History of Forest Research in Finland

Part 1. The Unknown Forest

by

Karl-Erik Michelsen



The Finnish Forest Research Institute

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Cover: A painting for the Viipuri Agricultural Fair in 1932 by Lemart Segerstråle

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Claës Wilhelm Gyldén (1802–1872), director of the National Board of Survey and Forests from 1854, was one of the central authorities in planning and implementing state forestry in Finland.

FOREWORD

Modern science proclaims itself objective, rational and international. This is an argument we have accustomed to accept as an unchallenged truth. Recent studies on the history of science and technology have, however, questioned this argument. As Roy Porter and Mikuláš Teich point out, "it is our conviction that the twists and turns of global scientific change will not be understood without regard for questions of indigenous language, education, communication, network, institutions, economics, social relations, politics, religious confession, patronage, and other comparable elements that can be called its national context".

Professor A.K. Cajander, the organizer of forest science in Finland, expressed almost the same opinion 60 years ago. According to Cajander, forest ecosystems are shaped by natural, cultural, social, political and economic forces which differed in each nation. Therefore, research methods and results developed in one country cannot be directly applied to another country and to another forest ecosystem. Forest science, according to Cajander, is always a "national science", although there are certain "universal scientific laws" which apply to all forest ecosystems.

The main purpose of this book is to investigate how and why forests came under scientific scrutiny in Finland. It was a very slow process. The first initiatives were made as early as the 1840s, but it took almost a century before forest science was firmly institutionalized. Why such a long time? In order to answer the question we have to take a close look at Finnish society in the 19th century. Clearly it is not enough to study only the "internal" development of forest science. As Charles Rosenberg and Robert E. Kohler have shown, scientific disciplines are social and cultural products which are created in national contexts. Hence, forest science in Finland is a complex system of knowledge which mirrors the values and expectations of 19th-century Finnish society. It is the intention of this book to explore these values and expectations and to investigate how they became formulated in scientific discourse.

There is clearly a social need for this book. During the past two decades environmentalists have complained that forest scientists and researchers have legitimized the "destruction of natural forests" in Finland. According to their argument, forests in Finland are nowadays man-made monocultures who serve only needs of modern large scale forest industries. Forest scientists have been stunned by this attack. According to them, statistics show that there has never been more forest in Finland than there is today.

It is not my intention to take sides in this seemingly long-lasting controversy. However, it is my strong belief that the level of debate would significantly improve if there are more information available concerning the history of forests and forest science in Finland. It is worth remembering that a century or two is a long time in human life, but a relatively short period in a forest ecosystem. Therefore, the decisions made at the turn of this century and even earlier still affect the structure of forests in Finland.

This study will question the myth of "natural forest" which has been highly celebrated by environmentalists. They have argued that before the emergence of modern large-scale forest industry, Finland was covered by virgin forests. There seems to be very little evidence to back up this myth. Farmers and peasants and forest fires destroyed most of the forest land hundreds of years before the first paper machine was installed in Finland. People didn't "love" forests, rather they feared the dark and unknown woods which provided shelter to wild animals and hostile spirits.

This study will also question the highly praised myth of forest industries as the ultimate source of wealth, progress and well-being in Finland. No doubt forest industries have played a major role in the development of modern Finland. But timber companies and paper and pulp companies had very little desire to protect forest resources. For the companies forests had only economic value. Therefore companies had no desire to invest money in the protection or preservation of forests in Finland. Similar attitudes were also very popular among Finnish peasants and farmers.

Because neither forest companies, farmers or peasants respected forests, it was the duty of the government to stop destruction and exploitation in Finland's forests. The government first established laws and regulations which restricted the use of forests. Because this did not produce satisfactory results, the government sought help from the scientific community. As a result, forests of Finland were placed under scientific protection. This study emphasises that the main task for forest science, research and rationalized forest management was from the very beginning to protect forests in Finland. It was believed that only science could act as a neutral and effective mediator between different interest groups who exploited the only renewable natural resource of the country. It was also believed that science and scientific research could repair damages in forests and increase their production of wood. This faith in science and scientific inquiry might sound strange today, but it was highly topical in the latter part of the 19th century and early part of this century.

This study explores the development of forest science and scientific research in Finland from 1840s to the beginning of the 1920s. The second part of the study will concentrate on the applications of scientific research in everyday forestry in Finland. The study will cover the period from the 1920s up to the present and will appear in 1998.

This study was started three years ago when the Finnish Forest Research Institute was approaching its 75th anniversary. Instead of concentrating on the history of the

institution itself, it was thought that a broader approach would better fulfil the needs of the personnel as well as a wider audience. Hence, the scope of this study was chosen to be the history of forest research in Finland. There are many people who have greatly contributed to this project. I would first like to thank Professor Matti Leikola, whose thorough knowledge of forest science as well as his sophisticated understanding of history have greatly helped me to accomplish this very interesting task. Also Professors Erkki Annila, Aarne Reunala, Eero Paavilainen and Mr Jaakko Pajamäki and Mr Tero Oksa have given me plenty of advice and support, but never interfered any of my interpretations.

Very special thanks to Mr Seppo Oja and Mr Erkki Oksanen who have given this book its visual appearance. Also Seppo Oja's broad knowledge of old forest literature has significantly helped me to locate the most important items of knowledge from masses of printed material concerning forests in Finland. Without the excellent translation by Jüri Kokkonen, this book could never have found readers outside Finland.

And last but not least I would thank my family who has supported me during many long days and nights of work.

Helsinki
July 4, 1995

Karl-Erik Michelsen



Photo: Brutus Lesche 1905. Univ. of Helsinki, Dept. of Forest Ecology

Opportunities for the sustained management of forests were almost unknown to most Finns as late as the 19th century. A Scots pine stand in the Forestry Region of Evo, age 120–130 years, dominant height 25–27 metres, volume 290 m^3/ha.

Awakening

The Autonomous Grand Duchy of Finland

In July 1807 two European emperors, Napoleon and Alexander I, entered into an important agreement at Tilsit in Poland. Napoleon promised not to attack the east, while Alexander undertook to persuade Sweden to join the continental system. Russia was given the right to invade Finland, the eastern part of the Swedish realm, should the scheme prove otherwise difficult. This duly happened; Sweden refused to side with Napoleon, and Alexander sent his troops into Finland. The ensuing war did not last long, and in 1809 Finland became part of the Russian Empire.

The new political situation spelt a thorough upheaval of Finnish society. The country had belonged to the sphere of western culture since the eleventh century, and though the long period of Swedish rule had not always been fortunate, Finns regarded the link with Sweden as a self-evident political fact. Relations with Russia, on the other hand, had traditionally been hostile, mainly for two reasons. Firstly, recurrent wars fostered an atmosphere of uncertainty and fear, particularly in the border regions. Secondly, Russia as a whole was a gargantuan neighbour, whose eastern culture, religion, language and authoritarian system of government were alien to the Finns.

Russia, however, had been undergoing fundamental change since the eighteenth century. The empire had expanded and the rigid structures of society had been actively reformed following the principles of Peter the Great. Progress, however, was slow, since Russia consisted of hundreds of more or less independent provinces, whose differences far outnumbered their similarities. The Finnish historian Matti Klinge correctly points out that "Russia was not a united centralized state, neither was it united nationally or religiously".

Although political reorientation from west to east was frightening, it offered Finnish society new challenges and opportunities. Compared with Finland, Russia was economically undeveloped, and its immense markets were now opened to the Finns. The capital, St Petersburg, almost at the border of Finland, promised a great deal in this respect. Emperor Alexander I, known for his liberal policies, offered the

Finns an easy start in their new political status. Instead of Russification, the emperor granted the new Grand Duchy of Finland a large degree of political autonomy. In addition, he promised to preserve the former laws, decrees and official privileges that had been granted under Swedish rule. The highest legal authority naturally lay with the Emperor, but the Finnish Diet was permitted to rule on the Grand Duchy's "own" affairs. Executive power was given to the Senate of Finland, supervising the work of the central offices, or departments, of state administration. The Emperor was represented in Helsinki, the capital of Finland, by a governor-general, who was also Chairman of the Senate's Economic Department. In St Petersburg, the "Committee of Finnish Affairs" presented Finland's affairs of state to the Emperor.

The administrative system established by Alexander I in Finland granted Finns more power than had been available under Swedish rule. Political autonomy and the country's own organs of government laid the basis for "independent" development. Freedom and "independence", however, were contingent upon absolute loyalty to the Emperor. Russia still feared that Sweden would retaliate via Finland. One of the tasks of Finnish government officials was to allay all possible suspicion and fears of this nature vis-à-vis Russia. "Dissidents" were silenced and internal conflicts were swept under the carpet. The Finns also refrained from open criticism of Russian actions at home or abroad. This absolute loyalty engendered a silence within the country that was to last almost a century, not being broken until the early years of the twentieth century, when international politics changed course and the Russian Empire dissolved.

Although strict self-censorship offended the basic rights of individuals, the resulting benefits more than compensated for any disadvantages. Finland was allowed to manage its own affairs and to develop its economic, social and cultural infrastructure. During the nineteenth century, Finland became in a sense a closed system, whose development was first guided by the Senate and from 1863 also by the Diet. Under the beneficent wing of Russian rule, Finland developed within a century into an economically and socially modern European state, with emerging large-scale industries, a strong national culture, its own currency and fiscal system, a relatively developed network of social security, and an extensive educational system.

Around the beginning of the nineteenth century, Finland was in poor condition. Considerable amounts of material and human capital had been drained by recurrent wars alongside Sweden in the seventeenth and eighteenth centuries. The development of the Finnish economy was controlled by strong mercantilistic policies, directing Finnish exports first to Stockholm, and only from there to foreign countries. With the exception of a few towns with foreign trading rights and the system of peasant seafaring, Finland's foreign trade was in the hands of leading Swedish companies until the close of the eighteenth century.

The integration of Finland into the Russian Empire began slowly. This was understandable in view of the time required to establish the country's own organs of



National Board of Antiques

The neo-classical centre of Helsinki was designed between 1820 and 1840 with the capital of the Russian Empire, St. Petersburg, in mind. The Senate building on Senate Square after the middle of the 19th century. Opposite the Senate is the Imperial Alexander University (present-day University of Helsinki) and on the third side of the Square is the Lutheran Cathedral of Helsinki. All were designed by the same architect, the German-born Carl Ludvig Engel (1778–1840).

government, to recruit officials, to draw up official codes and regulations, and to establish procedures on the practical level. Change was also slowed by the moving of the capital to Helsinki after the disastrous fire of Turku in 1827. The Russian authorities wanted Helsinki to become a symbol of their power, and the monumental centre of Helsinki was built with St Petersburg as its model.

The development of Finnish society did not come under way until the 1840s. After a slow start, the pace, however, became brisk. Reforms were speeded by the Senate and the central government administration subordinate to it. The latter was responsible for cash flow, schemes and projects related to the infrastructure, and relations between Finland and Russia. The governors-general, representing the Emperor, usually remained passive, and owing to the language barrier, or lack of motivation, had little interest in meddling in the affairs of the country.

Finnish society was developed simultaneously in many sectors. The capital structure of the economy was strengthened and state revenues were improved through indirect taxation and tariffs. Monetary reforms separated Finland first from the Swedish and then from the Russian monetary system. The conditions under which industry operated were developed through legislation and by establishing and

constructing the basic infrastructure. A specific act concerning joint-stock companies and official freedom of occupations were necessary preconditions for the emergence of large-scale industry. No less important was the network of canals with which the lake districts of Finland were linked with the economic zone of St Petersburg, as also the railways connecting the industrial and farming centres of the inland with the ports on the south coast. Alongside material reforms, the judicial, social and cultural framework of Finnish society was developed to withstand outside pressure and to ensure sufficient numbers of skilled workers for the needs of society.

Finnish historians have made thorough studies of the process of change which deeply affected Finnish society after the middle of the nineteenth century. Two significant background factors have been outlined. Firstly, the proximity of Russia and the political realities of this situation guided the course of political developments. Secondly, change was influenced by growing economic affluence, largely based on Finland's forest resources. The interaction of politics and the economy was further reflected in social and cultural developments. Finland gradually grew into an industrial society in the protective shadow of Russian rule.

The forest industries have an undisputed role in modern-day Finland, but the situation was completely different around the middle of the nineteenth century. The industrial revolution spread to Finland from the west, with the textile, metal and chemical industries as its vanguard. These branches of industry, however, had difficulties in achieving permanence in Finland. Although the Finnish iron industry had age-old traditions, it could not rely on domestic supplies of raw material. Similarly, the textile industry had to import most of its raw materials. As large-scale industry required renewable natural resources and sufficient sources of energy, the only real alternative was the forest industry. The iron industry, however, did not easily relinquish its leading role. The ironmills still believed that ores would be discovered in Finland, after which the country's immense forest resources could be used as a source of energy.

The struggle over the forests of Finland began in the middle of the nineteenth century. The opposing sides were the iron and forest industries and agriculture. The iron industry tried to maintain its former privileged position, while the forest industry realized its own boundless opportunities and demanded the privilege of utilizing forest resources. Agriculture was in a clearly more complex situation. It required forest resources for heating and building, but it also recognized the forests as a valuable opportunity for additional income.

Did Finland then lack sufficient areas of forest to serve all three sectors? There was no answer to this question around the middle of the nineteenth century. The accounts of settlers, farmers and travellers made it clear that endless forests of pine, spruce and deciduous trees stretched from southern Finland to Lapland in the north. Private persons owned forest mainly in southern Finland. The forests of the central and northern regions belonged to the crown. During Swedish rule there were recurrent

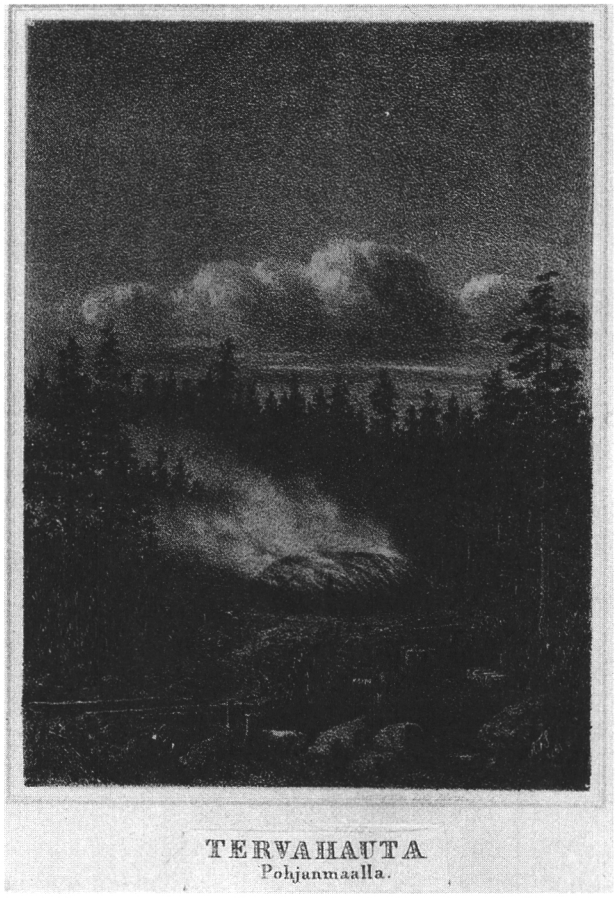


Illustration from Soldan's book from 1862

A Finnish tar-pit depicted by A.F. Soldan (1817–1885). Soldan was an engineering officer who followed F. Langenskiöld on his travels through Finland in 1859. He was soon appointed Director of the National Mint and his plans for modernizing tar burning were not realized.

attempts to limit the utilization of crown-owned forests, but these proved unsuccessful. The authorities had no control over the use of forest resources by farmers, sawmills and ironmills in the outlying wilderness regions. On the other hand, there were not even any active attempts at control, since the crown wished to promote the spread of farming from the fertile southern regions into the wildernesses of central, northern and eastern Finland. Farmers who had rented their land took advantage of this situation, felling timber from crown forests to use as building materials. The burn-clearing of plots for cultivation and the burning of tar were also common in all crown-owned forests. In addition, farmers often sold illegally felled crown-owned timber to sawmills.

Although the utilization of crown forests was against the law, the conditions under which people lived in these areas – far from any official authority – were extremely hard, and a total ban on the use of forest resources would have driven many families to the brink of starvation. Consequently, burn-clearing and the depletion of the forests continued. Further damage was caused by forest fires in the summer, which often started from slash-and-burn plots or from the burning of tar.

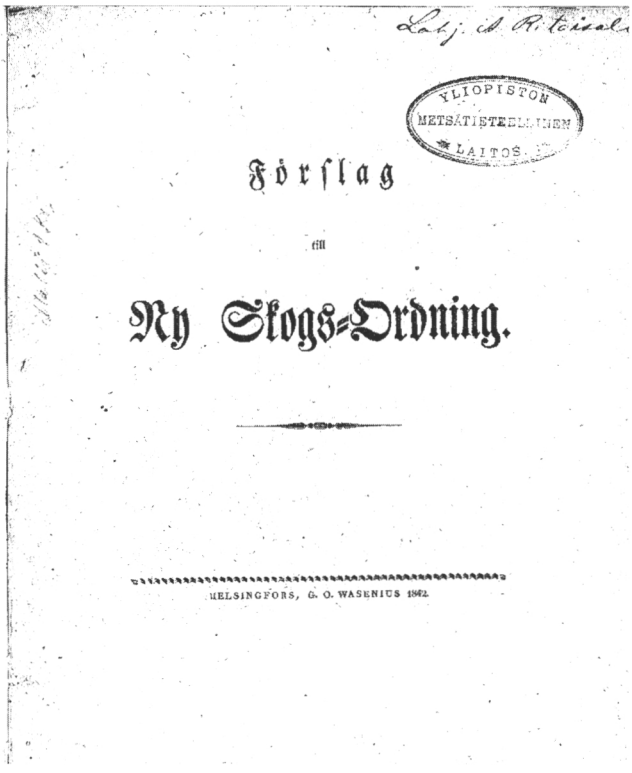
In order to secure forests for utilization by the state it was first necessary bring an end to their burning and uncontrolled felling. Next, the efficient care and control of the forests had to be ensured. Together, these courses of action made it possible to sell timber from crown forests to the lumber industry, both immediately and in the future. The state estimated that profits from the forests would at least partly finance the technological, social and cultural infrastructure of Finnish society.

In retrospect, the decision to initiate the rational management and utilization of crown forests appears to be self-evident. But this was not the case in the mid-nineteenth century – on the contrary. The systematic utilization of the forests required consistent decisions of industrial policy, a great deal of expert knowledge, and the establishment of various institutions. Centering on the forests of Finland, the issue was all the more sensitive. In one way or another, the forests, their utilization and care all influence Finnish society as a whole. Therefore official decisions in this area have always had significant social and political ramifications, being preceded and followed by active debate.

Discussion and Debate on Forests

As early as the eighteenth century, the authorities of Sweden-Finland were concerned about deforestation. These fears heightened in the following century when rumours spread to Helsinki claiming that most of the forests had already been destroyed in certain parts of Finland. This was attributed to continued burn-beating, the illegal acquisition of timber by the sawmills, and uncontrolled forest fires. For example, farmers in Karelia complained that the forests did not provide enough timber for building materials. This was unpleasant news for the decision-makers in Helsinki. If the rumours were correct, a shortage of raw materials and fuel threatened the nation and its industries. This in turn meant that state revenues could not be increased and, accordingly, the creation of the educational and cultural infrastructure had to be postponed.

Rumours of deforestation continued over the years. Information from the governors of the provinces showed, however, that damage was not quite as extensive as imagined, but in certain areas burn-clearance and the extensive felling of timber had, in fact, significantly reduced forest cover. As there was no precise data on the condition of the forests, the Senate appointed a committee in 1840 to study legal measures for slowing down the depletion of the nation's forests. This committee faced a difficult task: it had to draft legislation ensuring the future of the forests while providing industry, builders and farmers with sufficient raw material. This was an almost impossible equation. The future of the forests required the establishment of forest administration and professional forestry practices in Finland. This involved considerable investments by the government: Finland's forests required the appoint-



The Forest Committee of the year 1842 did not promote the creation of a state board for forestry. Instead, it stressed the importance of private ownership for better management and care of the forests.

ment of dozens, if not hundreds, of qualified foresters. On the other hand, the various sectors of industry fiercely competed over the control of raw materials. For the iron industry wood was fuel, and for the sawmills it was necessary raw material. These two sectors could not fit into the same "forest", and the committee had to decide whether state-owned forest resources were to be made available to the ironmills or the lumber firms. The forest issue was also important for agriculture. Restrictions on burn-beating threatened to deprive thousands of farmers of their daily bread. Furthermore, the unrestricted utilization of forests made the fencing of property, tar-burning and the heating of dwellings difficult.

The forest committee submitted its report in 1842. The report largely followed the structure of previous legislation concerning forests. The felling of crown forests and burn-beating were forbidden. The sawmills were given strict production quotas, and steam-driven sawmills were outlawed. Severe penalties were laid down for the illegal cutting of timber and unauthorized burn-beating.

The underlying ideology of the committee's report is interesting. Contrary to expectations, the committee did not attempt to "socialize" Finland's forests. On the contrary, the report stressed the importance of inalienable private ownership. This

was supported by the argument that the improved value of forests would encourage their owners to take better care of their property. Forest administration or specially trained foresters were not required; private ownership was felt to manage these needs as well.

The committee's report had a considerable element of wisdom to it. The depletion of crown forests had shown that the citizens did not understand the value of the forests; neither did they respect them. Several factors contributed to this attitude. People living in the wilderness could not understand why forests should be saved and protected. For most of them, the forest was a threatening and fearful place, the abode of wild animals and unknown spirits. When forest was cleared, the sun warmed the soil and it was possible to grow grain and other plants. Nor could the inhabitants of the wilderness assess the value of forests, since the felling of timber and its transport from the far-off forests to sawmills and the export market seemed far-fetched. This explains why crown forests were commonly regarded as "surplus land", to be freely utilized without restrictions.

The forest committee brought an end to the unrestricted utilization of crown forests. This was made possible by establishing ownership, i.e. the state took charge of its own forest resources. Though appearing paradoxical, this was a significant innovation in Finnish society. The state had naturally owned its forests previously, but the rights of ownership had remained unspecified. The Finns were not sure whether the forests belonged to the Tsar of Russia or to the Finnish nation. The problem was further complicated by Finland's undefined legal status within the Russian Empire. The country was an autonomous Grand Duchy, but did the Emperor own Finland, or did Finland have its own rights as a state? This problem was much discussed in the early 1840s, when the forest committee prepared its proposals. The "strong man" of the committee, J.J. Nordström, Professor of Law at the Imperial Alexander University of Helsinki, supported the "theory of the separate state". In his view, Finland was in reality a state, joined by special agreement to the Russian Empire in 1809. Consequently, the political rights of Finland were managed by its Diet, or – in its absence – by the Senate and the central offices of government administration. Following the recommendations of the committee, the crown forests were now made subject to the control of the Senate and its Agricultural Commission.

The committee's ruling was important in giving the forests of Finland a "new owner". The active role of the state as the owner of the forests meant that approximately half of the country's forests were removed from "free" use into the hands of their legal owner. The state could now monitor the care and use of the forests which it owned, and make the related official decisions. It could also severely punish those who destroyed state property or used it without due authorization.

The proposals of the forest committee provoked a wide debate that was to continue for two decades. The long, and often heated, exchange of opinions, however, led to significant results: Finnish forestry policies were specified and took

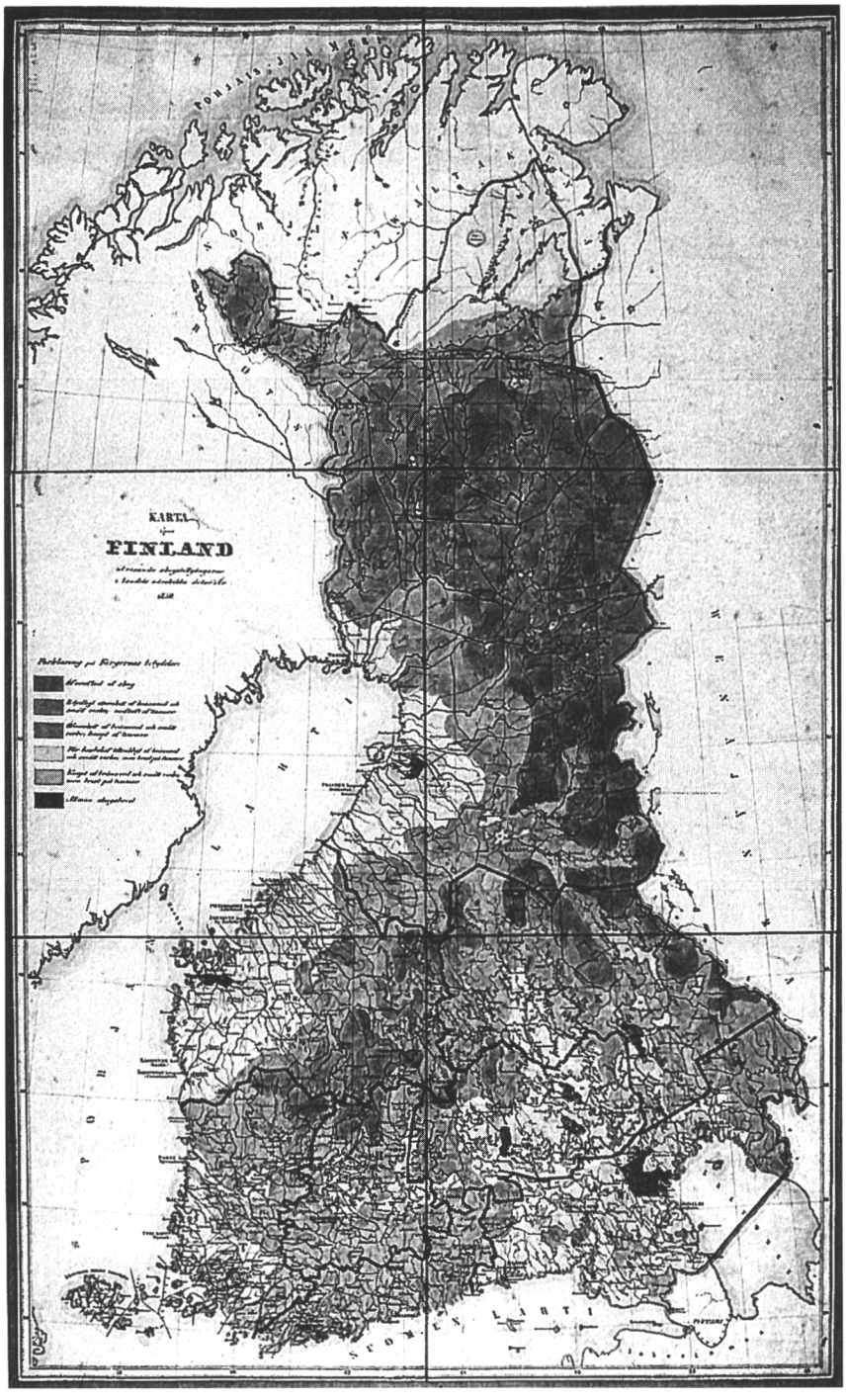


Photo from 1939. Metla photographic archives

People living in the wilderness could not understand why forests should be saved and protected. When forest was burned, the soil became fertile for agriculture. Slash-and-burn agriculture was widely practised in Finland until the end of the nineteenth century.

on a completely new course. When debate finally ended in the late 1850s, restrictions on sawmills were lifted and permanent forest administration and the scientific teaching of forestry were established. One of the goals of the new policies was to protect and care for the nation's forest resources, while extracting the greatest possible economic benefits from them.

How were such results achieved? The original proposals of the forest committee were rejected in many quarters. Sawmill owners felt that the proposed legislation was in effect "prohibition", intended to erode the basis of the Finnish lumber industry. The ban on steam-driven sawmills was an economic and technological setback, from which it was difficult to recover. Finland's sawmills had traditionally used water power, but the fluctuations in the water-levels of rivers restricted operations to only a few months each year. In addition, reliance on water power made it necessary to locate sawmills at rapids sites, far from ports and the export market. These problems



In the 1850s the forests of Finland were a subject of concern. Gyldén's topographical atlas from 1850 was the first description of the existing situation. The shaded areas show large stocks of timber. The black areas (red in the original) denote complete destruction of forest.

could have been eliminated had the sawmills been allowed to use steam-driven machinery. The steam engine would have been a significant technological advance with a great number of positive repercussions throughout the whole lumber industry.

The sawmill owners had good grounds for their criticism. The main point of dissension, however, was the greatly improved market for lumber. Major developments in infrastructure in Europe and Britain offered Finnish lumber a considerably better market than previously. Exports were also speeded by a wave of liberal policies, lowering import tariffs particularly in Britain. The proposals of the forest committee, however, undermined the efforts of Finnish sawmill owners to take full advantage of the new situation. If the sawmills could not be used throughout the year and if they were prevented from acquiring the necessary raw material, it was consequently impossible to increase production and exports. The sawmills accused the committee of a conspiracy intended to channel the resources of the crown forest to the ironmills. There was also some cause for this suspicion, as the committee did not restrict the acquisition of fuel by ironmills. In addition, some of the members of the committee had close contacts with the iron industry.

Neither did the committee's proposals please the farmers, who criticized the emphasis on private ownership. A particular problem was state ownership, which in effect made the crown forests unavailable to them. The severe forest policies impeded the farmers mainly in two ways. Firstly, they made it difficult to acquire more arable land and prevented the spread of settlement into outlying areas. Secondly, the ban on using the crown forests brought an end to additional income from timber felled on state-owned land and sold to the sawmills. The "closure" also restricted the burning of tar, for which the raw material was commonly obtained from crown forests.

For the farmers and peasants, the "forest issue" also had a deeper social significance. The so-called national awakening of Finland had just begun, and the Finnish-minded movement was in staunch opposition to the Swedish-speaking upper class. The goal was to create a civic society based on a Finnish-speaking class of farmers and peasants that could develop national identity and the necessary structures of government. These were needed to repel the threat posed by Russia and to raise Finland to the status of a nation among nations.

The committee's proposal to place the crown forests under the authority of the Senate and the Agricultural Commission threatened the development of civic society. In the mid-nineteenth century the Senate and the central government offices were almost completely manned by members of the Swedish-speaking upper class. Had the crown forests instead been made available to the farmers and peasants, the capital involved would have served the Finnish-speaking agricultural population. This course of action was strongly supported by J.V. Snellman in Kuopio, who became a symbol of the national awakening and the whole national development of Finland. Snellman's envisioned forest policies were the almost complete opposite of the ideas



Photo: Grünberg,1850s. National Board of Antiques

Lars Gabriel von Haartman (1789–1859) served as governor of the provinces of Varsinais-Suomi and Satakunta in 1830–1840. Being appointed the state treasurer and vice-chairman of the Finnish Senate (Cabinet) in 1840 he was the most influential politician in the whole country. He emphasized the value of forests as a national domain and he strongly promoted the establishment of forest administration in Finland.

proposed by the committee. Snellman was in favour of lifting restrictions on the lumber industry and the intensive utilization of forest resources. He regarded the forests as a valuable store of capital for Finnish agriculture, but these reserves had to be utilized as soon as possible before the European nations completely ceased to use timber. The revenue from the forests could be used to introduce efficient modern agriculture, which in turn would generate considerably more income than the forests, which accumulated capital at a slow rate.

Since its very beginning, the debate concerning the forests found itself in an almost total impasse. Despite this, all except one member of the Senate voted in favour of the forest committee's proposals when they came before the Senate in 1847. The dissenting vote, however, was decisive. It was cast by Lars Gabriel von Haartman, head of the State Finances Commission. This arrogant, though extremely experienced, government official was in effect Finland's most influential politician at the time. Von Haartman's opposition halted the forest committee's proposals for the time being.

In a detailed statement submitted to the Senate, von Haartman outlined his own programme for forest-related policies, basing on the concept of rationalized forestry. This idea contained three elements. Administration had to be given concrete means

to monitor, develop and manage the forests. Legislation was an important means, but a permanent system of administration to which the crown forests could be assigned was no less significant. Rationalized forestry also required the systematic care and management of forests, a task that had to be entrusted to scientifically trained foresters.

In his statement, von Haartman rejected the conspiracy theory put forth by the sawmill owners. He felt that, owing to insufficient deposits of iron ore, the iron industry had no future in Finland. Accordingly, the lumber industry was the only sector that would generate considerable income from exports in the future. This, however, did not mean that all restrictions on the utilization of forests should be lifted immediately. On the contrary, rationalized forest management permitted the easing of restrictions only when the precise area and condition of the country's forests were known. In this respect, von Haartman supported the committee's proposals of restrictions on sawmills, but he also wanted to restrict other activities that depleted the forests. In addition, von Haartman proposed the establishment of permanent forest administration and a corps of professional foresters and experts in the field. He ended his statement with the important proposal that the government should soon finance an extensive survey of Finland's forest resources and their present condition.

Von Haartman's programme was recorded almost verbatim in the Forests Act of 1851, which banned the use of steam-powered saws and placed yearly production quotas on sawmills. There were various means by which the depletion of crown forests was to be resisted. Burn-beating was forbidden, as also the unauthorized felling of timber. No direct action was taken with regard to the utilization of privately owned forests, but their unnecessary depletion was also made punishable by law.

In accordance with the Forests Act, forestry administration was established, for the time being under the authority of the State Board of Survey. The purpose of the new area of administration was to monitor, develop and take care of crown-owned forests. Trained foresters, each responsible for a specific area, were to be appointed for the purpose.

The new act was a significant step towards instituting rationalized forest management. Although the sawmill industry condemned it as tantamount to prohibition, it was in reality protective legislation intended to bring an end to illegal activities in the crown forests and the senseless destruction of forests. There is no evidence to show that the act was intended to be permanent. On the contrary, von Haartman's underlying idea was that once information on the total area of Finland's forests and their state was available and forestry practices organized, the restrictions on sawmills could gradually be lifted.

The Forests Act, however, could not silence rumours claiming that Finland's forests were in the process of destruction. That would have required research and a detailed survey of forest resources. Working in the background, von Haartman tried to organize an extensive survey providing objective information on the forests. Since

there were no trained foresters or researchers in this field in Finland, von Haartman approached Swedish experts. Their replies, however, were quite pessimistic. Forest research methods had been developed in Germany for several decades, but the results still remained unpromising. It was possible to measure the height, diameter and cubic volume of individual trees, but estimating larger areas of forest posed insurmountable problems. The number of unknown factors in the forest ecosystem was simply too great. Various kinds of trees, of different size, age and type, grow in forests. Forest land is not even like fields; forest cover is broken by lakes, rivers, outcrops of bedrock and bogs. These exceptional factors could not be computed with the mathematical methods of the early nineteenth century. Furthermore, information on the development of forests required data on the growth rates of trees and the factors influencing growth, which made research even more problematic. Growth rate could depend on the climate or soil, or both, but could also be influenced by the density of forest, human activities, pests and fungi, or these and many other factors in concert. Finally, the greatest problem was time. Forests grew slowly, and achieving objective results often required a period longer than the lifetime of a researcher.

Citing these facts, the Swedish experts politely declined von Haartman's offer to estimate the amount and condition of forests in the Grand Duchy of Finland. This left the Senate with no other opportunity than to pass the Forests Act of 1851 to gain time and to halt, at least for the time being, the depletion of the country's forest resources.

The Survey of the Forests of the Grand Duchy of Finland

Surprisingly, the survey of the forests of the Grand Duchy of Finland appeared as early as 1853. It had been prepared by Claës Wilhelm Gyldén, director-general of the State Board of Survey. Published under the title *Handledning för Skogshushållare* (The Handbook for Foresters), the survey ran to over 150 pages. Gyldén's long preface touches only briefly on his programme for forest policy and the results of the survey. This is followed by an encyclopaedic list of all species of trees growing in Finland, discussing their physical properties and possible applications. The next section reviews the forests and their importance for the economy and the environment, after which the author goes on to practical applications, i.e. forestry and evaluation methods and various ways of utilizing forests. In addition, Gyldén discusses pests and slash-and-burn agriculture, and presents a proposal for the organization of rationalized forest administration. There is also an example of a forest management plan which Gyldén himself had drawn up for the Halola Manor. Gyldén's book contains tables and an appendix of illustrations presenting instruments and equipment necessary in forestry and the evaluation of forests.

Gyldén drew up his claims regarding forest policies with particular care. In the spirit of the times, he based his ideas on the relationship of forests with the climate.



HANDLEDNING

FÖR

SKOGSHUSHÅLLARE

I

FINLAND.

Med tabeller, en planch och en skogskarta.

UTGIFVEN AF

C. W. GYLDÉN.

Öfver-Inspektor, Riddare af Kejs. Sta Annae Ordens andra och Sta Wladimirs Ordens fjerde klass.

HELSINGFORS 1853.

Tryckt hos H. C. Frii s.

"The Handbook for Foresters" (1853) by C.W. Gyldén was the first manual in silviculture and forest planning written for Finnish conditions. It served as the main source of information on organized sustained forestry until the 1880s when the textbooks by A.G. Blomqvist and P.W. Hannikainen were issued.

This was a common source of concern, uniting farmers, sawmill owners, ironworks proprietors and government officials. It was also an important topic on the international level. Gyldén pointed out that in every country settlement and means of livelihood were dependent on the forests, which controlled the local climate. The forests preserved the humidity and warmth of the soil, and they protected farmed land and the soil from cold, dehydrating winds. The issue of climate was particularly prominent in Finland, as "the importance of forest cover is naturally the greatest in hot and cold regions".

Gyldén's first task was to find out whether there were enough forests in Finland to protect the soils and arable areas against the influence of the climate. He based his study on calculations from the late 1830s by the German forestry expert von Frömbling. Firstly, he estimated the average yearly temperature of southern Finland to be approximately +5 degrees Centigrade. This suggested the conclusion that at least half the land area of Finland had to have forest cover to preserve the normal structure of the climate. Von Frömbling's formula, however, had to be adapted to Finnish conditions, where a considerable part of the forests consisted of deciduous trees, which lost their leaf cover during the cold months of the year. To obtain a sufficiently conservative estimate, Gyldén placed deciduous forest in the same class as bogs, outcrops of bedrock, meadows, fields and deforested areas. This gave the result that three-sevenths of the land area of Finland lacked "proper" forest cover.

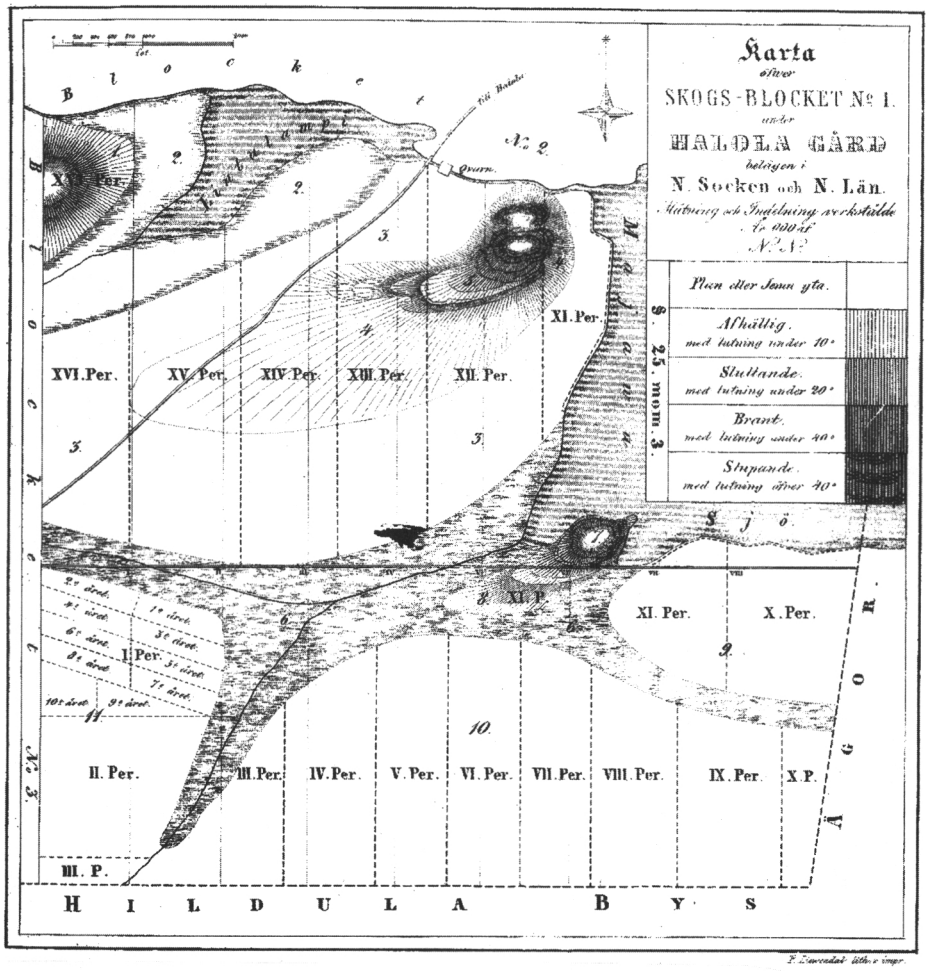
Although this figure was large, the situation was not hopeless since the remainder had sufficient cover. Gyldén warned his readers that "the above theory presents the conclusion that the depletion of Finland's forests will not, generally speaking, improve the climate. It would appear that if the destruction of forests continues, as already observed in certain regions, the result will be the undesired weakening of growth conditions, as already pointed out. The climate would apparently become less stable and the warmth of summer, as also the frosts of winter, would come later than at present. The water of the sea and the large lakes would warm later in the spring and cool only later in the autumn. The less forest there is to prevent them, the more freely will winds and air currents affect the climate. It is a known fact that winds dry the climate more than calm weather. Farmers need no longer complain about dry conditions in the spring if they were to spare at least those old forests of conifers which face the directions from which cold and dehydrating winds usually blow".

Gyldén's calculations showed that forest cover in Finland had thinned to an essential degree, but despite this the forests, at least so far, gave sufficient protection to the land. This was an important item of information, as it brought an end to the rumours that Finland's forests had already deteriorated beyond recovery. But it was not enough to calm the authorities responsible for the future of Finland's forests. Gyldén next had to prove that the country's forest resources were sufficient for future generations. His chain of reasoning had three parts.

Firstly, Gyldén calculated the proportions of land area consisting of a) roads and settlements, b) arable land, c) meadows, d) burn-cleared forest, e) other dry land, f) bogs overgrown with forest, g) treeless bogs, h) bare bedrock and fells. The calculations, per province, showed that unforested land amounted to a total of 152,000 square kilometres. Adding to the figure the inland bodies of water, the result was approximately 177,000 square kilometres.

Next, Gyldén presented statistics compiled per province showing the areas of forest. According to his estimates, there were over 95,000 square kilometres of forested land in the whole country, i.e. 59% of all dry land. The proportion of bogs was 37.8%. The future state of the forests was estimated by comparing the above figures with the number of population. Gyldén had quite new information at his disposal, as the population of the country had been counted by region in 1845. The census showed an urban population totalling 89,787, and a rural population of 1,457,937. Combined with the area of forest these figures indicated that 0.28 hectares of field, 0.97 hectares of meadow land, and 12.5 hectares of forested land were available per person.

Gyldén's complicated chain of reasoning culminated in statistics comparing the area of forests in Finland and its population with similar data from other European countries. This comparison revealed that "in comparison with other countries in Europe, Finland should have a considerable surplus of forestry products, and that we, in fact, utilize our forests less than other countries".



A management plan for a private farm was included in the handbook by Gyldén (1853). The regulation of the annual cut was made according to the example of H. Cotta's "*Flächenfachwerkmetode*".

Referring to his calculations, Gyldén claimed that there were simply not enough inhabitants in the Grand Duchy of Finland to use the country's immense forests. Therefore, there was no need to fear deforestation. Gyldén, nevertheless, had to prove his bold claims, which he did with two sets of statistics, of which the first presented exports of Finnish forestry products in 1850. Sawed goods clearly constituted the largest group, being exported to the amount of 267,000 units of 31.5 cubic feet of sawed planks. The amount of exported tar was 151,710 barrels (of 4 bushels each). Other forestry products were exported in such small amounts that they had no appreciable effect on the reserves of timber.

The export figures showed that Finland's yearly exports of timber totalled approximately 833,000 cubic metres. Gyldén then compared this figure with other statistics on the structure and amounts of domestic timber consumption. The greatest amount

of timber was consumed as firewood, 4.5 million cubic metres yearly. Next came the country's glassworks, brickworks and other small industries, which needed wood to fuel their steam engines. These establishments consumed approximately 2 million cubic metres of firewood yearly. Homes and the shipbuilding industry required 300,000 cubic metres, and the burn-clearing of fields consumed approximately 365,000 cubic metres of timber each year. In addition, timber decayed in the forests or was otherwise lost to a rate of at least one million cubic metres a year. According to Gyldén's calculations, some 10 million cubic metres of timber were consumed in Finland in 1850.

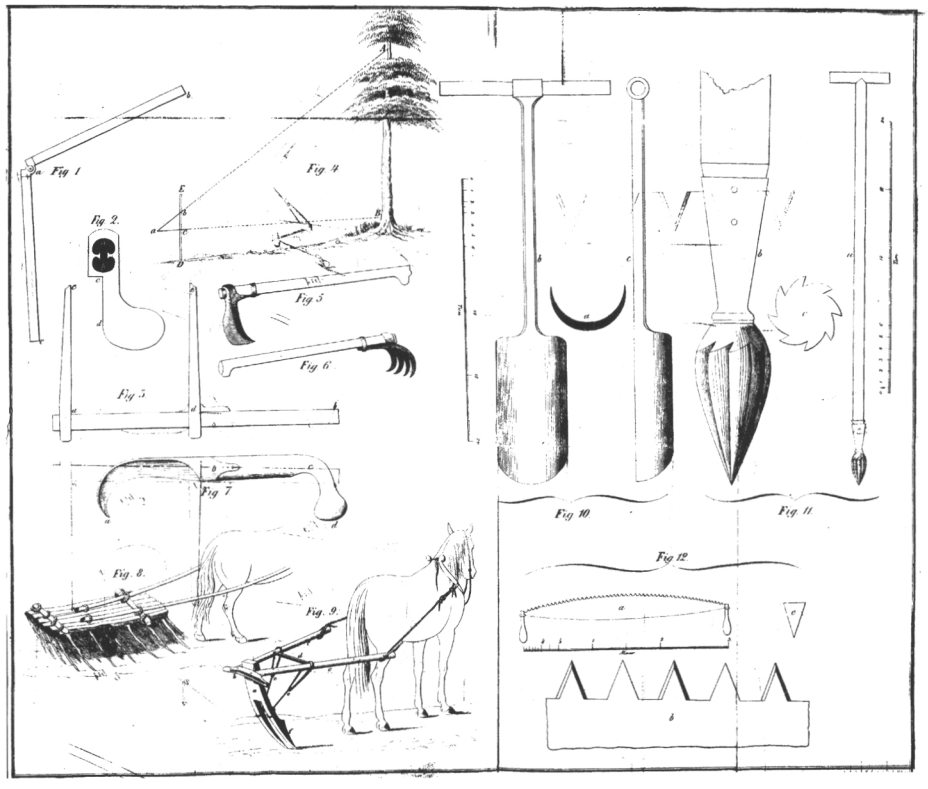
This figure may have seemed alarmingly high, but on the other hand Gyldén estimated the yearly growth of forests to be almost 30 million cubic metres. Furthermore, Gyldén was convinced that "this amount could be multiplied with the proper care of forests".

Gyldén's study had a clear message. There was no need to fear deforestation, since Finland's forests renewed themselves well and the reserves of timber were sufficient even for more extensive use. This naturally required the proper and rational management and care of forests. Restrictions had to be placed on burn-clearing and tar-burning, and more developed cultivation methods and other sources of income had to be offered to farmers. The sawmill industry could be expanded and production quotas could be eased if forests were renewed, managed and estimated regularly and with rational methods.

Following this idea, Gyldén devoted the whole concluding section of his book to rationalized forestry, presenting a thorough discussion of recent forestry and estimation, or cruising, methods. There was also a detailed description of instruments and equipment used in forestry and estimation. In addition, Gyldén added as an example a forestry plan for the Halola Manor. It based on the method of cutting by compartments at regular intervals. Gyldén's plan extended as far as the beginning of the 21st century.

How could the director-general of the Board of Survey draw up such an extensive work on the country's forests in the early 1850s? There are no notes or references in Gyldén's work, but the preface reveals his models. The estimates are largely based on his own experiences in directing the official reparcelling of land and related surveys of farms and forest holdings. The theoretical framework came from the pioneers of forestry research: Heinrich Cotta, Friedrich Wilhelm Leopold Pfeil, Georg Ludwig Hartig, Edmund von Berg, Karl Heyer and Friedrich Schultze of Germany, and Israel af Ström and Gustav Segerdahl of Sweden. Gyldén also appears to have relied on the Finnish expert Carl Christian Böcker and his work on the forests of Finland and Scandinavia, which appeared in 1829.

The empirical material for Gyldén's work consisted of land reparcelling and census records, and sample cuttings carried out by the Board of Survey in various parts of the country in 1851 and 1852. Gyldén apparently used the sample data to



On a separate sheet Gyldén depicted in his handbook of 1853 the most essential tools for forest mensuration, reforestation and harvesting.

calculate the precise amount of timber in the sampled areas. These figures were then combined with information from reparcelling and the censuses concerning the structure of Finland's forests, the quality of timber and the proportions of different species.

Gyldén appears to have been aware of the risks involved in such an extensive estimate, and he notes that "everyone acknowledges how problematic and difficult it is to estimate the overall growth of forests and their utilization. But if these [estimates] lead to the probable result that the country's forests already produce ten times the amount of exportable timber than presently assumed, and will produce twice the amount with proper silviculture, we cannot escape the fact that, owing to our 1200 kilometres of coastline and winter conditions suited to the felling and transport of timber, Finnish forestry will gain particular value and become an important instrument of progress. It will also certainly provide as secure an income as other means of livelihood that have thrived in this country".

Was Gyldén's book only a pamphlet on forest policy or a serious work on the subject? There will hardly be any final answer to this question. *Handledning för*

o g.	Kubik fot virke.		Periodernas nummer.	Afverkning.	Kubik fot virke.	
ama.	per stam.	per tunnel.			Särskildt.	Summa.
				Transport	937,150	
				Hjelpgallring i skogen N:o 4 inom perioderne XIV och XV, 45,43 tunnel.		
				3,770 träd à 6 kub. fot	22,620	
				D:o i skogen N:o 3 inom perioderne XIV och XV, 89,71 tunnel.		
				4,037 träd à 15 kub. fot	60,555	1,020,325
			XIII	**För åren 1974—1983.**		
67	92	15,364		7,630 träd à 92 kub. fot	701,960	
75	34	9,350		5,607 d:o à 34 kub. fot	190,638	
				Hjelpgallring i perioden XI, 61,82 tunnl. 379,572 träd af 20 år	10,794	
				D:o i perioden IX, 41,85 tunnl. 17,953 träd af 40 år	17,055	
				D:o i perioden VII, 41,85 tunnl. 8,202 träd af 60 år	22,145	
				D:o i perioden V, 41,85 tunnl. 5,064 träd af 80 år	28,865	
				D:o i perioden III, 42,28 tunnl. 3,236 träd af 100 år	32,258	
				D:o i perioden I, 46,38 tunnl. 2,684 träd af 120 år	34,006	
				D:o i skogen N:o 1, 16,48 tunnl. 675 träd à 18,23 kub. fot	12,305	1,050,026
			XIV	**För åren 1984—1993.**		
30	100	16.000		6,592 stammar à 100 kub. fot	659,200	
50	40	10,000		6,960 d:o à 40 kub. fot	278.400	
				Hjelpgallring i perioden XII, 71,24 tunnl. 617,300 träd af 20 år	12,632	
				D:o i perioden X, 50,65 tunnl. 28,400 träd af 40 år	17,516	
				D:o i perioden VIII, 41,85 tunnl. 8,202 träd af 60 år	22,145	
				D:o i perioden VI, 41,85 tunnl. 5,064 träd af 80 år	28,865	
				D:o i perioden IV, 41,85 tunnl. 3,683 träd af 100 år	29,464	
				D:o i perioden II, 46,29 tunnl. 2,684 träd af 120 år	34,006	1,082,228
			XV	**För åren 1994—2003.**		
50	108	16,200		7,276 träd à 108 kub. fot	785.808	
30	45	10,305		4,045 träd à 45 kub. fot	182,025	
				Hjelpgallring i perioden XIII, 66,98 tunnl. 509,879 träd af 20 år	13,486	
				D:o i perioden XI, 61,82 tunnl. 57,964 träd af 40 år	18,946	
				D:o i perioden IX, 41,85 tunnl. 8,202 träd af 60 år	22,145	
				D:o i perioden VII, 41,85 tunnl. 5,064 träd af 80 år	28,865	
				D:o i perioden V, 41,85 tunnl. 3,683 träd af 100 år	29,464	
				D:o i perioden III, 42,28 tunnl. 2,130 träd af 120 år	32,332	1,113,071
			XVI	**För åren 2004—2013.**		
77	110	19,470		2,916 Talltråd à 110 kub. fot	320,760	
40	116	16,240		4,695 stammar à 116 kub. fot	544.620	
				Hjelpgallring i perioden XIV, 69,04 tunnl. 574,200 träd af 20 år	13.920	
				D:o i perioden XII, 71,24 tunnl. 52,700 träd af 40 år	18,621	
				D:o i perioden X, 50,65 tunnl. 18,597 träd af 60 år	28,519	
				D:o i perioden VIII, 41,85 tunnl. 5,064 träd af 80 år	29,465	
				D:o i perioden VI, 41,85 tunnl. 3,683 träd af 100 år	30,140	
				D:o i perioden IV, 41,85 tunnl. 2,008 träd af 120 år	32,509	1,018,554

11

The cutting order for the Halola Estate, included in Gyldén's handbook in 1853, shows the dominant position of sustainability in forestry of those days. The last cutting budget covers the year 2013!

Skogshushållare contains a considerable amount of new international research on forests and their care and management, which would suggest that Gyldén tried to lay the basis for rationalized forestry. On the other hand, the time of publication and the information presented in the book are suited "too well" to the topical discussion and debate on forestry. We can only assume that Gyldén tried to shape opinions, eradicate fears and give discussion on forestry policies a new course. An interesting question is also why Gyldén regarded himself qualified to carry out a study which leading Swedish experts regarded as impossible. Although Gyldén had no actual training in forestry, he was perhaps the only person in the country capable of drawing up an estimate of Finland's forests in the mid-nineteenth century. He had been trained as a surveying engineer, and had served for many years at the State Board of Survey. As mentioned above, he participated in carrying out the census and the reparcelling of land. These duties took him to various parts of the country, providing him with a great deal of information on Finland's natural resources, means of livelihood and the conditions of the common people. In 1850 Gyldén prepared an atlas of Finland, presenting means of livelihood, areas of settlement, bodies of water and forests. This data, combined with sample cuttings of forest and theoretical models mainly from Germany, helped Gyldén prepare the first survey of the forests of the Grand Duchy of Finland. Although his results would hardly stand up to modern scientific criticism, they were nevertheless based on "scientific" grounds. Gyldén's book gave the debate on forestry the completely new basis of statistical information on Finland's forest resources and their condition.

Scientific Silviculture

Gyldén's positive assessments greatly exceeded the calculations of the authorities concerning Finland's forests and their carrying capacity. This naturally generated a considerable amount of pressure against the 1851 Forests Act. Gyldén obtained additional proof for his claims in an expedition carried out in 1854, which showed that at least two million saw-timber trees could be cut yearly in the forests of Eastern Finland alone. The sawmill industry thus had sufficient grounds to demand revisions to the Forests Act. The senators, however, did not have time to consider repealing the disputed eighth section of the Act (the "stranglehold section") before the winds of international politics reached the country. In the spring of 1854 Finland became involved in the Crimean War, which almost completely halted exports of lumber and tar to Europe. In addition, the British navy caused considerable damage to the Finnish merchant marine and destroyed stores of tar and timber awaiting export in Finnish ports.

The cessation of exports drove the sawmill industry to the verge of bankruptcy, and the situation could not have been relieved without the assistance of the authorities.

The Finnish Senate had to keep many businesses afloat by providing guarantees and low-interest loans. Despite the severe provisions of the Forests Act, central government administration still had confidence in the future of the sawmill industry. This course proved to be correct. After the war, Europe provided a greater export market for Finnish lumber than ever before.

The rapid improvement of conditions again revived discussion on Section Eight of the Forests Act. The sawmill industry tried to make full use of the promising markets, but was faced with the restrictions of the Act. The sawmills appealed to the Senate to be allowed to add to their quotas timber that had remained unprocessed during the war. This would have rapidly increased production without affecting the sustainable development of the forests. The Senate did not respond to these demands whereupon many sawmill owners took matters into their own hands.

The Forests Act was also criticized by the central government authorities of Russia. The new ruler, Alexander II (on the throne from 1855 to 1881), demanded quick reforms to improve the economy of the Empire. Visiting Helsinki in the summer of 1856, the Emperor dictated a statement for the minutes of the Senate, in which he urged the Finnish authorities to promote the country's industries, trade, means of livelihood and communications. The liberal political climate in St Petersburg forced the government administration of Finland to rid itself of its most conservative officials. Dismissed from their posts in this "perestroika" were Governor-General Menshikov and, two years later, Lars Gabriel von Haartman. Menshikov was replaced by the liberal Count F.W.R. Berg, and von Haartman had to give way to Fabian Langenskiöld, a gifted mathematician and an expert on Russian administration.

The liberalized policies of Imperial Russia and Gyldén's comforting information laid the basis for reforms to the provisions concerning sawmills in the 1851 Forests Act. It should be remembered, however, that change did not originate in Russia, but was the result of a long process, during which the condition of Finland's forests and the amount of timber were studied. The authorities did not "liberate" the sawmill industry before being assured that forest resources will suffice for the future.

The caution of the authorities is well indicated by the fact that Governor-General Berg undertook two extensive inspection tours to the countryside and the towns in 1856 and 1857. He paid particular attention to the infrastructure of Finnish society, the school system, health care and means of livelihood. He was satisfied with the Saimaa Canal, the buildings and services of various towns, and particularly with the fields and farms of Southern Finland. But the peripheral regions of the Grand Duchy were in a poor state. Slash-and-burn agriculture and tar-burning destroyed the forests, and the small plots and fields provided no protection against hunger and poverty.

The governor-general, nevertheless, took an optimistic view of the country's future. There was much work to be done, but the forests were a source of wealth which through proper management and protection would provide the foundation for


Kertomus

Suomenmaan Metsistä.

Helsingissä,

Suomalaisen Kirjallisuuden-Seuran kirjapainossa, 1859.

The report by Edmund von Berg on Finnish forests in 1858 was also translated into Finnish and printed the next year. This booklet gives a vivid picture of the state of the forests, but it also discusses the possibilities of their scientific management.

raising the standard of living. Edmund von Berg's official report to the Senate in 1857 confirmed Gyldén's observations. The crown forests of the eastern parts of Kuopio Province alone could provide a yearly yield over 1.2 million tree trunks, i.e. roughly 2.5 million lengths of sawmill timber. This corresponded to approximately a million units of 31.5 cubic feet of standard lengths of planks and boards.

Like Gyldén, the governor-general resorted to "scientific" methods in making decisions and recommendations. Edmund von Berg estimated the condition and extent of forest from sample plots felled in various parts of the country. For example, the Pielinen forest region in Northern Karelia covered an area totalling over 1.3 million hectares, of which slightly less than half was crown land. Basing on cartographic data, the governor-general estimated that around 80% (approximately 357,000 hectares) of crown land was forested. Dividing this figure with the age of full-grown trees (150 years), the result was slightly over 2450 hectares. Each unit of 0.49 hectares was estimated to have an average of 200 full-grown saw-timber trees, which meant that a million saw logs could be cut yearly in the Pielinen forests without endangering their overall structure. According to the governor-general's observations, privately owned forests would not provide as much timber, as part of them were

used in slash-and-burn agriculture and there was considerable utilization for household needs. Despite this, it could be estimated that the privately owned forests could provide an annual yield of 2.5 million saw logs.

Von Berg's report showed that the felling quotas laid down for the sawmill industry in the 1851 Forests Act were too severe. The governor-general, however, did not demand immediate changes to the Act. On the contrary, he tried to outline the actions necessary for the overall development of the Grand Duchy of Finland. Von Berg felt that the sensible and systematic utilization of the forests was the source of all progress. The industrial use of these resources would provide new jobs and means of livelihood in the rural areas. At the same time, the forests would rise in value, rapidly improving the economic conditions of the population. Although the sawmill industry was entitled to the role of being the "motor" of economic progress, it was not allowed to plot its own course. As the sawmills used timber from crown forests, the authorities were entitled to control and monitor the use and care of forest resources. This was an unnegotiable precondition. In fact, the governor-general joined ranks with von Haartman and Gyldén in demanding the rationalization of forestry and scientific silviculture.

Rationalized forestry did not, however, satisfy J.V. Snellman and his supporters. Although Snellman was in favour of liberalization in the sawmill industry, he did not accept the idea of concentrating forestry into the hands of a scientifically educated elite. The forests had to be cared for, but the responsibility had to be given to the farmers and peasants, for they alone could judge how much forest should be felled, and at what pace, to be of benefit to agriculture. The peasants also had a close bond with the forests, which meant that they could manage and care for Finland's main natural resource without additional costs.

Snellman's ideas did not please Gyldén, nor his closest assistant Rabbe Wrede, who both felt that forestry was such an important sector of society that it could not left to the peasants. Arguments for this position included hair-raising stories of how little the peasants valued the forests. According to Gyldén and Wrede, the reckless utilization and destruction of Finland's forests would never end unless silviculture and supervision were placed in the charge of an independent institution operating on scientific principles.

J.V. Snellman, however, did give up this easily, but went on to launch a public debate on rationalized silviculture. He felt that "the establishment of a separate institute of forestry already appears to have been decided; and we can only hope that not too many scientifically educated young men will be attracted to this field, where practical work requires no scientific skills. They will have requirements regarding work, status and income which will not be met by the office of forester. Estimating and parcelling forest and calculating yield with the aid of published tables require only practical experience, like the duties of an apprentice surveyor. Every peasant can learn to collect the seeds of conifers and deciduous trees, to sow them and to

carry out thinning where needed. Honesty is the highest requirement in such positions, as purchases and sales of timber from crown forests must be carried out with the forester as an intermediary".

In May 1858 Rabbe Wrede published a long reply criticizing Snellman's ideas. According to Wrede, "anyone with the least knowledge of silviculture is aware that the forester, if anyone, has to be trained to raise him above mundane everyday matters. It is also known that his work is based on specialist knowledge unavailable to ordinary government officials".

Wrede went on to note: "Surveyors can plot straight lines in the terrain or draft maps without special scientific training. And Mr J.V.S[nellman] feels that the training and duties of surveyors and foresters are completely comparable. He also thinks it is enough that a great deal of the land area of Finland, if not most of it, will be divided and measured by men trained in their duties through solely practical aspects. But if he were to visit the villages and ask the landowners about the real nature of this issue, ninety out of a hundred would weep with rage and curse those who prevented foresters from having a higher scientific education".

Gyldén and Wrede wanted foresters to have scientific qualifications on a par with those of lawyers. They felt these professional groups were almost identical in nature and in their principles of operation. The only difference was that lawyers applied the laws of man, while foresters studied and followed the laws of nature. According to Wrede, "the judge must know positive law and the structures of the social organism. The forester, in turn, must be faithful to the even higher legislation of nature herself. He must also know the meteorological and geological conditions of our country. These and other necessary skills all require a scientific education".

Snellman's reply appeared a few months later. Writing under the sardonic heading "Science in the Woods", Snellman crushed Wrede's arguments for scientific silviculture. He denied having belittled the need for scientific training for foresters, but he warned against educating too many "scientific foresters". In Snellman's view, only the higher officials of forestry administration needed basic scientific knowledge. Forest wardens and lower-level professionals would manage perfectly well with purely practical training. If the whole corps of forestry professionals were to be given a scientific training, the cost for the state would be excessive. Snellman argued for his claims with reference to Prussian statistics, noting that around the middle of the nineteenth century Prussia had only 1900 professional foresters, whose salary ranged from 130 to 160 thalers, the equivalent of one rouble in silver.

Snellman ended his reply with the following acerbic remarks: "Mr Wrede's fantasy of having scientists in Finland's forests can only be described as ridiculous. He would have done a far greater service by demonstrating how the present large appropriations for forestry administration already find their way into the hands of scientists. This is not generally known, and Mr Wrede himself receives a considerable share of these funds."

The supporters of scientific silviculture naturally declined to accept Snellman's criticism. In a further reply, they pointed out that Snellman's information on the numbers of foresters in Prussia and the costs of forestry administration was grossly mistaken. In fact, the forests of Germany were managed by a considerably smaller corps of professionals and at much lower cost.

In addition to the public arena, the supporters of scientific silviculture sought to establish their position in other sectors. In March 1858 Emperor Alexander II approved plans for establishing the Evo Forestry Institute. This, however, did not yet mean that the new institute would provide scientific training in forestry. Consequently, Gyldén and Wrede, with the assistance of the Senate, invited Senior Forestry Counsellor Edmund von Berg, the rector of the Forestry Academy of Tharandt, to visit Finland. Accompanied by Gyldén and Wrede, von Berg set out on an expedition to the forests of Finland on July 10, 1858. Their route first took them to the province of Häme to visit the future site of the forestry institute in the crown park or forest reserve of Evo. The journey continued north along the coast to Lapland, from where von Berg, Gyldén and Wrede travelled first east towards Kainuu and on to Northern Karelia. The return journey to Southern Finland passed via Lake Ladoga and the forests of Karelia. The expedition returned to Helsinki in mid-August and five days later von Berg submitted his report on the forests of Finland to the Senate.

The report emphasized the poor condition of Finland's forests. This was due to the lack of "any kind of scientific understanding of forestry." Von Berg went on to note: "Where timber is felled, it is done only for profit and not to grow new timber or to save existing forest. This is the most destructive way of clearing and felling forest, the type of forestry that most clearly shows how little the forests are valued and how their destruction is regarded as much more important and profitable than their care and preservation. The destruction of forest, in which the Finns have developed considerable skills, is furthered by the unregulated grazing of cattle, slash-and-burn agriculture and the highly destructive practice of burning over. More precisely put, all three means are used to serve the same end: the destruction of the forests."

Von Berg's tirade continued: "The untended, destroyed or burned forests which can be found in Finland have made me very sad and despondent. It was not with any great expectations that I set out to study the forests of Finland, but I did not expect to find such great damage. This can be viewed indifferently only with the greatest stupidity. The Finns live from the forest and in the forests, and like the old woman of the fairy-tale their stupidity and greed makes them kill the hen that lays the golden egg".

Despite the overall pessimism of his report, von Berg observed that "there are, however, enough of them [i.e. forests] to prove that the Finnish climate and soils do not prevent the growing of thick stands of forest... If forests are cultivated with the right methods, they will renew themselves by natural means, and no major expenditure is needed, so long as large tracts of land are not left without trees providing seeds."



Rabbe Zachris Wrede (1815–1901) was appointed Assistant Director for Forestry at the State Board of Survey and Forestry in 1857. In 1863–1870 he served as the first Director-General of the State Board of Forestry. He tried to develop the management of state forests, but the times were hard for sustainable forestry and Wrede resigned after seven years in office.

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Compared with Gyldén's work, von Berg's views were scientifically precise and argued. Although he spent only a few weeks in Finland, he was able to make thorough observations of Finnish forests, the properties of trees, their age structure and the relationship of the forests with the rest of society. Von Berg's report proves that his reputation as a scientist was well founded. This contribution can arguably be regarded as the first "scientific" estimate of Finland's forests.

Von Berg supported Gyldén's and Wrede's policies without reservation. He also confirmed Gyldén's estimates of Finland's forest resources and the consumption of timber. The report also contained proposals for the organization of forestry administration and the curriculum of the Evo Forestry Institute. The supporters of scientific silviculture strove to make full use of von Berg's report. It was first published in Swedish and German, and also in Finnish in the spring of 1859. J.V. Snellman's reply was not long in coming. In December 1858 the journal *Litteraturbladet* published his article attacking von Berg's report. According to the article, there was no need to establish a separate institute of forestry in Finland; the highest level of silvicultural training could be provided by the Mustiala Agricultural Institute. Snellman regarded this as the best alternative, as "the highest institutes of applied science, the institutes of technology, agriculture and forestry, are not yet topical". "There are two reasons for this. Firstly, Finland cannot offer work for a large number of persons with training

in applied science. Secondly, institutions of this kind are far too expensive if they will only turn out a few graduates each year... Therefore it would be less costly to educate the necessary number of experts at the cost of the state in high-level institutions abroad."

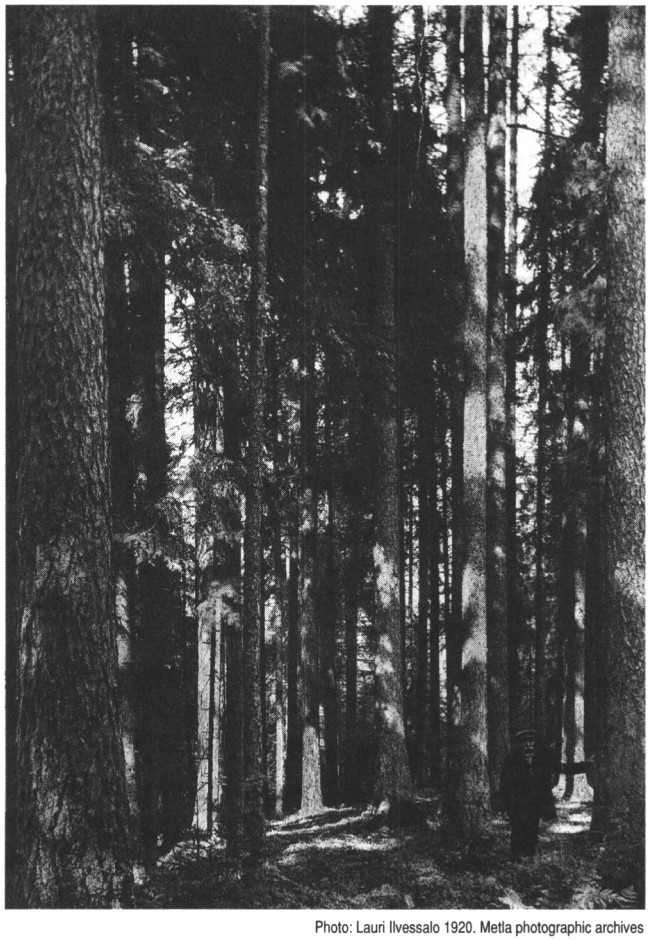
Von Berg responded personally to Snellman's criticism. He felt that Snellman was not familiar with his subject, and presented "incorrect information on German forestry, in addition to making offensive remarks about those who are trying to rationalize silviculture in Finland". He regarded this as irresponsible, since "every person with understanding and every patriot taking an unbiased view of Finnish society, must acknowledge that the improved care of the forests is the *sine qua non* of Finland's existence".

Finally, von Berg appealed to the Emperor so that reason would prevail and that Finland would have forestry administration on a scientific basis and a scientifically trained corps of foresters. But this did not yet pacify Snellman, who once again tried to change the course of matters. Snellman reiterated that the best material progress for Finland was by no means linked to the improved management and care of its forests. On the contrary, "the foundation of the Finnish economy is a thriving peasantry. It has divided among itself the small tracts of land. Therefore, Finland is not a country where independent forestry can be successful. Farming and animal husbandry have been, and must remain, Finland's main means of livelihood. They must also gradually develop into providing exports, since the forests cannot offer export articles".

Snellman's opposition to scientific silviculture was, however, unsuccessful. In December 1860 Emperor Alexander II approved the curriculum of the Evo Forestry Institute. Gyldén was appointed to draw up the regulations of the institute with the assistance of Anton Gabriel Blomqvist, a graduate of the Tharandt Academy of Forestry. An emphasis on scientific silviculture was thus ensured in the curriculum of Finland's first forestry institute.

The Liberation of the Sawmill Industry

The establishment of a scientifically trained corps of professional foresters and rationalized forestry administration laid the basis for the long-term sustainable development of Finland's forest resources. They also created the necessary conditions for lifting the existing restrictions on the sawmill industry. The authorities duly began preparations for revising the 1851 Forests Act. In the summer of 1860, Fabian Langenskiöld, the new head of the State Finances Commission, personally undertook a long and thorough trip within the country to study the state of the forests. He took the route followed by Gyldén, Wrede and von Berg two years previously, being thus able to verify the information given in the reports. Langenskiöld worked thoroughly.



The famous larch forest at Raivola in Uusikirkko. In places Siberian larch (*Larix sibirica*) grew to an amount of 1000 m^3/ha. The Russian authorities had established the forest in 1738 for the needs of naval shipbuilding.

Photo: Lauri Ilvessalo 1920. Metla photographic archives

Along the route were several sample plots approximately 0.5–1 hectares in area. All tree trunks that could provide saw logs were counted and measured, most probably using the so-called ice-cream cone method. This method, developed in Germany, was based on completely even-proportioned trees, which would resemble "ice-cream cones" if turned upside down. By knowing the length and diameter of the trunk it was possible to compute the volume of the tree. The volume of misshaped trees could then be obtained by subtracting from the basic values.

Langenskiöld's results largely corresponded to the estimates given by Gyldén and von Berg. Burn-clearing, the burning of tar and deliberate deforestation had destroyed large areas of forest in Central and Eastern Finland. At Saarijärvi, for example, a sample plot of 0.49 hectares contained only 77 trees 10 to 29 inches in diameter. The figures were even worse in the Pihtipudas region, where a sample plot revealed 260 trees averaging 50 years with a mean trunk diameter of only three inches. The condition of the forests improved towards the north. At Kolari in Western

Lapland, two sample plots, 0.49 hectares each, were measured. The first plot contained 195 trunks over 50 years old, of which each one met the requirements of saw timber. The second plot had 170 trunks of saw timber 15–23 inches in diameter. Langenskiöld was satisfied with the results, which disproved the widespread belief that the forests of Lapland suffered from heart rot.

Observations concerning the forests of Eastern Finland confirmed Gyldén's and von Berg's claims. Although slash-and-burn agriculture destroyed the forests, there was still enough raw material for the sawmill industry. Damages to forest were usually limited to the vicinity of settled areas. Outlying regions, on the other hand, still contained healthy forests, which had renewed quickly after forest fires, forming stands of mixed forest, spruce and pine. The age structure of Finland's forests, however, was seriously distorted. There was a great deal of old forest and young stands in burn-cleared areas, but the amount of middle-aged timber was quite small in all areas. If this was not soon corrected, saw timber would become unavailable in the near future. According to Langenskiöld, it was necessary to stop slash-and-burn cultivation and tar-burning, and to undertake proper forestry measures. Seedlings had to be planted in areas where timber regenerated poorly, and the growing of larch could be experimented with in some parts. A large stand of larches at Uusikirkko made a lasting impression on the head of the State Finances Commission.

Although Langenskiöld's estimates of the reserves of timber in Finland's forests differed in some respects from Gyldén's calculations, the discrepancies were nevertheless so minor as to have no effect on the final conclusions. Langenskiöld concurred with Gyldén, Wrede and von Berg that at least one million saw-timber logs could be procured yearly without endangering sustainable development. Increased felling also permitted reforms and development within the sawmill industry. According to Langenskiöld's estimate, steam-powered sawmills and improvements to the timber floating channels in rivers would provide yearly export revenues of up to ten million roubles.

The restrictions on the sawmills of the 1851 Forests Act were lifted in the early 1860s. The sawmill industry was now permitted to utilize the nations forest resources, although not without some limitations. Most of the provisions of the act of 1851 still remained in force, and official permission from the Senate was still required for the establishment of sawmills. Liberalism made its way into Finland's forests in the guise of strict bureaucratic procedure. Responsibility for silviculture and the protection and further development of the nation's forests was given to the State Board of Forestry, which became a separate central government office in the early 1860s. Rationalized forest administration was supported by the work of the Evo Forestry Institute, which was to begin the scientific teaching of forestry in the early 1860s.

Having continued for two decades, the great forestry debate culminated in a consensus with three elements supporting each other. The economic utilization of the forests was developed by offering the sawmill industry the "free" right to refine



Metla photographic archives

A Finnish sawmill at the end of the 19th century. The logs have been cut with axes. The use of hand saws became common only in the 1880s.

this renewable natural resource. The special position of the sawmills was underlined in relation to other parties, particularly the tar industry and those who practised slash-and-burn cultivation, upon whom the act of 1851 placed a great deal of restrictions. The Forests Act thus helped to speed structural change in agriculture, where an important issue had been the replacement of primitive swidden cultivation with more developed methods and forestry supporting the economy of the farms. The Forests Act did not directly interfere with the use of forests by the ironmills, which was not even necessary, since poor competitiveness shifted the focus of the iron industry from smelting to machinery production.

The third result of the forest debate was the introduction of rationalized forestry based on scientific principles. This also entailed a significant political decision. The "peasant forestry" proposed by Snellman would have given Finland's farmers and peasants the authorization and responsibility to care for the country's forests. If this would have happened, the forests would have become an important element in the civic society envisioned by Snellman. Now, this scheme was only partly realized, as forestry was placed in the hands of a new professional elite, represented by scientifically trained foresters. Science now marched into nation's forests – slowly at first but with a determination.

On his journey to Finland, Forestry Counsellor Edmund von Berg made a great number of sharp observations about the Finns and their living conditions. He summarized his experiences by noting that "Finland lives from her forests". By this von Berg meant precisely what he said. The forests were vital to Finnish society, not only economically but also socially and culturally. Without its forests Finland could not develop a united and sustainable culture. The great forest debate reflected the negative aspects of von Berg's statement. The feared depletion of the forests was a nightmare that no sector of society wanted to face. But reactions to it varied. The highest state officials feared the collapse of the economy if surplus value could not be extracted from the forests. The peasants took the perspective of energy supply. Without the forests, the fields would be affected by cold winds and night frosts, resulting in hunger, destitution and death. The same would follow if the supply of firewood ran out. As noted above, there were no alternative fuels, and the nation's forests were the only source of heat against the cold of winter.

For industrial entrepreneurs, the forests were the only renewable natural resource that could be used to a large scale to serve production. Although the degree of industrialization was still low, the forests interested all sectors of industry. It was not profitable to invest in production facilities, if the supply of raw material and fuel was uncertain. The sawmills also faced the problem of continuous rumours about the destruction of the forests. These in turn laid the basis for legislated protection measures placing restrictions on sawmills.

During the long and often heated debate, various ways to eradicate the fear of deforestation were sought. Restrictions, forestry policy, better definitions of forest ownership and a shift of focus to farming did not, however, allay these fears. This could only be done with objective and reliable information on the areas and condition of forests, and such information could only be provided by the science of forestry. This, however, was still in its infancy in the mid-nineteenth century. Research methods were inadequate, and experts lacked a clear theory upon which to base their conclusions. Despite these shortcomings, "scientific research" provided the final answer in the forest debate. These studies strove towards objectivity, although their methodology did not meet the highest requirements of the natural sciences. By applying and combining experiences and observations and the methods of various disciplines, it was nevertheless possible to prepare an estimate of forest area in Finland and the forests' capacity of regeneration. Although studies did not solve the actual problems, information helped curb fears. Scientific data also had an impact on the structures of power. The hitherto static society of rigidly defined estates engendered a scientifically trained corps of professionals in forestry. J.V. Snellman tried to oppose the emergence of this new factor in society, but his attempts failed. The reason for this was that Snellman could not offer any "scientific" explanations, only



Carl Fabian Theodor Langenskiöld (1810–1863) succeeded von Haartman as Treasurer of the State in 1858. He was an active proponent of sustainable forestry. Unfortunately his political career did not last very long: he was dismissed in 1863 after which he soon died.

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polemic and political views. These, however, did not fare well in a debate on something as unknown to all parties as the forests of Finland.

The forest debate resulted in freedom of action for the sawmill industry and the beginning of rationalized forestry measures. These two interdependent factors laid the basis of a forest-sector society. There have been various suggestions as to the time when this phenomenon first emerged. It is generally agreed that the transition from the agricultural basis to a society in which forest resources were industrially utilized did not occur in Finland until the 1920s. Many experts support this view.

Although it was not until the 1920s that all the aspects of forest sector society were in operation, the first concepts of a Finland relying on the forests and their riches were presented considerably earlier. Snellman, von Haartman and von Berg all saw the forests as the foundation of Finnish society, but it was not until Fabian Langenskiöld's forest-policy programme of the early 1860s that concrete proposals were made to create a society with an important forest sector.

Langenskiöld's system contained four independent, but also interlinked, interest groups: the forest industry, the peasants, the state, and the professional foresters. Each group had certain duties and responsibilities. The duties of the forest industry were to maintain its competitiveness on the international market, to effectivize production and to develop its structures of production technology. In Langenskiöld's system, the forest industry was synonymous with the sawmill industry. He regarded water-powered sawmills as outmoded; the sawmills of the future would run on steam and would be located on the coast at the mouths of river routes. This would jointly

provide three factors. Firstly, steam power would force the sawmills to renew their technology of production. Secondly, the coastal locations would speed the shipment of products to the European market. Thirdly, the sawmills at the mouths of the rivers would be the termini of the long chain of the production process, beginning in the forests and continuing along the floating routes to the sawmills. It was by no means profitable to saw logs into planks and boards in the inland. The raw material was to be floated to the coast. This saved transport costs and offered work for people living along the rivers.

Although the sawmills no doubt dominated the forest industry, Langenskiöld also discussed the diverse uses of timber. Finns were traditionally familiar with the making of tar and other valuable chemicals, such as resin and turpentine, from wood. Expanding the range of forestry products would alleviate the effects of economic fluctuations and also reinforce the vertical and horizontal integration of firms in this field. The further refinement of timber would also create a natural channel of cooperation between the sawmills and the peasants. In Langenskiöld's system the peasants, with their know-how of tar-making and the preparation of forest-based chemicals, could work at least part of the year as subcontractors to the forest industry. The state could participate in the industrial activities of the peasants and farmers by allowing tar-burners to use poor areas of crown forest. Once the resources of a forest area had been utilized, the professional foresters would take over and organize the proper working of the soil and the renewal of forest cover.

The farmers and peasants were given an important role in this system. They were to sell and deliver the raw material from the forests to the sawmills. In Langenskiöld's scheme they were reserve labour, living from farming in the summer and only in the autumn, winter and spring from the income provided by the forest industry. Living close to the sources of raw material, the farmers could easily and cheaply manage the cutting of timber and its transport. This offered several advantages. The cost of raw material remained low; there was work for the farmers and peasants; and social stability was ensured as no outside workers were sent into the forests. The landless peasants found work in the crown forests. In Langenskiöld's opinion, the state could at first pay wages in the form of grain and flour. This would gradually win the support of peasants and farmers unused to rationalized forestry for the envisioned forest-sector society. Langenskiöld felt that if such a society could be created it would "eradicate hunger, destitution and the eating of bark-mixed bread in even the poorest homes".

Central state administration was to be the primus motor of forest-sector society. Its task was to finance and construct networks of roads and floating routes for the transport of timber to the mills. The state would also be responsible for training professional foresters, for the renewal of unproductive forest, and improvements to the soil. The direction and supervision of the envisioned forest-sector society would thus remain in the hands of government officials and scientifically educated profes-



Hans Kejserliga Majestäts

Nådiga

Kungörelse,

angående

organisation af forststaten för wården och förwaltningen af kronoskogarne i Finland.

Gifwen i Helsingfors, den 7 Maj 1859.

Helsingfors, tryckt hos J. Simelii arfwingar, 1859.

Hans Kejserliga Majestäts

Nådiga

Kungörelse,

angående

organisationen af Ewois forstläroanstalt.

Gifwen i Helsingfors, den 15 April 1859.

Helsingfors, tryckt hos J. Simelii arfwingar, 1859.

Act concerning the establishment of the State Board of Forestry (left) was given on the 7th of May 1859. This act was replaced by a new one only half a century later, in 1921. The act on the establishment of the Evo Forestry Institute (right) was given in 1858. The Institute did not begin its activities until four years later, in 1862.

sionals. Langenskiöld emphasized that "the task of professionals in forestry was to bear responsibility for all work done in the forests". In other words, they had to teach the peasants sound forestry practices, renew felled forest, and prevent forest fires and the destruction of forest.

Fabian Langenskiöld's plan was an extensive programme requiring long-term effort and many difficult decisions by the authorities. At the same time, the forest industry was called on to take risks and the peasants and farmers had to change their attitudes. Furthermore, Finland required professionals in the field of forestry, familiar with their work and its setting. Langenskiöld himself had firm faith in his programme, observing in 1861 that "it ultimately appears that the progress of the forest issue is so closely linked with industry dependent on its resources that if the former wins, the latter will also win. Thus, the interests of the forest issue and the forest industry converge. The next question is how the proceeds can be shared as equitably and with as much mutual profit as possible".

Langenskiöld's programme listed a number of requirements and demands, but also offered a promise of the riches that sound and rational forestry would offer the nation. Gyldén's and von Berg's reports on Finland's forests also promised large profits. Although these promises were partly propagandistic, they lived on in the minds of both decision-makers and ordinary citizens. Accordingly, rationalized

forestry was weighed with a considerable deal of accountability from its very first stages. The pressure was particularly evident in forestry administration, which was expected to pay its own costs in addition to producing "millions of roubles" in revenue, as estimated by von Berg and Gyldén.

The development of a forest-sector society was already begun in the late 1850s. Steam power was permitted in the sawmill industry in 1858, although the permission of the Senate was still required for the establishment of new sawmills. The official position and organization of forestry administration was ratified at the beginning of the 1860s, when the government office headed by Rabbe Wrede became a separate office of government administration, no longer subordinate to the State Board of Survey. At first its staff numbered the director, a civil engineer and three junior foresters. New personnel had to be hired in 1863, when three senior foresters and ten district foresters were appointed to manage the crown forests. The scientific teaching of forestry began at the Evo Forestry Institute in 1863. The new institute was given the use of the Evo-Vesijako crown park, or forest reserve, in addition which teaching and laboratory facilities, a tar factory and a nursery for seedlings were built in connection with it.

The operative institutions of forest-sector society were supported through significant decisions on the state and infrastructural levels. The Estates of Finland, officially representing the people, assembled at the Diet of 1863, after an interval of almost fifty years. Monetary reform was carried out and legislation was passed concerning joint-stock companies and providing freedom of occupation. These measures created the legal and social framework for activating industries. The problems of transporting forestry products were solved with networks of railways and canals, which were built with state finds.

Great Expectations and Deep Disappointments

Although all factors were in readiness for the creation of a forest-sector society, the realization of this project met with delays. These were caused by a number of factors. In fact, the problems already began in 1862 with the sudden death of Fabian Langenskiöld. He was succeeded as keeper of the nation's finances by J.V. Snellman, who had moved from Kuopio to become a professor at the Imperial Alexander University in the late 1850s. Snellman was by no means a poor choice for this post. He continued Langenskiöld's reforms, and with his unswerving energy was able to carry out most of the significant reforms of the 1860s. Snellman's relationship with Finland's forests, however, did not change. Though not directly opposing rationalized forestry, he did not invest one single extra mark of state funds into developing this sector. A good example of Snellman's views regarding forest policies is found in an article by him published in the journal *Litteraturbladet* in 1861. Snellman notes:



Johan Vilhelm Snellman (1806–1881) was a prominent philosopher and one of the leading promoters of the Finnish national spirit. He was also an outstanding economist even if he did not believe in the long-term future of sustainable forestry in Finland. For many years Snellman was depicted on the largest denominations of Finnish bank notes.

"...unfortunately signs of the forest life can still be seen wherever the forests provide the sole means of livelihood, or most of it. It is there one finds poverty, brutishness and ignorance, and it is there drunkenness abounds, and the sacredness of private ownership is poorly known. The desire to replace farming with forestry, or to base our nation's welfare on it even to some degree, is tantamount to a desire to overturn the state of affairs and to teach the people to begin anew, at least three or four centuries back in the past".

In Snellman's opinion, professionals in the forestry sector had promised to enrich the economy with millions of roubles, and it was now time to fulfil that promise. Because, for other reasons, no results were forthcoming, rationalized forestry remained a prisoner of its own optimism. It had bound itself to producing results, and without results it was impossible to develop this sector.

The Diet also disappointed those who believed in the rapid emergence of a forest-sector society. Despite Langenskiöld's grandiose plans, the peasants in particular resisted rationalized forestry and a society based on it. The representative of the farmers and peasants at the Diet continually proposed the termination of the State Forestry Board and the closing of the Evo Forestry Institute. The main objection was not rationalized forestry per se, but money. The farmers felt that the forests did not provide economic benefits as often as they should, whereby rationalized forestry should be replaced by farming that would continuously produce bread, welfare and income for the peasantry. In accordance with this principle, there were motions in the Diet to have the crown forests given over to the peasants and farmers.

The debate on the official position of forestry and silviculture began immediately in the first Diet. The speaker of the Estate of the Peasantry forcefully noted that "the Board of Forestry, as for example in the County of Satakunta, generates a great deal of expenses for the state but few benefits. The state forests in this area have stands of young deciduous trees, which will never produce enough to defray the cost of employing forestry officials. The most profitable course for the state would be to make these lands subject to tax, whereby those living there, who do not own the land now, would be rescued from their present destitution, which will all but exacerbate and become all the more a strain on the nation if they are forced to move away".

Johan Erik Keto, also of the Estate of the Peasantry, added his own opinion for the record, stating that "the crown forests belong to the state and are thus the property of the whole nation. They should be maintained and supervised as well as other state property. There is one cause for criticism, namely the fact that these forests have not been taken under better care much earlier. Had this been done, many million logs, which have now disappeared without generating any income for the state, would have been saved to be of value today, and it would not have been necessary to consider other taxes. Therefore, I propose that the Board of Forestry be discontinued".

The Estate of the Burghers did not have an unequivocal position regarding rationalized forestry. The estate naturally supported the liberation of the sawmill industry and the development of the infrastructure, but it also opposed the spending of tax revenue on maintaining the bureaucracy of forestry. This placed rationalized forestry in an evil circle with only one way out. Forestry had to become self-supporting, in addition to generating profits for the state.

Professionals in the field, however, were not alone in influencing the profitability of forestry. On the contrary, the world market had by far the most important role. In the late 1850s the export market for lumber gained pace, but a recession already set in around the beginning of the 1860s. This crisis came at a fateful time. The production limitations on the Finnish sawmill industry had only recently been lifted, but the poor market dampened any enthusiasm to invest in steam power and new facilities. This led to a new vicious circle. As the sawmills did not increase production, sales of timber were reduced and the state received less revenue from the forests than expected. State forestry administration was directly accountable for its results and its income came from the sales of crown forests. Accordingly, it had to work at far less than peak efficiency from the very beginning. No new positions were established, and silvicultural and research projects were postponed indefinitely. This, in turn, continued the destruction of Finland's forests, as before. The official forester districts were simply too large to be properly supervised or developed. Since the farmers and peasants had no respect for government property, burn-beating, tar-burning and the theft of timber continued just as before.

These setbacks severely eroded Langenskiöld's dream of a modern society relying on the forestry sector. The fast realization of a forest-sector society was, however,

finally halted by a massive reversal. Around the middle of the nineteenth century the climate in Finland became more unstable than previously. At times, the summers were uncommonly warm and the winters were very cold. The situation worsened in the early 1860s, when summer was late in coming and night frosts destroyed crops in many parts of the Grand Duchy of Finland. A total catastrophe with resulting famine was only prevented when the state intervened. Fabian Langenskiöld rushed off abroad to obtain loans with which to buy grain. The journey was successful, but Langenskiöld's health weakened and he died in 1862. The climate warmed slightly after this, but only temporarily. The real catastrophe struck in the mid-1860s, when sudden night frosts in the spring and autumn destroyed the grain crop during several successive years. The results were so disastrous and so extensive that the state could no longer prevent famine. Between 1866 and 1868 over 250,000 people died of famine and accompanying diseases in Finland. The catastrophe was one of the worst of its kind in Western Europe during the past two hundred years.

The years of famine dissolved the basis of rationalized forestry. The Grand Duchy of Finland had to concentrate all its efforts on securing basic human needs. Agriculture, communications and social policies all gained importance in Finland in the late 1860s and early 1870s, while the efforts to develop a forest-sector society were left in the background. Sawmill proprietors could not afford to invest in new production facilities, and the timber market slowed down. This had an immediate effect on state and partly private forestry. As rationalized forestry was forgotten, the destruction of the forests continued and even gained pace. The authorities did not want to make the situation any worse, particularly in Eastern and Northern Finland, and the hungry peasants were allowed to extract what grain or income they could obtain from swiddens or tar-burning in the crown forests.

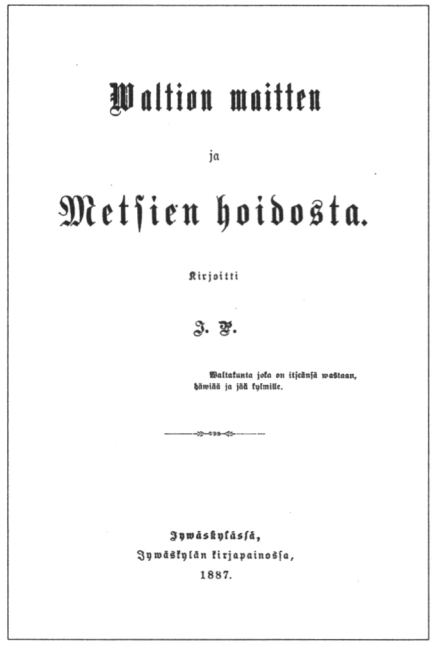
The first decade of rationalized forestry was thus an outright disappointment. Although the main official institutions had been established, silviculture, forestry research and the protection of forests remained more a dream than reality. In the mid-1860s, the accounts of state forestry administration showed an losses of 200,000 marks per annum. Salaries were a great strain on the budget. In the 1860s a total of 76 forestry professionals were immediately employed. But since the sales of timber and prices remained low throughout the decade, yearly income was clearly smaller than expected. This was naturally a severe disappointment to all those who expected rationalized forestry to generate profits for the state in a short time.

Impasse

From the very beginning Finland's corps of professionals in forestry had to work under a great deal of pressure. The peasants took a cold, and often hostile, attitude towards the new professional foresters. Particularly in the northern regions, the "forest lords" were received in a highly unfriendly way, and the situation was no better even in the capital. The senior officials of the State Board of Forestry had to fight for their own administrative sector in the Diet and within the central administration. The contemporary negative attitudes towards rationalized forestry were most evident in the press, which did not tire of criticizing professionals in the field and their work until the close of the century. The debate culminated in the 1880s, when Johan Pellikka published a number of inflammatory articles and pamphlets aimed against scientific silviculture. Pellikka claimed that "the State Board of Forestry and its officials had consumed all that had been achieved in the crown lands and forests. Furthermore, this was not enough, since the state has had to give more appropriations each year, at least until 1883. The State Board of Forestry and all the positions subordinate to it, as also the Evo Forestry Institute, should be discontinued, for they are all unnecessary. Once this is done, all timber and lands are to be sold to settlers. This would create 14,453 new holdings, each paying taxes to the amount of 200 marks, totalling 2,890,000 marks. The log timber would bring in approximately 45 million marks, which would be invested. At an interest rate of 4% this would generate 1,800,000 marks per annum. Together with the taxes, the revenue would be 4,690,600 marks, a sum considerably more than that currently generated by state forestry administration".

Pellikka's view of scientific silviculture was almost as dismal. In his opinion, "no more than one scientifically trained forester per province is required for supervising both state and privately owned forests. This means a total of eight for the whole country, and not one person more. Even this is a temporary situation, existing as long as the crown lands remain to be converted into holdings".

Despite outside pressure, rationalized methods were introduced into forestry. This proceeded simultaneously in two sectors. The Evo Forestry Institute and the Mustiala Agricultural Institute began regular experiments and the development of methods for measuring, estimating and felling timber. Also studied at the Evo institute were alternative uses of forest resources, tar-burning in particular. The government foresters tried to institute rationalized forestry practices in the crown forests. The first foresters in the field had a great deal of work on their hands. They estimated and measured forests, drew up cutting plans, studied floating routes, had trees marked, supervised the extinguishing of forest fires, studied actions for the renewal of forests, and generally kept an eye on the condition of the forests and changes to them. Such a wide array of duties naturally generated more questions than precise scientific answers to problems. In any case, the reports of the government foresters provided



Waltion maitten

ja

Metsien hoidosta.

Kirjoitti

J. P.

Waltakunta joka on itsenäsä wastaan, häwiää ja jää kylmille.

Jywäskylässä,
Jywäskylän kirjapainossa,
1887.

The policies of the State Board of Forestry did not meet with success in the 19th century. Johan Pellikka published a series of pamphlets in the 1880s and 1890s in which he strongly criticized especially the way of establishing crown tenant farms. Some authors, e.g. Väinö Kataja, Ilmari Kianto and Kalle Kajander, shared Pellikka's opinions in public.

the first truly empirical data on the nation's forests, their condition and the changes that had occurred in them. This material provided a considerably more precise overall view of the field than was available previously.

Forestry research as such was organized at the Evo Forestry Institute, which officially began its work in the spring of 1862. Engineering Colonel Alexander af Forselles was appointed director of the institute. He had no experience of forestry, or of related research, but had served with distinction in the Russian army as an engineer specializing in earth- and waterworks. Af Forselles was inventive, being particularly interested in heating and lighting devices. During his long lifetime, af Forselles took out several gaslight and gas-heating patents. He also specialized in natural medicine, writing a few works on the subject in the early 1860s.

Alexander af Forselles did not directly interfere with the curriculum of the Evo institute. He was responsible for teaching in engineering subjects, such as building theory. Forestry subjects were taught by young professionals who had been trained in Germany. Anton Gabriel Blomqvist taught silviculture, forest estimation and economics; J.E. Furuhjelm lectured in chemistry and other natural sciences; Erik Sederholm instructed in geology and forestry technology; C.A.J. Nyberg taught mapping; and N.K. Nordenskiöld was responsible for the teaching of mathematics and physics.

The curriculum was modelled after the Tharandt Academy of Forestry. A further German influence was the fact that all the faculty, except af Forselles, had studied at Tharandt. The Evo institute was thus intended to provide scientific teaching in forestry and to carry out scientific research in the field.

This concept, however, was too idealistic. The Evo institute had to manage without outside financing, which meant that the necessary funds and resources had to be obtained from the Evo forest reserve, or other business activities. The situation was far from easy. The reserve was in poor condition owing to forest-fires and swidden cultivation. At the time, the timber market was in a recession, and prices were at an all-time low.

Since sales of timber could not provide sufficient funds for the institute, af Forselles developed an alternative. He was interested in various aspects of forest-related technology, tar-burning in particular. Consequently, he took over the nearby Savijärvi tar and turpentine works with the intention of producing a variety of organic compounds, for example resins, turpentine, spirits, and, naturally, tar. In his letters to the Senate, af Forselles promised that Evo would soon produce such amounts of unrefined turpentine that it could replace the carbide hitherto used to light the streets of Helsinki.

Unfortunately, af Forselles' plan did not succeed. The Savijärvi facility remained unprofitable, and the Senate finally ceased to finance this seemingly hopeless venture. Af Forselles, however, did not give up. He commissioned the construction of a steam-powered locomobile which could be linked to a saw. The purpose of this scheme was to saw the logs felled in the forest reserve, thus improving the income of the institute. This plan also failed. During the first years, the institute ran at a deep loss. Between 1862 and 1866 only some 400 units of mast timber and ca. 1500 logs of "less valuable" timber were sold. These transactions provided hardly any income, and the Senate had to cover losses amounting to 3500 marks.

Despite all these setbacks, the institute launched a programme of systematic forestry research. Seeds and seedlings from the institute's own nursery were sown in burn-cleared forests. Various methods were tested in trial plots in the seeding and planting experiments. In addition, the seeds and seedlings of larch and Siberian fir were obtained from the Pechora River in Russia and from the Raivola and Puhos larch-growing areas near the eastern border. These tests were intended to find out whether larch could grow and multiply among other species of trees or whether it required its own habitat.

The tests led to significant results: it was not profitable to grow foreign species in Finland, as larch and Siberian fir did not thrive among other trees. The results were similar for seedlings obtained from North America and Japan. However, forests planted in former burn-cleared plots regenerated well and at a fast pace. Various planting and seeding methods were developed at Evo and were later applied in different parts of Finland when former swiddens were converted back to their original state. The experiences of thinning, pruning and regeneration felling and bog-drying gained at Evo were widely applied in later years. The benefits would probably have been even greater had the research been published. Forestry science, however, had no scientific journals or series at its disposal, and the results of studies had to be



Alexander af Forselles (1820–1896). Af Forselles was an engineering officer who acted as director of the Evo Forestry Institute from 1858 to 1870 and later as Director-General of the State Board of Forestry from 1870 to 1892.

National Board of Antiques

passed on by letter or through personal contacts.

The fate of the Evo Forestry Institute was not, however, dependent upon its scientific achievements or the ambitions of its faculty. The institute was a part of forest-sector society, whose future was governed by greater economic and political forces. As pointed out above, it was still debated in Finland whether the nation's wealth should be bound to the forests or to agriculture. In Snellman's opinion the development of agriculture would open the way for civilization and culture, whereas the forests spelt poverty and backwardness. This black-and-white concept was reinforced in the Senate in the early 1860s, when frosts destroyed crops and the nation's economy was endangered. In 1863 the Senate appointed a committee to study how the Mustiala Agricultural Institute could be developed into a higher-level institute of learning. The underlying idea was to concentrate the highest scientific teaching of both agriculture and forestry at Mustiala. Since the state could not afford to maintain two academies of forestry, the Evo institute was threatened with closure even before it had properly begun its work. The committee studied the matter from many angles. There were certain natural benefits in combining the teaching of agriculture and forestry. Both fields applied the same basic sciences, particularly chemistry and physics, and both required the support of engineering expertise in

construction theory, surveying, the laying out of ditches and mapping. The faculty at Evo was divided in its reactions to the committee's proposals. A.G. Blomqvist felt that forestry research in Finland would be saved by combining the two institutes. The forests at Mustiala were in better condition than at Evo, and would provide more income. Furthermore, basic-level teaching could be combined, which would spell savings in money and resources. Blomqvist also believed that the state would be more inclined to give funds for laboratories and research equipment if forestry science were incorporated in the highest-level teaching of agriculture.

As director of the Evo institute, af Forselles, however, was strictly opposed the committee's proposals. Experiences gained in Germany showed that similar institutes focusing on a single discipline were successful, but in institutes where both agriculture and forestry were taught, one field would benefit at the cost of the other. A good example was Tharandt in Germany, where high-level forestry research was carried out, but whose teaching and research in agriculture were on a very primitive level. This was also underlined by Forestry Counsellor Edmund von Berg, who felt that forestry and the agricultural sciences had grown apart to such a degree that students could not learn the basics of both fields at the same time.

Af Forselles' position won, and the Evo institute was permitted to continue its independent existence. But this was a short-lived victory. Economic problems continued, and the state took an increasingly rigid view of the "experiments" conducted at Evo. The situation worsened in the mid-1860s, when the first foresters graduated from the Evo institute. Together with colleagues who had studied abroad, they filled all the available positions in forestry administration. As the development of a forest-sector society still bided its time, and no new funds were appropriated for forestry or related research, the new professionals in the field lacked jobs. This was soon reflected in the numbers of students, which began to decrease alarmingly. The situation finally arose in which no new students applied to study at Evo. Accordingly, the Senate temporarily closed the institute in 1868. The equipment and library of the institute were moved to Mustiala, where forestry was taught by Alexander Borenius, a graduate of the Evo institute.

Historians have usually claimed that the Evo institute was closed down because of the lack of students. This was the immediate reason, but there were also broader developments in the background. Had the forest-sector society envisioned by Fabian Langenskiöld emerged in Finland in the 1860s and had the forest industry raised its production capacity, rationalized forestry and the Evo Forestry Institute would apparently have developed according to the original plans. This, however, did not happen. The years of famine and the strong resistance of the peasantry eroded the basis of rationalized forestry. The nation's resources were channelled into developing agriculture and communications. This course suited J.V. Snellman, who was in charge of state finances in the difficult years of the 1860s. Snellman had no sympathy for professionals in forestry. He stated to the Senate that in his opinion "the statement



National Board of Antiques

The Evo Forestry Institute was established in 1862, but temporarily closed in 1866. The school reopened in 1874 and before the highest level of forestry education was transferred to the Imperial Alexander University, the Evo Institute educated almost 300 professional foresters.

of the State Board of Forestry regarding the future sales of crown forests is unreliable. It is to be desired that these sales will sooner or later increase to such a degree that the Board of Forestry and the [Evo] institute can be maintained with the proceeds. But I remain convinced that this will not happen until the finances of the crown forests are managed in the same way as all other business and the produce is sold at the available price and not left to rot in the forests, as is done now. As matters stand now, I see no hope of new students enrolling at the institute during the lifetime of the present faculty".

Snellman's statement was a shock to those who still believed in rationalized forestry operating on scientific principles. Although Snellman's prediction was not borne out, the setbacks of the 1860s had a long effect on teaching and research in forestry. Scientific forestry had to give way to practically oriented forest management based on engineering skills.



Univ. of Helsinki, Dept. of Ecology

Industrialism represented an alien world of machinery, ruled by the unbending laws of economics and technology. Finland, however, became more and more dependent on forest based industries during the latter half of the 19th century.

The Land of the Forest Industry

The Great Change

J.V. Snellman had hardly pronounced his pessimistic prediction of the future of rationalized forestry when conditions began to improve for Finland. The Franco-Prussian War ended in 1871, and reconstruction in Central Europe revived the long dormant market for sawed timber. The new situation was particularly beneficial for the Finns, since most of the demand was for large-sized timber. Although swidden cultivation, tar-burning, unplanned felling and fires had all contributed to the destruction of the country's forests, the wilderness regions still provided sufficient amounts of large logs. By comparison, the Norwegians, who had long dominated the European lumber market, had by now felled most of their old forests.

The revival of the markets made it possible to carry out the social and economic reforms for which legislation had been passed in the 1860s. Currency reform and legislation concerning joint-stock companies helped provide capital and develop major industries. The officially decreed freedom of occupations speeded the mobility of labour, and reforms in social policies strengthened the basic structures of society. By the beginning of the 1870s, Finland had national self-government independent of Russia, a Diet for passing legislation, a professional corps of civil servants and an entrepreneurially minded bourgeoisie.

The improvement of the lumber market also revived discussion and debate on the economic basis of Finnish society. Fabian Langenskiöld's scheme of a society relying on forestry could not be realized in the early 1860s, but a social demand for it had now arisen. These plans competed with the ideal of an agricultural society as argued by Snellman. The two models were not necessarily mutually exclusive. The years of famine had shown that Finnish society did not live from agriculture alone. There was no way to predict climatic change, and agriculture had a productive structure too narrow in scope to respond to external or internal disturbances. Furthermore, the envisioned forest-sector society was too dependent on the fluctuations of the world market. The experiences of the 1860s showed that the lack of revenue from exports would also cripple agriculture.

A model combining the sectors of forestry and agriculture provided a feasible compromise, and a solution to these problems. As the value of the forests rose, agriculture had access to more capital, which could be invested in renewing its

structures of production. At the same time, the peasantry, living on their own land, provided the forest industry with reliable reserve labour at low cost. The two previously competing models of Finnish society were thus combined into a single system in which agriculture and forestry supported each other. At the same time priorities changed . Fabian Langenskiöld felt that Finland should invest all her efforts and resources in forest-based industries. This, however, was too radical a solution to be put into practice, since the industrial fabrication and refinement of forest products relied solely on the sawmills. In order to avoid catastrophes like the recent famines and to strengthen the economy, it was more important to attend to agriculture first, and in particular to making its structures of production reliable. The forests and industries based on them were needed, but only to produce more capital, job opportunities and affluence for Finnish agriculture.

Finnish society began to be developed in accordance with these principles in the early 1870s. Structural change was particularly rapid within agriculture. Grain cultivation gave way to livestock raising, and surpluses of Finnish butter and cheese could already be exported to St Petersburg in the late 1870s. Finnish dairy producers later acquired a share of the British market.

The state took an active role in developing agriculture and forestry. The Saimaa Canal had already linked Eastern Finland with the markets of St Petersburg in the late 1850s. The later network of railways increased and speeded communications with the inexhaustible markets of the east. The state also supported scientific and applied research in agriculture. The Mustiala Agricultural Institute came to have an experimental dairy and a machine-shop, where new types of ploughs and other implements were made. At Mustiala and other experimental facilities, more durable and more productive strains of cereals were developed. The state also supported the organizers of agricultural exhibitions and the establishment of organizations of farmers.

The industrial utilization of the forests also served structural change in agriculture. The railways, canals and ports speeded the shipment of timber to the international market. On the other hand, the development of agriculture provided Finns with more living space. The frontiers of the wilderness regions receded ever farther to the north and east. The large rivers of Central and Eastern Finland were made navigable and to serve as timber-floating routes, and rapids were harnessed to produce energy for sawmills, flour mills and in later years for paper and pulp mills.

The sawmill industry reacted quickly to the opening of the market. Dozens of applications for permission to establish steam-powered sawmills were received by the Senate, and – unlike in the 1850s – all were approved by the central administration. A new feature was the fact that these applications included ventures financed by foreign investors, particularly Norwegians. The adoption of steam power quickly raised production figures. In 1872, the Finnish industry passed the 100,000 standard mark (1 stand. = 4.67 m^3). Three years later production had reached 200,000 stand. These figures continued to grow for five years, by which time the 300,000 stand.



Metla photographic archives

The topography of the country permitted timber floating from the inland to the coastal areas. Before motor vehicles this was the dominant means of timber transportation. The role of railways has always been quite small in timber transportation in Finland.

mark had almost been reached. But then the market slowed down for over ten years, even to the point of threatening the whole survival of the industry. Fortunately, the market revived before the sawmills had reached the stage of a complete catastrophe. The boom period was a strong one, continuing until the beginning of the twentieth century. In the early years of the century, the Finnish sawmill industry produced over 500,000 stand. of lumber a year.

The expansion of the sawmill industry provided money, jobs and affluence. A great deal of these benefits found their way along the long chain of production into the Finnish countryside. But industrialization also left its mark on the milieu. Steam-powered sawmills at the mouths of rivers fostered industrial communities offering work to the non-landowning population. The chain of production meandered far into the inland regions along rivers, roads, railways and canals, linking the forests, rivers and lakes with the industrial centres and ports of Southern Finland, and the international market. A new rural society relying on the agricultural and forestry sectors replaced the old swidden, or burn-beating, economy of Eastern Finland. In the latter half of the nineteenth century, the Finland of the wilderness regions had gradually become an industrialized society. It may not have had all the characteristics of urbanized European industrialism, but in reality industrialization and agriculture relying on it took command in all sectors of Finnish society.

The sawmill industry was the economic motor of Finnish society until the close of the nineteenth century. In the 1880s it came to be accompanied and supported by the paper and pulp industry. This new sector emerged around the middle of the century, when the demand for paper first exceeded supply. Raw material, however, had been a bottle-neck. Fibres obtained from rags could not meet the suddenly increased demand, which meant that the industry had to find a renewable and easily refined raw material. The coniferous trees of the north provided cellulose either through mechanical action or by boiling. Either as such or combined with rag-pulp, cellulose could be used in the making of paper.

Finland was in an ideal position to take over the paper market of Russia, then in a rapid process of modernization. The Empire's own paper industry came under development, but long shipping distances and flaws in the structure of Russian society prevented the establishment of large production units. The Finns, on the other hand, soon learned to integrate wood-pulp facilities and cellulose and paper mills. Finland also had a great deal of unharnessed water power, spruce for both groundwood and sulphite cellulose, existing railway communications with St Petersburg and sufficient amounts of capital for establishing firms. Consequently, the new industry was soon successful. Though technologically more advanced, Sweden, Norway and Germany could not take over the eastern market, since Russian import duties gave Finnish firms permanent advantages.

The paper and pulp industry introduced a new dimension in Finnish society. New mills were built deep in the heartlands on the banks of rivers and rapids, particularly along the Kymijoki, Vuoksi and Kokemäenjoki rivers. These centres were linked to the large sawmills and ports at the river mouths and also to the forest regions. These developments reinforced the existing chain of production in the forest industry and speeded change to the built environment. Previously, the sawmills and forests were far from each other, but now the intervening space was taken up by a new industrial structure that began to shape the environment to a marked degree. The rivers and rapids were dammed, the felling of timber grew in extent, and floating routes became longer. Massive rafts of logs slowly drawn by steam-boats could now be seen on the large lakes of the inland regions. A new industrial culture developed around the felling and floating of timber and the paper mills. It had a rural image but the values of the industrialized world.

As predicted by Fabian Langenskiöld, the new forest-sector society provided welfare and affluence. The Finnish standard of living began to rise sharply in the 1870s. Although yearly economic growth was only around one per cent, the rise in the standard of living was clearly evident at different levels of society. Citizens could now enjoy the benefits of industrialization, such as consumer goods, lighting, heating and improved health care. One disadvantage was the rapid growth of population. The rural areas had excess population unable to find a living in the towns and cities. Neither was it possible to control all the aspects of rapid industrialization, and slums



Photo: Torsten Rancken, Metla photographic archives

Timber floating techniques were partly adopted from the west, from Norway and Sweden, and from the east, from Russia. In later years the life and work of timber-floating workers was greatly romanticized. In reality it was, as all forest work, hard toil in primitive conditions.

grew in the outskirts of the towns.

The main features of Finland relying on agriculture and forestry were an economy geared to exports and political consensus, which kept the country loyal to Imperial Russia. The export industries had two foundations. The sawmills served the western market, while the paper industry focused on the immense markets of Russia. As both market areas grew in the late nineteenth century, industry supplied a great deal of affluence and welfare for Finnish society. New developments spread quickly into all sectors of society along the chain of production of the forest industry. By the close of the nineteenth century, agriculture and forestry represented almost 90% of Finland's gross national product.

Historians have presented detailed accounts of late-nineteenth-century industrialization in Finland, but less attention has been paid to the concrete prerequisites for a society based in agriculture and forestry. Nor must we forget the forests. The history of Finland's forests remains to be written, although social change has often been explained with reference to the forests and their supplies of timber. This may be due to a lack of perspective. Historians and other experts acknowledge that Finland lives from her forests, but changes in the forests themselves and their relationship with change in society as a whole have not yet been considered.

Snellman's Course

The development of a society based on agriculture and forestry entailed a massive intervention by man and human society into the forests of Finland. As pointed out above, Finns had always used forest resources for various purposes. Areas of forest had been cleared into fields by burning over, and timber had been treated to provide tar. Moreover, the forests were the source of building materials and fuel. Although this earlier intervention resulted in a great deal of damage, the actual process was different. For a society based on agriculture and forestry, the forests were not a natural state of affairs, a way of life or an enemy, but an economic resource to be controlled, guided, shaped and adapted. Therefore, the architects of the new society were so strict in condemning the old practice of burn-beating, or swidden, cultivation. To a society in the process of industrialization, the old system was an "ignorant" and primitive culture.

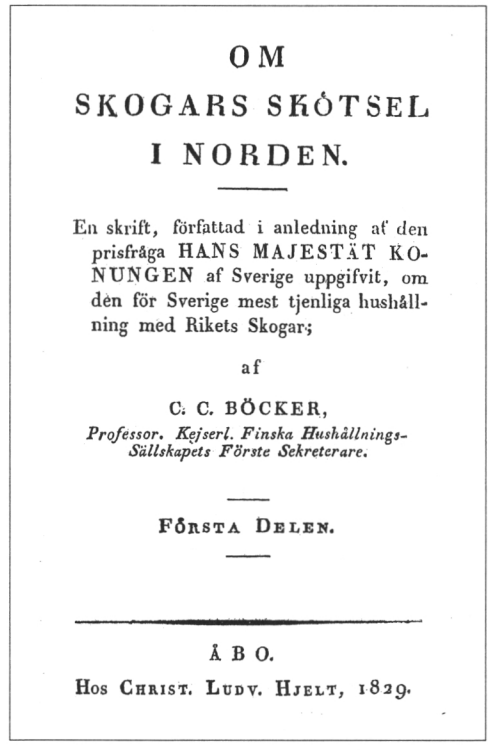
The forest debate, referred to above, drew a line between the old swidden economy and the new society based on agriculture and forestry. The forests were declared national property, which had to be managed rationally and protected against destruction by man and nature. Following this redefinition of the forests, attitudes regarding them began to change slowly but surely. The forests were no longer regarded as an enemy, as wilderness in its primeval state, nor even as burnt tracts of land destroyed by nature. These traditional views were gradually replaced by new concepts, such as commercial forest, seedling stand, felling area, thinned forest etc. The new terminology reflected the values and goals of a new type of society.

When Finns began the systematic utilization of the forests, they were hardly familiar with them. At the time, only two studies of Finland's forests, the structure of tree stands and their properties had appeared: a work written in the early years of the century by C.C. Böcker, secretary of the Finnish Society of Economics and C.W. Gyldén's *Handledning för Skogshushållare*, which appeared in the early 1850s.

Gyldén's book was highly significant for the emergence of the new society. He was the first to draw up a plausible estimate of Finland's forest resources and their yearly consumption. These figures showed that the industrial utilization of timber could be appreciably increased without risk to sustainable development. According to Gyldén, the forests grew at a yearly rate of almost 30 million cubic metres, which was sufficient for the sawmill industry, especially if the forests were properly cared for and all manner of waste were brought to an end.

The State Board of Forestry, however, wanted to check and verify Gyldén's estimates. A survey carried out in 1865 placed the reserves of log timber in the crown forests at some nine million trunks. In addition, the state-owned forests contained approximately five million trunks that could be used as railway sleepers.

For natural reasons, this single estimate could not tell whether the forests would produce sufficient amounts of new timber on a yearly basis. Therefore, the State



OM

SKOGARS SKÖTSEL

I NORDEN.

En skrift, författad i anledning af den prisfråga HANS MAJESTÄT KONUNGEN af Sverige uppgifvit, om den för Sverige mest tjenliga hushållning med Rikets Skogar;

af

C. C. BÖCKER,

Professor. Kejserl. Finska Hushållnings-Sällskapets Förste Sekreterare.

FÖRSTA DELEN.

ÅBO.

Hos CHRIST. LUDV. HJELT, 1829.

Carl Christian Böcker (1786–1841) became secretary of the Finnish Society of Economics in 1813. His most valuable work is his 1829 treatise on the management of the forests in the Nordic Countries. He was also an early pioneer in economic statistics, including forestry.

Board of Forestry drew up a new estimate of log timber three decades later. The new figures showed that the reserves of timber in the crown forests had increased by over 34 million full-length saw-logs and by over 45 million smaller logs. Although the forests were being utilized to an increasing degree, the timber stock grew at an even faster pace. During the First World War, forests under the supervision of the State Board of Forestry were estimated to contain 76 million full-length saw-logs. Smaller logs numbered almost 110 million. There are no corresponding estimates for the private forests, but the results were assumedly similar.

These estimates showed that the forests of Finland could regenerate quite well without human assistance. While consumption was less than the yearly growth of forest, the reserves of timber in the crown forests increased at a steady pace. These estimates, however, were influenced by the methods of calculation. The first estimates were based on results from a few sample areas, which were converted cartographically into assumed total figures for the whole country. As the maps were imprecise and the exact area of the crown forests was not known, the suggested total amount of timber was only an approximation. Survey and estimation methods gradually became more precise, and for example in Northern Finland in the late 1880s the crown forests were estimated with the line method. The number of sample areas increased and surveying equipment improved.

Although experts disagreed over the reliability of surveys and estimates, the message was nevertheless unmistakable. There were no natural obstacles to expanding the forest industry. The main problem lay with industry, which could not use all the timber produced yearly by the forests. This was particularly acute in the utilization of the crown forests, which were mostly situated in Northern and Eastern Finland. The steam-powered sawmills, on the other hand, were established in the western, southern and southeastern parts of the country at the mouths of the large rivers. Although the forest industry expanded its chain of production towards the north, the wilderness regions of Lapland and Kainuu were still too distant for any profitable use of their timber resources.

When the industrial utilization of forests began in Finland, government officials and industrialists were not primarily interested in the forests themselves, but in their reserves of timber. In some respects this was only natural, since there were still fears of deforestation. But alongside fears there were many calculated financial considerations. The officials and the forest owners estimated the amount of profit that could be obtained from the forests. This line of thinking was particularly prominent at the State Board of Forestry, which was responsible for the utilization and care of the crown forests.

The first years of the State Board of Forestry were far from easy, and the 1860s were, in a sense, a wasted decade. When the market for sawed timber opened up in the late 1860s, the Board tried to repair its rapidly sullied reputation. The goals and focuses of operations were redefined, and everything that was "unnecessary" was left out. The Board of Forestry tried to grab as large a share of the rapidly growing market as possible. This, however, proved to be difficult. As mentioned above, most of the crown forests were far away in the north, where there were no sawmills. Furthermore, the establishment of floating and transport routes from the wilderness regions to the termini of the chain of production was expensive and time-consuming.

Despite these difficulties, the State Board of Forestry was able to profit from the situation, gathering surplus revenue of over 600 million marks in the early 1870s. After this peak, the figures dropped for almost ten years, but despite the recession, were continually positive. Income began to grow rapidly after the mid-1880s. By the close the century, state forestry administration was making yearly profits of tens of millions of marks.

The financial performance of state-managed forestry and silviculture can be regarded as quite satisfactory, since all income came from the sales of timber. The state did not undertake any refining or manufacturing of its own, although the foresters repeatedly proposed since the 1850s that steam-powered sawmills be established in Northern Finland. These schemes were, however, rejected, and it was not until the beginning of the twentieth century that the state established sawmills to treat the large amounts of timber growing in Lapland and Karelia.

The sales of the log stock of the crown forests increased at the beginning of the



"The changing of the post". Directors-general Rabbe Wrede (right) and Alexander af Forselles (left). Af Forselles was appointed the new director of State Board of Forestry in 1870. The drawing was made by an unknown observer in the same year.

National Board of Antiques

1870s. The limit of 900,000 trunks proposed by Langenskiöld was exceeded in 1874. Although the state wanted to sell its timber, the proportion of the crown forests in the overall raw-material consumption of the forest industry was still only one-fifth at the close of the nineteenth century. This was due to long and difficult transport, and the lack of state-managed wood manufacturing operations.

When the market for the sawmill industry opened up, the state expected a fast increase of revenue. Expectations, however, did not match results. In the late 1860s in particular, it appeared that the senior officials of the Board of Forestry were not capable of making full use of the excellent market situation. Director-General Rabbe Wrede was particularly singled out for criticism, being accused of charging unduly high prices and even preventing sales. The critics were partly right. Wrede kept to the course which he had taken in the great forest debate, whereby the duty of the State Board of Forestry was to protect Finland's forests, and not to sell timber to the sawmills at lowered prices. According to Wrede, the sales of timber from state-owned forests could only be increased after the proper organization of forestry and surveys of crown forests. Only then would it be possible to decide from where timber could be sold, what kind of timber was to be offered and at what prices.

Wrede's position did not fare well. He had to resign from his directorship at the Board of Forestry, being replaced by Alexander af Forselles, former rector of the Evo Forestry Institute. The new director-general introduced new policies. Wrede's talk of protection measures was soon forgotten, and the State Board of Forestry set out to make as much profit as possible. Af Forselles argued for his course of action with reference to the laws of economics. Receiving more revenue, the State Board of Forestry could undertake more effective care and supervision of the forests. Af Forselles' "civil-engineering attitude" remained one of the foundations of Finnish forestry policy until the close of the nineteenth century.

Af Forselles' principles, however, were not all realized on the practical level. Time and again, the State Board Board of Forestry had to make compromises regarding the care and protection of the forests in order to generate profits. These compromises also made scientific research subordinate to the laws of economics.

Economic goals and the principles of rationalized forestry collided perhaps most clearly at the yearly timber auctions of the crown forests. These were held in various forestry districts, usually in the autumn. Sales were organized by the trunk or stem. The State Board of Forestry offered a certain amount of saw timber for sale, with a predetermined lowest buying price. Another, also common, arrangement was sales by concession, whereby the buyer and the selling party entered into an agreement spanning several years which permitted the buyer to obtain an agreed amount of timber in the crown forests for a predetermined price. The first sales of this nature were already carried out in the late 1850s, when the industrialist V.Z. Bremer was permitted to recover 2.4 million standard trunks from the crown forests. This agreement, however, was dissolved, because Bremer could not fulfill his own obligations. Sales by concession continued until the 1920s, being most common in Northern Finland, where it was expensive and time-consuming to obtain timber.

The various sales arrangements would have corresponded to the principles of rationalized forestry had the State Board of Forestry itself organized the measuring, felling and floating of timber. This principle was followed until the 1870s, but during af Forselles' term as director-general it became increasingly customary to sell standing timber. In other words, the buyer was authorized to fell the timber in the crown forests. Economic arguments were again cited, and were largely valid, since the measuring, cutting and floating of timber required labour and expertise. The problem, however, was that the State Board of Forestry had no control over the buyers. Sales of standing timber and concession agreements in particular left the state-owned forests almost completely in the hands of the buyers. The sawmill industry used only pine logs that were over 140 years old, over 20 feet long and had a minimum diameter of 25 inches. Since the quality requirements for raw material were strict, the markers and woodcutters chose only the best trees in this respect. This procedure, known as selection thinning according to set diameter, followed a simple principle. It was generally believed that each tree grew at its own rate. Once



Univ. of Helsinki, Dept. of Ecology

In the latter half of the nineteenth century, Finland became an industrial society. Sawmills, railroads, canals, rivers and lakes formed a complex industrial and technological network which channelled wealth and affluence into every sector of society.

the oldest trees were removed, the younger generation would replace them, and after a few decades a stand of full-grown trees was again expected. This belief, however, did not always correspond to reality. The best individual trees were also the best producers of seeds, in addition to which the largest trees disturbed the growth of younger timber. When the oldest generation was felled, all that remained was a degenerated generation of trees, which could not replace their predecessors.

Rationalized forestry would have taken a different course. A specific forest working plan would have been drawn up, based on cutting by compartments. When all the timber in a certain area was felled at the same time, the cycle of regeneration began according to the principles of Boreal nature itself. Cutting by compartment was particularly good for forest if the soil was lightly worked and the compartments were not made too wide. In this method, the cutting compartments were very narrow, 50–100 metres wide at the most. The other alternative was a "softer" method of regeneration in which timber of different age was felled in the selected compartment. The goal, however, was the same, i.e. to start the regeneration of forest "anew".

Cutting by compartments was, however, out of the question in the late nineteenth century. The sawmills required the largest and best-quality timber, which meant that there was no point in cutting all the timber in a selected area. The situation improved

somewhat when the paper and pulp industry began to use smaller and younger timber. The pulp mills and sulphite cellulose plants would only take spruce, as the pulp obtained from it was of a relatively light colour. Pine came into use as pulp material in the early years of the twentieth century, when the sulphate cellulose process was developed in Sweden and Germany.

The procurement of timber for pulp did not change the cutting methods followed in the forests. On the contrary, the buyers and sellers of timber were not able to coordinate operations, and pulp timber and saw logs were bought from different places at different times. In practice, this led to a situation in which the practice of selection according to set diameter increased. In addition to saw logs, timber suitable for making pulp was also collected. The results of thinning according to set diameter could be seen by the beginning of the twentieth century: the forests had a "ravaged" appearance, as the largest trees had been felled, and only seedlings and middle-aged (70 to 100-year-old) trees remained. This kind of forest regenerated slowly, if ever. In most cases the individual trees fell in the storms of autumn.

Rationalized forestry was also impeded by the methods used to measure and estimate standing timber. The official instructions of the Board of Forestry defined the various species and types of timber and the grounds for their pricing. For sawed logs, however, the instructions were insufficient. They were sold by the trunk and the price was established according to the volume of the logs. Measurement, however, was a difficult task, since the price varied according to all the flaws observed by the buyer in the trunks. Acceptable flaws influencing the price were, for example, too many branches, rot, cracks and asymmetrical shape. The sawmills were not slow to exercise their rights in this respect, employing "experts" who studied the stems and their flaws. The system of measurement and estimation led to a situation in which the sawmills were able to procure their raw material at prices much lower than the "real" rate. Consequently, the state suffered continuous losses. For example, in one year alone 86,000 stems, i.e. 37% of all felled timber, were rejected in the Kemi Forestry Inspection District.

The system of measurement and estimation employed by the Board of Forestry led to continual cut-rate sales of timber from crown forests. Worse still, the system made the foresters "tape-measure men" who were not required to have any scientific expertise, but only the desire and ability to serve and satisfy their customers. Furthermore, many professionals in the field became corrupt "experts" in the pay of the sawmills.

According to the official regulations of the State Board of Forestry, the officials were required to protect, care for and study the crown forests of Finland. In addition, the Board was to manage the forestry activities of the state. Only the latter duty was tended to in any proper manner. In the late nineteenth century the Board had become a government department solely interested in the economic utilization of the forests. This course greatly resembled the ideas on forest policy presented by J.V. Snellman in

the great forestry debate of the 1850s. In Snellman's opinion the duty of state forestry administration was to ensure that the crown forests would provide as much revenue as possible for the national economy, and agriculture in particular. The rationalized management of the forests was also important, but this was something the peasants and farmers could carry out on their own and without official supervision.

Around the close of the century, the Board of Forestry implemented the course outlined by Snellman. Despite this, the farmers and peasants were not satisfied with state forestry practices. In the Diet and in the press, the most severe opponents called for the termination of forest administration and official forestry activities. The Board responded to this by increasing its sales of timber. Hence the forests had no time to recover from the former effects of swidden cultivation, on the contrary. Although deforestation slowed down and slash-and-burn cultivation ceased almost completely by the beginning of the twentieth century, a considerable proportion of the forests were "ruined" by thinning them to such a degree as to be almost beyond utilization. Industrialized Finland was built with the riches of the forests, and the structure of production in agriculture and the overall infrastructure of society were all financed with forest revenues. Modernization, however, did not improve the ecology of the forests. Snellman and Langenskiöld were convinced that rising timber prices would automatically improve the standard of forestry. This belief was not borne out. Greed overruled the principles of rationalized forestry. The state, and also private landowners, tried to profit as much as possible from the good market situation, which meant that the destruction of the forests continued. The only difference with regard to the former swidden and tar-making economy was that now this destruction was being wrought by those whose duty it would have been to protect the forests and manage them in a rational manner.

A Lone Empiricist

For understandable reasons, forestry policies geared to the markets did not create any appreciable conditions for scientific research in the field. Around the close of nineteenth century Finland witnessed the same phenomenon as many industrialized western nations. The industrial system of production and the necessary technological infrastructure were first developed, and only then was scientific research initiated to study the sufficiency and dynamics of related natural resources. Science and technology did not guide industrial development in Finland. On the contrary, they supported this process by solving problems and by establishing a scientific and technological basis for economic, political and social decisions.

In this situation, scientific forestry research became the responsibility of one individual. In June 1867, A.G. Blomqvist, who had been a member of the faculty at Evo, was commissioned to gather data from various parts of the country for the

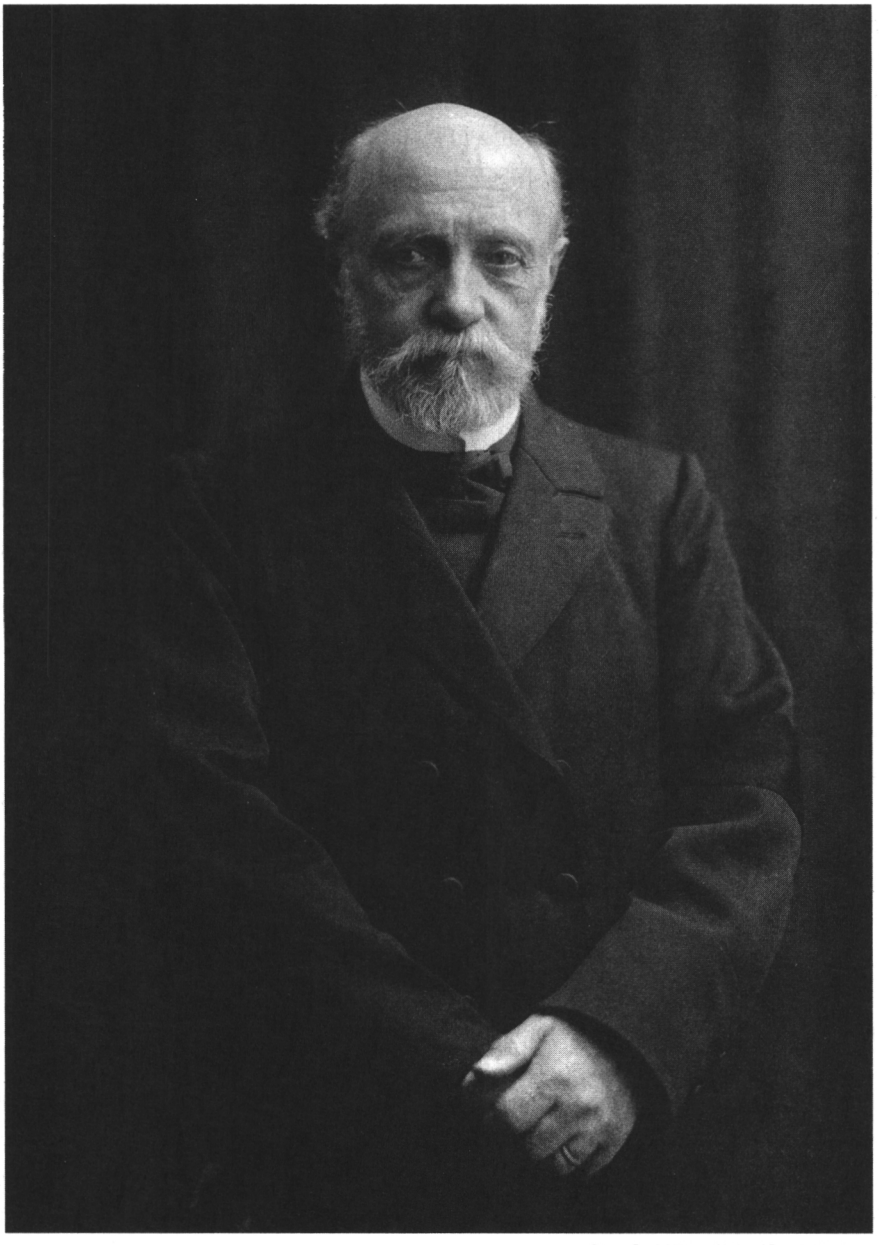


Photo: Daniel Nyblin. National Board of Antiques

Anton Gabriel Blomqvist (1836–1904) graduated in 1858 from the Tharandt Academy of Forestry in Saxony, Germany and was appointed lecturer in silviculture at the Evo Forestry Institute in 1861. He became the director of the Institute in 1874. A.G. Blomqvist published valuable treatises on silviculture, growth and yield studies and national forest economics. He is considered "the Father of Finnish Silviculture".

calculation of yield tables for pine, spruce and birch. This task was given to him by Rabbe Wrede, director-general of the State Board of Forestry. The purpose of this appears to have been to complement Gyldén's and von Berg's earlier studies with empirical research showing how and in what time Finland's three main species of trees became fully grown. Blomqvist was also required to note local forestry methods, particularly ways of felling, and tar-burning, swidden clearance and forest fires. Blomqvist was a natural choice for this demanding project. In the 1850s he had studied at the Tharandt Academy of Forestry in Germany under the world's leading experts in forest research. He was possibly the only person at the time in Finland who had the knowledge and theoretical qualifications necessary for calculating yield tables for various species.

The task was by no means easy. The yield tables were intended to provide a reliable picture of forest growth and the development of stands under different conditions and in various environments. Precise results required observations and measurements in stands of forest that were still in their natural state. In practice, this meant that Blomqvist had to find forests whose growth had not been influenced by man, at least to any major degree. Although Finland appeared to have an endless succession of wilderness regions, virgin forest was truly difficult to find by the middle of the nineteenth century. Swidden cultivation, tar-burning and grazing had all "consumed" Finland's forests to a far greater degree than suggested by the country's small population.

Blomqvist, however, was persistent in his studies, seeking and finally finding over 1300 stands of forest to be used as sample areas. Their size varied from ca. 9 ares to half a hectare. When the sample plot was laid out, Blomqvist began work. He estimated the trees growing in it, calculated the relative proportions of different species, and finally their cubic volume. The latter was done with the Pressler method, which had been developed in Germany and was particularly well suited to Blomqvist's purposes, as it did not require the felling of sampled trees.

Blomqvist soon discovered that the productivity of the soil depended on the specific nature of the location. There was a great deal of variation, and precise results would have required a detailed classification of conditions. Working on his own and with only limited time at his disposal, Blomqvist classed the sites into only three groups. The lowest, or worst, class consisted of sample areas on dry sandy and gravelly soil or in stands of pines and heather. In locations of this kind, there were unmixed stands of pine. The middle range was represented by sites in relatively fresh stands of forest. Here, pine was accompanied by spruce and birch. The best, or good, class consisted of sample sites in formerly cultivated areas, where spruce and birch formed mixed forest including a great number of other species.

Blomqvist's study (*Tabeller framställande utvecklingen af jemnåriga, slutna skogsbestånd af tall, gran och björk*) was published in 1872. Its value can hardly be overestimated. Blomqvist worked under extremely difficult conditions. His first

expedition was in the summer of 1867 to Central Finland and Ostrobothnia. In 1868 he journeyed to the north to study the forests of Lapland, and the last expedition was in the summer of 1869, to the forests of Eastern Finland, Karelia and the eastern parts of Uusimaa Province on the south coast.

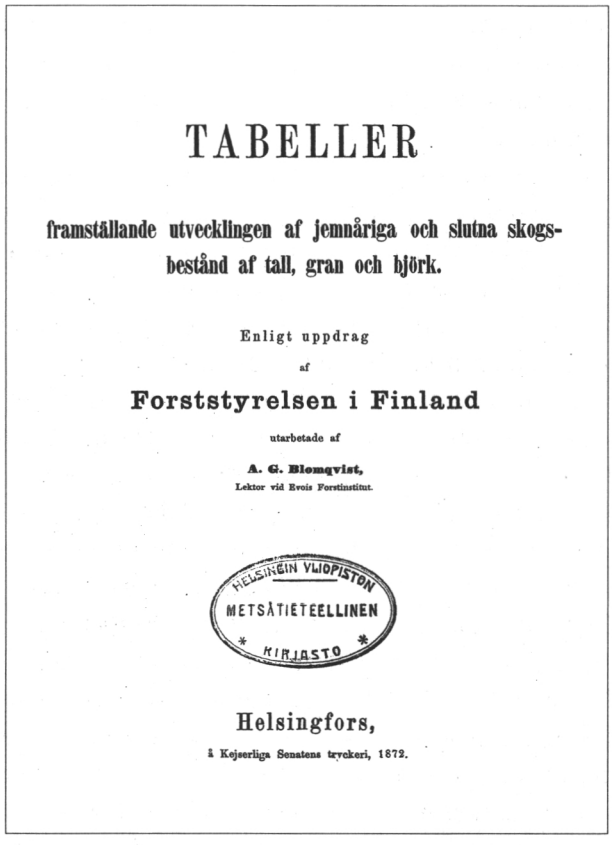
Blomqvist worked in various parts of the Finnish countryside, which at the time suffered from famine and epidemics. These severe conditions were naturally reflected in Blomqvist's studies. Human misery was compounded in the forests. Forest fires, swiddens, tar-burning and reckless cutting by sawmills had caused a great deal of damage in all parts of the country. The situation was particularly bad in Northern Ostrobothnia in an area which was the centre of the nation's tar industry. Blomqvist often had to travel dozens of kilometres to find stands of forest that could be used as samples. It was almost as bad in Central Finland. Forest fires, which had raged a decade previously, had destroyed large areas, in addition to which burn-clearing and tar-burning continued. The authorities did not want to interfere, as the starving rural population now had to be offered every possible means of livelihood.

Despite many difficulties, Blomqvist completed his work. The study was precise and factual, and when the figures of the yield tables were checked almost sixty years later hardly any mistakes could be found. In addition, Blomqvist prepared detailed descriptions of the properties, growth and regeneration of pine and spruce in different habitats in various parts of the country. He also intended to carry out a similar study on birch, but was unable to finish it. Blomqvist's specialist studies on pine and spruce were published in the early 1880s.

Blomqvist's studies offered a scientific definition of Finland's forests, in addition to a great deal of new information on the main species, their growth and the surrounding ecosystem. In economic terms, Blomqvist's results confirmed the views already presented by von Berg, Gyldén and Wrede. The nation's forests were in poor condition, but they regenerated naturally, and would do so even better if given good and expert care.

A.G. Blomqvist has, with due cause, been regarded as the founder of scientific forest research in Finland. But he remained a solitary empiricist, unable to raise a later generation of researchers who would have continued his work. A few young foresters, however, chose a career in research. Bernhard Ericsson graduated from Evo in the mid-1880s, remaining there as a member of the faculty and engaging in active research into forest survey and estimation methods. After an extensive study trip to Germany in 1894–1895, he published the first Finnish-language manual on forest survey theory, methods and measurement equipment in 1903. These methods also interested Albert Sivén.

Why did forestry research remain the field of only a few experts, while Finnish society as a whole was being based on agriculture and forestry? There are several reasons for this, most notably the policies of the State Board of Forestry. The development of scientific research in this field was the responsibility of the Board.



TABELLER

framställande utvecklingen af jemnåriga och slutna skogsbestånd af tall, gran och björk.

Enligt uppdrag

af

Forststyrelsen i Finland

utarbetade af

A. G. Blomqvist,

Lektor vid Evois Forstinstitut.

HELSINGIN YLIOPISTON
METSÄTIETEELLINEN
KIRJASTO

Helsingfors,

i Kejserliga Senatens tryckeri, 1872.

Growth and yield tables for even-aged stands of Scots pine, Norway spruce, and silver and white birch were included in a fundamental study by A.G. Blomqvist on the timber yield capacity of Finnish forests.

Although the Evo Forestry Institute reopened in 1874, its curriculum and resources were severely curtailed. Theoretical and scientific forestry were removed from the curriculum and the focus was placed on practical forestry and related technology. The new professionals in the field were taught to utilize forest resources, but not to maintain, study or protect the forests themselves.

Even in other respects, the State Board of Forestry had an unsympathetic attitude towards scientific research. Blomqvist tried to change the curriculum of the Evo institute in a more scientific direction on several occasions, but with no success. The Board consistently rejected all proposals of this nature. In the early 1870s Blomqvist proposed that each forestry region was to have an experimental stand, providing observations and research results on a regular basis. The Board insisted that such stands were not necessary, for their study and maintenance would only be a waste of money. Blomqvist persisted in his efforts until the beginning of the twentieth century, but finally gave up. Equally unsuccessful was a proposal which would have established an experimental forestry research institute as early as the late 1860s. This joint motion by the country's foresters was rejected as a result of opposition by the Board.

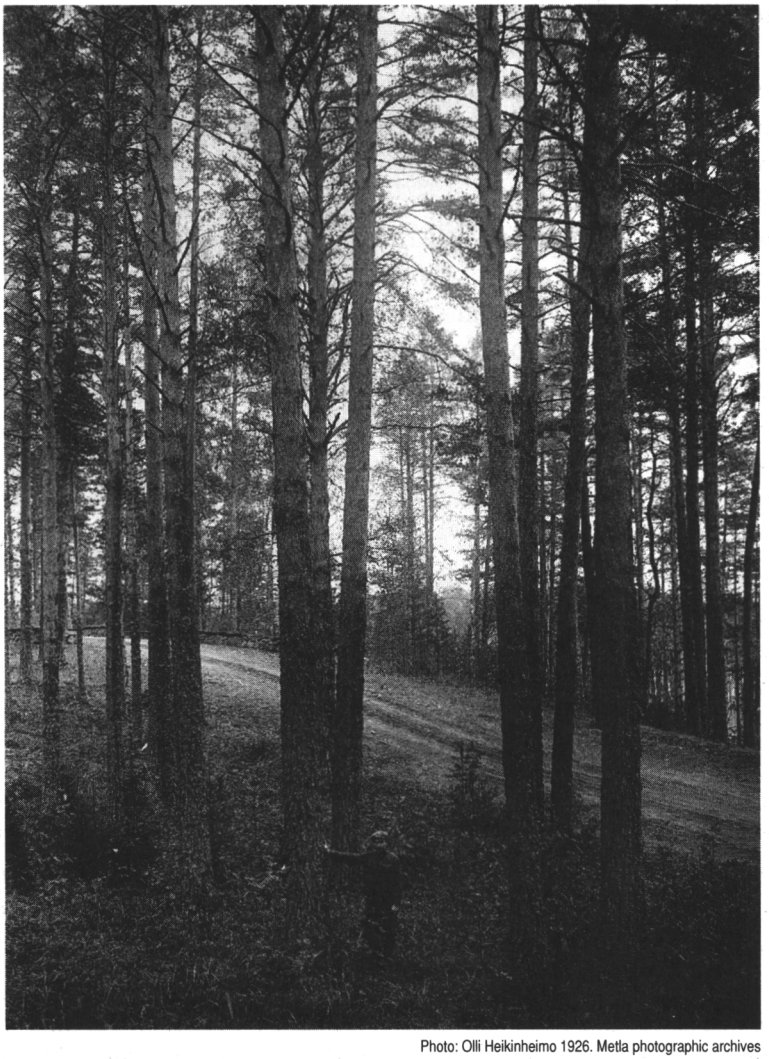


Photo: Olli Heikinheimo 1926. Metla photographic archives

Timber for the sawmill industry was the main product of the Finnish forests until the turn of the century.

Another important reason for slow progress in forestry research is to be found in Blomqvist himself. Although he was Finland's leading expert in the field by virtue of his extensive knowledge and expertise, he did not try to find or establish a broad theory that would have explained the regeneration and growth of Finland's forests. He was an empiricist, who persistently and gradually added to available knowledge on the nation's forests. As resources were limited, the store of knowledge grew too slowly, and the authorities could not see the value of even minor studies for the rationalized management and care of forests.

The Heirs of the Tar Industry

The emergence of the paper and pulp industry was a decisive change to the industrial utilization of forest resources. Cutting was no longer limited to the old stands of pine. Timber was now procured at the same time from larger areas. The large logs of pine were sold to the sawmills, while spruce was stripped, dried, cut into lengths and floated after one or two years to the paper and pulp mills. Birch was "rubbish timber" initially used only as fuel. The value of birch began to recognized towards the close of the century, when the bobbin and spool industry began to utilize the country's extensive birch resources. Aspen was also utilized in the matchstick industry. The sulphate cellulose industry used pine fibre.

The Finnish forest industry did not produce finished products but raw materials which were refined and fabricated in other contexts. Although paper, cardboard, pulp and sawed goods were all valuable semi-manufactured articles, they did not provide as much revenue as, for example, the products of the chemical and machinery industries, which were developed and refined to a high degree. Some industrialists even questioned whether products of a high degree of fabrication could be made from timber.

This was a timely issue for the chemical industry, which was in danger of being overrun by the forest sector. The making of cellulose relied on chemical processes, but cellulose pulp was only a raw material for paper, and not a finished product as such. The chemical industry tried to seek processes by which medicines, dyes or other products of organic chemistry could be made. The modern chemical industries of Western Europe and the United States relied on coal tar, from which innumerable synthetic products could be derived. This raw material was not available in Finland, but there was a great deal of hitherto unutilized pine containing the raw material for tar.

Traditional tar-making could not serve as the basis for the chemical industry. The tar-burning pits were inefficient, and the market for their products disappeared around the end of the nineteenth century. Furthermore, the traditional tar industry consumed too much forest. Despite these problems, it was not profitable to completely abandon tar-making. A number of interesting, and economically viable, chemicals could be obtained by distillation from pine.

Reforms in the tar industry already began to be planned in the 1860s. In 1860 A.F. Soldan, an engineering expert who had travelled widely in the United States and in many European countries, published a plan for expanding traditional tar-burning into an industry operating on a broad basis. In Soldan's scheme, the traditional burning pits were to be replaced by furnaces, which were considerably more efficient, faster and easier to operate. The new furnaces would not waste raw materials, and would preserve and recover the valuable chemicals provided by the process. Soldan assured his readers that the furnaces would provide not only



Photo: Brutus Lesche 1904. Metla photographic archives

Charcoal and tar pits were the first stage of chemical manufacturing based on wood.

traditional dry-distilled tar but also tar water or wood acid, turpentine, pitch and good-quality charcoal.

Soldan's suggestions were eagerly received, and tar and turpentine factories were established in various parts of the country. After only a few years, however, they had to cease operations, as they were too small and located too far away from the market. There were attempts to remedy the situation in the 1890s. The tar industry was concentrated in larger units closer to the river mouths and ports. Production increased, but only momentarily. The independent tar industry was now threatened by the sulphate-cellulose industry, which used the same raw material: waste from sawmills or small pine. The larger branch was more successful, and the tar industry as an independent sector all but disappeared around the beginning of the twentieth century.

The dream of chemically utilizing timber, however, did not die. Finnish chemists began to seek new opportunities for products among the waste chemicals of the cellulose industry. Working in Germany around the close of the nineteenth century, Ossian Aschan, docent in chemistry at the Imperial Alexander University in Helsinki,



Suomen Terwapoltosta

ja

kuinka se olisi parannettawa,

kirjoittanut

Aug. F. Soldan.

Ruotsista suomentanut

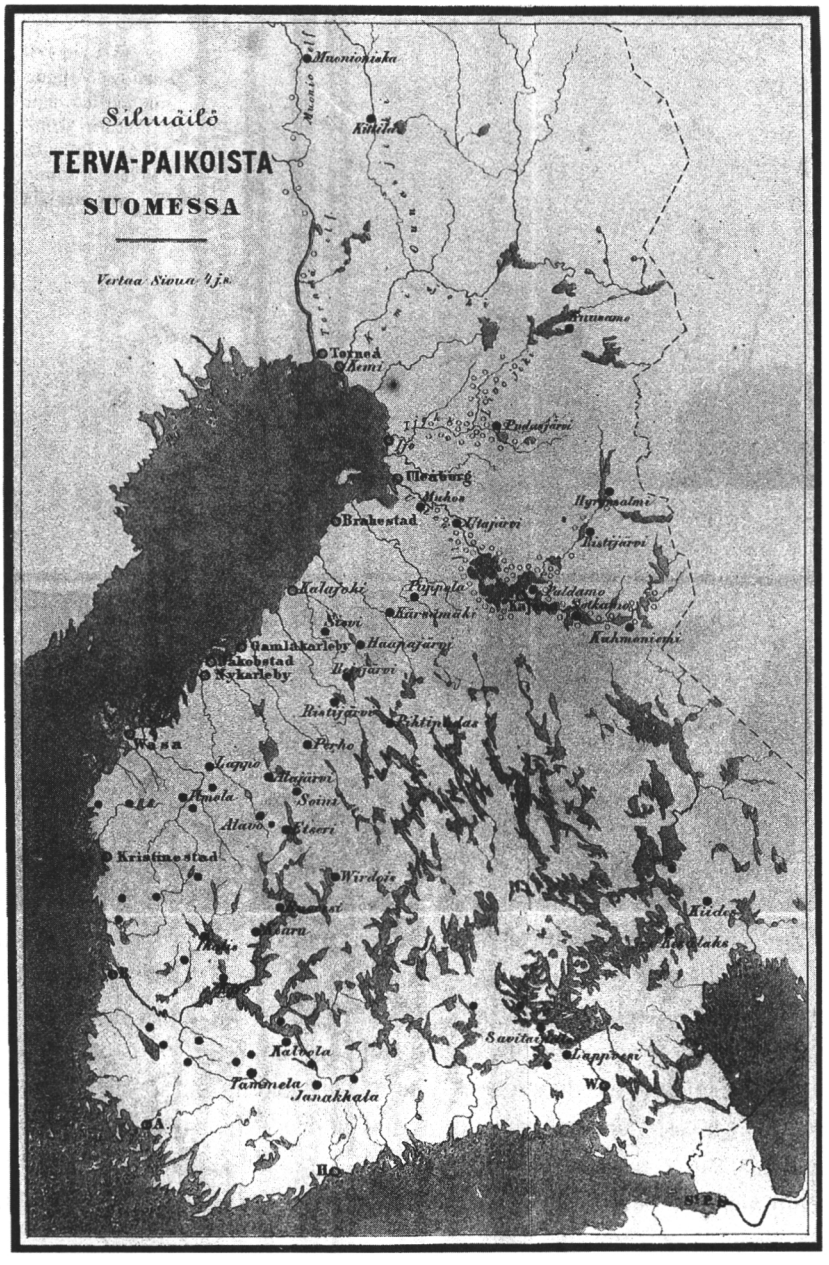
W. F. G.

Helsingissä,
Keisarillisen Senaatin kirjapainossa,
1862.

A.F. Soldan made a thorough survey of tar-burning activities in Finland in 1860–62. He also made plans for the technical development of tar distilling. His textbook was originally published in Swedish as then was usual but it was also translated into Finnish.

succeeded in developing a method for the synthetic manufacture of campher, an important substance for making medicines. The same problem also interest Gustaf Komppa, a chemist at the Polytechnic Institute in Helsinki. Aschan returned to Helsinki in 1908 and was appointed Professor of Chemistry at the University. Komppa became Professor of Chemistry at the University of Technology, also in 1908, which meant that inorganic chemistry gained a strong institutional foundation in Finland around the beginning of the century. Aschan and Komppa were both prepared to apply the results of research in industry. Komppa established his own firm, continuing research into campher and terpene and later the use of peat as a domestic fuel. Ossian Aschan persuaded the forest and chemical industries of Finland to establish an institute known as the Central Laboratory in 1916 as a centre for research into wood chemistry.

Although studies concerning tar and wood chemistry was not forest research per se, they had close links with scientific studies on timber and the forests. Already A.F. Soldan's scheme contained sophisticated instructions regarding the use and management of forests. Soldan pointed out that, properly organized, the tar industry would not destroy the forests. In the nineteenth century, the chain of production of the forest industry ended, for practical purposes, with the sawmills. Soldan felt that such a



Main areas of tar burning in Finland in the 1860s according to A.F. Soldan (1862). At the time Central and Southern Ostrobothnia were the core areas of tar burning. Later on the activities shifted further north to Kainuu and Southern Lapland.



Adolf Ossian Aschan (1860–1939) became professor of chemistry at the University of Helsinki in 1908. He was interested in the technical applications of chemistry, including wood chemistry.

National Board of Antiques

chain was too short, as there was a great deal of timber in the forests which could be put to use in industry. The tar industry could easily use woodcutting debris, stumps and dead or poorly growing pines. Furthermore, the method of cutting in compartments would make it possible for tar manufacturers to use small-sized timber and other wood that was not suitable for the sawmills.

Had there been systematic efforts to develop the tar industry, the forests of Finland would have gained a far different appearance. The use of forests is contingent upon their care and how they are developed. The sawmills required long, straight, thick trunks without knots. The paper and pulp industry also had strict quality requirements. Because branches, knots and misformed timber produced dark patches in the pulp, the mills tried to obtain as perfect and branch-free specimens as possible. These requirements were duly reflected in the care and further development of the forests. If the forest industry had concentrated on producing tar and other chemical compounds, sawed timber and paper would have remained intermediate products, and efforts would naturally have focused on developing the final products and the procurement of their raw materials.

Although plans of this nature were highly popular among chemists, the forest industry took a different course. Ossian Aschan wanted to develop the Central Laboratory into a centre of innovations for the chemical and forest industries, but research was terminated in the early 1920s. Following the wishes of the sawmills and the paper and pulp industry, the laboratory concentrated on the standardization of paper and pulp grades in order to strengthen the competitive position of the paper industry in the western market.

Although wood-chemistry studies remained limited, they nevertheless opened new perspectives on research into Finland's timber resources. The chemists explored this material and sought ways to utilize Finnish species of trees in industry. These studies produced a great deal of new information, particularly on the chemical structure of conifers and on cellulose, which in the twentieth century became an important raw material in Finnish industry.

The Contours of the Grand Duchy of Finland

The Academy of Turku, Finland's first university, was established in 1640 as part of the Swedish university system, which included the universities of Uppsala, Lund and Dorpat (Tartu). At first only government officials and clergymen were educated at Turku, but from the 1720s the Academy began to focus on the sciences and studies related to technology and the economy. Scholars such as Johan Browallius, Pehr Kalm, Pehr Adrian Gadd and Johan Gadolin introduced a new "Baconian" culture of scientific inquiry intended to provide as many practical applications of scientific knowledge as possible. Particularly during Kalm's, Gadd's and Gadolin's period an active culture of scientific research thrived in Turku. During the eighteenth century, a great number of dissertations were officially inspected at the Academy. These included subjects such as the growing of foreign domestic plants and trees in Finland, new cultivation methods, tar-burning, and sawing methods and techniques. There were also studies on various problems in agriculture.

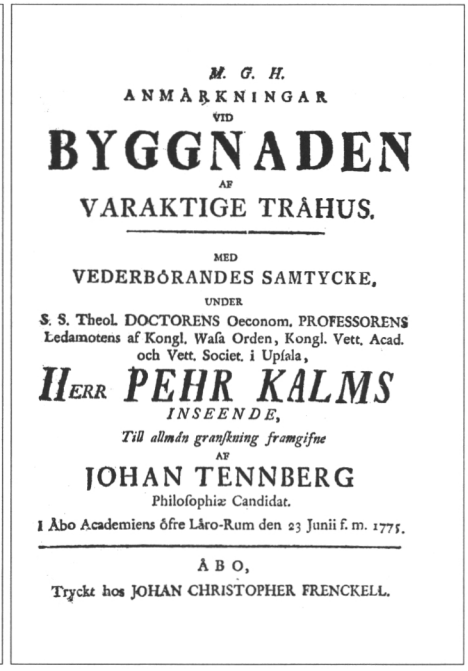
Although a great number of studies were prepared, the results were not passed on as desired to the farmers and peasants. One problem in particular was the poor level of education among the common people. The peasantry preferred to rely on established traditions instead of scientific applications. Furthermore, Finland lacked industry or industrial crafts which would have had use for the results produced in Turku.

Towards the end of the eighteenth century active scientific research dwindled at the Academy. The collapse finally came at the beginning of the nineteenth century, when Finland was first joined to Russia in 1809 and when slightly later a disastrous fire destroyed almost all of Turku in 1827. The Russian authorities moved the university to Helsinki, where it began operations in 1828 as the Imperial Alexander University. These were difficult changes. The professors of the old Academy did not want to move to peripheral Helsinki, where the university still lacked proper buildings, not to speak of any academic culture. The situation was by no means improved by the military administration of Tsar Nicholas I (on the throne from 1825–1855), whose strict censorship stifled academic debate.

In the middle of nineteenth century the university was provided with an impressive new building in the centre of Helsinki. Despite developments, the university did not



I. J. N.
OFÖRGRIPELIGA TANCKAR
OM
NÖDWÄNDIGHETEN
AF
SKOGARNAS
BETTRE WÅRD OCH ANS
I
FINLAND,
MED
Wederbörandes Tilstånd,
Under
PROFESSORENS I OECONOMIEN
Och Kongl. Vet. Acad. Ledamots
HERR PEHR KALMS
Inseende,
Uti et Academiskt Förfök
Utgifne
Af
DANIEL LITHANDER,
SATAKUND.
I Åbo Större Läro Sal, f. m. den 7 Julii 1753.
ÅBO Tryckt, hos Directeuten och Kongl. Boktr. i Stor-Förstendömet Finland, JACOB MERCKELL.



M. G. H.
ANMÄRKNINGAR
VID
BYGGNADEN
AF
VARAKTIGE TRÅHUS.
MED
VEDERBÖRANDES SAMTYCKE,
UNDER
S. S. Theol. DOCTORENS Oeconom. PROFESSORENS Ledamotens af Kongl. Wasa Orden, Kongl. Vett. Acad. och Vett. Societ. i Upsala,
HERR PEHR KALMS
INSEENDE,
Till allmän granskning framgifne
AF
JOHAN TENNBERG
Philosophiæ Candidat.
I Åbo Academiens öfre Läro-Rum den 23 Junii f. m. 1775.
ÅBO,
Tryckt hos JOHAN CHRISTOPHER FRENCKELL.

Two examples of graduate theses published at the Academy of Turku in the 18th century. The role of the professor was a leading one in the preparation of these small treatises. The thesis by D. Lithander (left) stressed better silviculture and the thesis by J. Tennberg (right) illustrated the benefits of better houses for peasants.

carry on the scientific traditions of the Academy of Turku. On the contrary, the new university focused on the humanities, theology and law. This was a natural choice, as Finland had to develop its own central administration in a short time, and future government officials had to be given a broad education.

The natural sciences were in a difficult position in Helsinki, where the academic atmosphere favoured "spiritual" disciplines bolstering national identity and strengthening the position of Finland vis-à-vis Russia. The experimental sciences were now regarded as alien, and even as a threat. The professors of the university felt that industry could acquire whatever know-how it required directly from abroad. There was a strong desire to maintain the Imperial Alexander University as a "pure" research institution without practical training. A good example of this attitude was the Evo Forestry Institute, which was located far away in the forests of Häme. Throughout the nineteenth century, the Mustiala Agricultural Institute also operated at a long distance from the capital.

Mustiala and Evo competed with each other. From a very early stage Mustiala established a separate department for forestry education. It was headed by Alexander Borenius, who had studied under Blomqvist at Evo. Training in forestry continued at Mustiala until the beginning of the 20th century.

The policies of the Imperial Alexander University differed greatly from those of universities in Sweden and other western industrial nations. In Sweden, experimental research in the sciences and technology were already emphasized around the beginning of the nineteenth century. The curricula and research programmes of universities and tertiary-level institutes of technology were revised to meet contemporary needs. The same course was followed at the University of Dorpat (Tartu) in Estonia. Although Estonia had belonged to the Russian Empire since 1721, the university was part of the German university system, developing in the nineteenth century into an extremely high-level institution concentrating on the natural sciences and technological research.

The Imperial Alexander University began to shift its focus of research and teaching around the middle of the 19th century. This was due to rapid change within Finnish society, to which the university had to respond. The construction of the Saimaa Canal and the railways and the establishment of nationwide educational and health-care systems required scientific and technological expertise, and scientifically educated personnel. Responses to increased demand for research included the establishment of laboratories and an increased emphasis on experimental research. In the 1880s technological research and teaching were concentrated at the Polytechnic Institute of Helsinki.

Although the natural sciences received a greater deal of attention at the Imperial Alexander University from the middle of the century, they still had to conform to the traditional ideology of research policies. This line of thinking, mainly influenced by J.V. Snellman, underlined the national significance of science and research. Absolute truths were important, but science, including the natural sciences, had to support a national project of education and civilization. The education of the common people and thereby the reinforcement of national identity were even more important than the economic applications of science and technology.

These principles also guided forest research at the Imperial Alexander University. Botany, to which forest research mainly belonged, did not strive to investigate the economic potential of the nation's forests. On the contrary, individual studies were intended to chart the whole flora of Finland and its regional features in as much detail as possible. In terms of research, flora was in the same position as the common people, whose culture, language and history of settlement were investigated by anthropologists, linguists and historians.

During the eighteenth century, botanical research had developed markedly at the Academy of Turku. This tradition of scholarship literally went up in smoke in 1827, when the fire of Turku destroyed the library and botanic gardens of the Academy. This meant that everything had to begin anew when the university was moved to Helsinki. The botanical collections gradually expanded, but most of the additions were the result of foreign expeditions rather than the collection of domestic plants. This was a good example of the state of botanical research in Finland during the first half of the

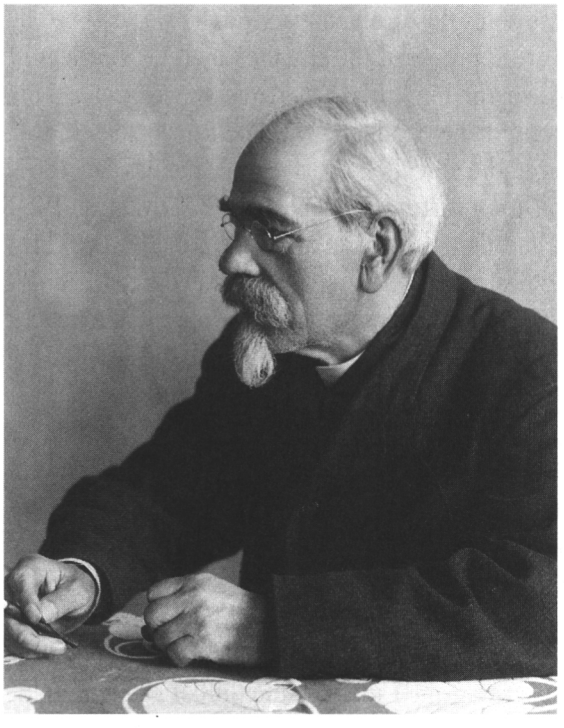


Photo: Viljo Kujala 1927. Metla photographic archives

Finnish geobotanists were especially interested in the areas immediately east of the country, i.e. the Kola Peninsula and East Karelia. On the other hand, the Swedish North, inhabited by a Finnish speaking population, did not arouse as much interest. Sample of flora from Petsamo – dwarf cornel (*Cornus suecica*).

nineteenth century. The professors who came to Helsinki from Turku were more interested in exotic foreign lands than the still peripheral capital and the plants of the regions beyond it. The only clear exception to this attitude was J. Fellman who undertook extensive expeditions to study the flora of Lapland. Fellman, however, was not a professor of botany, but a preacher who was active in Lapland in the 1820s and '30s.

The situation took a decisive change in the 1840s. A new generation of researchers, who had been born in the Grand Duchy of Finland, now began to lead botanical research. There was an obvious change in focus. The Societas Pro Fauna et Flora Fennica was established to support research activities. A spirit of national enthusiasm was also evident in the actual research. In the early 1840s Fredrik Nylander, docent of botany at the Imperial Alexander University carried out long expeditions to various parts of the country, publishing his results between 1843 and 1846 in a three-volume botanical atlas of Finnish flora. Around the end of the decade William Nylander continued his brother's work, raising the scientific standards of the *Societas Pro Fauna et Flora Fennica* and encouraging young scholars to publish scientific articles in the society's journal. William himself published a three-volume descrip-



National Board of Antiques

Johan Petter Norrlin (1842–1917) was the founder of the Finnish "school" of forest site classification. His own studies on plant communities as well as the taxonomy of genus *Hieracium* are notable contributions. He is, however, mainly known as the main teacher of A.K. Cajander (1879–1943).

tion of Finnish flora. He was appointed Professor of Botany in 1858, and within only a year he had prepared a list of all plants collected by museums in various parts of the country.

William Nylander had a considerable number of students, including J.P. Norrlin, who was greatly influenced by Nylander but went on to follow his own course in research. Norrlin was not interested in the collection and cataloguing of plants alone, but wanted to make a more thorough study of the inner dynamics of the plant kingdom. He was particularly interested in why certain plants always grew in certain habitats. These problems led Norrlin into the field of geobotany, studying the distribution of plants, their formation of communities in nature and their occurrence in various habitats. This field is also concerned with the structure of plants and the dependence of their vital functions on the habitat.

There was a definite need for geobotany in late-nineteenth-century Finland. Ethnologists, linguists and historians had discovered the roots of the Finns and their culture in Karelia and the far-off regions of Russia. Research showed that the Finns constituted their own, separate culture, which nevertheless had been influenced by the Swedes and the Russians. This provided a solid foundation for national ideology as formulated by Snellman. The basis would even be stronger if it could be proved that the Grand Duchy of Finland differed from Russia and Sweden also in natural-scientific terms.

Geobotany provided the means to study this problem. J.P. Norrlin was assisted by a number of young scholars who were prepared to seek the "natural" borders of Finland to the east, west and north. Norrlin himself travelled to eastern Karelia in the mid-1880s. A. Oswald Kairamo, one of his students, travelled north to the Kola Peninsula. Kairamo's results inspired the so-called Great Kola Expedition in 1887. The participants were, in addition to Kairamo, the zoologists R. Envald and J.A. Palmén, the geologist W. Ramsay, and the geodetician and surveyor R.A. Petrelius. Even these efforts did not end the desire to undertake far-off expeditions. Finnish naturalists organized several dozen expeditions to the Kola Peninsula and the eastern parts of Karelia. In addition, geobotanists studied the flora of the Åland Islands, the western archipelago and the valley of Tornionjoki River and its origins.

This active programme of research produced a great deal of new information on Finland's flora, its distribution and regional differences. It could also be seen how man had influenced flora and its distribution. Geobotanists and geologists also fulfilled their specific national duties. The expeditions to the Kola Peninsula and Eastern Karelia showed that Finland's "natural" borders were by no means identical with its political borders: Finnish-type flora and soils extended much farther to the east. The "natural" border between Finland and Russia extended south from the White Sea, east of Lake Onega and across Lake Ladoga to the Gulf of Finland. In the west, the Tornionjoki River valley was the political border, but there was no clear difference between Sweden and Finland in terms of natural habitats. This led to a new definition according to which Finland was a separate area in the naturalist sense, but clearly a part of Fennoscandia, to which Sweden and Norway also belonged.

Although J.P. Norrlin had studied at Evo in the 1870s, he did not particularly emphasize the forests in his studies. Similarly, his students concentrated on flora and specific habitats, but not on the forests or Finland's stock of timber. This seemingly strange choice is a good indication of the national role of geobotany and the natural sciences. Their purpose was to provide objective basic-level research on Finnish nature and its phenomena. A great deal of information on the forests was also obtained. A. Oswald Kairamo demonstrated that the northern boundary of the forests was shaped by dry and cold winds. The winds evaporated moisture from the soil, which controlled the spread of forest. On an expedition to Russia, A.K. Cajander, in turn, observed that certain types of forests grew in certain types of habitat in the valley of the Lena River. Kaarlo Linkola studied swidden plots in the areas north of Lake Ladoga, comparing their flora with changes in the surrounding environment, thus outlining the influence of man on forest conditions.

Geobotany unwittingly produced important basic-level data for forest research. No less important information was obtained from research projects aimed at developing Finland's tar industry and the chemical refinement of wood. There was, however, no forestry research as such in late-nineteenth-century Finland. A.G. Blomqvist and some of the faculty members and students at Evo, however, applied the methods of



Metla photographic archives

The destruction of forests in Finland continued although slash-and-burn agriculture slowly diminished. Sawmills and paper and pulp mills utilized only the "best" trees. After selection thinning the forests had a ravaged appearence, as the largest trees had been felled, and only seedlings and middle-aged trees remained.

forest science in developing the forestry methods.

Why then were Finland's forests not studied with scientific methods although there had already been decisions to this effect in the 1850s? There were many reasons for this, perhaps the most important being the lack of a proper research institution. The Evo Forestry Institute could have provided the facilities for systematic forest research, but personnel and funding were reduced to such a degree in the 1870s that no research could be carried out.

The university, on the other hand, carried out no research concerning the forests, because other applied and professionally oriented sciences than medicine were not accepted. The scientific study of forests was introduced as if by mistake along with geobotanical studies. This, however, could not amount to the same as systematic, planned research. The geobotanists themselves were not aware of contributing to forest science, since their goal was to outline the boundaries of Finland's flora, its habitats and distribution.

Neither was the forest industry interested in the scientific study of the forests. The sawmills obtained sufficient numbers of large logs from the state and privately owned

forests, and so long as raw material was available, there was no desire to spend extra funds on the future. The establishment of a Central Laboratory had very little to do with the study of forest resources but mainly with continuing the chain of production of the forest industry.

Finland was no exception in this respect. Germany was the only country around the close of the nineteenth century where forests were systematically studied on a scientific basis. Both Sweden and Russia had academies of forestry, but also there research was overruled by practical aspects. In Finland, the history of forest research followed a common course of development. The scientific study of an industrially utilized natural resource will begin only when the availability of that resource is threatened. Towards the end of the nineteenth century, no such threat could be envisioned in Finland, although there was continuous talk of deforestation. The reports by Gyldén and von Berg and the estimates drawn up by the State Board of Forestry, however, all showed that the stock of timber both regenerated and grew.

From the perspective of the forests, the situation was not good. As they were not studied scientifically, they were neither cared for or managed with scientific methods. Unfortunately, this did not mean that the forests were left to grow in peace. Industrial society expanded rapidly towards the end of the century, and the forest industry extended its procurement of timber ever deeper into the wilderness regions. Although there were still virgin forests, their number continuously decreased. The forests were treated arbitrarily, and were not regenerated. Nature ultimately took care of regeneration, but its cycles were far too long for man to accept. This finally led to a situation in which the care and regeneration of the nation's forests had to be managed with scientific methods.



Photo: Hj. Schroderus 1928. Metla photographic archives

Finland was not characterized by giant metropolises, large factories or electric power lines, but by forests, small villages and bogs which provided work, raw materials and wealth for the young nation.

The Finnish Nation

The World of the Past

The Finnish author Paavo Haavikko has noted that "towards the close of the nineteenth century Finland's role in the Russian Empire had become an oddity." "Finland was part of Imperial Russia, and subordinate to it, but as a market for the products of Finnish industry, Russia had the role of a colony or a developing nation."

Haavikko's observation is correct. In only six decades, Finland had developed into an "independent" nation with its own currency, laws and civil service, a uniform culture, and two languages, neither of which was Russian. These developments, both political and national, were carried out in an extremely disciplined manner. With respect to the Empire, Finland consistently projected the image of a completely loyal border region with no political or ideological conflicts possibly threatening Russia. At the same time, self-censorship and efficient control by the authorities ensured that no separatist demands were voiced in Finland.

Relations with Russia were managed with great care. So long as Russia remained politically distant, the Finns could develop their own society without outside interference. Developments within the Grand Duchy of Finland progressed at an increasing pace in the late nineteenth and early twentieth century. Economic policies relying on agriculture and forestry channelled money and affluence into the various sectors and classes of society. Increased affluence fuelled the growth of towns and raised the standard of education among the common people. Ideologically, Finnish society continued to be shaped and developed according to the concepts of J.V. Snellman. Loyal, nationally-minded, officials were appointed to leading positions, and the foundation of society as a whole was formed by the free citizenry. The duty of each individual was to contribute to the progress of the nation. In Finland, civil duties and obligations of various description were given a particularly strong emphasis and became at least as important as civil rights.

The last decades of the nineteenth century were a period of beauty and harmony in Europe. At least for the moment, war and national strife appeared to be things of the past. "The century of the bourgeoisie" was able to show its best sides. In the words of the Austrian writer Stefan Zweig:

"In its liberal idealism, the nineteenth century was truly convinced that it was on a direct and unerring path towards the best possible world. Past eras with their wars, famines and revolutions were viewed with contempt and ascribed to a time when mankind had not yet reached maturity and a sufficient degree of enlightenment. In only a few decades even the last vestiges of evil and violence would finally be conquered. This belief in uninterrupted and continuing progress had the effect of a religion at the time. People had more faith in progress than in the Bible, and the daily miracles wrought by science and technology seemed to be undeniable proof of this gospel".

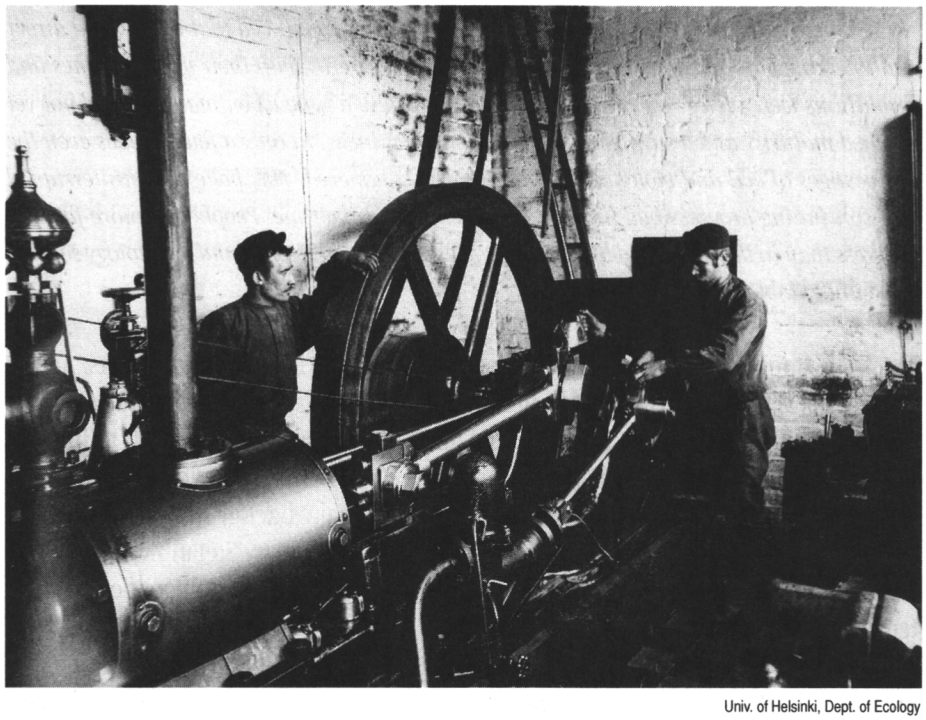
The Belle Epoque, however, contained strong social and ideological tensions. Antagonisms between the working class and the bourgeoisie were heightened, and the old multinational realms began to crumble. Nationalism gave added strength to individual cultures. These, however, found themselves restricted by various pan-cultural movements and currents. Relentlessly marching on in the background was a massive industrial, technological and scientific revolution. As noted by Stefan Zweig, science and technology established faith in a better future, but they also engendered more tensions and pressures.

Although Finland tried to remain outside international conflicts, and particularly the turmoil within Russia, it was neither willing nor able to isolate itself from the rest of the world. New ideologies spread unchecked across the borders of nations and empires. Industrialism provided affluence and welfare, but the industrial mode of production also introduced capitalism, socialism and social conflict. The main problem for the Finns, however, was Russia, itself in the process of rapid modernization. The national awakening of Russia gave rise to Pan-Slavism, demanding greater political and cultural uniformity throughout the Empire. This was a greater threat to the future of Finland than any other ideology. "Great Mother Russia" would hardly have accepted "an independent Grand Duchy" blatantly profiting from the economic backwardness of the rest of the Empire.

Finnish fears became reality around the close of the century. A "programme of Russification" was instituted to join Finland more closely to the Empire culturally, economically and socially. This programme marked the beginning of the so-called first period of oppression, a particularly difficult time for the Finns, who now completely lost their faith in the Emperor and his good intentions. The situation was even worse in state administration, as the Russians tried to use every means possible to undermine Finland's hitherto special standing within the Empire.

This first period of Russian oppression ended with the General Strike of 1905, which followed the Russo-Japanese War. Finland was now given a pause, but a second period of oppression began in 1908, continuing until the First World War. The aftermath of the Bolshevik revolution finally severed Finland's political links with Russia in December 1917.

The official Russification programme led to a severe crisis in Finland around the



Univ. of Helsinki, Dept. of Ecology

The steam engine became a symbol of the age of industrialism. Finland also tried to establish its position in rapidly changing world increasingly dominated by machines, large companies and scientific expertise.

turn of the century. The Finns had just developed their industrial system, which could now have been used to full advantage. The new attitude of the Russian authorities, however, shook the foundations of Finnish industry. If relations with the east were not in order, Finland could not develop its own society to its full potential. Conservatives tried to pacify the situation and reinforce national unity. The more radical elements launched active and passive resistance to Russian policies. Although these movements resorted to different models, they had the same goal: to ensure Finland's separate standing vis-à-vis Russia.

The political crisis of the turn of the century seriously undermined the autonomy of Finland and its economic system which was based on separate political status. Russification threatened the position of the Finnish paper industry in Russia and the standing of the sawmill industry in the western market. There were, broadly speaking, two reactions to the impending danger. Some representatives of industry belittled the threat, claiming that the Empire was in a process of modernization whereby Fenno-Russian relations would find a new basis providing improved opportunities for Finnish industry. This optimism was not shared by the conservatives, who feared that Russia would crush Finland's separate status, which would also wreck the industrial system. This threat could be countered by a strong consensus shared by all

the leading economic interest groups in society.

Though conflicting, these viewpoints had the same goal. Both wished to keep industry viable and in operation. The representatives of both positions were also deeply concerned about Finland's forests and their future. This was necessary, since the country's industrial system, agriculture and public authorities were increasingly dependent on the resources and revenues of the forests. The Finns feared that they would lose the benefits which had been gained, and it was in the common interest to overcome these fears.

The Struggle for the Forests

By the beginning of the 1890s, Finland had for the most part developed an economy based on agriculture and forestry. Structural change in agriculture proceeded as planned. Mechanization and cereal strains offering better yields made grain cultivation more efficient, and livestock production increased markedly. According to available statistics, the total area of arable land in 1880 was roughly 830,000 hectares. This figure was to grow to two million by 1920. The most common cultivated species were oats, rye and hay used as fodder. The number of cows rose from around 800,000 head to over 1,100,000 head by 1920. Over 800 dairies were established around the beginning of the century. Before the First World War, yearly butter production peaked at almost 14 million kilograms. The corresponding amount of cheese was roughly 2.5 million kg.

Agriculture developed at a rapid pace, but forest-based industries expanded even faster. By the First World War the yearly production of sawed timber had risen to almost 900,000 stand. The degree of fabrication also rose considerably. In addition to sawed logs, Finnish manufacturers now offered planed timber and other fabricated products. This was made possible through developing sawmill technology. The operating speed of the traditional frame saw was increased and the floating, lifting, moving and feeding devices for logs became more effective. The productivity of the sawmills improved as individual facilities were incorporated in larger concerns. By 1920 seven sulphate cellulose mills had been established, all of which were in the major sawmill centres, such as Kotka, Pori and Valkeakoski.

As early as the turn of the century, the paper industry had begun to rival the sawmills as Finland's leading industrial sector. Paper production expanded at a very fast rate. Although the starting points were modest, production figures for 1916 were 18 times those calculated for the mid-1880s. Progress of this scope required the almost equal growth of the groundwood and cellulose industry. The yearly increase in the production of wood pulp and cardboard was almost 10 per cent. Sulphite cellulose production grew even faster. By the First World War, the output of sulphite cellulose was 420 times that recorded in the 1880s.



Photo: Olli Heikinheimo 1924. Metla photographic archives

As conditions changed, Finns took a more protective altitude towards the forests. The unplanned use and destruction of the forests came to an end and was replaced by scientific forestry on a national basis. The forests changed, albeit slowly. Destruction caused by a storm in the Raivola larch forest in 1924.

The paper and pulp industry was almost completely dependent on foreign technology. Paper machines and cellulose digesters could not yet be manufactured in Finland. The machinery industry, however, soon learned to make simpler pulp grinders and water-powered turbines. The paper machines were usually bought from Germany, Switzerland or the United States. Around the beginning of the twentieth century Finnish paper mills had a total of 60 paper machines, each producing around 2000–3000 tonnes of paper a year. There were 16 sulphite cellulose plants with a total of 42 digesters in 1915.

The forest industry included the sawmills, and the paper, groundwood, cardboard and pulp mills. In addition, there were spool and bobbin factories and the various sectors of the furniture industry. These manufacturers refined and fabricated Finnish timber both mechanically and chemically for the eastern and western markets. The range of products was extremely broad. For example, paper in hundreds of different sizes and grades was exported to Russia, which naturally placed a strain on production facilities, and impeded the establishment of manufacture on a large scale.

Although the forest industry was clearly the largest provider of export earnings in the Finnish economy, agriculture was still regarded as its main sector. This view dated from the 1870s, when the focus of the economy had been placed on developing



Photo: Brutus Lesche 1905. Univ. of Helsinki, Dept. of Ecology

Students of the Evo Forestry Institute planting forest. The protection of the forests entailed regeneration. Nature's own means were supplemented with scientific methods.

agriculture after the famines and the poor "forest years". The dominance of agriculture was also evident in the forest policies of the close of the century, which did not emphasize the economic gains that could be obtained from the forests or the needs of rationalized forestry. On the contrary, the forests were to provide as much raw material as possible for industry, and building materials and fuel for the peasants and farmers. The sustainable development of the forests or good prices for timber were not the prime considerations for felling. Rationalized forestry was even felt to be unnecessary, since forests could be cleared into fields if they did not regenerate naturally.

Although intellectual and economic resources were channelled into agricultural reforms, developments did not meet expectations. This was due more to the Finnish climate and the country's geographical location than to agriculture itself. As already predicted by Lars Gabriel von Haartman in the late 1840s, efficient agriculture could not be practised in Finland. On the other hand, the forests provided almost inexhaustible supplies of raw material for the lumber industry.

The supporters of a traditional agrarian society naturally refused to accept this fact. They felt that agriculture entailed other values than economic gains alone. Agrarian society represented stability and traditional culture. Industrialism represented an alien world of machinery, ruled by the unbending laws of economics and

technology. Although the forest industry could in no way be compared to the massive metal and chemical industries, it was still regarded as a representative of a scientific and technological culture threatening traditional Finnish values.

The assault of agriculture against the rising power of the forest industry began impressively in 1901, with the publication of *Metsät ja yhtiöt* (The Forests and the Companies) by the author Kalle Kajander. This book accused the sawmills of the senseless destruction of the nation's forests. According to Kajander, "there is much talk of dangers to our country. Foreign affairs and wars are followed closely, but this struggle raging at present in our forests hardly merits a mention. At most, there is a weak whimper in the newspapers because of some failure, or we may hear the popping of champagne corks in the restaurants of rural towns where profitable deals are being celebrated. An organized war on a regular basis has been declared against Finland's forests. The generals of this assault are mainly the sawmills, the pulp mills, the bobbin factories and other wood manufacturers. Its troops are well-trained and skilled lumber mercenaries. The ranks of the conquering army are swelled by the many traitors lured from the side of the poor forest owners by the heady smell of victory and shiny coins."

Kajander and his supporters claimed that Finland's forests could only be saved if the forest industry were banned from owning or buying forests. Under such a ban, the forests and their resources would be in the hands of the state and the peasantry. This suggestion naturally shocked the forest industry, whose owners had invested everything they could in production facilities. Now the possibly most important link in the chain of production was in danger of falling into the hands of a hostile peasantry.

The forest industry did not hesitate in launching a counter-attack. A reply by senator Heikki Renvall notes: "Since the forests are the basis of progress for the Finnish people and the source for most of our country's necessary export articles, society must ensure the preservation of the forests. It is also in the interests of society to place the forests in the ownership of those who generate the most value from them, in other words, those whose products will permit the import of most of the goods required by our people". In view of this fact, it was more than natural that "in this respect the interests of society will not clash with a course of development in which industry will obtain the forests not required by agriculture".

The struggle for Finland's forests was in reality a conflict between the traditional and modern worlds. By the beginning of the twentieth century the forest industry had begun to predominate in relation to agriculture. Although agriculture still accounted for 33% of the gross national product, this proportion had by now decreased by over 10%. Officially, the forest industry provided approximately 15% of the gross national product, but its share in real terms was much larger. Within the framework of forest-sector society the forest industry was linked to a considerable number of other areas. Around the beginning of the century, the forest industry and other industrial sectors were in fact as important as agriculture for the Finnish economy. Because of this, the

ownership of the forests was no longer the main issue. No less important was know-how regarding the proper care of the forests to ensure that they would produce timber in the future.

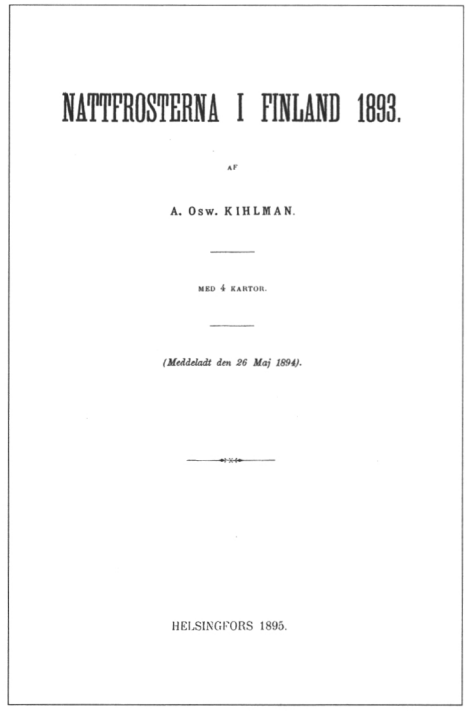
The Return of an Old Enemy

The farmers and peasants accused the forest industry of destroying the forests and of robbing poor landowners of their property. The timber firms and companies in turn accused the peasantry, claiming that the farmers themselves destroyed forests and neglected their proper care and regeneration. Although these accusations were sometimes exaggerated and propagandistic, they had some basis in fact. The aggressive timber firms forced their way into the wilderness regions, blatantly pressuring the poor farmers to sell their forests. The allure of easily gained money was often too much for the impoverished inhabitants of the outlying regions. As a result, the timber firms managed to acquire roughly one million hectares of forest land towards the close of the nineteenth century.

This, however, was not the core of the issue. The peasants resented the fact that in many transactions farms as well were acquired by the timber firms, making formerly independent farmers the tenants of the forest industry. Situations of this kind often ended in misfortune. Having sold their forests, the farmers had no source of important additional income in years of poor crops. This meant that the economic difficulties of the farmers continued, and some had to give up farming completely. As farms were abandoned, the timber firms left the fields untilled, which was a source of humiliation to the agricultural community. It also weakened the overall position of agriculture in relation to the forest industry. If this course of development were permitted to continue, the forest industry would gradually acquire an increasing share of Finland's forests and farmlands. The peasantry felt that this would lead to a catastrophe in the forests and on the farms, as the acquisitive lumber entrepreneurs were only interested in maximizing profits at the costs of the farmers.

The timber firms, on the other hand, claimed that the farmers and peasants lost their land, because they were not able to care for their forests and properties. This, too, was partly true. Although burn-beating and tar-burning had ceased in most parts of Finland by the beginning of the twentieth century, farmers and peasants still felled forest without any particular plans in mind. Timber was sold to sawmills, or was used in construction and for heating. Forestry of this nature undermined the structure of the forests themselves. The sawmill entrepreneurs felt that Finland's forests could be saved only if industry were freely allowed to acquire them. The forest industry had a real desire and need to regenerate, manage and develop the country's forests.

The war of words between the peasantry and the timber firms, however, was only apparent. In fact, none of the parties concerned had anything to do with rationalized



NATTFROSTERNA I FINLAND 1893.

AF

A. Osw. KIHLMAN.

MED 4 KARTOR.

(Meddeladt den 26 Maj 1894).

HELSINGFORS 1895.

A. Oswald Kihlman (Kairamo) conducted a broad survey of the night frost phenomenon in 1893–95. According to his studies forests provided important shelter against cold northern winds.

forestry. The timber firms selected only the best logs, while the farmers felled large and small trees at random according to their immediate needs. The State Board of Forestry was officially required to care for and protect the nation's forests, but this was only a formality, since the Board sold as much timber as possible from the crown forests to meet its own financial needs.

This situation could not continue any longer. Along with agriculture, the forests and the sectors of industry relying on them were the foundation of the economy. Around the middle of the nineteenth century J.V. Snellman proposed that the forests be utilized to develop agriculture, but forestry policies of this kind were now a thing of the past. The country's resources of timber now supported a massive industry which had far brighter prospects than agriculture.

The foundations of Finnish forestry had to be speedily renewed. Silviculture, regeneration and the use of forests had to be placed on a rational and systematic basis. Having invested considerable amounts of capital in mills and the whole chain of production, the timber firms required new policies concerning forestry. These were also needed by the farmers, who still owned a considerable proportion of the country's forest land.

The State Board of Forestry also required new models for its operations. Despite its market-oriented policies, it had not succeeded in generating sufficient revenue for the state. During the last half of the nineteenth century, the crown forests accounted

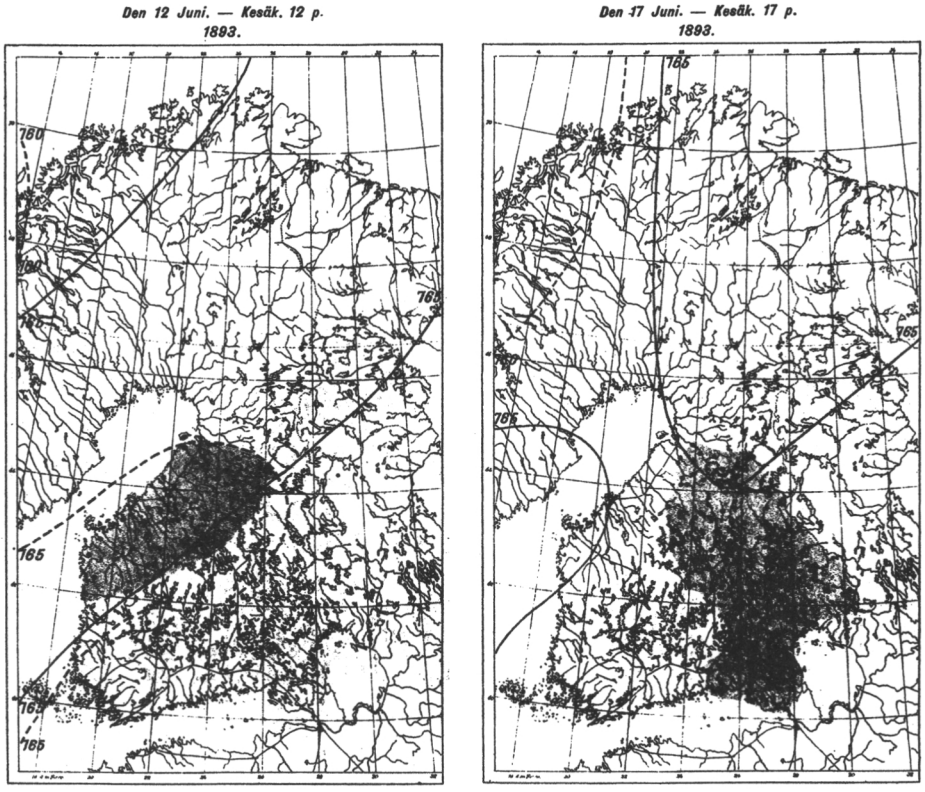
for approximately ten percent of raw materials bought by the sawmills. There were a number of reasons for these poor figures. The Board was understaffed, which meant that proper surveys of forests could not be carried out. Without precise information, it was not possible to draw up the forest working plans. On the other hand, most of the crown forests were situated too far from sawmills and the paper and pulp mills to be optimally utilized.

At the close of the nineteenth century, market-oriented forestry had found itself in a crisis not only in Finland but also in other countries. The underlying reason was again the old fear of deforestation. In 1894 a bill was passed in Sweden requiring crown officials to monitor the growth and regeneration of forests. This legislation stipulated that the management of the forests and state forestry in general were to be based on scientific data. A great number of expectations were placed on scientific forestry, which was expected to ensure the future of the forests, and to provide the greatest possible long-term economic returns. The same concepts applied in a scheme launched in Russia in 1895 to survey the Empire's crown forests and to prepare scientific proposals for improving forestry and forest management.

Finland closely followed solutions and developments in neighbouring countries. These clearly showed that a new way of thinking was also required in Finnish forestry policies. The actual initiative, however, did not come from abroad. The underlying reason was an old nightmare that caught the Finns unawares in the early 1890s. In the second week of June 1892, the temperature suddenly dropped to below freezing point, and night frosts occurred in many parts of the country causing severe damage to the grain crop. Although the new strains were more resistant to cold conditions, the crop was finally destroyed in August, when the frosts struck again.

Finland, however, was spared the catastrophe of famine as the productive structure of agriculture had considerably diversified towards the close of the century. The lost crop could now be replaced with imported grain. Although the frosts did not lead to deaths, they were still a threat that deeply shocked the Finns. The farmers feared that the situation would be repeated the next year, as had happened in the late 1860s. These dire predictions were borne out. In June 1893, the weather again cooled and unstable conditions continued throughout the summer. The crop was again insufficient, and there were shortages in certain parts of the country. Worst of all, the frosts reoccurred. In May 1894, temperatures dropped below freezing in large areas, and the same occurred in early September.

This time, however, the effects of frost on flora could be observed in detail. In the winter of 1893 A. Oswald Kairamo, one of the country's leading geobotanists applied to the Finnish Society of Geography for a grant to study the phenomenon of night frosts. The funds were awarded, and Kairamo mailed questionnaires to one thousand farmers in various parts of Finland. The farmers were asked to monitor changes in temperature and their effects on plants. Fortuitously, Kairamo began to study night frosts in the same year that frosts seriously affected Finnish agriculture. This provided



Illustrations of mean temperatures by A. Oswald Kairamo in his treatise on night frosts in Finland. The article was published in vol. 10 of *Fennia*, the journal of the Finnish Society of Geography.

a great deal of empirical data on night frosts, and their movements and effects in various parts of the country. The survey was repeated during the following two years.

Although agriculture in Finland had suffered from night frosts for centuries, this phenomenon and its underlying mechanisms were still unknown in the late nineteenth century. Night frosts had already been studied in the early years of the century by G.G. Hällström, Professor of Physics at the Academy of Turku, Hällström claimed that it was caused by the evaporation of water. This, however, was a mistaken conclusion, as Hällström was not familiar with the radiation of heat. However, he gave farmers the correct advice. The best way to combat night frosts was to drain fields and marshy areas. According to Hällström, dry land conserved heat and did not release moisture into the atmosphere.

Selim Lemström, a physicist at the Imperial Alexander University in Helsinki, began to study this phenomenon in the second half of the nineteenth century. Lemström was better equipped to solve the problem than his predecessors, as by now physicists had successfully investigated the radiation of heat. Lemström proved that night frosts occur when heat radiates from the soil. Colder air then flows under the

rising warm air. On a cloudless night when the air does not circulate, the surface of the ground will irradiate heat into the higher strata of the atmosphere. The less clouds there are in the sky, the faster the heat will be radiated. Because layers of air near the ground are heavier, they will cover the surface with cold air. Night frosts are particularly prominent on level ground, whereas in contoured terrain the heavy, cold air will flow into gullies and depressions and the surface, which is at a higher elevation, will remain warm. Selim Lemström instructed farmers to drain bogs and to light fires of tarry wood around the edges of fields. The resulting smoke would thus form a "cloud" preventing the rising of heat from the surface and reflecting it back.

Physicists explained the mechanism of night frosts, and were also able to suggest simple technical means by which frosts could be prevented locally. But they could not explain why night frosts occurred in the spring and late summer, when the temperature of the air was usually above freezing. Neither could they establish whether night frosts were caused by general changes in the climate which could not be influenced by human action, or whether they were caused by human impact on the environment.

The relationship of climate and culture concerned scientists and scholars in many parts of the world in the late nineteenth century. The American George Marsh was one of the first to launch discussion on this topic. In the 1860s he published a widely read book describing changes to nature caused by man and their further influence on the climate. Marsh's work was also known in Finland, and it triggered much debate among professionals in forestry and agriculture. There were distinct reasons for this. Burn-beating, forest fires and unplanned felling brought about changes in forests with unknown consequences. Farmers continued to clear new fields, which revealed the surface and altered the established natural order. Finns already knew from the Bible that the lands around the Mediterranean originally had dense forests and fertile soils. The situation now was completely different: civilization had destroyed the green valleys of cedars and the fertile plains. In their place were arid deserts barely growing anything. Finnish professionals in forestry and agriculture were interested in knowing how the cutting of forest and the clearing of fields affected the climate.

In the 1860s Zachris Topelius, Finland's national author at the time, published a book entitled *Maamme* (Our Land), which was widely read among all classes of society. Topelius warned against cutting down the nation's forests, which he compared to the fur of a bear: if the fur is cut, the bear will freeze to death in the winter.

The influence of forestry and agriculture on the climate, and night frosts in particular, was studied at the Evo Forestry Institute in the late 1870s. However, the data collected by E. Furuhjelm, a lecturer at the institute, was so limited as preclude any broader conclusions. The first nationwide study of the phenomenon was carried out around the close of the century by Theodor Homén, Professor of Hydrology at the Imperial Alexander University in Helsinki. Homén investigated the evaporation of water from the sea, lakes, the soil, fields and the forests. He installed devices measuring the rate of evaporation in various locations throughout the country. The

results confirmed what Topelius had already said. The forests were indeed a protective cover, binding moisture and levelling the effects of changes in the climate. Large bogs, lakes, the sea, and open spaces cleared by man all evaporated moisture. Homén claimed that the risk of night frosts grew significantly where forests and fields were cleared without due consideration. This risk was particularly great in the northern and northwestern parts of the country. Homén suggested that sufficiently large areas of forest cover were to be left in place in the watershed areas to stop the dry, cold winds blowing from the Arctic Ocean and the mountains of Norway and Sweden.

Homén's results also confirmed observations made by A. Oswald Kairamo. Kairamo had demonstrated how dry, cold winds blowing from the Arctic Ocean defined the border of forest vegetation in Northern Finland and the Kola Peninsula. Consequently, Kairamo demanded that a sufficiently large area of protective forest cover was to be left growing in the watershed area.

The studies on night frost raised a number of important questions. Assuming that the forests regulated the climate, how were they to be cared for and managed to combat night frosts, freezing winds and cold temperatures in general? These questions had a direct bearing on the contemporary debate concerning silvultural and felling methods. A.G. Blomqvist and other professionals in the field were strongly in favour of felling by compartments. Although this was the best method in view of regeneration, it could increase the probability of night frosts. If the compartments were too large, the surrounding forest could not spread its seeds into the whole area, whereby regeneration was impeded. In principle, the method of thinning did not lay bare any large contiguous areas; only the largest trees were felled. Thus preserved, the forest cover also provided protection against night frosts. Thinning, however, seriously weakened the structure of forests over longer periods. The main problem was naturally clear cutting that exposed the soil at the same time over a large area. This method was not generally used, although it was sometimes applied to regenerate forest that had fallen into poor condition as the result of thinning. Similarly, clear cutting or burning over were the only possible methods that could be used to regenerate stands of poor yield.

The studies on night frosts forced professionals in the field to take a close look at their own methods of cutting and regeneration. Assuming that the forests regulated the climate, the felling compartments had be in sectors that were so narrow as to pose no threat to the climate. Similarly, clear cutting had to be abandoned, or cleared areas had to planted very soon after felling.

These questions naturally interested the forest industry. The owners of the timber firms had generally been confident that the country's forest resources would suffice far into the future. Discussion did not concern the effects of various cutting methods, much less regeneration. All parties concerned expected nature finally to regenerate the forests. The situation, however, had changed. The studies concerning night frosts

had shown that regeneration was necessary. If this aspect was ignored, the climate could become colder and the natural regeneration of the forests would in turn slow down. In the worst possible scenario, the forests would no longer regenerate and the forest industry would lose its source of raw material.

The agricultural sector also had to take a new look at its attitudes concerning forestry. J.V. Snellman demanded that the forests were to be gradually felled and replaced by fields. In his view, this would be the path to civilization in Finland. The night-frost studies eroded the basis of Snellman's policies. The reckless cutting of forest could cause night frosts and consequently ruin crops. If this were true, Finnish agriculture and forestry were in fact bound to each other through the agency of the climate. The forests were not only an economic resource, but also played a decisive role in the equilibrium of nature itself. This, in turn, was the *sine qua non* of both agriculture and forestry.

Three Committees

The studies on night frosts, the examples of neighbouring countries and the strong development of the forest industry all forced the Finns to reconsider the grounds of forestry policies. The underlying principles of the State Board of Forestry had to undergo radical reforms. The utilization of privately owned forests had to be placed under some form of public control. Furthermore, the relationship of the forests with the climate had to be speedily investigated.

The implementation of new forestry policies, in turn, required sufficient resources in terms of both personnel and materials. It was particularly important to increase the staff of the Board of Forestry in order to reduce the forestry management districts to reasonable size. This would permit the more effective care and supervision of the crown forests. Added personnel also required the expansion and revision of training and education in the field.

In the Finnish culture of public administration, major reforms affecting society are not carried out in government ministries but in select committees. These are means of seeking a broad consensus, binding all interest groups concerned. This principle was also followed when the new forestry policies were created. In the last years of the nineteenth century and at the beginning of the twentieth century three committees were appointed to study the use and management of privately owned forests, the administration and care of crown forests, and related settlement policies concerning forest land owned by the state.

The committee concerned with the state and management of privately owned forests began its work in 1897. This was a radical choice of time. Although the use and exploitation of privately owned forests had already been a source of concern to the authorities towards the close of the eighteenth century, they refrained from



A. Oswald Kairamo (1858–1938), a skillful geobotanist and one of the most powerful politicians in Finland at the turn of the century. He became the main architect of the new forest policies.

National Board of Antiques

encroaching upon private ownership as far as possible. All the former forestry committees and legislation based on their proposals expressly underlined the inalienability of private ownership. Consequently, forestry policies in reality concerned only the crown forests, comprising approximately half of the country's forested areas.

The privately owned forests, however, could not be left outside the new forestry policies. In the preamble to its report, the above-mentioned committee duly noted that "the importance and value of forests in our country have greatly increased over the past decades; not only through the immense growth of timber exports but also through the development and growth of industries using domestic timber and through other forms of utilizing timber. Even though we may observe some degree of increased concern for protecting the forests from destruction and fires in places in our oldest farming regions, where areas of forest have mostly been reduced, the general utilization and care of Finland's forests is by no means in any proportion to the value attained by forestry products. It is a commonly known fact that Finnish silviculture is on a very low level not only in the sense that sustainable production is rarely the goal but also in the sense that even our present forest resources are often squandered without any corresponding benefits. One of the main reasons for this is without doubt the lack of sufficient knowledge about the basis of rational forestry and related profitable procedures."

The committee was aware that landowners could not be forced to care for their forests. But the situation could improve if they could be made to undertake reforms and to develop rationalized forestry methods on a voluntary basis. The best way to make the private sector interested in sound forestry was to provide counselling and guidance free of charge. This could be done in a very simple way through Finland's numerous agricultural and economic associations. The committee therefore proposed that these organizations be given yearly state grants to hire forestry advisors who had graduated from the Evo Forestry Institute or from similar training schemes. Because a single advisor alone could not manage large areas, he could be assisted by forest wardens with lower-level training in forestry. In addition, state funds could also be used for awards to landowners who had taken exemplary care of their forests.

According to the proposal, "the forestry advisor should actively work to generate common interest in the rational utilization and care of the forests and, following detailed instructions from economic and agricultural organizations, provide teaching in forestry at farmers' and adult education institutes, to hold courses on a touring basis according to need, and at meetings and on other suitable occasions offer assistance and guidance in the rational utilization of the forests and instruction to those intending to sell timber or forest land".

The proposals of the committee differed completely from the previous, "Snellmanesque" forestry policies, according to which the landowners and peasants themselves could manage and care for their own forests. The private forests committee placed the responsibility for forestry measures on the shoulders of professionally trained foresters and forest wardens. This was a radical change, as only five decades previously Snellman himself had used a great deal of energy and influence to repel such ideas.

The establishment of a nationwide advisory organization naturally required the rapid expansion of teaching and training in the field. The committee therefore proposed that lower-level schools for forest wardens should be established as soon as possible throughout the country. The committee felt that this would permit the fast and low-cost training of a large number of experts in forestry, who would know how to assist landowners in preparing and carrying out cutting by compartments, to seed and plant forests, and to thin standing timber.

The credibility of the advisors naturally depended on their skills. This again was a difficult problem. Previous experience showed that the peasants took a cold and even hostile view of "trained forest lords". The problem, however, could be solved if the professionals were indisputable experts in their specialist fields. This could not be realized by training alone; research was also required. The committee accordingly observed that "detailed research into the state of Finland's forests has long been an important issue among professionals in the field. It has been pointed out that the results of the extensive studies carried out in most European countries on the influence of forests on the climate and other natural conditions as well as on the



Photo: unknown 1903. Univ. of Helsinki, Dept. of Ecology

New forestry policies placed the main responsibility for controlling, developing and monitoring forests on scientifically trained professionals. This offered numerous career opportunities for young men. Shown here are young trainees resting at a forest cabin in Saarijärvi in 1903.

benefits of various methods of forestry definitely cannot be applied directly to Finnish conditions, whereby independent studies in this field are needed here. With reference to the great importance of the forests to our country, there have been demands that, following the example of other civilized nations, we should establish an institute of experimental forestry to study the conditions of the forests and forestry methods. It has also been proved that without such an institution it will be impossible to find support for measures by the state for protecting the forests, nor will it be possible to develop forestry administration suited to the specific conditions of our country".

The committee suggested two ways of organizing forestry research. The first alternative solely consisted of research related to the care of the forests. Here, experiments should focus on developing silvicultural methods. This research institute would study the planting and seeding of forests, both natural and by human agency, thinning and various methods of cutting. There would also be research on the growth mechanisms of trees. These studies would then provide the necessary data for computing tables of growth and yield for forestry measures.

The second alternative was a research institute focusing on "scientific observation". In practice this implied a body studying the influence of the forests on the

climate, and the temperature, precipitation and rates of evaporation in the soils and in the air. Studies could investigate how the forests influenced changes in the water levels of rivers and lakes and in the fertility of the soil. In addition, there would also be research on what specific types of forest decreased the effect of cold and dehydrating winds on the soil.

Since the committee's own expertise was insufficient for judging the relative importance and timeliness of either alternative, professionals in the field were consulted. As could be expected, the professionals recommended the establishment of both experimental institutes. Studies on the climate were important, as Finland was a relatively large country, extending as far north as the Arctic Ocean. Results were available from abroad, but these could not explain the complex relationship between the climate and forests in Finland. The "scientific observation" unit would have a natural connection with the Central Institute of Meteorology. It would not be costly to establish the new facility, as the Institute of Meteorology already had a comprehensive network of observation units. This could be complemented with observation devices and facilities for investigating the relationship of the forests with the climate.

The need for an experimental institute in silviculture was argued for in almost the same terms. The nation's forests formed a whole that could not be tended with methods developed elsewhere. In Finnish conditions, research into silviculture was a particularly demanding field because of the severe climate and relatively poor soils. The committee went on to observe that "an important aim in forestry will therefore be the study of growth and related conditions and the development of silviculture based on them. Owing to the long period of forest growth and the slow emergence of the results of all forestry measures, development work will be difficult without systematic, scientifically accurate observations". The new experimental unit would best be suited to the Evo Forestry Institute, in addition to which there would be observation stations and trial plots in various parts of the country.

The private-forests committee fulfilled prior expectations. Although the farmers had a strong representation on the committee, rationalized forestry was not questioned. On the contrary, the committee laid down the aim of developing a scientifically trained corps of professionals in forestry, who would be responsible for the care and management of privately owned forests and for training the landowners to become good foresters.

The committee studying the condition and care of the crown forests began its work in 1896. Its specific task was to "issue a statement on the principles upon which state forestry should be based. In addition, the committee will address the following issues: a) the possibility of increasing revenue from crown forests by budgetary measures, b) the necessary measures for effective forestry operations in the crown forests to ensure sufficient yield from forestry areas, and c) the necessary changes to existing regulations concerning the marking, sales, cutting and delivery of timber to ensure regeneration and the growth of stands of forest."



Rationalized forestry called for planning and systematic research. This in turn required scientifically trained foresters and permanent research institutions. A stand of sample trees being measured by a surveyor in Punkaharju in 1924.

Photo: Martti Lappi-Seppälä 1924. Metla photographic archives

The crown forests committee was thus required to propose fundamental changes to the principles of the State Board of Forestry. Although the Board had succeeded in generating profits since the beginning of the 1870s, the amount of revenue did not satisfy the central state authorities. Some even claimed that forestry revenue could be multiplied through the proper care of the state's own forests, and by applying timber pricing and sales principles beneficial to the seller and not the buyer alone.

The crown forests committee felt that the guiding principle of state forestry should be to generate as much forest and land "rent" as possible. The term "forest rent" meant the balance remaining from forestry revenue after expenses. "Land rent" was the balance remaining from gross forest-land income after forestry-related production costs and related interest.

The committee noted: "... there is no general objection to the view that the purpose of the state's forests is primarily to be a source of revenue for the state and that the utilization of these forests must mainly be organized in view of this aim. Increasing state revenue is an important and valuable goal for crown forestry, and

from this point of view it is completely justifiable for the state to be an owner of forest land. The special nature of forestry and the fact that ordinarily a forest will produce yield only after two human lifetimes mean that the state, just as well as a private individual, but at less cost, can utilize land suited only to forestry. The state can also take into consideration the requirements of the common good. The committee therefore maintains that state forestry should be regarded primarily as economic activity, with the chief aim of increasing productivity and yield and the generation of as large a permanent revenue for the state as possible".

How did the policies proposed by this committee differ from the earlier ones? The main difference lay in the principle of combining rationalized forestry procedures with optimum economic yield. The Forests Act of 1851 had already underlined the protection and rational care of the forests, but it also restricted the utilization of forests and the available economic gains. Similarly, the 1881 Forests Act aimed at providing more effective economic utilization, but still continued to limit the overall use of the forests.

The crown forests committee established new parameters for the State Board of Forestry. State forestry operations were now expected to be profitable, while still ensuring sustainable development. This required planning and scientific data as the basis of rational forestry.

The new forest policies proposed by the committee reflected general aims prominent in Finnish society around the turn of the century. The country was developing and becoming industrialized, but at the same time relations with Russia were deteriorating. There were attempts to curtail and control uncertainty and change by ensuring the basic operations of society and the economy. This, however, required expert information. The surveys of the crown forests still remained to be completed, and no one was quite sure how much timber – and of what kind – was to be found in the state-owned forests. The committee felt that "an important reason for the relatively low yield of Finland's crown forests is the fact that their stock of timber has mostly remained unknown. ... precise knowledge of the forests must be regarded as the necessary basis for systematic and rational forestry and accordingly for increasing revenue".

The crown forests had to be surveyed with the line method, in addition to which there were to be sample plots where all the trees were counted. The committee pointed out: "... forest surveys will no doubt be of great importance for developing forestry insofar as they will provide in a short time an overview of the timber stock of the crown forests and relevant conditions, and the starting points for organized cutting".

The task of the Board of Forestry was to draw up management, cutting and silvicultural plans for various forestry districts on the basis of surveys and estimates. One of the ideals in this respect was a nationwide plan, as had been carried out in various parts of Germany. A general, nationwide forestry plan was also being



Photo: Brutus Lesche 1904. Univ. of Helsinki, Dept. of Ecology

The Evo Forestry Institute was perhaps the greatest loser in the new forest policies. The highest level of forestry education was moved to the Imperial Alexander University in Helsinki and the Evo Institute concentrated on educating only forest wardens.

considered in Sweden. Such a plan was useful in that it offered the possibility of a uniform basis for felling and forestry measures. The committee, however, felt that there was no need for such an extensive plan in Finland, since "strict control may make management plans somewhat rigid, which might prevent their application in varying local conditions and the utilization of scientific data and experience, thus binding forestry to inflexible procedures that would prevent development."

The committee recommended cutting by compartments. This method, however, could not be immediately adopted in the crown forests, since a great deal of oversized saw timber had accumulated over the decades. Once this timber had been felled, the forests would again be in a more or less normal state, and cutting by compartments could be carried out.

Carried out with care and with sectors that were not too long, cutting by compartments permitted natural regeneration without human intervention. The committee, however, urged forestry professionals to drain bogs and marshy areas, to collect cones and to establish nurseries. This would gradually expand efficient forestry to include areas of hitherto poor yield.

The underlying principle of the crown forests committee was to ensure sustainable development: "Unless required by special considerations, management plans are to

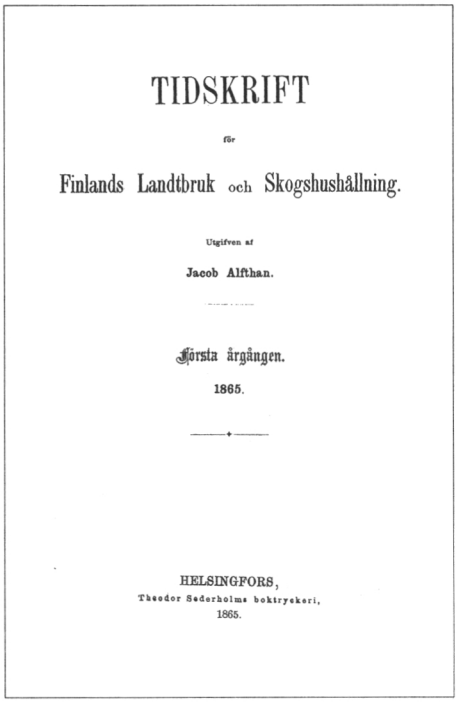
follow the principle of sustainability. Therefore, the amounts of timber to be cut must be relative to the known timber stock and growth rate and must also take into account the establishment of regular forest conditions".

The State Board of Forestry lacked sufficient resources for such a demanding programme. There were not enough foresters, and the forestry districts were hopelessly large. The committee therefore proposed that the number of foresters be increased and that they would be assisted by forest wardens and estimators or appraisers. Furthermore, the organization of the State Board of Forestry was to be developed. The best alternative was a central government office or department supervised according to a collegial system. The forestry districts of the crown forests were to be divided into smaller units to permit the regional foresters to manage, estimate and fell the forests in their respective areas.

The committee also wished to reform the training of foresters. The Evo institute alone could no longer meet the increasing need for education and training in the field. The committee therefore proposed that highest-level training in forestry should be moved from Evo to the Imperial Alexander University of Helsinki. Similar courses of action had been followed in many countries. In Germany, the highest level of forestry training was provided by the universities. In Denmark, the University of Technology in Copenhagen served this purpose, and both St Petersburg and Stockholm had separate academies of forestry. The committee felt that it was now high time for Finland to follow international trends and to place the teaching of forestry on an academic basis.

The organization of the highest level of forestry training had been discussed on several occasions. In the 1860s, the Polytechnic Institute of Helsinki was proposed as a venue; this scheme, however, failed because of economic reasons. The idea reoccurred in various connections, but for one reason or another failed to be realized. Now, however, there were better opportunities to carry out reforms. The 1890s saw a change in the official attitudes of the Imperial Alexander University regarding the applied sciences and training for professions. Conservative academic views had to give way to a more flexible position. The university no longer rejected modern applied sciences, but actively tried to integrate them with the traditional faculties. The highest scientific teaching of agriculture was officially moved from the Mustiala institute to the Imperial Alexander University in 1896. The new "Section of Agriculture", with two permanent professorships and two assistant positions, initially operated as part of the Faculty of Philosophy.

The crown forests committee felt that the academic teaching of forestry was well suited to the "Section of Agriculture". The development of forestry science required contacts with the academic environment and scientific research in progress there. The transfer would also provide economic benefits. The training of foresters required studies in several areas of the natural sciences, which could be organized within the Faculty of Mathematics and Science at the Imperial Alexander University.



TIDSKRIFT

för

Finlands Landtbruk och Skogshushållning.

Utgifven af

Jacob Alfthan.

Första årgången.

1865.

HELSINGFORS,
Theodor Sederholms boktryckeri,
1865.



Metsätieteellinen
Tutkimuslaitos

FINSKA FORSTFÖRENINGENS

MEDDELANDEN.

FÖRSTA BANDET.

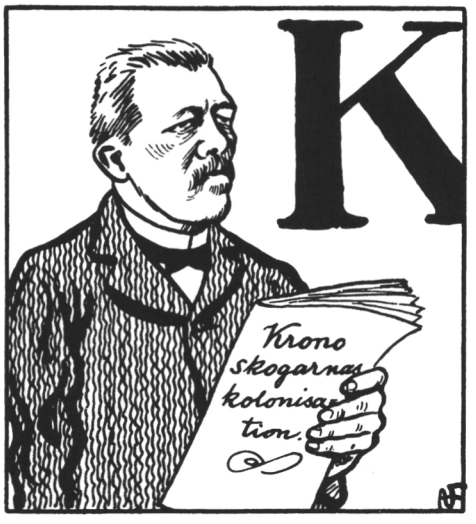
HELSINGFORS,
FINSKA LITTERATUR-SÄLLSKAPETS TRYCKERI,
1879.

The first journals in forestry began to appear in the 1860s and 1870s. They provided foresters and agronomists a forum for discussion and debate.

The committee felt that highest-level teaching in forestry could be begun at the university if a permanent professorship in forestry and an assistant position were established. The Evo Forestry Institute would not be closed but would provide the necessary practical training for foresters. As the position of teaching in forestry became established at the university, the Evo institute would be converted into a school for forest wardens.

The crown forests committee also addressed the means of developing scientific research in the field. There were, however, a great many problems. Forestry research differed clearly, for instance, from agricultural studies, where experiments were usually conducted during a single growth period and in limited areas. Studying forests took years and required large areas. This naturally impeded the establishment of a permanent research institution. On the other hand, forestry research was not as expensive as agricultural research; the necessary labour was cheap, and experiments did not require costly equipment or facilities.

The crown forests committee came to the same conclusions as the private forests committee. Forestry research could be divided into two areas: one for investigating the relationship of the forests and the climate, and another focusing on the growth, regeneration and utilization of the forests. Of these alternatives, the one concerning research into forestry measures found clear support: "In carrying out its duties, the



National Board of Antiques

Kairamo, sin gamla vana trogen,
vill att vår senat ska' „dra åt skogen".

"The Colonization of Crown Forests". A.O. Kairamo invented the idea of "forest villages". They provided new land for settlers, but restricted the use of the crown forests. The Swedish-minded *Fyren* newspaper ridiculed Kairamo's plan in 1908.

crown forests committee has in connection with many important issues come to recognize the difficulties which, in the evaluation of state-managed forestry and its future planning, arise from insufficient studies on the varying growth and attendant conditions of forests in Finland, the effect of various forestry methods on yield etc. Accordingly, the committee is convinced that we can no longer postpone the establishment of a modern experimental forestry institute without producing serious problems for the future".

The crown and private forests committees laid down new principles for systematic, rational forestry. This, however, was not enough. Rational procedures required that the ownership of the forests was made distinct in all respects. This was a broad social issue, discussed almost weekly in the press, and in various sectors of public administration. There was in fact need for such discussion. Towards the close of the nineteenth century, the ownership of forests in Finland was in a seriously disorganized state. Proportionately, the state owned half the country's forests, with the remainder belonging to private persons, organizations and companies. Although in principle the proportions remained the same, there were significant changes within the respective sectors towards the close of the nineteenth century. The expanding forest industry, in particular, tried to obtain as much forest as possible, which was only natural for capitalist industry trying to control all sections of its chain of production. "Free" forest, however, was only available for the peasants and public organizations, since the state did not sell its own forest lands. The timber firms sent their own aggressive representatives into the wilderness regions of Finland, and often farmers, in the midst of economic problems, could not resist the temptation of easy money. In this way, the timber companies acquired approximately one million

hectares of forest around the end of the nineteenth century. The firms also bought considerable tracts of farmland. The farmers were allowed to remain as tenants, but without the additional income provided by the forests, farming was difficult. Many farms were accordingly acquired by the timber firms.

At this time, the population of Finland increased markedly. Although the towns and industrial communities of Finland offered a livelihood to an increasing number of landless citizens, only a small proportion of Finns moved into the towns. Large groups of non-landowning people formed in the rural areas, renting small farms from the owners of large estates or finding work, when available, on the farms and in the forests.

Around the close of the nineteenth century, the situation in the Finnish countryside developed in an alarming direction. The farmers attacked the timber firms, accusing them of robbing their land and destroying the whole rural culture of the country. The landless population, in turn, was dangerously sympathetic to socialist ideas which had come from the west. There were increasing calls for land reform, and the even distribution of land to all citizens.

State administration intervened before the conflict endangered stability in society. The state had prepared a solution, as it was possible to distribute land from the crown forests to the landless population. This seemingly simple solution, however, was not suited to the new forest policies. In order to be profitable, the new holdings would have required not only arable land but also forest. As the landless population continued to grow, the state would gradually have had to give increasingly larger areas of crown forests to the peasants. This, in turn, would have limited the state's own forestry operations, and it was also feared that the new holdings would gradually be obtained by the expanding forest industry.

The ownership of forest was discussed in the crown forests committee and in the early years of the twentieth century in a select subcommittee addressing the problem of the landless population. These bodies proposed an interesting solution to the problem. The landless population could be given holdings from crown forests, but village-type communities were to be favoured instead of individual farms. In the villages, each farmer would have his own fields, but the forest land would be jointly owned. This would have required the authorities to provide a much smaller area of forest than if each settler had been given his own stand of forest. The common forest was easier to manage and supervise. In view of the intention of separating holdings from forest areas with poor yield, the whole scheme may even have been economically beneficial to the state over a longer period.

The "forest villages" were to become economically independent through cooperative activities, which at the time were spreading rapidly into the Finnish countryside. Economic cooperation generated economic security and shared responsibility, which would make the villages more resistant to the advances of the timber firms.

The forest villages were a partial, yet important, solution to the debate on forest

ownership. The relations of ownership were finally laid down in the early years of the twentieth century, when the timber firms were banned from buying forest land. These measures were in accordance with Swedish examples. The legislation for this, known as *Lex Pulkkinen*, was regarded as "prohibition" by the forest industry. Such an interpretation was quite possible, but in reality the act was part of a grand compromise established in the forests of Finland around the turn of the century.

This compromise consisted of several elements. As always, each party concerned had to give up something in order to receive something. Here, the basis of compromise was the new forestry policy of the authorities, aimed at maximizing economic benefits while ensuring the future of the forests through rational forestry based on scientific research. The forest industry was deprived of the opportunity of acquiring forest land, and private forest owners lost their absolute right to decide on forestry measures. Although the latter restriction was not of any major degree, the establishment of an advisory organization brought professional foresters into the privately owned forests, where they were to stay from then on. The farmers and new settlers, in turn, lost their rights to the crown forests.

What then did this compromise offer? Surprisingly, all it gave was the promise that, with scientific and rational care, the forests would provide the whole nation with welfare and a secure future. Although this promise might seem meagre in comparison with the above-mentioned losses of rights, it was ultimately the only alternative. The old forest policies had been proven wrong, for example by years of recurrent night frosts and denuded forest land. The new policy, however, opened the way to a new situation, in which rational forestry would constitute the economic basis of Finnish society. The ensuing wealth would not remain in the hands of a few families of capitalists, but – as noted by Dr. Hannes Gebhard – "would fall as a fine, fertilizing rain on all sectors of society".

The grand compromise placed a great number of requirements on professionals in forestry. Responsible for Finland's forests and their future, they in turn placed their faith in science. Research was intended to create the forestry methods applied by foresters, forest wardens and advisors. This would ensure that the forests would in fact grow and regenerate, providing the forest industry with raw material, the state with sufficient revenue from the forests, and the farmers with a sufficient store of capital and additional income in emergencies.

The new forest policy underlined the protection of the forests. This idea had emerged towards the close of the nineteenth century, when deforestation still continued despite legislation. Since it was impossible to place a total ban on the use of forests and they could not be closed to man, protection remained the only course. Studies concerning night frosts had introduced the concept of protective forest cover left growing in high watershed areas to prevent the effects of cold dehydrating winds. The protection of the forests as a whole was the task of professionals in forestry, who could rely on the objective and neutral results of research and forest management

plans based on the latter. The ideology of protection became deeply entrenched in the mentality of Finnish professionals in forestry. They felt that the forests could be utilized economically if they were rationally and systematically managed. Protection and utilization were thus no longer contradictory aims. On the contrary, they were one and the same.

A Finnish Solution

Although official committees have always had a great deal of political authority in Finland, they are ultimately only advisory bodies, and the realization of their proposals remains the responsibility of politicians. This principle also applied to the three committees discussed above. Their proposals paralleled each other, but in order to be realized they required considerable changes in attitudes on the part of political and administrative institutions.

Historians often seek important figures in the past who implement major reforms on their own. Placing undue emphasis on individuals, this approach sometimes distorts our view of history. The reforms enacted in Finnish forestry, however, are linked to an individual whose importance cannot be denied.

A. Oswald Kairamo had a clear idea of how Finnish forest-sector society should be organized to ensure the sustained development of the forests and to make them provide the maximum economic benefits for agriculture, the forest industry, and the state. Although Kairamo had not been a member of the private forests committee, he clearly influenced its proposals through his personal and political contacts. Kairamo chaired the crown forests committee, and sat on the subcommittee concerned with the landless population.

A. Oswald Kairamo was thus "the right man" to reform Finnish forestry policies. He was a geobotanist of both domestic and international repute, whose studies had first concerned the northern boundary of forests in the 1880s and the phenomenon of night frosts in the following decade. Kairamo had personally gathered scientific data on Finland's forests and their condition. His scientific career, however, met with opposition in the 1890s. Kairamo became a staunch supporter of the Finnish national movement, even Finnicizing his original family name of *Kihlman* into *Kairamo*. A radical Finnish spirit, however, became an obstacle to Kairamo's academic career. He was not appointed as a full professor of botany, but as supernumerary professor in 1897.

This consolation, however, did not satisfy him. Kairamo gave up his research and went into politics. He soon became a prominent and influential figure in the Old Finnish Party, representing the conservative wing of the Finnish-minded (so-called *Fennoman*) movement. In 1903 Kairamo became a member of the Senate of Finland. He was also influential in economic pursuits, being elected chairman of the

Pellervo Society, Finland's leading agricultural cooperative and participating in the founding of the nationalistic Kansallis-Osake-Pankki bank. Kairamo also headed the Central Organization of Finnish Wood Manufacturers, the consortium of the Finnish forest industry.

In the mid-1890s Kairamo combined his scientific expertise with his political aims to lay the foundation of the new forest policies. Geobotany and night-frost studies had demonstrated that the nation's forests could not much longer withstand their present use by the forest industry, the State Board of Forestry and the peasantry. Kairamo was also aware that agriculture, the forest industry and the state all required forestry managed on a solid and sustainable foundation.

Kairamo was faced with a difficult project requiring compromises among several conflicting interests. He did not trust the timber firms, who represented the old Swedish-speaking capital owners and whose promises of "sound forestry" had mostly remained unrealized. But neither did Kairamo trust the Finnish peasantry. On his expeditions he had seen far too many examples of how the "people" managed the forests. The State Board of Forestry was no better, being manned by Swedish-speaking officials lacking a sincere desire to care for and develop the nation's forests.

Kairamo could only trust science and scientifically trained professionals. As the Swedish-speaking elite was unreliable, forestry science and the forestry profession had to be manned as soon as possible by Finnish-speaking and Finnish-minded foresters and researchers. Kairamo's principle clearly emerged in the statements concerning research and training in the reports of the crown forests committee and the private forests committee. These texts emphasized the uniquely different nature of Finland's forests. Examples from abroad could be utilized in forestry and related research, but the actual work had to be done in Finland.

State-managed forestry was the core of Kairamo's scheme. The forest policies of Snellman now had to be put aside and replaced with state forestry operating on an active and rational basis. This would be implemented by an administratively re-formed and "ethnically cleansed" State Board of Forestry.

Kairamo strove towards a gradual reduction in the free private ownership of forests. Guidance and counselling were the first steps in this direction. In addition, the renewed regulations of the State Board of Forestry included a significant ruling according to which the state foresters should also monitor the condition and development of privately owned forests.

Kairamo was not in favour of strict legal measures completely banning the timber firms from buying forest land, but he could not prevent the passing of the relevant bill. The damage, however, was not irreparable, as Kairamo believed that rational forestry would provide the timber firms with sufficient amounts of raw material at low cost.

Together with Hannes Gebhard, A. Oswald Kairamo promoted the idea of "forest villages". These had been the subject of successful experiments in England, from



Though an active politician, A.O. Kairamo remained a genuine scientist.

Photo: O.H. Porkka 1929. National Board of Antiques

where Gebhard obtained the idea in the early years of the twentieth century. There was also a Finnish basis for the concept of forest villages, which greatly resembled the forms of settlement of the original population of Finland, Karelia and the Kola Peninsula. Each family had its own hunting and farming territory, but the village commonly owned the forests and other areas.

The ideas put forth by A. Oswald Kairamo reflected the overall state of Finnish society towards the close of the nineteenth century. Political autonomy had to be preserved, but its basic structures needed to be adapted to the requirements of the day. A strong national awakening had bolstered the self-image of the "Finns". The requirement now was to take political power from the Swedish-speaking upper class and to place it in the hands of a Finnish-speaking intelligentsia, as represented by Kairamo himself. It was necessary, however, to preserve the economic interests of the Swedish-speaking upper class, as most of the available capital in Finland was, in fact, in the hands of a few dozen families. Kairamo proposed a genial solution to this seemingly impossible equation. He created a system by which the forest industry, owned by the Swedish-speaking upper class, became dependent on raw materials owned by Finnish peasants. This made both groups in turn dependent on a Finnish-speaking and Finnish-minded corps of professionals in the field of forestry. Through the agency of the State Board of Forestry, this corps would be responsible for the rational management of Finland's forests according to the principles of sustainable forestry.

Kairamo's Protégé

A. Oswald Kairamo was an active figure, also known as an *eminence grise*, negotiating and mediating behind the scenes. The implementation of the new forest policies remained the task of two young men: P.W. Hannikainen carried out reforms in the administration, management and utilization of crown forests, while Aimo Kaarlo Cajander organized scientific forestry research and the training of professionals in the field.

P.W. Hannikainen was an excellent choice for the task. His father, Pietari Hannikainen, was a staunch Finnish-nationalist agitator, who had founded the nationalist journal *Kanava* in the 1840s. Hannikainen senior later became the editor-in-chief of the newspaper *Suometar*, the organ of the nationalist *Fennoman* movement.

The extreme nationalism of his father and family naturally influenced P.W. Hannikainen. Despite this, he chose a career in forestry, traditionally the domain of young Swedish-speaking men. Hannikainen junior enrolled at the Evo Forestry Institute in 1876, graduating as a forester two years later. He then entered the service of the State Board of Forestry.

Hannikainen, however, did not become an ordinary official of the Board. In 1882 he surprised the profession by publishing the book *Metsien hoidosta* (On Forestry), *vol. I Metsänkasvatuksesta* (On the Growing of Forest). This was the first work on forestry published in the Finnish language that was based on scientific data. Three years later, Hannikainen completed a second volume entitled *Metsätalouden järjestämisestä* (On Forest Management). He also translated forestry terminology into Finnish, and in 1887 founded *Suomen Metsänhoitolehti* (The Finnish Forestry Journal), the first professional journal in forestry to appear in Finnish.

Hannikainen's activities provoked mixed reactions within the profession. He was not directly condemned, but his projects were belittled. Hannikainen was mainly regarded as a young opportunist, who employed extreme nationalistic means to bolster his own position. A.G. Blomqvist, who was the most influential figure in the whole field, took a positive view of Hannikainen's initiatives, but did not want to embroil the profession in language strifes.

Hannikainen, however, was adamant. He strongly felt that foresters serving the Finnish people should be fluent in the Finnish language. To him, this was the *sine qua non* of rational forestry in the country. In his own journal and in other writings he urged the Evo institute to begin teaching in Finnish, thus permitting young Finnish-speaking men to become foresters. Furthermore, he demanded that the State Board of Forestry was to follow existing legislation concerning the country's official languages and translate into Finnish all major agreements and other documents.

Despite considerable public exposure, Hannikainen's career at the State Board of Forestry made little progress. His position was made permanent in 1892, but the duties of "senior forester in charge of official residences" hardly satisfied this



National Board of Antiques

P.W. Hannikainen, the young and extremely ambitious new director of the State Board of Forestry graduated from the Evo Forestry Institute in 1878. Hannikainen is shown standing in the far right of the picture with his fellow class-mates.

ambitious young man. At this stage, A. Oswald Kairamo took a hand in matters. Following a proposal by Kairamo, Hannikainen was appointed secretary of the private forests committee; he also became a member of the crown forests committee. Hannikainen made effective use of the situation. He appears to have been the author of the official report of the private forests committee, in addition to influencing the wording of the report of the crown forests committee. Collaboration with Kairamo strengthened Hannikainen's position within the profession.

From then on Hannikainen's career was guided by chance. The first period of Russification began in 1899. Ernst Wrede, Director-General of the Board of Forestry, a member of the Constitutional faction in Finnish politics, followed the calling of his own conscience and resigned in protest over the new Russian policies. Kairamo, who took a moderate view regarding Russia, soon had Hannikainen appointed to Wrede's former post before the Russians could name their own candidate. In 1902 Hannikainen, aged only 44, became Finland's most senior forestry official.

Hannikainen eagerly took on his new tasks, which included reforms at the senior level of the Board. The old Swedish-speaking elite had to give way, being replaced by a group of professional executives who had adopted the *Fennoman* ideology, despite the fact they were mostly Swedish-speakers themselves. Hannikainen's policies began to be implemented by T.A. Heikel, Robert Montell, Carl Johan Nummelin and Ernst August Nylander.

The oversized forestry districts were now reduced, and the number of foresters was increased. By 1906, eighteen new forestry districts had been established. Ten years later, there were 87 districts, offering work to young foresters. Although there was no direct discrimination against Swedish-speaking foresters, Hannikainen preferred Finnish-speakers. The profession was gradually Finnicized, an explicit goal of Kairamo's "programme".

Hannikainen had a clear course of action. The State Board of Forestry strove to carry out the proposals of the private forests and crown forests committees to the letter. There were good opportunities for this because of the strong growth of the timber and paper market in the early years of the century. Hannikainen, however, did not repeat the mistakes of his predecessors. He did not sell timber from state forests at cut-rate prices. On the contrary, the Board tried to gain control over the whole chain of timber production. There were now serious attempts to stop the sales of standing timber and to shift the focus of operations to delivery cutting. In addition, the Board began to participate in wood manufacturing. In 1905, the state built a small sawmill near a local railway station at Siuro. It was intended to make ties for railway tracks. Three years later, the state acquired the Kevätniemi sawmill at the mouth of the Lieksanjoki River in northern Karelia, and the Sukeva sawmill was bought in the following year. During the First World War, the State Board of Forestry built the Uuksu sawmill on the Karelian Isthmus.

In economic terms, Hannikainen's policies were greatly successful. Delivery cutting increased from nil to one-quarter of all cutting by the First World War. Increasing amounts of timber were sold from the crown forests. By the beginning of the new century sales amounted to roughly half a million cubic metres per five-year period. Around the eve of the First World War, the corresponding figures were over two million cubic metres. Consequently, state forest revenue multiplied from ca. 1.7 million marks at the turn of the century to 14 million marks by the mid-1910s (figures per 5-year period). Although increased personnel and investments raised costs, there was still a surplus of almost eight million marks during the first half of the 1910s.

How were the crown forests managed? Hannikainen no doubt tried to follow the principles of sustainable development and rational forestry, but it proved to be surprisingly difficult to match theory with practice. The starting point here was the recommendation of the crown forests committee whereby over-aged timber had to be felled. Only then could rational and systematic forestry measures be applied to normal stands of even-aged forest. The State Board of Forestry, however, again



Photo: Brutus Lesche. Univ. of Helsinki, Dept. of Ecology

Although P.W. Hannikainen promoted rationalized forestry, he had very little time or resources to invest in the regeneration of forests. Here students of the Evo Forestry Institute test new planting methods.

confronted old problems. The demand for large-sized timber varied in different parts of the country, and it was particularly difficult to find buyers for timber from the old forests of the northern regions. Hannikainen had to agree to large-scale sales by concession to dispose of the over-aged timber of Lapland. The results, however, were depressing. The timber firms felled forest only along the rivers in order to keep transport costs low. This led to the denuding of large areas before the concession agreements were terminated in the late 1910s.

The now reformed State Board of Forestry also achieved positive results. There attempts to regenerate forests of poor yield by seeding, and by the beginning of the 1910s seeded areas totalled over 1000 hectares. Although this was a relatively small area, it marked a significant change. At the turn of the century only some 100 hectares of new forest had been seeded. In addition, there were increasing numbers of specific forest management plans. By the beginning of the century, some 20 percent of all state-owned forests were within the sphere of systematic and planned forestry measures. In practice, however, this did not mean that the forests were maintained or cared for in any rational manner. Cutting by compartments was still rare, and selection thinning was mostly practised. The latter method was developed so that, wherever possible, the area in question was cleaned to permit forest to grow "from a fresh start".



National Board of Antiques

Werner Cajanus (1878–1919) was a highly gifted statistical mathematician, who developed a new method to classify forest growth.

Although the Board of Forestry did not institute all the principles of rational forestry during Hannikainen's directorship, these attempts should not be judged too harshly. Forestry methods were still based on late-nineteenth-century scientific research, mostly from Germany and Sweden. Finnish studies in the field were still almost non-existent, and the new graduates in forestry from the Evo institute did not necessarily know the best forestry methods for all situations. But the most important change with respect to the previous situation involved attitudes. During Hannikainen's term, the senseless destruction of the country's forests gradually came to an end, to be replaced by systematic and planned forestry. These changes were not immediately visible in the forests themselves, but the course had nevertheless changed. The goal now was to use the forests so that they would also provide income in the future.

Cajander's Realm

P.W. Hannikainen was a natural choice as the new director-general of the State Board of Forestry. But who would be similarly equipped to reform research and training in forestry? A.G. Blomqvist of the Evo Forestry Institute was still without doubt Finland's most able researcher in forestry. But he had no place in Kairamo's plans. Blomqvist was too old, and a member of the Swedish-speaking intelligentsia. He had a few younger students, but they lacked academic degrees, or did not support the Finnish national movement.

Werner Cajanus was one of the main candidates. He was a highly gifted statistical mathematician who began to develop a quality classification of forest growth, trying to conclude which sample plots could be placed in the same series of development. Interpretations of results, however, were difficult, as the height, shape and diameter of trees varied without any regularity. Cajanus tried to solve this problem by comparing the distribution of diameter figures for stands of forest, applying a descriptive method developed by the Swedish astronomer Carl Vilhelm Charlier. This placed forest surveys and estimation on a completely new level. The previous methods had been based a simple, deterministic law of nature and could not give precise results. Although the frequency distribution model borrowed from Charlier offered no final solution to this difficult problem, it made it possible to calculate amounts of timber and their development much more precisely than before.

Cajanus did not, however, fit into Kairamo's plans. Therefore he began to seek a suitable candidate from among his own circle, which seemed considerably more promising. Geobotany particularly interested young scholars who had followed the calling of the nationalist *Fennoman* movement to seek their fatherland in the east and the west. But geobotanists were not explicitly interested in the country's forests. This, however, was no obstacle to Kairamo. Although the specific goals of geobotany and forestry research diverged to some degree, the practical aspects of research were not necessarily that far from each other. Forest science applied the results of the natural scientists, and the latter needed the assistance of forestry experts.

Kairamo required a person capable of bridging forestry and applied science with the so-called pure natural sciences. In this task he was assisted by his old teacher, J.P. Norrlin. Kairamo visited Norrlin in the summer of 1902, and the latter apparently suggested Aimo Kaarlo Cajander.

Who was Aimo Kaarlo Cajander? He was not a public figure like P.W. Hannikainen, nor a known supporter of the extreme nationalist movement. These "demerits", however, did not influence Kairamo's decision. In the contrary, Kairamo sought a person who had the necessary scientific qualifications but was politically "neutral". This was particularly important, since researchers and professionals in forestry were not to be branded as supporters of political factions. Kairamo naturally made sure that Cajander had a solid Finnish family background. He had been born and brought up in a completely Finnish family, and his father was known for his nationalistic sentiments in their home town of Uusikaupunki.

Cajander belonged to the young *Fennoman* intelligentsia, and in Kairamo's view he was the personification of everything required by the new forestry policies. Cajander was a skilled and industrious researcher, who had made good progress in his academic career. In addition, he was extremely ambitious and capable of organizing scientific research and implementing even difficult solutions in research policies.

A.K. Cajander was blissfully unaware of Kairamo's plans when he began his studies in botany at the Imperial Alexander University in 1896. He made fast progress in his

studies, graduating as Master of Arts in 1901, after which he was appointed to a supernumerary assistant position at the University's Museum of Botany. Following the spirit of the times, he went on several expeditions to Lapland and Karelia. The first one was in the summer of 1899 to the shores of the White Sea, where Cajander studied the distribution and habitats of flora. In the following summer he was accompanied by the zoologist Bertel Poppius on travels farther east, as far as the Lena River. The flora and growth habitats of the river valley were the subject of study. Cajander went on his third expedition in 1902 to the valleys of the Tornionjoki and Kemijoki rivers in Northern Finland.

Cajander began to prepare a thesis in geobotany from the material gathered on his expeditions. The work was completed in 1903, and submitted for the degree of Licentiate in Philosophy under the tile *"Die Alluvionen des unteren Lena-Thales"*.

The young scholar's career, however, took a complete different turn in 1903. Senator Kairamo asked Cajander to give up his work in geobotany and to take on the task of reforming forestry research and training in Finland. Although the young docent was no doubt flattered by the offer, it did not quite correspond to Cajander's wishes. He wanted to become director of the University's Botanic Gardens, and would probably have been appointed to the post if Kairamo had not intervened.

Cajander, however, did not wish to oppose A. Oswald Kairamo. This was an obviously wise decision , since Kairamo was a greatly influential figure whose support was valuable to any young researcher in the field. Accordingly, Cajander laid aside the materials from his expeditions, and enrolled at the Evo Forestry Institute in 1903. This "academic setback", too, was Kairamo's idea. The latter demanded that Cajander complete the forester's degree, and also gain practical experience in forestry.

The Evo institute was in an almost chaotic state when Cajander arrived there. A.G. Blomqvist had recently retired, and the fate of the institute had, for practical purposed, already been sealed. The forestry committees of the turn of the century had unanimously proposed the moving of higher-level forestry training to the University of Helsinki and the conversion of Evo into a school for forest wardens.

Cajander was an obviously over-qualified student at Evo. He nevertheless took his forester's degree. In reality, Cajander was immediately recruited to the faculty at Evo, being made responsible for the science curriculum.

A. Oswald Kairamo was now in a hurry. Reforms in state-managed forestry proceeded well in the able hands of P.W. Hannikainen, and the new advisory organization for privately owned forests began to emerge. However, the third and most important element of the new forest policies, research and training, were still unorganized.

In 1906 Cajander received a grant from the university to travel to Central Europe to study the forests and growth habitats of southern Germany and the Alpine regions. This was only part of a larger scheme. Soon after embarking on his journey, Cajander received a letter from Finland, requesting him to investigate the organization of forestry research in the Central European countries. The letter had been signed by



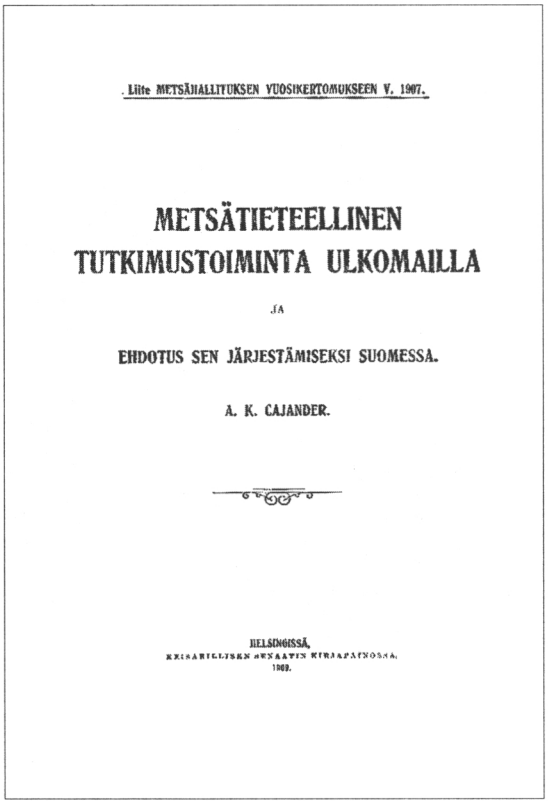
Photo: Rembrandt. National Board of Antiques

A.K. Cajander (1879–1943) was an ambitious geobotanist who became the real founder of forest research in Finland.

Director-General P.W. Hannikainen of the State Board of Forestry, but the real author was no doubt Senator A. Oswald Kairamo.

Cajander now had two tasks on his hands. He was involved in developing a general theory by which the methods of geobotany could be applied in the study of forests. At the same time, he visited the forestry research institutes of Germany, Austria, Hungary, Switzerland and France, and the corresponding facilities of Denmark and Sweden on his return journey. The purpose of these visits was to gain information on the organization, administration and costs of research.

Cajander returned to Finland in 1907, but did not prepare a report on his travels, as he was immediately posted to Evo as the acting director of the institute and the senior forester of the Evo-Vesijärvi forestry district. These official duties, however,



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EHDOTUS SEN JÄRJESTÄMISEKSI SUOMESSA.

A. K. CAJANDER.

HELSINGISSÄ,
KEISARILLISEN SENAATIN KIRJAPAINOSSA.
1909.

A.K. Cajander published his report concerning forest research in Europe in 1909. The organization of the Finnish Forest Research Institute was based on this report ten years later.

were only a fraction of Cajander's immense workload. In 1907–1908 he published several studies on Finnish forests, bogs and forestry. He also represented the Evo institute on a committee planning the moving of teaching in forestry to the University of Helsinki. In his "spare time" Cajander toured the forests of southern Finland, adding to the data which he had gathered in Central Europe.

In retrospect it seems almost impossible that one person alone could have managed all these tasks and duties. Cajander, however, had the energy and ambition to carry out his mission, and things now began to progress at a fast pace. The official ruling according to which senior-level teaching in forestry was transferred to the Imperial Alexander University of Helsinki was issued on the 28th of December 1907. Although the University officially approved this measure, a great deal of work still remained. Cajander had to enter into a bitter struggle with representatives of agricultural disciplines concerning the specific content of academic teaching in forestry. The professors in agriculture wanted to include agricultural chemistry and physics as mandatory courses in the forestry degree. Cajander strongly opposed this idea, maintaining that geobotany and biology were the foundations of training in forestry. After a heated debate, Cajander's position won, and academic teaching in forestry became an independent scheme, although institutionally subordinate to



Metla photographic archives

The early headquarters of the Finnish Forest Research Institute were located in downtown Helsinki close to the Senate and the University.

agricultural studies at the university. This gave Cajander free hands to organize the contents and requirements of teaching in forestry. This solution also had a definite ideological aspect. Academic teaching in agricultural subjects was still the domain of the Swedish-speaking elite. Cajander was now able to keep forestry, as an academic area, in the hands of Finnish-speaking and Finnish-nationalist experts. This position was reinforced when Cajander was appointed Professor of Forestry. The chair of Forest Mensuration went to Werner Cajanus, also a staunch supporter of the nationalist movement. Very soon Cajander also took over this position.

The transfer of teaching in forestry to the University of Helsinki was an important step in reforming the training of professionals in the field. But this alone did not ensure the position of forestry sciences in the academic community. Competition was harsh, and new fields did not easily become established. In 1909 A.K. Cajander founded the Finnish Society of Forest Science. This was a bold move as there were still no forestry experts in Finland with high academic qualifications, and forestry was not even regarded as a separate academic field. Cajander, in fact, was the only forestry expert in the whole country with a doctorate, albeit in botany. Cajander, however, did not hesitate. The academic teaching of forestry had to rely on the support of scientific institutions. Strategically important persons were recruited into



Metla photographic archives

The Finnish Forest Research Institute started modestly. The staff consisted of only a few officials. Olli Heikinheimo was appointed the first director and his wife, Ester, acted as secretary.

the Society; the first chairman was P.W. Hannikainen, and charter members included A. Oswald Kairamo and J.P. Norrlin. As pointed out by A. Benj. Helander, the Finnish Society of Forest Science was synonymous with A.K. Cajander in the early years. Cajander delivered most of the papers, in addition to planning and guiding the Society's activities.

There was also another reason to establish the Finnish Society of Forest Science. Agricultural activists were about to start their own society, and forestry was to be a part of the programme. Now Cajander effectively blocked these plans and ensured that forest research remained completely in the hands of the Finnish speaking elite.

Academic teaching and a scholarly society supporting it were necessary to the professionalization of the field. Improving the academic status of forestry required systematic research. As mentioned above, the private and crown forests committees unanimously recommended the establishment of an experimental research facility in the field of forestry. Cajander had investigated the practical aspects of such a scheme on his study trip to Central Europe, but the implementation of these plans still had to wait.

Cajander now had to organize the transfer of forestry teaching to the University of Helsinki, and he simply lacked the time to draw up a detailed report on European forestry research institutes for the State Board of Forestry. This report did not appear

until 1909, being published as a supplement to the annual report of the State Board of Forestry. Cajander was thorough, presenting an extensive and detailed report. The first section of his text reviews the development of forestry science, particularly in Germany. This is followed by descriptions of the organization, administration and tasks of research bodies in various countries. Finally, the report contains a detailed plan on the kind of research institution best suited to Finnish conditions.

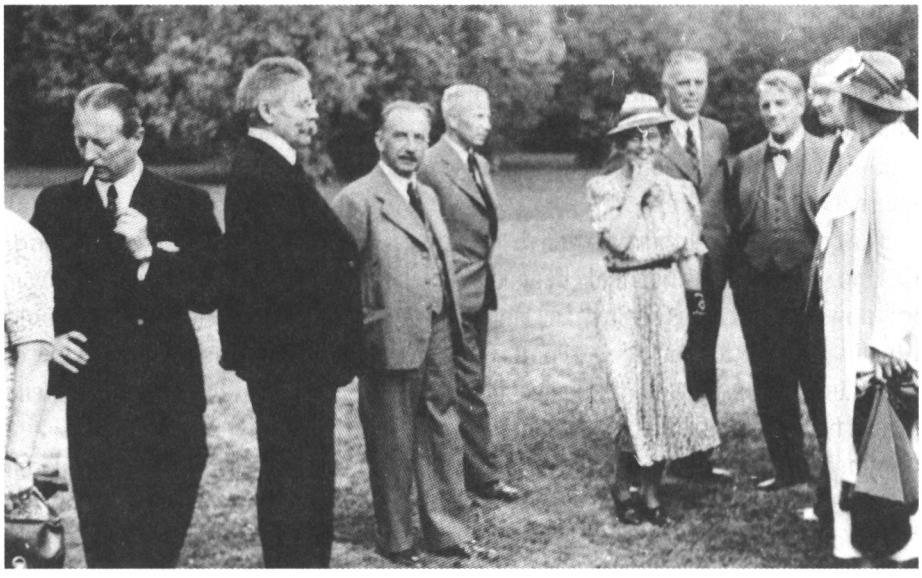
Cajander's plan was clear and lucid. The forest research institute would encompass two complementary traditions of research. The biological and forest-mathematic tradition developed by A.G. Blomqvist at Evo would support practical forestry, while the geobotanical tradition of J.P. Norrlin would be the theoretical basis for forestry science in general. Together, these two traditions would engender a completely new direction with elements of both the "pure" natural sciences and applied forestry research.

According to Cajander, "the purpose of the forest research institute is to lay the scientific foundation of Finnish forestry through systematic research and experimentation... In their publications, researchers should prove that they are thoroughly familiar with scientific research, biological forest studies, forest mathematics, forest soil studies, and botanical topography. The two first-mentioned areas require practical experience and the third a knowledge of the theory of forestry".

Although Cajander wanted to develop an independent scientific research institution, it was in reality an integral part of Kairamo's new envisioned system of forestry. According to Cajander, "the research institute will operate as independently as possible under the aegis of the State Board of Forestry." Furthermore, the research institute was to collaborate closely with the University of Helsinki, the Finnish Society of Forest Science and the Tapio Forestry Society, an advisory body to private forest owners. The purpose of the institute was to be "a unit of basic-level research", producing data and information for the use of other bodies and units within the forestry system as a whole.

Cajander's scheme was detailed and precise, but it lacked one important aspect. Cajander made no mention of the relationship of the forests with the climate, a topic figuring prominently in the statements of the various forest committees. This was not an oversight but a strategic choice. Cajander's aim was to monopolize forestry research as the specialist domain of geobotanists and forest scientists. This would not have succeeded if the forests were noted as having a decisive influence on the climate, and vice-versa. According to Cajander, forest growth and the structure of forests were dependent on the habitat. Accordingly, the climate could be replaced by the habitat in the equation.

Cajander's plans were so thorough that they could have been immediately applied in establishing the envisioned research institute. Since this was to be a permanent administrative institution, official permission from the Senate of Finland was required. As usual, the Senate appointed a committee to study the practical measures of



National Board of Antiques

A.K. Cajander arranged many meetings and seminars. Here he is entertaining prominent forest researchers and their spouses. From the left: Prof. Sven Petrini, A.K. Cajander, Prof. Fabricius, Prof. Y. Ilvessalo, Prof. M. Lévon and Prof. Erik Lönnroth.

the scheme. The membership of this committee did not pose any threat to the plans. On the contrary, it was chaired by A. Oswald Kairamo and included J.P. Norrlin and P.W. Hannikainen. The first secretary was Werner Cajanus, later replaced by A.K. Cajander.

The committee began its work in April 1909. It was generally expected to prepare its report in a short time. This, however, did not happen; the committee was not to submit its report until 1913. In his studies, Risto Sarvas has tried to explain the slow progress of this venture, suggesting as possible reasons disagreements on the level of principle between the committee and Cajander's original plan. This is not a plausible explanation. Sarvas fails to note that the second wave of Russification policies aimed against Finland's autonomous position began at this time. Instead of a brutal "cultural occupation", the Russians now tried to subdue the Finns by manning the Grand Duchy's main government offices and departments. The Senate was the country's nerve centre, but the Russians were also interested in other government offices. Had the Forestry Research Institute been established in 1909, it would probably have been staffed with Russians, or at least researchers trained in Russia. The Finns could hardly have been able to compete with the scientific and scholarly qualifications of researchers from the St Petersburg Academy of Forestry.

Had this happened, Kairamo's grand scheme would have fallen apart. The Russians would have dominated research, and thereby the training of professionals in the field, and possibly even Finnish forestry as a whole. This might have improved the

state of Finland's forests, but it did not suit the overall policies of the nationalistically oriented Grand Duchy of Finland. The committee skilfully tried to gain time. It postponed its report while waiting for changes in the political climate. At the same time, the teaching of forestry at the University of Helsinki was speeded, and Finland gradually began to acquire a corps of researchers in the field that could compete internationally.

The committee's strategy proved to be correct. When it finally submitted its report, Finland's political position had changed. The threat of the impending First World War was now in the air, and the Russians lacked the means to threaten Finland. This would explain why the committee's report was ultimately an almost verbatim copy of Cajander's proposal from 1909. The alterations and changes were mostly cosmetic means by which the committee legitimized its own work.

Although the committee recommended the founding of the Forestry Research Institute, the scheme itself remained to be realized. The reason for this was now the First World War, which made it necessary to postpone the plans until late 1917. The situation again changed. The country now became independent and there was no longer any threat of Russian occupation. In December 1917 the Parliament of Finland passed the act necessary for founding the research institute, but the process of national independence and the Finnish civil war, which broke out in January 1918, again postponed the launching of the institute until the summer of the following year.

Cajander's realm was now complete. It had three foundations: academic teaching in forestry, the Finnish Society of Forest Science, and the Forest Research Institute. Within a decade, Cajander had built an ensemble of institutions providing a scientifically adequate framework for this new discipline in Finland.

Cajander ruled his realm autocratically. He was Professor of Forestry, chairman of the Finnish Society of Forest Science, chairman of the Board of the Forest Research Institute, and from 1918 Director-General of the now National Board of Forestry. His power grew in the 1920s, when he was appointed to the boards of the Enso-Gutzeit and Veitsiluoto forestry companies, both under state control. The crowning achievement came in the 1930s when A.K. Cajander became the Prime Minister of Finland.

A.K. Cajander was highly aware of his own power. All major appointments in the field of forestry policies passed through his hands. He selected, fired and appointed all those who influenced the management, study and utilization of the nation's forests. Cajander demanded absolute loyalty. He could not stand "dissenters" or opponents to his forestry policies. He kept a particularly close watch on the academic teaching of forestry, the work of the Forest Research Institute, and the decisions taken by the National Board of Forestry. He was thus able to build up a massive network linking most of the country's professionals in forestry, or at least the most important figures.

Cajander followed a clear course in his appointments. He chose young, Finnish-speaking and Finnish-minded professionals, who were prepared to develop and further his own forestry policies and scientific concepts. Olli Heikinheimo, principal

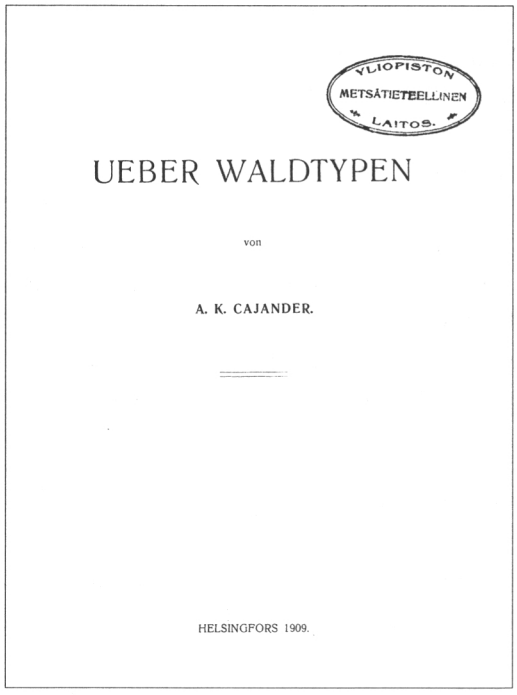
of the Evo Forest Warden School, became the first director of the Forest Research Institute. O.J. Lakari was at first Professor of Forest Mensuration, but in 1918 Cajander made him head of forest mensuration at the National Board of Forestry. This provided a position for Yrjö Ilvessalo, who immediately began to plan the first nationwide survey of the forests. The chairs of forestry were held by V.T. Aaltonen and by V. Kujala from 1919. Common to all these researchers was the fact that they were Cajander's students and completely loyal to their "chief".

Cajander's influence also extended to the university and the National Board of Forestry. Appointments, resignations and transfers were all referred to him, which resulted in a situation in which "Cajander's men" held almost all the major positions related to research, training and administration in the field.

Science in the Woods

In 1907 Cajander travelled to Europe to study forests and forest habitats in southern Germany and the Alpine regions. This, however, was no ordinary "study trip". While studying at Evo, Cajander had become aware of how difficult in fact the proper study of the forests was. There were several methods of estimating and surveying forests, and the classification of forests was based more on the individual researcher's preferences than on any "scientific" typology. This was the source of a number of problems. Results were unreliable and could not be compared. Studies rarely approached the forests as a larger ecological system, since researchers were interested only in the trees and their dimensions and growth properties. Basing on these experiences, Cajander came to the conclusion that forestry research required a theoretical basis that would a) explain growth and change in forests and the timber stock and b) provide a uniform basis for classification by which different types of forest could be distinguished.

This was by no means an easy task. Unlike other natural sciences, forestry studies recognize no overall theory. The forest ecosystem was far too complex for its changes, development and variation to be explained with reference to a single theory alone. In addition, research concerning forests is carried out within various disciplines, which further prevented the establishment of a uniform theory. Cajander, however, kept to his course. J.P. Norrlin and other geobotanists had demonstrated how the habitat played a decisive role in the structure and development of plant communities. Cajander himself became convinced of Norrlin's theory in 1902 during his studies of plant communities on the Lena River. He observed how certain habitats always produced a certain type of forest. Norrlin based his concepts on Darwin's theories, according to which natural selection and continuous competition laid down the relationships and proportions of species. The strongest and most adaptive species survived, while the weaker species were destroyed.



A.K. Cajander's main work "Ueber Waldtypen" was published in 1909. It became the theoretical foundation for forest research in Finland.

This concept was the basis of Norrlin's own theory. But Cajander took it one step further and began to study why certain species always survived better than others. As a geobotanists, he assumed that this was due to the soil. Habitats had certain "in-built" properties consistently favouring certain species. A habitat was the site of a fierce competition for living space, but certain communities of plants always emerged victorious.

Cajander applied Norrlin's ideas to the forests, claiming that "the overall structure of plant communities in various habitats and their related exterior physiognomy resulted from the fact that the struggle for survival in each individual habitat was generally won by those species whose exterior and interior structure and specialized biological properties provided the best opportunities for this. A further reason is the fact that among these species, at least within certain limits, there will be a selection of biotypes (formation of species) mainly according to the same principles".

The suggested the fact that "the primary factors of the habitat generally define the type of forest, suggesting in turn that on the basis of forest type it would be possible to achieve indirectly a natural and biological classification of habitat independent of the dominant species of trees. Such a classification could be the basis for methods based on the properties of the soils and the timber, which could be developed further in cases where the indirect classification based on forest types is not satisfactory as such".

According to Cajander, "a distinct forest type includes all stands of forest – with



Metla photographic archives

The theory of forest types was applied in the National Forest Inventories which started in the beginning of the 1920s. Young surveyors travelled Finland back and forth to obtain exact data on forests.

timber in an exploitable, or more or less exploitable, state and of normal density – whose range of species and ecological-biological character are largely similar. A type will also include stands of forest whose flora differs from the above considerations only with respect to the age, cutting, changing of species and other factors which must be regarded as temporary but in no case permanent. Permanent differences will result in a new forest type if the differences are considerable, or in a sub-type if they are less essential but still significant."

Cajander published his theory, *Ueber Waldtypen*, in Fennia, the journal of the Finnish Society of Geography in 1909. Later it was republished in the first volume of *Acta Forestalia Fennica*, the new series of the Finnish Society of Forest Science. The text was entitled *Über Waldtypen*. The presentation of this theory was well timed, and it immediately began to be taught at the University of Helsinki and discussed at the meetings of the Society. it also became the foundation of advisory work within the private sector of forestry. And finally, it became a paradigm unswervingly followed by the Institute of Forest Research.

As all the leading forestry scientists, academic faculty members and administrative officials in the field were "Cajander's men", the new theory was soon laid down as the theoretical basis of Finnish forestry in general. The theory of forest types maintained that the soils defined the development and form of forests. Investigations of forest types would also reveal what kinds of forest grew in Finland, and also pointed to the

type of forest that would ultimately grow in various areas.

The forest type theory permitted more precise surveying methods than previously. It also made it possible to develop more effective methods of forestry management, regeneration and cutting. The theory also suggested that the heavy working of the soil and its manipulation would change the "in-built" system so that the resulting forest type would also change. This naturally provided significant opportunities to manipulate bogs and marshy areas, and to introduce efficient forestry into areas of poor yield.

A.K. Cajander brought science into the forests of Finland. This fact has often been ignored in histories of Finnish forestry. The theory of forest types was not an isolated set of concepts thought up by an individual scientist. On the contrary, it was part of a much broader process by which the various sectors of Finnish forestry were re-ordered. Rational forestry was based on science and required scientific institutions. But institutions alone do not produce scientific results. An inner renewal of the discipline is required, and this was specifically offered by Cajander's theory of forest types.

How did Cajander's theory influence the appearance of forests? Change was naturally slow in this respect. The forest type theory had a "biological" basis, i.e. it viewed the forests from a broader perspective than their timber alone. It forced scientists and foresters to take a good look at the soils, and not only the dominant species of trees and their properties. The theory thus established a new order within the forests and offered a real basis for rational forestry. Selection cutting and other "destructive" methods were gradually rejected and replaced by methods of regeneration. These were not necessarily any more "natural", since the forest type theory contained a significant human element. Cajander perhaps relied on the good intentions of researchers and foresters to "protect" the nation's forests. As times changed and the economic value of the forests grew, the human need to manipulate and guide the course of nature correspondingly increased. Cajander naturally did not consider this aspect in 1908, when deforestation was still feared as the result "senseless" human activity.

Rational forestry had been a subject of discussion since the 1840s, but it took almost a century before Finnish society was finally prepared to apply these principles. During the long interval, a massive forestry system emerged, being based on science and rational human action. Forest science as practised in Finland did not come from Germany, as previously assumed. Neither did it emerge at the Academy of Turku or the Evo Forestry Institute, nor develop directly from these starting points into the Institute of Forest Research and the related activities of the University of Helsinki. On the contrary, forest science in Finland arose through the joint influence of a variety of factors and encompassed different traditions of science and research.

A.K. Cajander himself assessed the state of the discipline in 1934. Responding to the question of whether forest research is a science he noted: "Hardly anyone has any



Photo: Olli Heikinheimo 1926. Metla photographic archives

Although forest science was a "national science" it also had very close ties with the international scientific community. A group of American foresters visited Finland after the International Forest Congress in Rome in 1926.

doubts in answering that question today. But only a few decades ago the situation was completely different. At the time, forest science was not highly valued even in the major civilized nations, much less here. Foresters themselves were not even convinced that such a science was necessary. Though not all foresters were so unassuming as the one who said that all a forester needs to know is that a tree grows with its roots in ground and the top pointing skyward, requirements of knowledge were not very broad within the profession. The University of Helsinki awarded an honorary doctorate to A.G. Blomqvist, the director of the Evo Forestry Institute, but, generally speaking, the scientific community hardly recognized forest science as an equal to the so-called pure sciences."

Cajander then went on to answer the question "Is forest science a national science?". His answer reads as follows: "Without doubt. Forest science has a solid foundation in the habitats of Finland. It studies the nation's forests, the spruces under which we live. It studies the wealth upon which the livelihood of the people largely depends: the forests whose ashes used to fertilize the burn-beaten plots where grain grew and which still provide the income and products that make our own culture possible. What science could have a more national orientation than one which ensures the livelihood of the people and its spiritual life?"

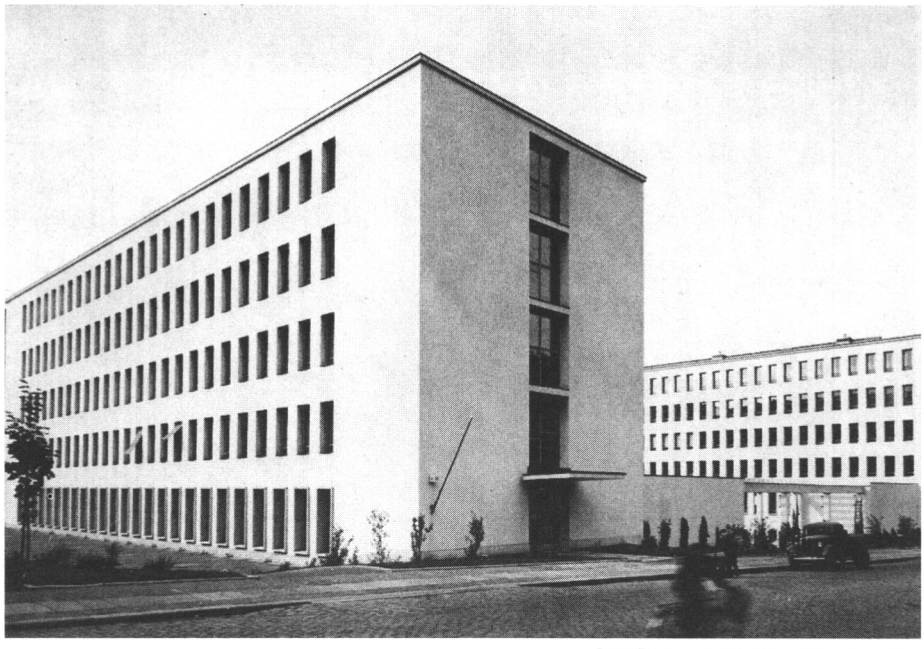


Photo: Erik Lönnroth 1940. Metla photographic archives

Forest science became well established in modern Finland. As a symbol of this, the Finnish Forest Research Institute and the University's Faculty of Forestry were located in a modern functionalist building, *Metsätalo,* in Helsinki in 1939.

Finally Cajander responded to the question "Is forest science international?": "It is completely international. Like all sciences, forest research aims at establishing universal truths regardless of national borders. Around the turn of the century, this field was in a state of depression in Finland. Earlier efforts had dwindled as their representatives had aged, and new developments had not yet emerged. When work was again begun, no one asked whether forest research was a science. It was begun with the firm conviction that forest research was a science just like any other. There were no deliberations on its possible national character. It was clearly felt that improving forestry in Finland was absolutely necessary for the nation's future and it was also known that this could not be done without a scientific basis. That was enough to set out on the course."

Selected References

This book is based almost entirely on primary sources. The following list of references arranged by chapter includes only archival sources which have been most valuable in preparing "The Unknown Forest". Old and recent articles and books concerning the history of forests in Finland have been omitted from this list. The complete list of references and footnotes are given in the Finnish version of this book .

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