

ACADEMY OF SCIENCES OF THE ESTONIAN S.S.R.

FOREST RESEARCH IN THE ESTONIAN S.S.R.


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FOREST RESEARCH IN THE ESTONIAN SSR

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INTRODUCTION

The forests of the Estonian Soviet Socialist Republic belong to the mixed forest subzone of the Eurasian conifer zone. They cover almost 30 per cent of the territory of the Republic. The predominant tree species are the pine (*Pinus silvestris* L.), which makes up 46 per cent of the wooded area; the spruce [*Picea excelsa* (Lam.) Link] — 20 per cent; the birch (*Betula verrucosa* Ehrh. and *Betula pubescens* Ehrh.) — 28 per cent; the aspen (*Populus tremula* L.) — 3 per cent; the black alder [*Alnus glutinosa* (L.) Gaertn.] — 2 per cent; and the grey alder [*Alnus incana* (L.) Moench] — 1 per cent. Other species (such as the oak, the ash, etc.) are less common. Altogether 87 native tree and shrub species grow in the Republic.

As a result of the increasing exploitation of the land, the forests have been preserved mainly on poor and excessively moist soils, the more fertile areas having been brought under agricultural cultivation. The island of Saaremaa, the environs of Tallinn, and the Paide district are relatively poor in forests; the districts of Kilingi-Nõmme, Mustvee and Räpina are relatively rich in forests.

According to the mode of ownership the forests of the Republic may be divided into the following groups: 1) state-owned forests managed by government agencies accounting for 55 per cent of the total forest resources of the Republic, 2) forests belonging to state farms (6 per cent), 3) forestry training centres and experimental cultures (1 per cent), 4) forests belonging to miscellaneous

organisations (5 per cent), 5) forests owned by collective farms (33 per cent).

The state-owned forests are subordinated to the Board of Forest Management of the Ministry of Agriculture and are divided into 18 forest administrative regions, which are subdivided into 155 forestries.

The planned management of the forests in Estonia took its rise about a hundred years ago. 21 per cent of the forests of the Republic belong to Forest Group I (which includes the Green Belt, wooded health resorts, surface protection cultures, nature conservation areas, etc.) where clear-cutting is forbidden; 79 per cent of the forests belong to Forest Group II, where clear-cutting is allowed within the limits of the annual accretion.

Forest research in the Estonian SSR is mainly carried out by the forestry sector of the Institute of Zoology and Botany, which is affiliated to the Academy of Sciences and domiciled in Tartu. The sections of botany and zoology of the above Institute also take part in the investigation of the forests of the Republic, especially in the field of forest flora and fauna. Questions of afforestation and the introduction of exotic tree species are studied by the Institute of Experimental Biology of the Academy of Sciences, and by the staff of the newly-founded Botanical Gardens in Tallinn.

Forest research is also carried out by the Chairs of Silviculture and of Forest Economy and Forest Management in the Faculty of Forest Management and Hydromelioration of the Estonian Agricultural Academy in Tartu, by the Chair of Systematic Botany and Geobotany in the Faculty of Mathematics and Natural Science of Tartu University, and by the Forestry School at Kuremaa.

The Nature Conservation Commission of the Academy of Sciences and the Nature Conservancy Board attached to the Council of Ministers deal with the protection of

forest areas and the organisation of research work in the nature reserves and national parks.

All amateur naturalists working in the field of forestry are united by the forestry section of the Naturalists' Society (LUS) of the Academy of Sciences. Professional silviculturalists, together with many research and educational workers, are also organized by the forestry section of the Scientific-Technical Association of Land and Forest Management in Tallinn.

The present pamphlet gives a short survey of the forest research work carried out by the above-mentioned institutions and organisations in the post-war years. The materials presented have been mainly drawn from the following serial publications:

1. Metsanduslikud uurimused. [Forest Research] — published by the Academy of Sciences; issued non-periodically; articles in Estonian, with abstracts in Russian, German or English; presents researches of the forestry sector of the Institute of Zoology and Botany. Vol. I appeared in 1957, Vol. II in 1959.

2. Eesti NSV Teaduste Akadeemia Toimetised. (Bioloogiline seeria). [Transactions of the Academy of Sciences of the Estonian SSR] — quarterly; first issued 1952; carries papers on forest research, (from 1956 in the "Biological Series") articles mainly in Estonian, with summaries in Russian, and German or English.

3. Loodusuurijate Seltsi aastaraamat [Year-Book of the Naturalists' Society attached to the Academy of Sciences of the Estonian SSR] — issued yearly; articles mainly in Estonian with summaries in Russian; beginning with Volume 50 also summaries in a foreign language.

The "Loodusuurijate Seltsi juubelikoguteos" — a special jubilee edition — was published in Tartu in 1953. Volumes 48—52 of the Year-Book have appeared since the war.

4. Abiks loodusevaatlejale. [A Guide to Amateur Naturalists] — a non-periodical publication of the Naturalists' Society; issued in Estonian with summaries in Russian; from the 28th issue onwards with summaries also in a foreign language.

The Guide has been published since 1951; issues 1—41.

5. Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik. [A collection of papers published by the Estonian Agricultural Academy] — non-periodical; articles mainly in Estonian with summaries in Russian.

This publication was started in 1955, Nos. 1—13 having appeared to date. Articles on forestry are contained in Nos. 1, 2, 3, 6, 10 and 11.

6. Eesti Loodus. [Estonian Nature] — a popular-scientific magazine published by the Academy of Sciences; launched in 1958; bimestrial; articles in Estonian with summaries in Russian and English.

7. Sotsialistlik Põllumajandus. [Socialist Agriculture — devoted to problems of agricultural production] — published monthly from 1944—1958; from 1959 onward fortnightly.

8. ENSV Põllumajanduse Ministeeriumi Metsamajanduse Peavalitsuse ja Põllu- ja Metsamajanduse Teaduslik-Tehnilise Ühingu metsamajanduse sektsiooni bülletään. [Bulletin of the Board of Forest Management of the Ministry of Agriculture of the Estonian SSR and of the forestry section of the Scientific-Technical Association of Land and Forest Management] — a non-periodical publication in Estonian; issued Jan. 1958, June 1958 and Dec. 1959.

1. FOREST RESEARCH IN THE PAST

The first silvicultural publication which appeared in Estonia was a book by Andreas Lövis "Anleitung zur Forstwirtschaft für Livland" (246 pp), published simultaneously in Riga and Tartu in 1814. The same author compiled another book bearing the title "Über die ehemalige Verbreitung der Eichen in Livland und Estland," which was printed at Tartu in 1824. The first silvicultural book in Estonian is "Juhatus metsavahtidele" (A Guide to Gamekeepers, 84 pp) by A. Lütkens. This was followed by M. Maurach's "Praktiline metsaasjandus" (Practical Silviculture) in German with an Estonian translation by O. Daniel at Tartu in 1924. From the view-point of forest research all these books have only a historical importance, though the two authors last named were both head keepers and men of wide practical experience.

The Baltic Forestry Society, founded in Riga, 1867, may be regarded as the initiator of planned forest research. From 1890 on Tartu became the seat of this society. The members of the society were mostly German forest-owners and silviculturalists, and only a small number of them, mainly foresters, were Estonians. The society organized discussions and excursions. President of the society was M. Sievers, who strenuously advocated the cultivation of various exotic tree species. His chief published work is the "Verzeichnis der in Livland anbauwürdiger Gehölze," Riga, 1890. Among the other authors of silvicultural publications who delivered reports at meetings of the society, F. Berg and A. Orlowsky are widely known.

During the period 1918—1940 forest research work was carried out mainly by enthusiasts. It is true that a Forest Research Institute was founded at Tartu on Dec. 1, 1936, but there was only one post on its staff — that of the director himself. After a year a "scientific assistant," or research worker, was added to the staff. As Estonian forests were in an unsatisfactory state at that time, the Institute chiefly studied questions of forest protection. In 1931 experimental forest districts were founded at Voltveti, Sagadi, Sõmerpalu and Kuusiku. The research superintendents of these experimental forestries took an active part in research. Two of them were appointed in 1937, the remaining two still later. Of the experimental forest districts which existed before the foundation of the Forest Research Institute only that of Voltveti is worth mentioning. Forest research was also carried out by the Institute of Natural Resources (founded in 1937, researches begun in 1938), with its forestry section which consisted of two specialists in silviculture.

The Forestry Department of the Faculty of Agriculture of Tartu University, together with its forestry training and experimental centre at Järvselja, achieved somewhat better results. The more substantial investigations (including diploma theses) of the Forestry Department were published in the "Transactions of the Forestry Department of Tartu University." The Academic Forestry Society, which was attached to the University, organized meetings at which silvicultural papers were read and discussed, and published books on silviculture and kindred subjects. Various silvicultural articles were also published in the magazine "Eesti Mets" (The Estonian Forest).

Landscape detail from South Estonia. The wooded shores of Lake Piigandi. *Photo by P. Pere.*

SE Estonia is rich in forests and swamps. View from Võisiku Hill. *Photo by P. Pere.*









Forest research work was intensified after the historical events of June, 1940. The personnel of the Forest Research Institute was doubled; but the Second World War, which shortly intervened, put an end to this enthusiastic and promising activity.

During the German occupation (1941—1944) no purposeful forest research work was done in Estonia.

1946 was the foundation year of the Academy of Sciences of the Estonian SSR. The Institute of Biology, with its forestry sector, started work within the framework of the Academy a year later (in 1952 the Institute was renamed as the Institute of Zoology and Botany). By the end of 1959 the staff of the forestry sector consisted of 16 members, including 7 research workers, 2 senior engineers, 3 assistants and 4 post-graduates. In the spring of 1959 a new experimental station was called into existence on the island of Saaremaa. Valuable assistance has been received from the laboratory of forest soil science, staffed (at the end of 1959) by 1 research worker and 2 assistants. Other organisations and groups engaged in forest research have been mentioned above.

Like forestry research, the training of specialists in silviculture started in Estonia in the nineteenth century. In the seventies forest personnel began to be trained by prominent district supervisors for their subsequent appointment as keepers. Persons who had undergone a two years' course of training under District Supervisor Cornelius at Karksi qualified for the post of forester or trained forest foreman. In order to receive a higher silvi-

Forest road at Laatre. *Photo by P. Pere.*

Eighty-year-old mixed forest of spruce, pine and birch in Central Estonia. *From the photo archives of the forestry sector of the Institute of Zoology and Botany of the Academy of Sciences of the Estonian SSR.*

cultural education, one had to study at the Institute of Forestry in St. Petersburg or at some special higher educational establishment in Western Europe, chief of which was the Eberswalde Academy of Forestry in Germany. However, this entailed considerable expense, and only a few Estonians could afford it.

The training of silvicultural specialists in bourgeois Estonia was carried out at the Department of Forestry of the Faculty of Agriculture of Tartu University. The Department was founded in 1920 with three chairs: the Chair of Silviculture, the Chair of Forest Management, and the Chair of Forest Utilization. In bourgeois Estonia nine Master's and five Doctor's theses were accepted here. In comparison with the present requirements, the previous doctoral theses roughly correspond to our more extensive "Candidate's" theses. The number of graduates from the Department of Forestry in the period 1920—1940 was 90. The number of graduates from the same department in the first year of Soviet power, 1940/1941, was 10.

After the war silvicultural specialists were trained at the Faculty of Forestry, which up to 1950 was attached to the University. In 1951, however, it was transferred to the Estonian Agricultural Academy, which was then founded. In 1958 two former faculties of the Estonian Agricultural Academy were united to form a new faculty — that of Forest Management and Hydromelioration. In the period 1945—1960, 604 silvicultural specialists received a higher education. Of these 397 are specialists in forest management, 122 in forestry industry, and 85 in forest amelioration. 17 silviculturalists have won the degree of Candidate of Sciences either at the Academy of Sciences of the Estonian SSR or at corresponding institutions of other Soviet republics.

II. THE PRESENT STATE OF FOREST RESEARCH

1. The scope of investigations and main lines of research

The leading forest research institution in Estonia — the forestry sector of the Institute of Zoology and Botany of the Academy of Sciences — is primarily concerned with "the extension of the wooded area of the Estonian SSR and the raising of the timber yield." This problem constitutes the basic task of forest management in the Republic, and offers wide opportunities for theoretical investigations and generalisations. It forms an organic part of the basic problem of the Academy of Sciences of the USSR — the complex study of natural resources.

In profile the forestry sector is forest-biological. Research work combines the study of theoretical problems with the elaboration of practical measures for forest improvement. In order to ensure that the theoretical aspect is not divorced from the practical side of the work, the forests are treated on the one hand as natural objects, obeying their own specific laws of life and development, on the other hand as a timber reserve for the national economy and as a means of modifying undesirable natural phenomena.

Research is of a biological and ecological nature, i.e. tree species and forest communities are studied in their mutual dependence on site factors (climate, relief, soil, ground vegetation, forest fauna). Hence forest biology involves the study of a number of related subjects, particularly of soil science, botany and zoology.

Research has been concentrated on the all-round study of alvar, swamp and grove forest site types, with a view to securing a constant improvement in methods of maintenance and exploitation. Up to 1954 the research programme also included the study of wooded heaths, and beginning from 1960 work in this field has been resumed.

In studying the above-mentioned forest site types, special attention is devoted to the following problems:

In alvar forests — the rotation of mineral substances between forest and soil. This problem is of vital importance both for raising the productivity of alvar forests and for the afforestation of alvar areas. The latter was previously studied as an isolated problem.

In swamp forests on peaty soils — the process of swamp formation and the drainage of bogged-up areas. The aim of research here is to raise the efficiency of forest management. Within the limits of this broad sector the following secondary problems are receiving separate treatment: the regeneration of forest clearings on drained transition bogs, the expedient drainage of forested transition bogs and fens, and the afforestation of treeless peat bogs. Palynological research into the history of forests and the genesis of swamps has been recently initiated.

In grove forests the main attention has been directed to the study of relations between different tree species. The aim of research is to find out the possibilities of reconstruction of low-quality forests on fertile soils by means of maintenance fellings and methods of forest cultivation. In this connection attention is paid to the possibility of enriching the specific composition of forests by the addition of valuable native and exotic species, and to the acclimatization of promising exotic species.

The fourth cycle of problems studied at the Institute of Zoology and Botany embraces all of the three above-mentioned forest site types and is concerned with the improve-

ment of the quality and the state of health. It is dealt with chiefly by the sectors of botany and zoology. Here belong many problems connected with forest protection in the fields of phytopathology, forest entomology, ornithology and mammalogy.

The research problem of the Faculty of Forest Management and Hydromelioration of the Estonian Agricultural Academy fundamentally coincides with that of the Institute of Zoology and Botany. The subjects are very closely related and can mostly be included under the thematic cycles already mentioned. In addition, questions of wood science and seed technology are studied here.

Some investigations undertaken by specialists of the Institute of Experimental Biology of the Academy of Sciences and by the University aim at the enrichment of green plots and forests with valuable tree and shrub species. One investigation of the Institute of Economy of the Academy of Sciences deals with questions of forest economy.

The leading position in forest research is occupied by the Institute of Zoology and Botany. Of the 39 problems now in hand 28 are being investigated at the Institute, including 18 in the forestry sector, 1 by the soil science group, 2 at the silvicultural experimental station and 7 in the sectors of botany and zoology. Of the remainder, 7 research themes are being studied at the Faculty of Forest Management and Hydromelioration of the Estonian Agricultural Academy, 1 at the Institute of Experimental Biology attached to the Academy, 1 at the Institute of Economy and 2 at the University.

From 1945 to 1959 more than 1200 articles on forestry were published in all. Of these over 200 were printed as separate papers, the others in the form of articles in various collections and in the periodical press. Fourteen per cent of the total are translations from the Russian. The largest section is devoted to questions of silviculture,

many papers being directly concerned with forest cultivation.

The vast majority of papers have been contributed by workers of the Institute of Zoology and Botany attached to the Academy of Sciences. Thus 9 out of the 12 more extensive original investigations in Estonia are from workers of the Academy, or have been printed in publications of the Academy. In the period 1947—1959 the staff of the forestry sector of the Institute alone has published altogether more than 200 papers or articles on forestry. It is noteworthy that the majority of them have been published in recent years.

The Institute of Zoology and Botany has also compiled a bibliography of post-war works and articles on forest research, published by the forestry sector of the Institute under the title "Metsanduslik kirjandus 1945—1958" (Literature on Forestry 1945—1958).

2. Forest biology and silviculture

Forest soil science

As an independent field of research, forest soil science is still developing in Estonia. Of the investigations in forest soils under the bourgeois regime only one is worth mentioning — A. Nõmmik's "On the decomposition rate of fallen leaves and needles and the loss of some of their constituent elements."* Although this gives a good survey of the chemical composition of the debris of the chief tree species growing in the soil conditions of Estonia and their relative decomposition rate, its results cannot — on account of their artificial character — be applied to natural

* Published in the book "Eesti Metsanduse Aastaraamat" (Year-Book of Estonian Forestry), № 9, Tartu, 1939.

forests, especially to stands growing in other soil conditions.

During the post-war period of Soviet Estonia, problems of forest soil science have been treated in greater detail only as constituent parts of investigations on forest ecology. Thus the chemical and physical properties of soils in swamp forests and swamps have been studied by P. Kollist, U. Valk, V. Hainla and U. Riispere (v. swamp forests). The moisture regime, the mechanical composition and, above all, questions of the nutrient content of heathlands have been touched upon in the investigations of U. Valk and P. Rõigas (v. heath forests). Analogous investigations have been carried out in alvar forests by E. Pihelgas and E. Kaar (v. alvar forests), and on the agriculturally low-productive sandy soils of SE Estonia by M. Margus. Problems of podzolization and the origin of hardpan have been discussed in investigations on forest ecology by O. Henno (v. heath forests). The morphological characteristics of forest soils and their relation to forest types have been studied by A. Karu and L. Muiste in their work on the classification of forest types in Estonia (v. forest typology).

Beginning from 1956 forest soil science has developed into an independent branch of research in the forestry sector of the Institute of Zoology and Botany. Researches have been begun in the relations between the forest-growing properties of the soil and the forest vegetation. In the course of these investigations special attention is being paid to the study of the quantitative and qualitative aspects of the rotation of substances between forest vegetation and soil, i.e. the quantity of debris, ground vegetation and forest litter, the chemical composition of the soil and the intensity of soil respiration (biological activity) in different forest types and soil conditions. The preliminary summing up of results shows that the first prerequisite for the raising of soil productivity on alvar

soils is the intensification of the rotation of substances between forest vegetation and soil, and in this the pine has certain advantages over the spruce (Sepp, 1957; 1959). Some questions concerning the dependence of the productivity of stands on the chemical composition of the underlying limestone and the morphological properties of the soil have also been elucidated.

Forest soil research is proceeding hand in hand with other investigations of an ecological slant, thus linking up with the complex study of natural conditions and the problem of raising the productivity of forests.

The immediate task of forest soil science in the Estonian SSR is the preparation of a map of forest soils in the Republic and the compilation of cartograms showing the forest-growing properties of soils. The first steps in this direction have already been taken.

Analysis of soils and vegetable matter has been assigned to a three-member team of forest soil specialists working in the chemistry laboratory of the Institute of Zoology and Botany. Modern research devices are applied here and methods are being steadily improved. Thus, for instance, the complexometric method of analysis, the flame photometer and the polarograph are used in determining various elements. Work has been begun on the analysis of the composition of microelements and organic matter.

Sepp, R., 1957. [The silvicultural properties of alvar soils.] Looalade metsastamise ja loometsade majandamise küsimusi. Tartu. (Estonian.)

Old limestone quarry on a characteristic alvar area of northern Estonia. *Photo by H. Paves.*

Immature natural spruce stand in the Purdi forest district. *From the photo archives of the forestry sector of the Institute of Zoology and Botany of the Academy of Sciences of the Estonian SSR.*









Sepp, R., 1959. [The quantity and composition of forest debris in alvar forests.] Eesti NSV Teaduste Akadeemia Toimetised. Bioloogiline seeria, № 1. (Estonian with Russian and German summaries.)

Dendrology

Dendrology is a field where silviculturalists and botanists work in closest cooperation. At the present moment the silviculturalists and botanists of our Republic, in collaboration with their Latvian and Lithuanian colleagues, are compiling a survey of the dendroflora of the Baltic countries, under the supervision of A. Vaga of the Academy of Sciences of the Estonian SSR.

A. Paivel's survey of the dendroflora of Estonia is nearing completion. In 1956 A. Paivel completed his survey of the dendrology of W Estonia for the forestry sector of the Institute of Zoology and Botany. As a result of this investigation it was found that alongside 87 native tree and shrub species there are about 1000 species introduced into Estonia from outside, nearly half of which have been acclimatized.

"The Flora of the Estonian SSR," Vol. I (1953), published by the Institute of Zoology and Botany, and compiled by K. Eichwald, gives a survey of the class of conifers.

A number of special investigations, mostly by Estonian silviculturalists, have been devoted to the cultivation of promising trees and shrubs.

Forty-year-old natural birch stand in the Räpina forest district. *Photo by O. Henno.*

200-year-old pines on a moraine ridge in southern Estonia. Height of trees 32—34 metres; diameter of stems 1.3 metres at height of 60—70 cms. *From the photo archives of the forestry sector of the Institute of Zoology and Botany of the Academy of Sciences of the Estonian SSR.*

Thus the poisonous spindle-tree (*Evonymus europaea* L.), which is widespread in S Estonia and contains guttapercha, has been studied with an eye to its possible cultivation by silviculturalists V. Ritslaid and J. Laasimer and botanist K. Eichwald.

The hazel has been studied by A. Siimon, and the forms of the aspen by M. Ojamaa.

A number of investigations have been devoted to problems of the cultivation of exotic tree species. We may mention the investigations on the larch by E. Laas, the Douglas fir by H. Taimre, and the walnut tree (*Juglans cinerea* L.) by O. Henno.

Within recent years a series of researches have been concluded by M. Margus, of the forestry sector of the Institute of Zoology and Botany, on the northern oak (*Quercus borealis* Michx.), the Murray pine, the Douglas fir and the larch. This work is rapidly expanding in scope.

Eesti NSV floora I, 1953. Tallinn. [The flora of the Estonian SSR I.](Compiled by A. Vaga and K. Eichwald. Contains a survey of the class of conifers. Estonian with Russian summary.)

Eesti NSV floora II, 1956. Tallinn. [The flora of the Estonian SSR II.] (Compiled by K. Eichwald, S. Talts, A. Vaga and E. Varep. Contains a survey of trees and shrubs belonging to the families of the *Berberidaceae, Saxifragaceae, Rosaceae.* Estonian with Russian summary.)

Eichwald, K., 1953. [On *Evonymus* sp.] Loodusuurijate Seltsi juubelikoguteos. Tallinn. (Estonian with Russian summary.)

Henno, O., 1955. [The cultivation of *Juglans cinerea* L. in the Estonian SSR.] Eesti NSV Teaduste Akadeemia Toimetised, № 1. (Estonian with Russian summary.)

Ilves, A., 1955. [On the biology of reproduction and natural regeneration of the ash (*Fraxinus excelsior* L.).] Loodusuurijate Seltsi aastaraamat, № 48. Tallinn. (Estonian with Russian summary.)

Laas, E., 1955. [Results of the cultivation of the larch in the Estonian SSR.] Loodusuurijate Seltsi aastaraamat, № 48. Tallinn. (Estonian with Russian summary.)

Laas, E., 1959. [Dynamics of the height increment of the larch in a nursery in the growing season.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 6. Tartu. (Estonian with Russian summary.)

Laasimer, J., 1953. [Possibilities of the cultivation of the spindle-tree in the Estonian SSR.] Loodusuurijate Seltsi juubelikoguteos. Tallinn. (Estonian with Russian summary.)

Margus, M., 1958. [Cultivation of the Douglas fir in Estonia.] Metsamajandus, № 2. (Estonian.)

Margus, M., 1958. [Possibilities of cultivating *Quercus borealis* Michx. in Estonia.] Eesti NSV Teaduste Akadeemia Toimetised. Bioloogiline seeria, № 3. (Estonian with Russian and German summaries.)

Margus, M., 1959. [Larch cultures and their state of health.] Eesti NSV Teaduste Akadeemia Toimetised. Bioloogiline Seeria, № 3. (Estonian with Russian and German summaries.)

Margus, M., 1959. [The Murray pine in Estonia.] Loodusuurijate Seltsi aastaraamat 1958, № 51. Tallinn. (Estonian with Russian and German summaries.)

Michelson, A., 1949. [On the cultivation of poplars and larches in the Estonian SSR.] Metsakultiveerimine ja metsapäevad. Tallinn. (Estonian.)

Ojamaa, M., 1959. [The biological forms of the aspen in our forests.] Sotsialistlik Põllumajandus, № 19. (Estonian.)

Paivel, A., 1957. [Conifers introduced into W Estonia and possibilities of their cultivation.] Eesti NSV Teaduste Akadeemia Toimetised. Bioloogiline Seeria, № 3. (Estonian with Russian and German summaries.)

Paivel, A., 1957. [Some promising exotic tree species for cultivation on alvar areas in Saaremaa.] Looalade metsastamise ja loometsade majandamise küsimusi. Tartu. (Estonian.)

Siimon, A., 1952. [Possibilities of cultivating the hazel in collective farm forests.] Sotsialistlik Põllumajandus, № 6. (Estonian.)

Taimre, H., 1954. [Possibilities of cultivating the Douglas fir in the forests of the Estonian SSR.] Eesti NSV Teaduste Akadeemia Toimetised, № 4. (Estonian with Russian summary.)

Vilbaste, G., 1948. [Trees and shrubs in winter.] Puid ja põõsaid talvel. Tallinn. (Estonian.)

Vilbaste, G., 1953. [On the distribution of the *Potentilla fruticosa* L. in the Estonian SSR.] Loodusuurijate Seltsi juubelikoguteos. Tallinn. (Estonian with Russian summary.)

Örd, A., 1958. [Notes on cultures of the *Fraxinus pennsylvanica* Marsh.] Metsamajandus, № 2. (Estonian.)

Лаас, Э. Э., 1956. [Laas, E. The larch in Estonia.] Внедрение лиственницы в лесные насаждения. Москва — Ленинград (Russian.)

Пайвель, А. Н., 1954. [Paivel, A. Tree and shrub species introduced into the island of Saaremaa.] Eesti NSV Teaduste Akadeemia Toimetised, № 2. (Russian.)

Forest typology

On the basis of striking differences of site conditions Estonian forests can be divided into dry forests on mineral soils and swamp forests on peat soils. In the first group one can distinguish alvar forests as a peculiar site type characteristic of N and NW Estonia. They are situated on shallow humus-calcareous soils, where the Ordovician and Silurian limestone bedrock crops out here and there on the surface.

In the post-war years, research into forest types began in circumstances where we had a mass of different forest types described by a number of authors, but no single, universally accepted classification suitable for practical needs. Researches, however, continued and were more productive than previously, as can be seen from the completion of several investigations on forest types and the drawing up of new classifications.

L. Laasimer's paper (1946) on plant communities of alvar pine and spruce forests was the first work with a forest-typological slant completed after the war. Alvar forest types were later treated by E. Kaar and L. Muiste (v. alvar forests).

Of other types of forests growing on mineral soils, heath forests have received most attention. L. Laasimer gives a geobotanical description of heath forests in general. L. Muiste brings data on pine forests in SE Estonia, treating the growth process and productivity of stands not only according to their quality class but also with regard

to single forest types (v. heath forests). Sites and forest types of heath and grove forests and of the so-called "palu"-forests[1] have been discussed by A. Karu (1955). A. Kalda (1958) has made a geobotanical study of valuable broad-leaved forests. A. Ilves, A. Karu and V. Masing have investigated swamp forests.

The first complete typological classification of Estonian forests on mineral soils was produced by A. Ilves (1935). The author distinguishes 14 forest types within the limits of 5 site types (alvar forests, heath forests, the so-called "laane"-forests,[2] grove forests and grove-like forests[3]). The same author has written an investigation into swamp forest types in which he likewise distinguishes 14 forest types within the limits of 3 site types (forests growing on fens, transition bogs and raised bogs) (Ilves, 1956). In 1956 A. Karu completed a new classification of forest types based on extensive factual material. This was later improved by the author himself, and after his death still further developed by his close associate L. Muiste. In its latest version this classification, which comprises forests growing on mineral soils as well as swamp forests, 25 site types are distinguished in Estonia, each of which includes one or more forest types (Karu, Muiste, 1958). In the course of the extensive field work which preceded it, more attention was paid to the characterization of stands and growth conditions than in any previous researches in this field. A. Karu and E. Muiste's classification is now in general use, as the one which best corresponds to the requirements of silvicultural practice. Preliminary results summed up by the Office of Aerophotography and Forest Management show that most

[1] Types of pine forests on fertile podzolic soils.

[2] Types of spruce, birch or aspen forests on podzolic soils of average fertility.

[3] Forests of valuable broad-leaved trees, such as maple, elm, ash, etc., on fertile humus-calcareous soils.

widespread are the *Vaccinium myrtillus, Vaccinium vitis-idaea* and *Oxalis acetosella* types.

Apart from these purely forest-typological studies, we may also note L. Laasimer's investigations (1958[1], 1958[2], 1958[3]), which deal with the relationship of forest typology and geobotany and discuss the problem of the division of the territory of Estonia into geobotanical regions.

[A. Karu's emended forest-site types of Estonia.] A. Karu parandatud Eesti metsakasvukohatüübid. 1957. Eesti Aerofoto Metsakorralduse Kontor. Tallinn. (Estonian.)

Ilves, A., 1953. [Types of Estonian firm-land forests.] Loodusuurijate Seltsi juubelikoguteos. Tallinn. (Estonian with Russian summary.)

Kalda, A., 1958. [Present-day distribution of valuable broad-leaved forests in the Estonian SSR.] Tartu Riikliku Ülikooli Toimetised, vihik 64. Tartu. (Estonian with Russian and German summaries.)

Karu, A., 1955. [Forest-site types and forest types on podzolic and bogged-up areas.] Sotsialistlik Põllumajandus, № 7. (Estonian.)

[Karu, A.], 1956. [Tables for the determination of forest types.] Metsatüüpide määramise tabelid. Tallinn. (Estonian.)

Karu, A., Muiste, L., 1958. [Site types of Estonian forests.] Eesti metsakasvukohatüübid. Tallinn. (Estonian.)

Laasimer, L., 1946. [The ecology of the alvar forests.] Eesti NSV Tartu Riikliku Ülikooli Toimetised. Bioloogilised teadused 2. Tartu. (Estonian with Russian and English summaries.)

Laasimer, L., 1958[1]. [Division of the Estonian SSR into geobotanical districts.] Eesti NSV geobotaaniline rajoneerimine. Tartu. (Estonian with Russian and German summaries.)

Laasimer, L., 1958[2]. [Forest typology and geobotany.] Eesti NSV Põllumajanduse Ministeeriumi Metsamajanduse Peavalitsuse ja Põllu- ja Metsamajanduse Teaduslik-Tehnilise Ühingu metsamajanduse sektsiooni bülletään. Jaanuar. (Estonian.)

Masing, V., Trass, H., 1955. [Guide to the plant ecological and coenological study of swamps.] Abiks loodusevaatlejale, № 23. Tartu. (Estonian with Russian summary.)

Ильвес, А., 1956. [Ilves, A. Types of swamp forests in the Estonian SSR.] Типы болотных лесов Эстонской ССР. Автореферат. Тарту. (Russian.)

Лаасимер, Л. Р., 1958[3]. [Laasimer, L. Division of the Estonian SSR into geobotanical districts.] Ботанический журнал, том 43, № 3. (Russian.)

In the pre-war period only a few investigations on the cultivation of forests had been carried out. In the post-war years this research was considerably intensified. This was brought about in the first place by practical needs. As an inheritance from World War II there were clearcut areas in Estonia which on poor sites had remained woodless, but on richer sites had become covered with low-quality broad-leaved thickets. After the war these areas were subjected to extensive afforestation. This, however, did not always give the desired results. On extreme sites (such as alvar areas, heaths, etc.) previously forested areas in many cases remained unforested regardless of their repeated cultivation. Thus there arose a need to elaborate methods which would give better results.

With this aim in view, research was started at silvicultural research and educational institutions. Great attention was paid to site conditions with a view to discovering the factors obstructing growth and adopting counter-measures. Such investigations have been carried out on poor sandy, agriculturally worthless, woodless areas by M. Margus, on dry heathlands by U. Valk and P. Rõigas, on swampy hardpan areas by O. Henno (v. heath forests), on transition bogs, and forest clearings on transition bogs, by P. Kollist and U. Riispere (v. swamp forests), on alvar areas by E. Pihelgas and E. Kaar (v. alvar forests).

Besides the afforestation of extreme sites, researches have taken place in the reconstruction of low-quality broadleaved forests (created by natural regeneration on relatively fertile soils) by cultivation with the more valuable tree species. This work is centred in the forestry sector of the Institute of Zoology and Botany of the Academy of Sciences, where an investigation is on the verge of completion by M. Margus. The problem has also been

dealt with in a number of articles by A. Karu (1952, 1955) and V. Seesmaa (1958).

The subject of seeds has been examined by E. Laas (1956, 1959) and E. Pihelgas (1958, 1959[1], 1959[2]). E. Laas has completed an extensive investigation dealing with the quality of larch seeds. E. Pihelgas is at present studying the selection of pine seeds.

A number of narrower investigations have been carried out on the cultivation of exotic tree species and valuable hardwoods, including different larch species, the ash and the Pennsylvanian ash, the common and the northern oak (*Quercus borealis* Michx.), the Douglas fir, the Murray pine, the walnut tree, the hazel, the species of *Evonymus* and the band-willow (v. dendrology).

Other questions of forest cultivation (preparation of the ground, upkeep, profitability and administration, etc.) have been treated in independent articles advocating progressive methods which have justified themselves in practice.

[Forest cultivation and arbor days.] Metsakultiveerimine ja metsapäevad. 1949. Tallinn. (Estonian.)

[Forest Research I.] Metsanduslikud uurimused I. 1957. Tartu. (Estonian with Russian, German or English summaries.)

Karu, A., 1952. [Reconstruction of low-quality broad-leaved thickets.] Sotsialistlik Põllumajandus, № 3. (Estonian.)

Karu, A., 1955. [Importance of the reconstruction of forests in the Estonian SSR.] Loodusuurijate Seltsi Aastaraamat, № 48. Tartu. (Estonian with Russian summary.)

Laas, E., 1959. [Importance of the sowing season and the preliminary processing of seeds in cultivation of the larch.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 6, Tartu. (Estonian with Russian summary.)

Laas, E., Peep, U., 1959. [Quality of the planting stock in forest nurseries.] Sotsialistlik Põllumajandus, № 8. (Estonian.)

Pine forest of *Oxalis* site type. *Photo by L. Muiste.*

35-year-old birch stand of *Mercurialis-Aegopodium* site type on fertile soils. *Photo by O. Henno.*







Pihelgas, E., 1958. [The influence of the extraction temperature on the quality of pine seed.] Sotsialistlik Põllumajandus, № 11. (Estonian.)
Pihelgas, E., 1959[1]. [Dependence of the quality of pine seed on the age of the stand and the site.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 6. (Estonian with Russian summary.)
Pihelgas, E., 1959[2]. [On the fertility and quality of seeds of the Scots pine.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 11. (Estonian with Russian and German summaries.)
[Proceedings of the scientific conference on forest drainage.] Metsakuivendusalase teadusliku nõupidamise materjalid. 1957. Tartu. (Estonian.)
[Reforestation of heathlands and the maintenance of wooded heaths.] Nõmmealade taasmetsastamine ja nõmmemetsade majandamise küsimusi. 1958. Tartu. (Estonian with Russian and English summaries.)
Rõigas, P., 1959. [The influence of bad planting on the growth of pine plantations.] Sotsialistlik Põllumajandus, № 5. (Estonian.)
Seesmaa, V., 1958. [The cultivation of clearings overgrown with thickets in the Tähtvere forest district.] Sotsialistlik Põllumajandus № 2. (Estonian.)
[The afforestation of alvar areas and the management of alvar forests.] Looalade metsastamise ja loometsade majandamise küsimusi. 1957. Tartu. (Estonian.)
Лаас, Э. Э., 1956. [Laas, E. Researches in the quality of larch seed and their utilization in the conditions of the Estonian SSR.] Исследование качества семян лиственницы и их целесообразного использования в условиях Эстонской ССР. Автореферат. Тарту. (Russian.)

Thinnings

In spite of the fact that the extent of the areas under thinning has increased and the practice of thinning has become more frequent, the number of publications dealing

Mature first-quality birch stand, *Polypodium* site type. *Photo by P. Pere.*

120-year-old pine forest of *Vaccinium* site type in Saaremaa. *Photo by E. Kaar.*

with this subject is modest. A. Karu and O. Henno deserve mentioning as authors of such investigations.

In spite of the scarcity of publications, the scope of the research work itself has been gradually expanding. This is due to the administrative activities of the Board of Forest Management of the Ministry of Agriculture of the Estonian SSR, which has begun to organize the founding of permanent experimental areas.

The Kuremaa Forestry School, too, is engaged in thinning research. On the initiative of H. Taimre, the school has experimented with permanent sample plots since 1949, especially in mixed stands of birch and spruce. The first results of these experiments have just been summed up.

Experimental areas have also been founded in the Forest Research and Experimental District at Järvselja by A. Karu and L. Muiste, members of the Chair of Silviculture of the Estonian Agricultural Academy.

The problem of thinnings is discussed in T. Krigul's extensive investigation, which has just been completed at the Chair of Forest Economy and Forest Management of the Estonian Agricultural Academy, and which deals primarily with natural self-pruning in pine and spruce stands and the application of artificial pruning to produce high-quality industrial timber. At the same chair O. Henno is continuing his study of the cultivation of high-grade birch for industrial purposes. Within the limits of this subject he considers the growth process of common birch stands on mineral soils, analyses the composition of the stands with a view to achieving higher productivity, and incidentally discusses the question of thinning.

From 1957 H. Rebane, of the forestry sector of the Institute of Zoology and Botany, has studied the growth process, ecology and biology of better-quality mixed young stands of hardwood and spruce, where the question of thinning is also involved.

Henno, O., 1958. [Rectification of the birch stem by means of thinnings.] Sotsialistlik Põllumajandus, № 4. (Estonian.)
Henno, O., 1959. [The cultivation of valuable industrial birch.] Sotsialistlik Põllumajandus, № 15. (Estonian.)
Karu, A., 1951. [The importance of thinnings in combating *Fomes annosus* Fr. in spruce stands.] Sotsialistlik Põllumajandus, № 10. (Estonian.)
Karu, A., 1951. [Thinnings in birch stands with spruce seedlings.] Sotsialistlik Põllumajandus, № 1. (Estonian.)
Krigul, T., 1959. [The pruning of coniferous stands for the production of high-quality industrial timber.] Sotsialistlik Põllumajandus, № 16. (Estonian.)
Krigul, T., 1959. [Time expenditure in pruning pine and spruce stands and its compensation.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 6. Tartu (Estonian with Russian summary.)
Krigul, T., 1959. [Dependence of the diameter of a branch and its angle with the axis of the tree on the height of the branch in pine and spruce stands.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, Nr. 11. Tartu. (Estonian with Russian and German summaries.)
Laasimer, J., 1952. [Possibilities of raising labour productivity in thinning work.] Sotsialistlik Põllumajandus, № 10. (Estonian.)
Rebane, H., 1959. [Thinnings in mixed young stands of hardwood and spruce on fertile sites.] Sotsialistlik Põllumajandus, № 12. (Estonian.)
Taimre, H., 1959. [The importance of thinnings in the rectification of mixed spruce-birch stands.] Sotsialistlik Põllumajandus, № 10, (Estonian.)

Forest phytopathology

Up to 1945 forest phytopathological research in Estonia was of a rather casual nature. The investigations which had appeared before that year treat of only a few common fungus pests of the most dangerous type (such as *Fomes annosus* Ft., *Lophodermium pinastri* Chev., *Peridermium pini* Willd., etc.). Most of the articles published contained data borrowed from the corresponding literature in German and illustrated with a few examples taken from local

Estonian practice. O. Daniel's text-book on forest protection suffered from the same defects. Of the few outstanding investigations mention should be made of the articles by A. Karu on *Fomes annosus* Fr. and *Melampsora pinitorqua* Rost. and A. Mathiesen's work on *Peridermium pini* Willd. The mycological studies of E. Lepik (e.g. on *Peridermium pini* Willd.) are also characteristic of the forest phytopathology of the period.

Since 1945 research has been more thorough and more varied in many respects, though still somewhat limited in extent. A. Karu continued his investigations on the biology and prevention of the spruce pest *Fomes annosus* Fr. (1951, 1953), paying special heed to its dependence on soil conditions. Similar questions have also been studied by A. Jürimäe, who brings new data in his articles (1958[1], 1958[2]) on the biology, infection, distribution and effects of *Fomes annosus* Fr. and *Armillaria mellea* Quelet. L. Muiste has compiled a summary on larch canker (1957), in which he points to the probability of the occurrence of two *Dasyscypha* species in Estonia. Many investigations, chiefly mycological in content, treat of *Polyporaceae,* the cause of root-rot, and discuss the ecology of their distribution (Parmasto, 1953; 1956[1]; 1956[2]; 1957; 1958). I. Etverk (1958) has published a short article on *Peridermium pini* Willd. An extensive handbook on forest protection, containing both a summary of the materials published and a number of new articles, has been compiled and is shortly to appear in print. Research has started on the heart rot of the aspen, caused by *Fomes igniarius* Kickx. (A. Nilson), and on the *Fusarium* species, wich attack larch seedlings (H. Parmas).

All the above-mentioned investigations have been carried out by men who have treated forest phytopathology as a sideline of some other subject. An immediate task will be the extension of research into forest phytopathology, especially in the field of forest plant diseases.

Etverk, I., 1958. [*Peridermium pini* Willd. in the forest district of Sagadi.] Sotsialistlik Põllumajandus, № 9. (Estonian.)

Jürimäe, A., 1958[1]. [Raising the productivity of spruce stands in N Estonia.] Sotsialistlik Põllumajandus, № 6. (Estonian.)

Karu, A., 1951. [The importance of thinnings in combating *Fomes annosus* Fr. in spruce stands.] Sotsialistlik Põllumajandus, № 10. (Estonian.)

Karu, A., 1953. [The dependence of *Fomes annosus* Fr. on soil conditions in spruce stands of the Estonian SSR.] Loodusuurijate Seltsi juubelikoguteos. Tallinn. (Estonian with Russian summary.)

Muiste, L., 1957. [The larch canker in the Estonian SSR.] Eesti NSV Teaduste Akadeemia Toimetised. Bioloogiline Seeria, № 3. (Estonian with Russian and English summaries.)

Muiste, L., 1959. [Damages caused by *Fomitopsis annosa* (Fr.) Karst in the pine forests of SE Estonia.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, Nr. 11. Tartu. (Estonian with Russian and German summaries.)

Parmasto, E., 1953. [*Polyporaceae* of the Estonian SSR and their role in forestry.] Eesti fauna ja floora uurimise küsimusi. Tallinn. (Estonian with Russian summary.)

Parmasto, E., 1956[1]. [Catalogue of the most important *Polyporaceae* in the Estonian SSR.] Abiks loodusevaatlejale, № 26. Tartu. (Estonian with Russian summary.)

Parmasto, E., 1956[2]. [On the biology of *Fomitopsis annosa.* (Fr.) Karst.] Eesti NSV Teaduste Akadeemia Toimetised. Bioloogiline seeria, № 3. (Estonian with Russian and English summaries.)

Parmasto, E., 1957. [On the biology of *Inonotus obliquus* (Fr.) Pil. in the Estonian SSR.] Loodusuurijate Seltsi Aastaraamat, № 50. Tartu. (Estonian with Russian and English summaries.)

Кару, А. П., 1956. [Karu, A., Dependence of the damage caused by *Fomes annosus* Fr. on soil conditions and forest management in the spruce stands of the Estonian SSR.] Зависимость повреждения корневой губкой *(Fomes annosus* Fr.) от почвенных условий и ведения хозяйства в еловых насаждениях ЭССР. Автореферат. Тарту. (Russian.)

Пармасто, Э. Х., 1958. [Parmasto, E. Development and spore discharge of the fruiting bodies of the *Polyporaceae.*] Eesti NSV Teaduste Akadeemia Toimetised. Bioloogiline seeria, № 2. (Russian with Estonian and English summaries.)

Юримяэ, А. К., 1958[2]. [Jürimäe, A. Spruce forests of the Estonian SSR and measures for the improvement of their state of health.] Ельники Эстонской ССР и мероприятия по улучшению их санитарного состояния. Автореферат. Тарту. (Russian.)

In the post-war period questions of forest protection have been mainly investigated by workers in the field of forest management. H. Parmas, engineer and forest pathologist, has worked out methods of prevention for combating pine weevils and secondary forest pests (1954, 1955). On the initiative of A. Merihein (1959[1]) experiments have been initiated to stimulate the natural regulation of the numbers of forest pests by increasing the population of red ants.

In view of the need of improving the state of forest protection in Estonia and reviving research in forest entomology, a group of authors (V. Maavara, A. Merihein, H. Parmas, E. Parmasto) have compiled "A handbook of forest protection," which is to appear in 1960. This book sums up all the data on Estonian forest pests and their prevention.

In recent years a group of entomologists of the Institute of Zoology and Botany have investigated the entomofauna, including forest pests of several types of alvar and swamp forests (Maavara, 1957, 1959), as part of a general survey of the natural communities of the Estonian SSR. The results of their investigations will be published in the course of the next few years in the form of monographs.

Maavara, V., 1956. [Handbook of the young entomologist.] Noore entomoloogi käsiraamat. Tallinn. (Estonian.)

Maavara, V., 1957. [Forest pests in spruce stands of alvar areas.] Looalade metsastamise ja loometsade majandamise küsimusi. Tartu. (Estonian.)

Maavara, V., 1958. [Bark beetles as the most harmful pests in spruce stands.] Eesti NSV Põllumajanduse Ministeeriumi Metsamajanduse Peavalitsuse ja Põllu- ja Metsamajanduse Teaduslik-Tehnilise Ühingu metsamajanduse sektsiooni bülletään. Jaanuar. (Estonian.)

Maavara, V., 1959. [Bark beetles on pines.] Teaduse ja tootmise eesrindlikke kogemusi. Metsamajandus. Tallinn. (Estonian.)
Merihein, A., 1959[1]. [Simple biotechnical methods in forestry.] Teaduse ja tootmise eesrindlikke kogemusi. Metsamajandus. Tallinn. (Estonian.)
Merihein, A., 1959[2]. [Means of avoiding ravages of the larger banded pine weevil.] Sotsialistlik Põllumajandus, № 11. (Estonian.)
Parmas, H., 1954. [The prevention of pine weevils by dusting with hexachloran.] Männikärsakate tõrje heksakloraani tolmpreparaadiga. Tallinn. (Estonian.)
Parmas, H., 1955. [Prevention of secondary forest pests.] Sekundaarsete metsakahjurite tõrje. Tallinn. (Estonian.)

3. Forest mensuration and forest management

Forest mensuration as an independent branch of research has been studied to a modest extent in the Estonian SSR. This work has been carried out mainly at the Estonian Agricultural Academy. T. Krigul discusses the suitability of the Hohenadl method for the calculation of timber resources and their growth increment. A. Vars considers the accuracy of simple formulas for estimating the volume of trees. In the field of volume tables mention should be made of N. Gryazin's assortment formulas for pine, spruce and birch stands in the Estonian SSR (compiled under the general guidance of N. Tretyakov), which are at present in use.

Work has started on the compilation of local yield tables. A paper by N. Gryazin on the growth of cultivated pine stands in SE Estonia is nearing completion. In another investigation L. Muiste gives data on the productivity of the pine forests of SE Estonia according to both quality class and forest types (v. heath forests). O. Henno is studying the cultivation of industrial birch and drawing up local yield tables, indicating quality classes and forest types.

Questions of mensuration have also been touched upon in papers dealing with other subjects, such as T. Krigul's articles on natural self-pruning and artificial pruning in pine and spruce stands, and in stands of birch, aspen and black alder (v. thinnings.)

The papers on forest management include articles by N. Gryazin on the cutting age and technical maturity of Group II forests of the Estonian SSR, and on the expediency of the existing cutting regulations in Estonian conditions. A study with an economical slant by the same author on the reserves of the timber-processing industry of the Estonian SSR may also be mentioned.

Krigul, T., 1959. [The Hohenadl method for the estimation of the timber yield and its increment.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 11. Tartu (Estonian with Russian and German summaries.)

Грязин, Н., 1949. [Gryazin, N. Raw material supplies for the factory equipment industry of the Estonian SSR.] Сырьевая база фабрично-заводской промышленности Эстонской ССР Таллин. (Russian.)

Грязин, Н., 1953. [Gryazin, N. Basic tenets of the organisation of forest management in Group II forests of the Estonian SSR.] Основы организации лесного хозяйства в лесах II группы Эстонской ССР. Автореферат. Тарту. (Russian.)

Грязин, Н., 1959. [Gryazin, N. Cutting ages in Group II forests of the Estonian SSR.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 6. Tartu. (Russian with Estonian summary.)

Грязин, Н., 1959. [Gryazin, N. Maturity ages of Group II forests of the Estonian SSR.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 6. Tartu (Russian with Estonian summary.)

Грязин, Н., 1959. [Gryazin, N. The regulations governing final cutting need further differentiation.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 11. Tartu. (Russian with Estonian and German summaries.)

Mixed plantation of pine and birch at Järvselja. *Photo by H. Paves.*

80-year-old cultivated oak stand in the Reiu forest district. *Photo by P. Pere.*









4. Forest utilization

The first investigations in the field of wood science and forest utilization in Estonia go back to bourgeois times. The chief leader of these investigations was K. Verberg (Veermets). B. Haller and J. Kõresaar were active in the field of wood science and E. Kohh, K. Salev, J. Visnapuu and others in that of forest utilization.

In the post-war period research in wood science and forest utilization has been carried out by the Faculty of Forest Management and Hydromelioration of the Estonian Agricultural Academy. Chief attention has been paid to wood science (K. Veermets and N. Oll). K. Veermets (1955, 1959[1], 1959[2], 1959[3]) deals mainly with the technical properties of pine timber (structure of timber, volume weight per unit, bending strength, compressive strength and hardness) on the basis of sample logs taken from different sites. In an independent investigation (Veermets, 1956) he deals with the properties of the Douglas fir. N. Oll (1958, 1959[1]) has studied the technical properties of pine timber on the basis of samples taken from underground parts of wooden constructions of varying age, comparing the properties of pine timber which has lain in the ground from 20 to 700 years with those of raw pine timber.

Since the war, papers on forest ulitization have been written by V. Ritslaid, K. Veermets and E. Soom. V. Ritslaid (1947) has dealt with the organisation of lumbering, K. Veermets (1949) with questions of the substitution and rational utilization of timber, E. Soom (1955) with expenditure on forest roads.

Immature cultivated spruce stand in the Kohtla forest district. *Photo by P. Pere.*

Old oak forest at Rakvere. *Photo by A. Karu.*

Ritslaid, V., 1947. [The organisation of lumbering in cutting areas.] Metsaülestöötamise organiseerimine raielangil. Tartu. (Estonian.)
Veermets, K., 1949. [The economical utilization of timber.] Metsakultiveerimine ja metsapäevad. Tallinn. (Estonian.)
Veermets, K., 1956. [Technical properties of the timber of the Douglas fir.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 2. Tallinn. (Estonian with Russian summary.)
Veermets, K., 1959[1]. [The technical properties of pine timber from the alvar forests of N Estonia.] Loodusuurijate Seltsi aastaraamat 1958. № 51. Tallinn. (Estonian with Russian and German summaries.)
Веэрметс, К., 1955. [Veermets, K. Technical properties of pine timber in their relation to site conditions (on the basis of data from the Kaiavere forestry district).] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 1. Tallinn. (Russian with Estonian summary.)
Веэрметс, К., 1959[2]. [Veermets, K. The technical properties of pine timber.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 11. Tartu. (Russian with Estonian and German summaries.)
Веэрметс, К., 1959[3]. [Veermets, K. Alvar pine forests of the Estonian SSR and the technical properties of their timber.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 6. Tartu. (Russian with Estonian summary.)
Кальтер, Н., 1959. [Kalter, N. Improvement of forest roads.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 11. Tartu. (Russian with Estonian and German summaries.)
Олль, Н., 1958. [Oll, N. The use of timber in the foundations of buildings on weak and strongly compressible grounds.] О применении древесины при сооружении оснований зданий на слабых и сильно сживаемых грунтах. Автореферат. Тарту. (Russian.)
Олль, Н., 1959.[1] [Oll, N. Preservation of pine timber in underground constructions.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 6. Tartu. (Russian with Estonian summary.)
Олль, Н., 1959.[2] [Oll, N. Preservation of spruce timber in underground constructions.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 11. Tartu (Russian with Estonian and German summaries.)
Соом, Э., 1955. [Soom, E. Efficiency of shield forest haulage roads for motor traffic.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 1. Tallinn. (Russian.)

5. Game management

Most of the game to be found in the forests of Estonia (the elk, wild goat, blue hare, etc.) make use of them as a permanent or a temporary place of habitation. They exercise on forest renewal an influence — either direct or indirect — which is mostly negative in character. The nature and strength of this influence often depend on the quantity of game. Thus in recent years the elk, whose numbers have increased roughly tenfold in comparison with pre-war years, has become increasingly harmful. But the damage caused by the comparatively rare wild goat to forest renewal is slight at present as compared to that of the pre-war period.

The study of the relative and optimum densities of the game population, the distribution of their habitats, their ways of securing food and a number of other questions, forms the link between zoological and forest research.

The first investigations of this type in Estonia were made by A. Mathiesen, who analyses the direct influence of even-toed hoofed mammals on forest growth and regeneration. No other such investigations were carried out under the bourgeois regime, although there appeared a great number of notes and observations on certain species of game.

Research into questions of game was resumed in Soviet Estonia in 1950, in connection with the introduction of the raccoon dog (Ling, 1952; 1953). In the following years this research expanded to include the whole game fauna of the country. A preliminary summary of the collected data has been published in "Mammals of the Estonian SSR" by J. Aul, H. Ling and K. Paaver, and in a number of articles (Ling, 1955[1]; 1955[2]; 1956[2]). Apart from these a candidate's thesis has been written on the subject, and a number of diploma theses have been submitted by students of the Faculty of Forest Management and Hydromelioration

of the Estonian Agricultural Academy, and that of Mathematics and Natural Science at Tartu University. At present the features and distribution of the main habitats, the real and potential densities of game populations in different habitats, the influence of even-toed hoofed mammals on forest growth and renewal etc., have all become objects of deeper study. The problem of determining the basic principles for evaluating the quality of hunting areas has also been taken in hand.

Aul, J., Ling, H., Paaver, K., 1957. [Mammals of the Estonian SSR.] Eesti NSV imetajad. Tallinn. (Estonian with Russian and German summaries.)

Ling, H., 1952. [New fur-bearing animals in the Estonian SSR and methods of observing them.] Abiks loodusevaatlejale, № 6. Tartu. (Estonian with Russian summary.)

Ling, H., 1953. [On the enrichment of the Estonian SSR with new fur-bearing animals.] Eesti NSV fauna ja floora uurimise küsimusi. Tallinn. (Estonian with Russian summary.)

Ling, H., 1955[1]. [Changes in the distribution range of the wild hog (*Sus scrofa* L.) in the Baltic countries within the last few centuries.] Loodusuurijate Seltsi aastaraamat, № 48. Tallinn. (Estonian with Russian summary.)

Ling, H., 1956[1]. [Materials for estimating the importance of the fox (*Vulpes vulpes* L.) in the national economy of the Estonian SSR.] Loodusuurijate Seltsi aastaraamat, № 49. Tallinn. (Estonian with Russian summary.)

Линг, Х., 1955[2]. [Ling, H. Wild fauna hunted for their pelts and means of increasing their numbers.] Фауна промысловых млекопитающих ЭССР и пути ее реконструкции. Автореферат. Тарту. (Russian.)

Линг, Х., 1956[2]. [Ling, H. Mange in foxes in the Estonian SSR.] Зоологический журнал АН СССР, № 7. (Russian.)

6. Nature conservation

Serious attention began to be paid to questions of nature conservation in the thirties of the present century, thanks to the initiative of G. Vilberg (Vilbaste).

The statutes and by-laws on which nature conservation in the Estonian SSR is based date back to 1957. The movement of nature conservation is now developing by leaps and bounds. There are 4 national parks and 26 permanent nature reserves in the Republic, to which may be added a great number of individual objects. Extensive new forest preserves are being organized, with a total of over 3,000 hectares.

From the silvicultural standpoint, the cultivated stand of northern oaks in the national park at Neeruti is of special value. In the Nigula national park (which comprises an extensive tract of raised bog situated among forests and containing a number of untouched wooded humps) there are excellent possibilities for the study of the genesis of swamps and swamp forests. Protection has also been extended to the grove forests of Atlantic origin at Puhtu, on Abruka Is. and elsewhere, the wooded water-meadows at Jänijõe, the oak forest at Mihkli, etc.

Protected tree species include such rarities as *Sorbus aria* Crantz, which does not occur elsewhere in the Soviet Union. Altogether 335 ancient trees, 50 parks and dendrological collections have been placed under protection.

The new forest preserves are to include grove forests (the Forestry Training and Experimental Centre at Tihemetsa), heath forests (the Forest District of Sagadi), alvar forests (the Forest District of Vardi), swamp forests (the Forest District of Kabala), and various cultivated stands (the Forestry Training and Experimental District of the Estonian Agricultural Academy at Järvselja).

Researches into the various forest communities to be found here have been proceeding since 1959, and permanent sample plots are being created, where the growth of stands and ecological factors can be studied over a long period of time.

Eilart, J., 1957. [The role of the forestry workers of Saaremaa in the field of nature conservation.] Looalade metsastamise ja loometsade majandamise küsimusi. Tartu. (Estonian.)
Eilart, J., 1958. [A new stage in the development of nature conservation in the Estonian SSR.] Eesti Loodus, № 1. (Estonian with Russian and English summaries.)
Eilart, J., 1958. [Forests and their protection.] Eesti NSV Põllumajanduse Ministeeriumi Metsamajanduse Teaduslik-Tehnilise Ühingu Metsamajanduse Sektsiooni bülletään. Jaanuar. (Estonian.)
Kumari, E., 1958. [Nature conservation in Estonian forests.] Nõmmealade taasmetsastamise ja nõmmemetsade majandamise küsimusi. Tartu. (Estonian with Russian and English summaries.)
Margus, M., 1959. [Forest research in nature conservation areas and preserves.] Looduskaitse bülletään nr. 1. (Estonian.)
Paivel, A., 1955. [An enthusiast dendrologist Mihkel Rand and his garden.] Eesti NSV Teaduste Akadeemia Toimetised, № 4. (Estonian with Russian summary.)

III. THE COMPLEX STUDY OF FORESTS

Every effort is made to apply the complex method of study, the principles of which have been elaborated by Academician V. N. Sukachev. The ecological factors prevailing in forests, problems of health, productivity, regeneration etc. — all of these have to be borne constantly in mind. Perhaps more extensively than elsewhere the complex method is now being applied in the study of swamp forests. But work is already developing along the same lines in alvar forests, and a beginning has been made with the complex study of grove forests.

1. Alvar forests

Alvar forests are widely distributed in N and NW Estonia and on the western islands of the Estonian SSR. The area under alvar forests is now relatively small, making up only 2.1 per cent of the total forested area of the Republic. But in the remote past it was considerably larger. In place of the previous alvar forests extensive woodless areas or alvars covered with juniper and hazel bushes have spread over N and NW Estonia, especially in the western archipelago. Their reforestation has been under discussion for some time.

Alvar forests were formerly described by P. Thomson, K. Linkola, H. Kosenkranius and T. Lippmaa, who have approached the problem mainly from the point of view of

forest types. K. Linkola called the Estonian alvar forests "semi-grovelike forests" (Halbainwälder, puolilehtometsi), for alongside plants which are characteristic of xerophilous heath forests there also occur mesophilous plants.

Alvar forests are generally sparse and open. They are characterized by the presence of conifers, chiefly pines, whereas deciduous trees play a very slight role. Stands are low and possess a low degree of density. Junipers dominate the underwood, as deciduous trees and shrubs have usually been destroyed by cattle.

The herbaceous vegetation is mostly composed of xerophilous and calciphilous plants. Grasses and plants of steppe origin occur in great numbers, and both L. Laasimer (1946) and A. Ilves (1953) point out the similarity of alvar and steppe forests.

Since the war alvar forests and the reforestation of alvars have been treated by A. Ilves, E. Kaar, A. Karu, L. Laasimer, L. Muiste, E. Pihelgas and R. Sepp. Continuing the researches into the ecology of alvar forests initiated by T. Lippmaa, L. Laasimer (1946) has discussed the ecological and floristic properties of the alvar pine and spruce woods in Rangu heath and their trends of development. She shows that in natural conditions the spruce ousts the pine. A. Ilves, A. Karu and L. Muiste have studied alvar forest types for purposes of classification. A. Karu (1956) has distinguished five types of site conditions in the alvar forests of Saaremaa. These have been more fully described and defined somewhat more precisely by L. Muiste (1957) and E. Kaar (1959).

Questions of forest renewal have been studied in clearings of alvar forests by E. Pihelgas (1957[1], 1957[2]) and on

Spruce lower storey in an old aspen forest in the Maidla forest district. *Photo by P. Pere.*

Pine stand tapped for resin in the Ilumetsa forest district. *Photo by L. Muiste.*









woodless alvar areas by E. Kaar (1959). Ecological researches have been carried out with the aim of ascertaining the peculiarities of forest regeneration in clearings of previous alvar forests and the prospects for reforestation of woodless alvars. On the basis of observations carried out over a period of two years E. Pihelgas (1957[1], 1957[2]) has clarified the microclimatic conditions in clearings. In addition, he deals with the influence of ground preparation methods on soil moisture, analyses the ground vegetation and the development of the root system, and examines the effect of cutting methods on natural regeneration. Particularly valuable is his work on forest cultivation experiments, which contains a number of practical suggestions.

Questions of the soil, soil moisture, and microclimate of alvar forests and especially alvars have been extensively dealt with by E. Kaar (1957[1], 1957[2], 1959). Particular attention is paid to the possibilities of preserving and raising the moisture content of the soil by using different methods of ground preparation. Analysing the microclimate, the author gives data on temperature conditions at the surface and in the soil up to a depth of 20 cms, the temperature and relative humidity of the air, and the wind. Attention is also paid to the influence of shrubs and large granite boulders on the soil moisture and microclimate in their immediate vicinity.

Using data gathered from experimental stands and industrial cultures, E. Kaar has thrown light on many

Wild goats in the swamp at Kerreti. *From the photo archives of the forestry sector of the Institute of Zoology and Botany of the Academy of Sciences of the Estonian SSR.*

Overgrown spruces with lower storey of young spruce attaining 15 metres in height. *From the photo archives of the forestry sector of the Institute of Zoology and Botany of the Academy of Sciences of the Estonian SSR.*

questions connected with the reforestation of alvars, such as preparation of the soil, the methods, times and materials of cultivation, problems of maintenance, and the peculiarities of different tree species. Practical suggestions are made on the basis of the results obtained. Besides site conditions and forest cultivation E. Kaar also discusses the productivity of alvar forests.

The relationship of stands and soils is dealt with in great detail by R. Sepp (v. forest soil science). He shows that the silvicultural properties of soils do not depend so much on the thickness of the fine-grained surface horizon as on the intensity and nature of the weathering of the limestone. The chemical composition of the limestone bedrock also exerts a certain influence on the rate of soil formation and the productivity of stands — the process of weathering is faster on calcareous rocks and slower on dolomitized limestone. Examining the rotation of substances between vegetation and soil, R. Sepp shows that, contrary to the previous widely-held opinion as to the favourable influence of the spruce on the development of alvar soils, the pine is to be preferred to the spruce as the total amount of the pine debris exceeds that of the spruce and contains less lime.

Questions of forest protection find treatment in V. Maavara's investigations (v. forest entomology), which show that, on account of their dryness and openness, alvar forests are somewhat more subject to insect pests than other forest types.

Research into alvar forests and alvars, which is still proceeding, is mainly carried out by the Institute of Zoology and Botany of the Academy of Sciences of the Estonian SSR.

Ilves, A., 1953. [Types of Estonian firm-land forests.] Loodusuurijate Seltsi juubelikoguteos. Tallinn. (Estonian with Russian summary.)

Ilves, A., 1957. [Possibilities of the application of forest types to the management of alvar forests.] Looalade metsastamise ja loometsade majandamise küsimusi. Tartu. (Estonian.)

Kaar, E., 1957[1]. [Conditions and possibilities of the afforestation of alvar areas in Saaremaa.] Looalade metsastamise ja loometsade majandamise küsimusi. Tartu. (Estonian.)

Kaar, E., 1957[2]. [The alvars of Saaremaa and possibilities of their afforestation.] Eesti NSV Teaduste Akadeemia Toimetised. Bioloogiline seeria, № 3. (Estonian with Russian and German summaries.)

Kaar, E., 1959. [Silvicultural properties of the alvar areas of Saaremaa and possibilities of their afforestation.] Metsanduslikud uurimused II. Tartu (Estonian with Russian and German summaries.)

Karu, A., 1956. [Forest types in the alvar areas of Saaremaa.] Metsamajandusalase teadusliku sessiooni materjalid. Tartu (Estonian.)

Karu, A., 1959. [On the concept of alvar areas and their economic utilization in Estonia.] Loodusuurijate Seltsi aastaraamat 1958, № 51. Tallinn. (Estonian with Russian and German summaries.)

Laasimer, L., 1946. [The ecology of the alvar forests.] Eesti NSV Tartu Riikliku Ülikooli Toimetised. Bioloogilised teadused 2. Tartu. (Estonian with Russian and English summaries.)

Maavara, V., 1957. [Forest pests in coniferous stands of alvar areas.] Looalade metsastamise ja loometsade majandamise küsimusi. Tartu. (Estonian.)

Muiste, L., 1957. [Types of alvar forests.] Looalade metsastamise ja loometsade majandamise küsimusi. Tartu. (Estonian.)

Pihelgas, E., 1957[1]. [Methods of cultivation in the reforestation of alvar forest clearings.] Looalade metsastamise ja loometsade majandamise küsimusi. Tartu. (Estonian.)

Pihelgas, E., 1957[2]. [Forest cultivation in clearings of alvar forests.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 3. Tallinn. (Estonian with Russian summary.)

Pihelgas, E., 1959. [The development of the root system of pine on alvar soils.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 11. Tartu. (Estonian with Russian and German summaries.)

[Questions of the afforestation of alvar areas and the management of alvar forests.] Looalade metsastamise ja loometsade majandamise küsimusi. 1957. Tartu. (Estonian.)

2. Heath forests

Heath forests make up more than one-fifth of the total wooded area of Estonia. Most of them are to be found in the SE, N and NW, and in the western archipelago. They are usually situated on dry podzolic sands and form cowberry, heather and lichen pine areas. As a result of the intensive podzolization of the soil, hardpan is seldom present. Where it does occur, the heaths commonly have a thick layer of raw humus, suffer to a greater or lesser extent from excessive moisture, and tend to develop into raised bogs.

Among the papers which have been published in the post-war period, either heath forests or the afforestation of heathlands and sandy areas has been treated by O. Henno, A. Karu, L. Laasimer, M. Margus, L. Muiste, P. Rõigas and U. Valk. Forest regeneration has been dealt with by P. Rõigas and U. Valk in *Cladonia* and heather site types, by O. Henno on bogging-up hardpan soils, and by M. Margus in the agriculturally low-productive sandy areas of SE Estonia, which have as yet not been used for the cultivation of forests. The types of heath forests have been studied by A. Ilves, A. Karu, and L. Muiste with a view to classification. They have been treated as an independent problem by L. Laasimer (1958). Among dry sites she distinguishes as geobotanical units the *Cladonia, Calluna* and *Vaccinium* site types; among sites that are in process of changing into raised bogs she distinguishes the *Vaccinium-Sphagnum* and *Ledum* types; while one, namely the *Myrtillus* type, has been set apart as a borderline type in the transition from heath forests to other more fertile sites.

Special attention has been paid to the regeneration of heath forests on the poorest sites, especially those which have been denuded by forest fires and fellings. Attempts at reforestation have not always given satisfactory results, and in place of previous heath forests there now extend

woodless heathlands. Questions of the reforestation of such heathlands and of the management of heath forests form the subject of a special collection of articles published in 1958 by the forestry sector of the Institute of Zoology and Botany.

In order to throw light on the peculiarities of growth and the reasons for failure, most studies of heathlands and sandy areas have been given an ecological slant. Thus in those parts of his investigations which deal with site conditions, M. Margus (1955[1], 1955[2], 1957) has stressed the edaphic factors (soil texture, chemical properties of the soil, moisture content, etc.) and the vegetation, and has carried out stationary observations of the microclimate. The latter included the measurement of minimum and maximum surface temperatures during the vegetation period, temperatures of the top-soil, the humidity of the air and wind velocity. Apart from site conditions the main attention has been devoted to forest cultivation experiments, on the basis of which practical suggestions have been made.

Conditions of growth have been exhaustively dealt with in investigations by U. Valk (1953[1], 1957), who has also studied the microclimate, soils, vegetation and experimental cultures. His examinations of the microclimate of heathland sites during two vegetation periods covers temperature conditions on the surface, the temperature of the top-soil (to a depth of 20 cms), the temperature and relative humidity of the air, and the wind. He also gives a survey of the silvicultural value of different soils, especially dwelling on the moisture content and the possibility of raising it by full ploughing. As regards results, detailed information is given on the 1939—1940 experimental plantations in the Sagadi and Valgejõe forest districts on the northern littoral (Valk, 1957; 1958[1]). The general practical conclusions suggest that the best results in the afforestation of heathlands are obtained by plant-

ing pine and birch seedlings on a full-ploughed surface, the predominant tree species for the heathlands being the pine.

The dependence of the yield capacity of dry pine forests on soil conditions is treated by P. Rõigas (1956, 1957, 1959), working in the Sagadi forest district. The author lays special stress on the dependence of the growth of pine cultures in coarse-grained sandy soils on the thickness of the raw humus horizon. Of vital importance is the correct spacing of beds. P. Rõigas brings data showing the dependence of crown closure on the number of beds in a given site, and that of growth and development on the crown closure. The dependence of the depth and the density of the vertical root system of trees in pine plantations on ploughed and unploughed soils is treated as a separate question. In conclusion the author makes an important practical suggestion to the effect that ploughed surfaces on heathlands call for a smaller number of beds than unploughed land.

O. Henno (1955, 1956) has studied the process of swamp formation on heathlands and the possibility of the reforestation of bogged-up heathlands in the Tihemetsa forest district in SW Estonia. He gives a detailed discussion of the formation of hardpan and the ground water regime of hardpan areas. Of the forest growth conditions in hardpan soils, he deals with the soil factor (both chemical and physical) and plant cover. Checking with experimental cultures, he comes to the conclusion that, for the successful afforestation of hardpan soils in process of changing into bogs, it is necessary to carry out drainage of the soil, deep ploughing and fertilizing with lime.

Pine forests of SE Estonia, which belong to the class of the so-called "palu"-forests* and heath forests, are discussed by L. Muiste (1958, 1959[1], 1959[2]), who concen-

* Types of pine forests on fertile podzolic soils.

trates on the problems of raising productivity and the state of health of stands, and thinning methods.

Researches in heath forests are still proceeding, and are conducted mainly at the Institute of Zoology and Botany of the Academy of Sciences of the Estonian SSR and at the Faculty of Forest Management and Hydromelioration of the Estonian Agricultural Academy.

Henno, O., 1955. [The afforestation of hardpan areas in process of changing into bogs.] Loodusuurijate Seltsi aastaraamat, № 48. Tallinn. (Estonian with Russian summary.)

Laasimer, L., 1958. [A geobotanical characterization of wooded heaths and their development in Estonia.] Nõmmealade taasmetsastamise ja nõmmemetsade majandamise küsimusi. Tartu. (Estonian with Russian and English summaries.)

Margus, M., 1955[1]. [Afforestation of areas unsuitable for agricultural cultivation in the Estonian SSR.] Loodusuurijate Seltsi aastaraamat, № 48. Tallinn. (Estonian with Russian summary.)

Margus, M., 1957. [Afforestation of agriculturally low-productive areas in SE Estonia.] Metsanduslikud uurimused I. Tartu. (Estonian with Russian and German summaries.)

Muiste, L., 1959[1]. [On the typology and productivity of cultivated pine stands in SE Estonia.] Loodusuurijate Seltsi aastaraamat 1958, № 51. Tallinn. (Estonian with Russian and German summaries.)

Muiste, L., 1959[2] [Studies in the growth process of cultivated pine stands in the forest regions of SE Estonia.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 6. Tartu. (Estonian with Russian summary.)

Rõigas, P., 1957. [Investigations and notes on burnt pine heaths in the Sagadi Forest District.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 3. Tallinn. (Estonian with Russian summary.)

Rõigas, P., 1959. [Experience in the recultivation of burnt pine areas.] Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik, № 6. Tartu. (Estonian with Russian summary.)

[The reforestation of heathlands and maintenance of wooded heaths.] Nõmmealade taasmetsastamine ja nõmmemetsade majandamise küsimusi. 1958. Tartu. (Estonian with Russian and English summaries.)

Valk, U., 1957. [The afforestation of dry heather wastes.] Metsanduslikud uurimused, I. Tartu. (Estonian with Russian and English summaries.)

Valk, U., 1958[1]. [Problems of reforestation of dry burnt clearings on pine lands.] Eesti NSV Teaduste Akadeemia Toimetised. Bioloogiline seeria, № 4. (Estonian with Russian and English summaries.)

Valk, U., 1958[2] [Some points concerning the maintenance of wooded heaths and the reforestation of heath areas.] Nõmmealade taasmetsastamise ja nõmmemetsade majandamise küsimusi. Tartu. (Estonian with Russian and English summaries.)

Валк, У., 1953[1]. [Valk, U. The study of ecological conditions in dry heathlands with a view to afforestation.] Исследование экологических условий в сухих верещатниках в целях их облесения. Автореферат. Тарту. (Russian.)

Валк, У., А., 1953[2]. [Valk, U. Experiments in the reforestation of dry burnt pine lands in the Estonian SSR.] Научная сессия по вопросам биологии и сельского хозяйства. Рига, 22—26 октября 1951 г. (Russian.)

Маргус, М. М., 1953. [Margus, M. Utilization of the agriculturally low-productive lands in SE Estonia for afforestation.] Использование малопродуктивных в сельскохозяйственном отношении площадей юго-восточной части Эстонской ССР для лесонасаждения. Автореферат. Тарту. (Russian.)

Маргус, М. М., 1955[2]. [Margus, M. The afforestation of agriculturally unsuitable lands in the Estonian SSR.] Лесное хозяйство, № 9. (Russian.)

Муйсте, Л. Ю., 1958. [Muiste, L. Studies of cultivated pine stands in SE Estonia.] Исследование в сосновых насаждениях искусственного происхождения в юго-восточной Эстонии. Автореферат. Тарту. (Russian.)

Рыйгас, П. Х., 1956. [Rõigas, P. Studies of the growth process in pine plantations of the Sagadi Forest District.] Исследования развития роста в сосновых культурах лесничества Сагади. Автореферат. Тарту. (Russian.)

Хенно, О., 1956. [Henno, O. The development of hardpan in soils of the Estonian SSR: ecological conditions and possibilities of reforestation.] Образование рудяковых площадей в Эстонской ССР, экологические условия и возможности восстановления леса на них. Автореферат. Тарту. (Russian.)

Birch forest in winter. *Photo by P. Pere.*

Young spruce stand in a white robe of snow. *Photo by P. Pere.*









3. Swamp forests

Nearly half of the state forest resources of the Estonian SSR suffers from excessive moisture of the soil. Hence the drainage of swamp forests occupies a very important place in forestry research. Forest draining was started in Estonia more than a hundred years ago. But the first researches in swamp forests and their draining (J. Luik, R. Riisperg, etc.) date back only to the twenties and thirties of the present century. They were confined to a few limited areas and dealt mainly with the influence of draining on the productivity of the pine.

In Soviet Estonia much attention has been paid to the draining of swamp forests as a basic means of raising forest productivity. 275,000 ha of lands suffering from excessive moisture have been included in the total drainage area (divided into classes I and II according to priority of draining). For this reason questions of the draining of swamps and forests and their post-drainage management occupy an essential place in Estonian forest research, which is centred at the forestry sector of the Institute of Zoology and Botany of the Academy of Sciences. A few independent investigations have also been made by workers of other research and educational institutions (Tartu University, the Estonian Agricultural Academy, etc.).

Most of the literature published to date has a decided ecological and biological slant. Research covers all of the three basic swamp site types (fens, transition bogs and raised bogs), the chief stress having been laid on transition bogs. Investigations may be grouped under three

Coastal sand dunes with common birch and pine. *Photo by Ü. Tamm.*

Mature pine of *Vaccinium* type on a steep slope in the Sonda forest district. *Photo by P. Pere.*

heads: 1) ecology and classification into types; 2) productivity and drainage; 3) regeneration and afforestation.

Site conditions of swamps and swamp forests form the subject of many papers. Soil conditions in transition bogs and wooded transition bogs have been dealt with by V. Hainla (1956[1], 1959), P. Kollist (1956, 1957, 1959) and U. Riispere (1957), who give more or less detailed discussions of the physical (soil moisture, aeration, volume of weight per unit, special weight, etc.), chemical and biological properties of the soil in wooded transition bogs and their relation to drainage. The influence of the moisture content of peat soils on the germination of conifer seeds, on the growth of seedlings and on the physiological processes taking place in the seedlings has been studied by U. Riispere (1956[1]), using pot culture tests. The temperature and freezing of peat soils and their relation to drainage and cutting have been dealt with by P. Kollist (1956, 1957, 1959). Data on soil conditions in raised bogs (nutrient content, moisture regime, temperature and freezing) are analysed by U. Valk (1956, 1959[1], 1959[2]). Among the researches on the hydrological regime of transition and raised bogs, the influence of drainage on the depth of the ground water level has been dealt with mainly by V. Hainla (1957) and U. Valk (1956, 1959[2]).

The microclimatic regime of wooded transition bogs (especially the extreme temperatures at the surface and in the air layer directly above it) and its relation to drainage, cutting and ground cover vegetation have been studied by P. Kollist (1954, 1955, 1957) and U. Riispere (1956[1], 1956[2]), who discuss the microclimatic regime of clearcut areas in drained transition bogs from the point of view of both natural and artificial regeneration. Analogous researches have been applied by U. Valk (1959[1]) to treeless raised bogs.

Many papers have been contributed on the ground cover vegetation of swamps and swamp forests as a vital ecological factor in regeneration and a primary element of site conditions. P. Kollist (1955, 1957) and U. Riispere (1956[1], 1956[2]) are concerned with the effects of drainage and cutting on the ground vegetation of transition-bog forests, their influence on the process of natural regeneration and their role in the selection of cultivation methods. The influence of drainage on the ground vegetation of transition bogs and the use of the ground cover to determine the rate of draining intensity have been studied by V. Hainla (1956[1], 1956[2], 1957). New means of checking the efficiency of draining in forests on raised bogs by means of the ground vegetation have been proposed by V. Masing (1955), who has also (1959) analysed the characters of plants best suited to define site conditions.

A. Ilves has submitted a classification (1956) of swamp forest types to suit Estonian conditions. The question of swamp forest types has also been dealt with by A. Karu (1957).

Studies of ecological conditions in wooded transition bogs, raised bogs and fens are being continued at the forestry sector of the Institute of Zoology and Botany. Research has been extended to cover the biological properties of certain tree species growing in swamps and swamp forests. The forestry sector has also set up permanent experimental plantations on transition and raised bogs in order to study the changes in soils, ground cover vegetation and stands after drainage, and to determine the expedient intensity of drainage.

The productivity of swamp forests and its dependence on drainage have been analysed mainly by V. Hainla (1956[1], 1956[2],1957, 1959), whose studies of wooded transition bogs supply interesting data on the net increase in yield obtainable by drainage at a given average depth of the ground water table during the growing season. The

increment rates in height, diameter and volume before and after drainage are not only compared, but also brought into direct relation with the state of repair of ditches. Results indicate that a substantial improvement in site conditions can be achieved by lowering the ground water table on transition bogs during the period of growth to a depth of 40 to 50 cms. At the same time the productivity of the main species growing on drained transition bogs — the pine, spruce and white birch — is compared. On the whole the pine and spruce are two to three times more productive than the white birch. While pine and spruce stands may be raised to third quality by intensive drainage, the white birch does not exceed the fifth quality class.

Productivity of the common birch on drained transition bogs has been shown by P. Kollist (1956, 1957, 1959) to be far superior to that of the white birch. The forestry sector of the Institute of Zoology and Botany (V. Hainla) is engaged at present in the study of the effect of drainage on productivity in stands of different composition growing on fens.

Questions of regeneration and afforestation have been studied in transition bogs by P. Kollist (1955, 1957) and U. Riispere (1956[1], 1956[2]), and in treeless bogs by U. Valk (1956, 1959[2]). P. Kollist discusses natural regeneration on drained transition bogs after clear cutting. Intensive draining and cutting are followed by important changes in ecological conditions, as a result of which conifers (pine and spruce) tend to be ousted by the white birch. The productivity of the white birch on drained areas, however, is so low that drainage expenses are barely compensated. Cultivation is therefore unavoidable, and only in a few exceptional cases is it possible to rely on natural regeneration modified by thinnings at the proper seasons. U. Riispere has conducted experiments in cultivation methods for forest clearings on transition bogs. Preliminary

results indicate that planting is better suited to the prevailing site conditions than sowing. On account of frost heaving, cultivation on unprepared ground gives better results than cultivation on prepared ground (i.e. cleared of turf, deepened and loosened). In view of the density, height and rapid growth of the grass, the planting-stock should be as sturdy as possible (pine: 2—0 seedlings; spruce: 2—2 transplants). Work on forest cultivation in transition bogs is continuing at the forestry sector (U. Riispere), and additional experimental plantations are founded from time to time.

Afforestation possibilities of treeless raised bogs have been studied by U. Valk, using experimental plots and plantations, and here, too, researches are still proceeding.

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4. Grove forests

On the subject of grove forests opinions vary. L. Laasimer (1959)*, in the vegetation map of Estonia compiled under her supervision, distinguishes the following categories: 1) valuable broad-leaved forests, 2) spruce and mixed spruce forests rich in species, 3) grovelike pine forests. The total area of grove forests is given as 81,000 ha, of which 73,000 ha are grovelike coniferous forests. The majority of the latter are grovelike spruce forests, which account for 5.3 per cent of all the forests on Estonian territory. Where A. Karu (1955) refers the *Oxalis, Filipendula, Polypodium, Tilia* and *Aegopodium-Hepatica* forest types to the group of grove forests, L. Laasimer is prepared to accept only the last two of these. Of the types jointly proposed by A. Karu and L. Muiste (1958) she recognizes only *Mercurialis-Aegopodium, Fragaria-Hepatica* and *Corylus*. Of the grove-forest types listed by A. Ilves (1958[2]), which include the *Oxalis, Hepatica, Filipendula* and *Polypodium* grovelike spruce forests, L. Laasimer (1959) excludes *Oxalis*, and partly also *Filipendula*.

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* L. Laasimer, Grove-forest types, 1959. (MS at the Institute of Zoology and Botany).

It should be noted that there are no specific studies of Estonian grove forests, if one does not take into account A. Kalda's unfinished investigation (1958) into the present distribution of valuable broad-leaved forests in the Estonian SSR. The very concept of the grove forest as a geobotanical unit is so limited that it is only in the last few years that grove forests have come to be looked on in Soviet forestry research as a possible field for complex study. First mention was therefore due to the discussion on questions of definition and classification. Nevertheless many papers on practical forest cultivation are concerned, in one way or another, with types which have been included in the grove-forest group.

The most extensive of these are devoted to the reconstruction of low-quality young stands, main stress being laid on the improvement of composition, as one of the best means of raising productivity. A. Karu and M. Margus are among the most active workers in this field.

A. Karu has concentrated his efforts on the reconstruction of low-quality immature hardwood stands (1950[1], 1955). Analysing the structure and composition of different forests, he has drawn up concrete reconstruction projects according to quality classes and soil regions. Methods are discussed in the light of local practice (Karu, 1952).

Detailed and systematic researches in the reconstruction of low-quality forests are being conducted at the forestry sector of the Institute of Zoology and Botany

Pine forest of *Cladonia* site type in the Iisaku forest district. *Photo by J. Vilbaste.*

Mineralized fire line in the Koorküla forest district. *Photo by P. Pere.*

Late spring motif of flooded stand of black alder in the Laeva forest district. *Photo by U. Valk.*

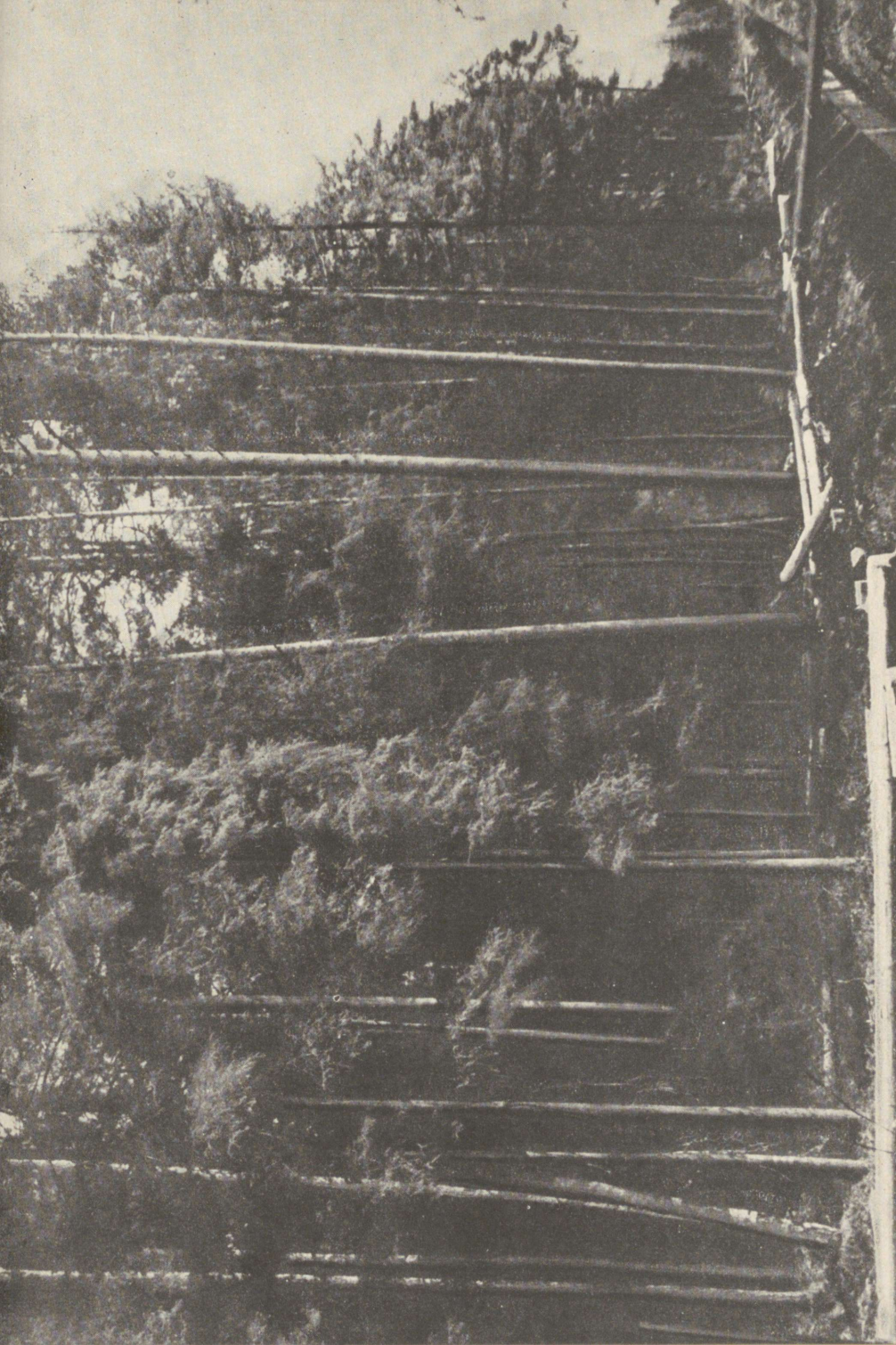
Forest on an undrained transition bog in the Venevere forest district. *Photo by P. Kollist.*

















(M. Margus). This work was begun in 1954. Methods have been adjusted to the ecological factors of the environments, the biological properties of the species in hand, and previous experience. Concrete proposals have been made concerning the pattern of planting, the width of aisles and the choice of species suitable for the reconstruction of grove-forest types (Margus, 1956).

The rearing of valuable hardwoods, though integrally connected with the general problem of forest reconstruction, has not received extensive or systematic treatment. A. Ilves (1953[1]) has discussed basic principles and made concrete suggestions for the selection of sites. He has also collected copious data on the reproduction of the ash (Ilves, 1955). A. Karu (1950[2]) has treated the planting and tending of common oak plantations.

The problem of maintenance fellings is also closely bound up with the reconstruction of low-quality young stands. Fullest treatment has been accorded to cuttings of varying intensity in birch stands with spruce seedlings. The importance of maintenance fellings in repelling the inroads of fungus pests of the Norway spruce has been studied by A. Karu and A. Jürimäe (v. forest phytopathology). Both investigators find that late and inadequate felling has substantially contributed to the bad state of health of spruce and especially grovelike spruce forests in earlier times.

Mature forest on a drained transition bog in the Vaimastvere forest district. *From the photo archives of the forestry sector of the Institute of Zoology and Botany of the Academy of Sciences of the Estonian SSR.*

Raised bog at Põltsamaa. In the foreground a pool covered with floating peat moss. *Photo by V. Masing.*

White birches on an undrained transition bog in the Väätsa forest district. *Photo by V. Hainla.*

Raised bog at Parika overgrown with sedge. *Photo by V. Masing.*

T. Krigul has investigated the application of both natural and artificial pruning to high-grade spruce and pine stands for industrial purposes, covering the technical, biological and economic aspects of the problem (1959). However, this paper cannot unreservedly be classified under the complex study of grove forests, as only one of the forest types discussed — that of mixed (i.e. grovelike) spruce forests — belongs here.

A useful research centre has been founded at the Kuremaa Forestry School in the Kaarepere forest district, where the maintenance of mixed spruce-hardwood stands, such as abound in the vicinity, forms the main object of study. The results already achieved have made it possible to draw practical conclusions for the structural regulation of spruce-hardwood forests (Taimre, 1959).

Another excursion into the field of grove forests is represented by N. Ojamaa's work on the biological forms of the aspen (1959).

Of the unfinished investigations on thinnings O. Henno's work on the production of industrial birch (begun 1957) deserves mention. In addition to questions of biology, increment etc., the author discusses the shape of the stem and the possibility of regulating it by means of thinnings (v. thinnings). The data obtained to date suggest that the shape of the stem is at its best when the length of the crown in mature stands constitutes about one-third of the total height. Another point of interest is that the productivity of the birch in mixed stands of birch and spruce is as much as 40 cubic metres per hectare higher than in pure birch stands.

From 1957 the growth process, ecology and biology of mixed young stands of spruce and hardwood on fertile sites have been studied at the forestry sector (H. Rebane), special attention being paid to thinning methods. These researches have been applied to the most typical grove-forest areas, especially the *Mercurialis-Aegopodium* type.

The results available up to the moment suggest that birch cuttings have been in places excessive or premature, and that insufficient heed has been given to the necessity of obtaining a balanced composition (Rebane, 1959).

In 1958 the forestry sector turned its attention to the cultivation of the aspen (A. Nilson), with the object of finding methods of raising rot-free stands.

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Eesti NSV Teaduste Akadeemia Eksperimentaalbioloogia Instituudi (EBI) Botaanika aed. [The Botanical Gardens of the Institute of Experimental Biology of the Academy of Sciences of the Estonian SSR]. Tallinn, Keemia t. 41.

Eesti NSV Teaduste Akadeemia juures asuv Loodusuurijate Selts (LUS) [The Naturalists' Society Attached to the Academy of Sciences]. Tartu, Hariduse t. 3.

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Sepp, Ragnar — Forest soil science. ZBI.
Taimre, Helmut — Silviculture, dendrology. KM.
Vaga, August — Dendrology. TRÜ.
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Veski, Vello — Dendrology. EBI.
Vilbaste, Gustav — Dendrology. Tallinn, Vase t. 18—8.

CONTENTS

Introduction (*M. Margus*) 3

I. Forest research in the past (*M. Margus*) 7

II. The present state of forest research 11

1. The scope of investigations and main lines of research (M. Margus) 11
2. Forest biology and silviculture 14
   - Forest soil science (*R. Sepp*) 14
   - Dendrology (*M. Margus*) 17
   - Forest typology (*U. Valk*) 20
   - Forest cultivation (*M. Margus*) 23
   - Thinnings (*H. Rebane*) 25
   - Forest phytopathology (*E. Parmasto*) 27
   - Forest entomology (*V. Maavara*) 30
3. Forest mensuration and forest management (*A. Nilson*) . 31
4. Forest utilization (*K. Veermets*) 33
5. Game management (*H. Ling*) 35
6. Nature conservation (*M. Margus*) 36

III. The complex study of forests 39

1. Alvar forests (*M. Kaar*) 39
2. Heath forests (*U. Valk*) 44
3. Swamp forests (*P. Kollist*) 49
4. Grove forests (*H. Rebane*) 55

Some addresses 61

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Distribution of forests in the Estonian SSR according to predominant tree species. 1 — swamps; 2 — spruce forests; 3 — mixed spruce and broad-leaved forests; 4 — mixed pine and broad-leaved forests; 5 — pine forests.

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