SUOMEN METSÄTIETEELLINEN SEURA — FINSKA FORSTSAMFUNDET

SILVA FENNICA

90.

ARBEITEN DER
FORSTWISSENSCHAFTLICHEN GESELLSCHAFT
IN FINNLAND

PUBLICATIONS OF THE
SOCIETY OF FORESTRY
IN FINLAND

PUBLICATIONS DE LA
SOCIÉTÉ FORESTIÈRE
DE FINLANDE

HELSINKI 1957

Suomen Metsätieteellisen Seuran julkaisusarjat:

ACTA FORESTALIA FENNICA. Sisältää etupäässä Suomen metsätaloutta ja sen perusteita käsitteleviä tieteellisiä tutkimuksia. Ilmestyy epäsäännöllisin väliajoin niteinä, joista kukin yleensä käsittää useampia tutkimuksia.

SILVA FENNICA. Sisältää etupäässä Suomen metsätaloutta käsitteleviä kirjoitelmia ja pienehköjä tutkimuksia. Ilmestyy epäsäännöllisin väliajoin.

Finska Forstsamfundets publikationsserier:

ACTA FORESTALIA FENNICA. Innehåller vetenskapliga undersökningar rörande huvudsakligen skogshushållningen i Finland och dess grunder. Banden, vilka icke utkomma periodiskt, omfatta i allmänhet flere avhandlingar.

SILVA FENNICA. Omfattar uppsatser och mindre undersökningar rörande huvudsakligen skogshushållningen i Finland. Utkommer icke periodiskt.

SUOMEN METSÄTIETEELLINEN SEURA — FINSKA FORSTSAMFUNDET

SILVA FENNICA

90.

ARBEITEN DER
FORSTWISSENSCHAFTLICHEN GESELLSCHAFT
IN FINNLAND

PUBLICATIONS OF THE
SOCIETY OF FORESTRY
IN FINLAND

PUBLICATIONS DE LA
SOCIÉTÉ FORESTIÈRE
DE FINLANDE

HELSINKI 1957

Suomalaisen Kirjallisuuden Kirjapaino Oy Helsinki 1957

Silva Fennica

N:o 90 (1957)

OUTLINES OF CARTOGRAPHICAL AND TIMBER SURVEYING UNIT

KULLERVO KUUSELA

HELSINKI 1956

Contents

Suomalaisen Kirjallisuuden Kirjapaino Oy Helsinki 1956

Introduction

After the Second World War the Finnish Forest Service was faced with large re-mapping and timber surveying projects in Northern Finland. Compared with other expenses, the labour and, in a lesser degree, the personnel costs increased during the war. The governmental funds for re-mapping purposes were very limited. In order to re-map the large and extensive areas, the only way was to abandon the ground methods and to look for new procedures.

At the same time the photogrammetric equipment of the Finnish Army was made available to the civil service. Since 1947, several forest mapping projects have been carried out in close co-operation between the Forest Service and the Army Topographic Service. The total area photographed is 4.9 million acres (2

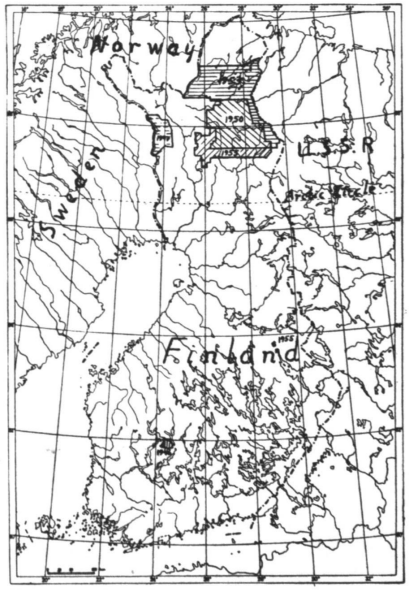

Fig. 1. Map showing the area of the aerial photographic missions for the Finnisch Forest Service mapping work.

million hectares) and the area of completed projects 1.7 million acres (0.7 million hectares).

The present scheme of the mapping procedure employed in Northern Finland has been developed by a number of foresters and photogrammetrists in the last years. Among them, Mr. K. Löfström, the Chief of the Photogrammetric Bureau of the Army Topographic Service, has assisted as an initiator and technical expert. Although not a forester himself, he has taken active interest in the photogrammetric problems of Finnish forestry, and his help has been invaluable to the foresters.

Even the first results of the photogrammetric projects were more than promising. The costs of the conventional ground methods were cut down by 40—50 per cent. The largest project thus far, including the lake basin of Inari and an area of 2 million acres (0.8 million hectares) could not have been carried out without photogrammetry.

The main advantage of the mapping procedure employed by the Finnish Forest Service is its flexibility and elasticity rendering alterations and improvements possible. If necessary, it may be carried out at very low cost. Because of the limited funds available, the first project Yli-Tornio was carried out without any other photogrammetric instruments than stereo spectacles and pocket stereoscopes. The Radial Line Plot of Yli-Tornio was partly analytic and partly graphical.

Supplementary equipment was purchased step by step. The mechanical triangulators were used in the second project. Later emphasis was laid on development of Photo Interpretation. Mirror stereoscopes, interpretation aids, transferring instruments, etc. were linked to the procedure.

Now, when tradition-bound prejudices are thawing down, more funds are coming available, and new instruments suitable for forestry purposes are appearing on the European markets, the time has come to improve and complete the procedure so far used.

The present mapping procedure will be described phase by phase. In each phase some suggestion will be presented regarding the alternative ways in procedure and utilization of new equipment.

Outlines of Cartographical and Timber Surveying Unit

Source Material

In Northern Finland, the aerial photographs as Source Material are taken with a wide angle Finnish Horizon Camera (focal length = 10 cm) using panchromatic film. The photographic scale is 1: 40 000 and the format of the negative 18 cm × 18 cm. Because of the tilt angles obtained in the two pictures of the horizon line for every exposure, rectified photographs can be used in all phases of the procedure.

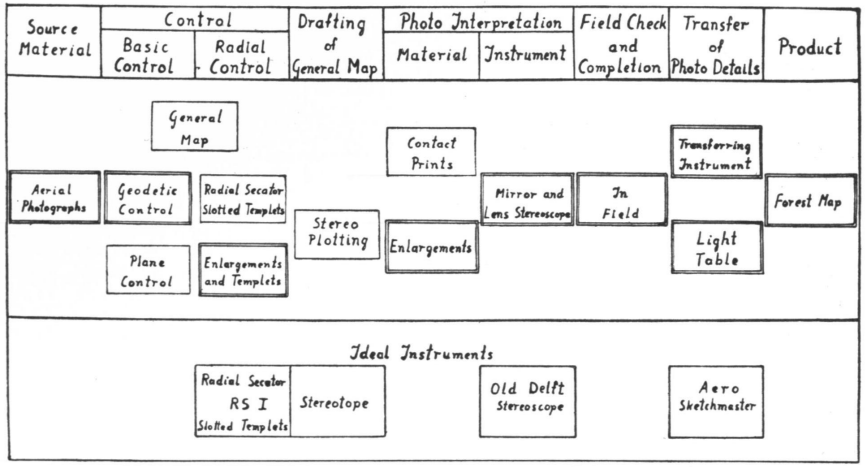

Fig. 2. Sketch of alternative ways of producing Forest Maps. The phases within the double lines show those used by the Finnish Forest Service.

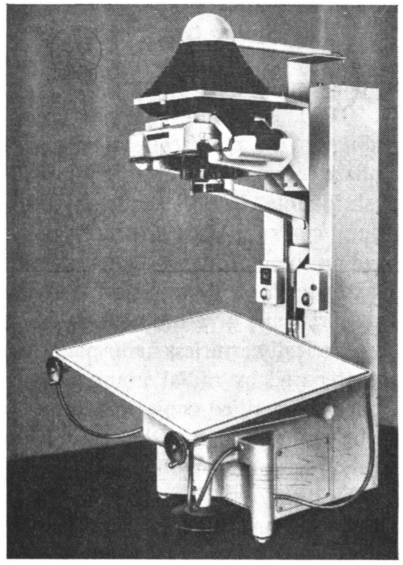

Fig. 3. Automatic Rectifier SEG V may be used for the compilation of controlled mosaics of woodland (Photo: Courtesy by Zeiss-Aerotopo).

Basic Control

The purpose of the Basic Control is to provide the proper amount of well scattered control points for the Radial Line Plot.

The planimetric details of a reliable and recent General Map (published in Finland in the scale of 1: 20 000) may be used to control the Transfer of the Photo Details. (It should be noted that the General Map is considered to include all the terrestrial, drainage, and cultural features of general interest. It may be completed to make up Special Maps like ones used in forestry, geology, engineering, etc. Further, only the planimetric maps are under consideration in this paper.) The map details are enlarged to the proper scale and this enlargement makes up the base map for the later phases. — A good General Map being available, Radial Line Plot and Stereo Plotting will be omitted in the procedure.

If the area lacks sufficient ground control and is large enough, Geodetic Control will be carried out by conventional ground methods. This has been the case in the large mapping projects in Northern Finland, where four or five control points are considered satisfactory for forestry purposes in each square of 11.5 mi. × 11.5 mi.

If a small area lacks sufficient ground control and if the line net of the property boundaries can not be used as such, the Plane Control is measured on the ground.

Radial Line Plot

In Forest Service mapping projects, the Ground Control is extended by the Radial Line Plot in the scale 1: 20 000. The rectified copies are made on an approximate scale of 1: 20 000 according to the statoscope altimeter readings. The set of enlargements used in this phase is exposed on wet paper and treated with glycerine in order to make them unshrinkable, flexible, and easy to handle. They are called glycerine prints. The ground control points, the nadir points as radial centres, and the pass points are marked on these prints.

The Radial Line Plot is assembled by the »Lazy Daisy»-type, mechanical triangulators. The horizon measurements give the tilt angles with a mean error of 0.1^g, thus rendering possible a practically errorless nadir point triangulation.

Based on the control prepared by radial triangulation, the exact enlargement ratios are calculated and new rectified copies made in the scale 1: 20 000. These prints, on semimatte paper, are used in the Photo Interpretation and in the Field.

The Radial Line Plot may be compiled also by the slotted templets. The Radial Secator RS I, produced by the Zeiss-Aerotopograph, is a good instrument for punching the templets. The slotter allows correction of the tilt expressed in nadir distances up to 20^g and varying of the scale of the templets with respect to the photograph within the limits of 0.7 × and 1.8 ×. Thus the contact prints may be used and, as a further advantage, the photographs with the points marked on them

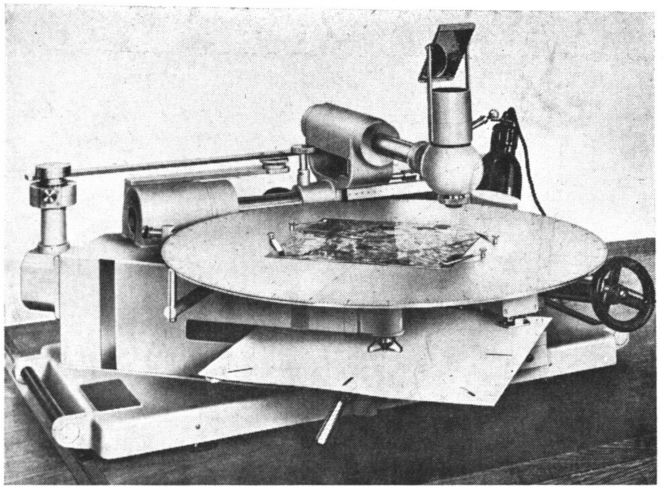

Fig. 4. Radial Secator RS I (Photo: Courtesy by Zeiss-Aerotopo).

remain intact for later phases, and errors in transfer of the control points are avoided. — If the slotter is of old type and the negative format small, enlargement are preferable in the Radial Line Plot.

Drafting of the General Map

If the project area is mountainous and the land use intensive containing numerous property boundaries, a reliable planimetric map may be produced in the desired scale by a third order stereo plotter. On the European markets, the Zeiss-Aerotopograph's Stereotope Plotter is a suitable instrument at a reasonable price. The parallel instrument in the United States is the K.E.K. Plotter.

In this phase, the general map details are drafted on the base and these details control the forestry details in the later phases. The stereo plotting may be omitted in the procedure, specifications of the forest maps and the local circumstances permitting it.

Photo Interpretation

As many of the forestry details (site and stand lines, logging camps, roads, water ways, dams, flumes, etc.) as possible are mapped on the photographs in the office by the Photo Interpretation technique. The photographs and the professional skill

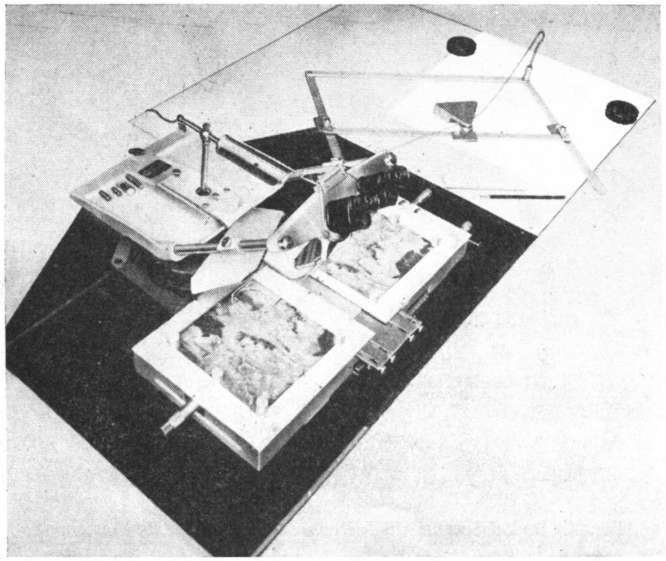

Fig. 5. Stereotope Plotter (Photo: Courtesy by Zeiss-Aerotopo).

Fig. 6. The Old Delft Scanning Stereoscope has been succesfully used in Photo Interpretation (Photo: K. Setälä).

of the photo interpreter permitting, the timber stand are stratified into volume classes in this phase.

In the Finnish Forest Service work the Photo Interpretation is carried out under mirror stereoscopes. In spite of the comparatively small photographic scale, the clear and distinct terrain and vegetation features of the northern forests allow very reliable sketching of the site and stand lines. The Field Checks have proved that 80—90 per cent of the photo details, needet in the final Forest Map, have been correctly interpreted by experienced foresters.

The Old Delft Scanning Stereoscope (made in Holland) has turned out to be an ideal instrument in Photo Interpretation. It is a mirror prism stereoscope with magnification selective at 1.5 × or 4.5 ×. Movement of the prisms within the optical train of the instrument enables the operator to scan the entire model, either on the contact prints or on the enlargements, without moving the stereoscope or the photographs. The viewing position of the operator is favourable.

Ordinary mirror and lens stereoscopes can be succesfully used in this phase. Using the lens stereoscope on large size prints is inconvenient because the model cannot be viewed without bending or cutting the prints.

In northern Finland the enlargements have been found preferable to the contact prints for Photo Interpretation because the photographic scale 1: 40 000 is too small for the field work. The net or mapping area to be photo interpreted is outlined in every photograph. Using the area around the radial centre makes the image displacement as small as possible in the Photo Detail Transfer.

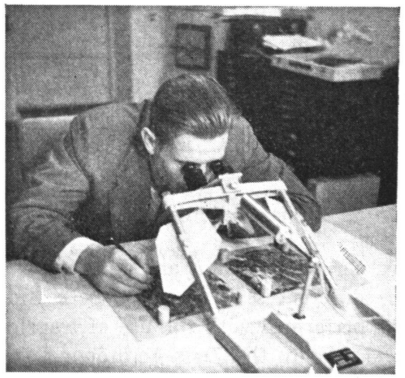

Fig. 7. OV mirror stereoscope (made by Zeiss-Aerotopo) in Photo-Interpretation (Photo: K. Setälä).

Field Check and Completion

The photographs interpreted in the office are checked and completed in the Field. This may be done in connection with the stand by stand estimation of the silvicultural condition, stand treatment, volume, and other data needed for timber management plans.

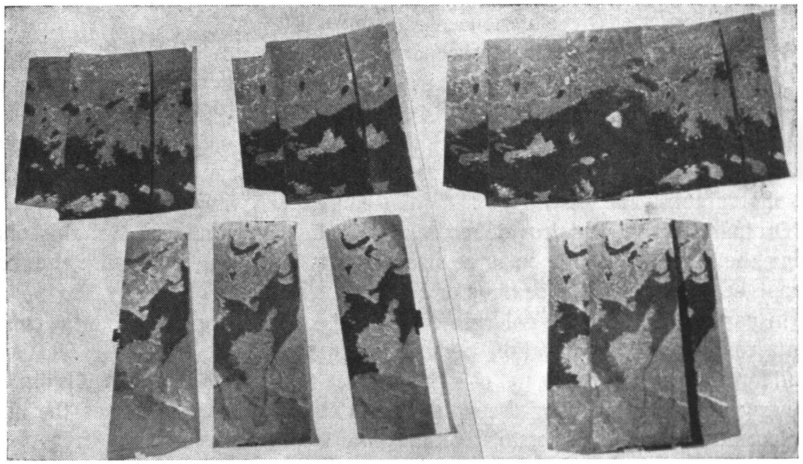

Fig. 8. Picture showing the compilation of stereograms for Field work. Stereograms of each strip may be put together to illustrate larger areas (Photo: K. Setälä).

In the Forest Service work, the stereograms are prepared for the Field. The interpreted photographs are cut along the vertical lines of their net areas. Every central piece is stitched to the side pieces of the adjacent photographs, thus forming a stereogram.

Transfer of Photo Details

After the field work, the photo details are transferred to the map base sheets. Regardless of the scale differences between the base and the photographs, the transfer may readily be performed with the use of transferring instruments. The Aero-Sketchmaster, produced by the Zeiss-Aerotopograph, seems to be the best transferring instrument on the European markets. In the United States, there are many different and cheap types of them. If the instrument is employed efficiently, the comparatively expensive Saltzman Projector is suitable. The Seelyscope, constructed in Canada, is cheap and practical for forestry purposes.

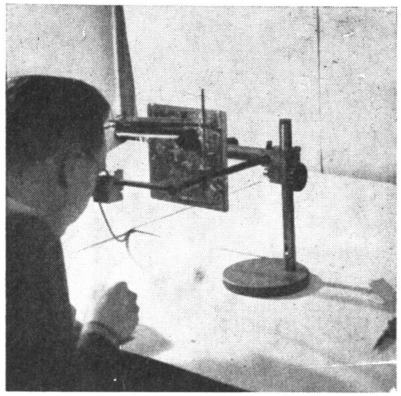

Fig. 9. Aero-Sketchmaster in Transfer of Photo Details to the map base (Photo: K. Setälä).

If the photographs and the base are of the same scale, the photo details may be transferred to transparent map base sheets. This may be done on the light table or, if the sheet is very transparent, on the drafting table. — Both instrumental and light table transfer have ben used in the Forest Service work.

Product

The final Forest Map is compiled and produced from the finished and checked map sheets in the scale desired, which in Northern Finland is 1: 40 000

Conclusions

Natural surroundings, the intensity of forestry, the amount of mapping work to be done, and the funds available determine the manner of carrying out forest mapping and timber surveying projects. If the forest area under modern timber management plans is several million acres (the area of the Finnish National Forests is about 17 million acres), the ideal implemental framework for a Mapping and Timber Surveying Unit in Finland would be:

Radial Secator RS I (Zeiss-Aerotopo[1]) and slotted templets for the Radial Line Plot

Steretope Plotter (Zeiss-Aerotopo) for Drafting General Maps

The Old Delft Scanning Stereoscope (N. V. Optische Industrie De Oude Delft, Holland) for Photo Interpretation

Aero-Sketchmaster (Zeiss-Aerotopo) for Transfer of the Photo Details

[1] Zeiss Aerotopograph, Munich, Western Germany