and must have served at least one year as a practicing Forest Officer. The Doctor of Science degree is based on a more thorough scientific knowledge of the subject area, but has the same general requirements as the Licentiate degree. However, in this case the emphasis is on research and the dissertation. The latter is examined and graded by a thesis committee consisting of the candidate's supervisor, an 'opponent' (i.e., external examiner), and one or more additional committee members. In accordance with Finnish tradition, the dissertation defense may be attended by members of the academic community and others. Increasingly, it is becoming common

to bypass the Licentiate thesis and to proceed directly to the Doctoral program.

The requirements for post-graduate studies are stringent, and it is usual for candidates to spend many years working towards higher degrees. The requirement to work as a Forest Officer for at least 1 year ensures practical experience, and the candidate normally gains additional experience in teaching and research during the degree program. However, this means that candidates often must make considerable economic sacrifices in order to complete higher degrees. Candidates are frequently in their mid to late thirties before they complete their Doctoral degrees, although by this time they are clearly mature and experienced scientists.

University of Joensuu

The M.Sc. program in forestry at the University of Joensuu was established in 1982 (Kellomäki 1987), and currently accepts about 30 new students annually. There are about 10 professors and assistants on permanent staff. Major study areas include forest soils, silviculture, growth and yield, and timber management planning. The training in forest sciences is complemented by courses given in other departments, in particular biology, chemistry, computer science, economics and statistics, mathematics, and physics.

Graduation requirements in terms of course credits, thesis preparation and field training are similar to those at the University of Helsinki (Kellomäki 1987). The students attend summer field courses at a modern, fully equipped field station at Mekrijärvi, east of Joensuu. Programs are being planned for the Licentiate and Doctorate degrees. The Joensuu Research Station of the Finnish Forest Research Institute (Metsäntutkimuslaitos) is situated on the university campus, and provides excellent opportunities for cooperation in research.

Helsinki University of Technology

The main institution of higher technical education is the Helsinki University of Technology (Anon. 1984). Its Department of Forest Products provides instruction in mechanical wood technology, paper technology, pulping technology, wood chemistry, and printing technology. There are about 15 professors and associates on permanent staff. About 20 civil engineers graduate annually from this university with an M.Sc. in forest-products technology.

Other Universities and Research Organizations

Other universities also offer training related to mechanical and chemical wood technology. For example, The Åbo Akademi (at Åbo/Turku) has a Department of Chemical Engineering with four areas of specialization: process chemistry, process technology, wood chemistry and pulp and paper technology. Also at Åbo is the Institute of Wood Chemistry and Pulp and Paper Technology (Huurinainen 1980).

The Finnish Forest Research Institute, the main state-supported agency devoted to forestry research, makes a major contribution to forestry education through the secondment of research staff to assist in teaching university courses or in providing field training. Such assignments are the norm for most researchers rather than the exception, as in Ontario. At the same time, many researchers work toward their Licentiate or Doctorate as part of their research program in the Institute. In this way, the level of training and expertise within the Institute is continually being raised, and undergraduate

students benefit from close contact with a dynamic research environment. Research staff from the Institute may also serve on university thesis committees and often provide assistance and guidance to graduate students.

Evaluation of Forestry Education Needs.

Forestry education for professional foresters in Finland — forest technicians, forest engineers and forestry graduates — has been evaluated from the standpoint of the needs of potential employers (Lehto 1979). This evaluation was based on a questionnaire directed at various forestry organizations within the country. In nine ranked teaching areas, verbal communication skills were considered to be highly important for forestry graduates and forest engineers, but of secondary importance for forest technicians. Administrative skills were considered to be second in importance for forestry graduates, third for forest engineers, and fifth for forest technicians. In contrast, a good knowledge of factors influencing roundwood supply was considered of primary importance for forest engineers and forest technicians, but not so important for forestry graduates. It becomes clear that the education of technicians and engineers is oriented towards technical and operational forestry skills, whereas that of graduates emphasizes management and administrative skills.

The continuing educational needs of professional foresters in Finland have been evaluated in another opinion survey (Juslin 1977). This study assessed, among other things, the most common types of work carried out by forestry professionals in different fields of employment, viz.: state forestry, private forestry, forest industry, education and research. In addition, the study listed the 15 most important subjects for continuing education within each employment category, as judged by both employees and employers. Some of the most important topics identified for forest technicians were measurement of raw wood, logging and transport, plus employee safety and protection. For forest engineers, the topics included negotiation and conference techniques, environmental protection and management, and verbal communication. Topics identified as important for forestry graduates included a knowledge of foreign languages, personnel management, and fundamentals of management, plus economic problems in the forestry industry, the psychology of leadership, and marketing of forest products for graduates of the marketing program.

International Forestry

"We depend in so many different ways, economically and culturally, on what happens elsewhere in the world . . . There is every reason to believe that it is an excellent investment to send researchers abroad and invite foreign scientists and scholars to Finland. . . it is important for university teachers to visit other countries, to gain new knowledge and learn to adapt themselves to foreign conditions . . . students, too, should have more chances to go abroad to study and to receive practical training." (Lehto 1988)

Finland's commitment to foreign aid is reflected both in the establishment of training programs in developing countries and in the education of its own students. Educators consider it important that Finnish forestry students understand and be able to deal with matters involving cooperation with developing countries (Jokelainen *et al.* 1982). At the University of Helsinki, for example, a short course on developing countries is required for students majoring in forest resource management, although it can be taken by other students as well. In addition, courses on forests and forestry in developing countries, of 2 weeks duration, are arranged annually in

cooperation with universities in Denmark, Norway and Sweden. Topics include tropical environments, wood properties and uses, land-use planning, forest inventory, agroforestry, logging and transport, wood markets and trade, and Nordic aid policy.

As part of Finland's foreign-aid initiative, forestry teachers and scientists are encouraged to obtain working experience in developing countries. Many professionals have participated in foreign assignments through international organizations or bilateral projects in Asia, Africa and Latin America. Often these projects include the training of native foresters. Such work assignments provide practical experience for teachers in international cooperation and also open up possibilities for cooperative projects and trade opportunities.

Because of its long tradition and experience in forestry and forest industries, Finland is deeply committed to forestry training in developing countries. Training is considered the best form of cooperation and the best way to achieve lasting results in the forestry sector. Since 1967, Finland has organized specialized training in forestry for developing countries as part of its development cooperation scheme. The 'Forestry Training Program for Developing Countries' provides training courses, workshops and seminars at regular intervals on logging, sawmilling, wood-based panels and other related subjects. These courses are provided to forest industry personnel from developing countries at the Forestry College at Kotka. Two other forestry education initiatives being undertaken through the foreign-aid program are the development of a forest-industry school in Tanzania and a forestry college in Zambia.

Many foreign students, from developing and developed countries alike, choose to study in Finland, and to work toward the M.Sc., Licentiate and even Doctoral degrees in forestry. While we were in Finland, there were students from Thailand, China, Japan and Canada working on forestry degrees. There are currently 23 foreign students studying forestry at the University of Helsinki and the University of Joensuu. In most faculties a knowledge of the Finnish language is essential in order to undertake studies at the M.Sc. level. However, higher degrees can be earned by individually tailored programs of instruction, reading and research. The English language plays an important role, since in many subjects the assigned reading is mostly in English.

Connections between Canada and Finland are strong. Finnish expertise has been influential both in research and in university teaching in Canada (e.g., Päivänen 1983, Jeglum 1985). Many Finnish students, researchers, and foresters have spent time studying and/or working in Canada or the United States as part of an educational or work experience. Conversely, Canadian scientists, students and forest managers can learn a great deal by visiting Finland and studying the forests and forest management in that country. Such exchanges serve to expose our foresters to the more careful and intensive forestry practices of Europe, and give a preview of the direction in which our own forest management practices must inevitably follow.

Concluding Comments

The forestry education system that has evolved in Finland appears to be considerably more comprehensive and better structured than that in Ontario. Furthermore, there is a very clear understanding of the roles that the vocational education system and the universities play within the forestry sector

as a whole. In part, this may be attributed to strongly centralized control under the Bureau of Forestry Education, which serves to integrate all aspects of forestry education at the technical and university levels. At the same time, the demand for specialized training programs geared to the needs of potential employers is clearly driven by the more intensive approach to forest management that exists in Finland. The result is that, at all levels, training programs are more specialized, frequently longer, and of greater depth than those offered in Ontario.

An overall strategy for technical education in forestry seems to be lacking in Ontario, perhaps because of the absence of a strong central organization for developing and guiding the programs of different educational establishments. Indeed, technically oriented forestry education tends to be developed on an *ad hoc* basis, and it is frequently characterized by competition between educational establishments for students, funding and courses. With education costs climbing higher, there is a clear need for better integration of effort, as well as a better coordinated system for responding to the requirements of potential employers. Specifically, we need to establish a central mechanism for assessing the needs of employers and the future demands within various job categories. As Ontario becomes committed to more intensive forest management, we can undoubtedly expect the demand for technical specialists and a well trained work force to increase. We should be planning for this now.

A fundamental difference between the secondary educational system in Finland and that in Ontario is the development of a strong vocational education system that accommodates young people who will not go on to university. With the completion of their compulsory education, when students are about 16 years of age, many Finnish youths are ready for training in a vocation. It may be questioned whether we in Canada are forcing many of our young people to continue too long in more academic pursuits, when in fact they would be better suited, and perhaps would prefer, to follow more practical technical vocations. This question becomes even more relevant when one considers the increasing numbers of high school students who drop out from Grades 10 to 12 because of lack of sufficient interest or guidance. As a result, Canadian society is losing several years of valuable time during which potentially productive young people could be usefully engaged in training for careers.

Vocational and technical forestry training in Finland — for forest workers, forest technicians and forest engineers — is carefully tailored to meet the needs of potential employers in industry, government, and the private sector. Training extends to all elements of the work force and, even at the operator/worker level, is generally broader in outlook than purely technical training. For example, basic principles of forest biology and environment are taught in the first year of all programs, including those for forest workers and machine operators. This creates a trained work force with a high level of understanding and awareness of forestry goals and issues, as well as, it seems, a greater sense of personal involvement and responsibility. It is significant that considerable emphasis is also placed on continuing education, for both full- and part-time workers, to maintain and upgrade skills within the work force.

Except for vocational training (e.g., forest technicians), basic forestry technical training in Ontario, such as for machine operators or forest workers, generally takes the form of short training courses or on-the-job training. Such training may prepare the worker for the job at hand, but does not

attempt to instill an awareness of forestry issues that is the mark of a cadre of professional forestry workers. This is undoubtedly a reflection of the less intensive nature of the forestry effort in comparison with that in Finland, and of the fact that forestry employers in Ontario at present do not have as high expectations of their workers and do not demand a well trained and knowledgeable work force. However, as forest management becomes increasingly technical and intensive in nature, employers should be demanding not only a higher level of technical training but also workers with a high degree of forestry awareness. This is not a one-way street, of course. For more intensive educational and training programs to be successful, not only must potential employers define their needs, but they must also support the educational programs by hiring trained workers in preference to untrained workers.

As a general comment on the training of forestry graduates in Finland, there seems to be a high level of participation and cooperation by different forestry organizations, including the forestry industry, in both the development and the conduct of university training programs. This involvement may range from advice and consultation to direct collaboration with forestry faculties by way of teaching staff or assistance with field training. It is not surprising, then, that university curricula are highly attuned to the needs and demands of these potential employers and the technological standards by which they operate. The result, reflected in the fact that Finnish foresters graduate with the equivalent (more or less) of an M.Sc. rather than a B.Sc.F., is that training is both more intensive and of longer duration than in Ontario universities. It is our observation that the system turns out mature individuals with a substantially broader background and perhaps a greater depth of understanding than we tend to expect from fresh forestry graduates in Canada. By the time most Finnish foresters graduate they have already acquired considerable academic and practical expertise in their chosen field, and can therefore step directly into a job without having to undertake much additional training.

With the changes now taking place in Canadian forestry, we need to consider the need for new approaches to the education and training of future forest managers. At the same time that the forestry sector is completing the transition from "timber mining" to full "resource management", the forestry profession is becoming increasingly technical and complex. In comparison with 15 to 20 years ago, there is more to forestry today than harvesting and sustained yields. Many of the current issues — economics, land-use questions, environmental impact, the use of chemicals — are highly political, and require that a forest manager have more than the typical narrowly focused forestry education to be able to respond to society's increased expectations. In a recent review, Thirgood (1988) makes the case for increasing the liberal content of university forestry programs in order that graduate foresters may communicate with the public and politicians as well as understand and respond to their demands. In Finland, forestry curricula already reflect this outlook; university degree programs provide not only the essential academic and scientific training, but also emphasize the development of skills in communications and negotiation, administration, management, and foreign languages. By contrast, vocational programs in Finland emphasize more the technical skills, such as roundwood supply, wood measurement, logging and transport, and employee safety.

Any discussion of forestry education in Finland would be incomplete if it failed to recognize the societal setting in which the system has developed. In general, there is a high level of public awareness and appreciation of the value of

the forests and of the need to improve the forestry enterprise and make it as efficient and productive as possible. Forestry issues are frequent and prominent items in the news media, and forestry figures prominently as a political issue at all levels of government. Recently, a major assessment of the forestry sector was published (Anon. 1986), that includes a policy statement on forestry for the next 20 years ("Forestry 2000"). This makes many important predictions and recommendations, and will undoubtedly have a major role in shaping the future of forestry in Finland. Significantly, the issue was debated publicly, both in the media and elsewhere, with public input by politicians and leaders at the highest level.

Perhaps because of the public's appreciation of the country's forest resource, the forestry profession in Finland has a higher profile and is more highly regarded than it is in Canada. This is directly reflected in attitudes to forestry education. At the same time, forest workers at all levels generally have greater pride in their jobs and a greater sense of responsibility. It is not without significance that many of the cultural traditions in Finland — 'The Finnish Way' — are derived from the forest. From earliest times the forest has provided sanctuary, fuel, wild foods in the form of berries and mushrooms, and the materials from which wooden utensils and hand crafts were made. The forest has also been an inspiration for art and literature. The name for the Finnish god of the forest, 'Tapio', is a commonly used first name for men, and the word is also employed in the name of the state organization responsible for private forestry, the Central Board of Forestry TAPIO. The reproduction of the painting by Pekka Halonen, shown on the cover of this issue of The Forestry Chronicle, captures the essence of the Finnish reverence for the forest landscape.

In conclusion, we were impressed with the organization and quality of the Finnish forestry education system, especially its success in instilling a high level of technical ability and awareness in members of the work force. As noted earlier, considerable attention has been devoted to developing a comprehensive forestry education system, with program options closely geared to the needs of potential employers. However, it is not just a question of matching the training to job opportunities. The expectations of forestry-sector employers appear to be much higher in Finland than in Canada, in terms of both vocational training and practical ability. Clearly, we must be prepared to match these standards, and adjust our educational system accordingly, if we are to meet the challenges of the future forest.

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