None of the treatments affected the numbers of fungi that grew from stratified or unstratified *A. grandis* seeds. More than 80% of the fungi isolated from these seeds were *Trichoderma* spp. or Mucorales. Most of the remaining isolates were *Penicillium* sp. or *Papulospora* sp.; 3% of the stratified and 5% of the unstratified seeds yielded the pathogenic fungus *Geniculodendron pyriforme,* described by Salt (Trans. Br. Mycol. Soc. 63:339-351, 1974). The most effective treatments for reducing the numbers of fungi on stratified *A. amabilis* seeds were 15% H_2O_2 for 12 or 24 h or 30% H_2O_2 for 3 h (Table 1). The latter treatment was also the best for eliminating fungi on unstratified amabilis fir seeds. *Trichoderma* sp. accounted for 90% of the fungi isolated from both stratified and unstratified *A. amabilis* seeds. The remainder of the fungi were *Penicillium* sp., or Mucorales.

None of the H_2O_2 treatments were of any benefit in increasing the capacity or the rate of germination of *A. grandis* or *A. amabilis* seeds. Certain treatments effectively reduced the numbers of seed-borne fungi, but there were no corresponding increases in seed germination. More studies are needed to determine if these fungi affect viability of *Abies* seeds before germination.—D.G.W. Edwards and Jack R. Sutherland, Pacific Forest Research Centre, Victoria, B.C.

Assessment of the Necessity of Grinding Conifer Foliage for Chemical Analysis.—To study the nutrient status of forest sites, either soil or foliage samples may be analyzed. Soil analysis is relatively expensive, and foliar analysis may be the better method of assessing the nutrient regime of forest sites (Lowry, Soil Sci. Soc. Am. Proc. 39:125-131, 1975).

Before analysis, foliage samples are customarily ground to pass through 1 mm mesh (MacDonald, Can. For. Serv. Inf. Rep. M-X-78, 1977) because it is assumed that homogeneous and more representative subsamples are obtained from ground than from unground materials (Kalra and Edwards, IUFRO News 7:10-11, 1974). However, fine-ground materials cling to surfaces if they have acquired a charge of static electricity. This leads to difficulties in weighing and incomplete transfer of samples to micro Kjeldahl flasks. Grinding is time-consuming and therefore expensive. This note reports the results of a study designed to assess the efficacy of omitting the grinding of foliage before chemical analysis.

The material studied consisted of 25 balsam fir, 21 white spruce, 8 red spruce, and 54 black spruce oven-dried current foliage samples. Samples were analyzed for percentage concentration of nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg) by the methods used in the analytical service laboratory (MacDonald, 1977). Four replicates of each foliage sample, two ground and two unground, were analyzed for each element. Analytical results from all species were similar and were pooled for statistical analysis. Possible differences in the quantities of nutrients determined in ground and unground samples were assessed by the t-test. The measurement variance was calculated from differences between pairs of samples receiving identical preparation and analysis. The effect of grinding was assessed by an F-test applied to the ratio of the measurement variances for ground and unground samples. Analytical results, standard deviations, and indications of significant differences are presented in Table 1.

There was no significant difference in recovery of N, P, and K between ground and unground foliage; unground foliage yielded significantly more Ca, while ground foliage yielded significantly more Mg. Measurement variance, as indicated by standard deviations, was generally greater with unground foliage for all elements except N and was significantly greater for K and Mg. This was expected because of the more homogeneous nature of ground material. However, in the ground material, measurement variance was greater for N. A further N analysis was done to verify this unexpected result. During the second N analysis, the ground and unground foliage samples were wrapped in paper before digestion preliminary to Kjeldahl distillation. This precaution was taken to avoid possible variability in N analyses of ground foliage caused by the adherence of the fine-ground material to the outside of the Kjeldahl flask. This occurred during transfer of the samples and resulted from static charges on the glass. The results of the second N analysis agreed with those of the first analysis: there was no significant difference between analytical recoveries from ground and unground foliage. Again the measurement variance was significantly greater for the ground foliage. We are unable to account for this unexpected result. Samples from individual species were also statistically analyzed separately; results similar to those for the pooled data were obtained.

TABLE 1

Average percent concentration of nutrients in current foliage from four conifer species (standard deviations)

Nutrient	Nutrient concentration (%) in conifer needles†			
	Ground	(S.D.)	Unground	(S.D.)
N	1.14	(.091)*	1.14	(.072)*
P	0.17	(.011)	0.17	(.012)
K	0.71	(.047)*	0.69	(.067)*
Ca	0.35*	(.038)	0.37*	(0.044)
Mg	0.09*	(.012)*	0.08*	(.018)*

†Means of 216 determinations.
*Values within individual element analysis are significantly different (P = 0.05).

Generally, there may be some advantage in grinding foliar samples before analysis for elements other than N. However, many analysts may feel that the differences between ground and unground samples are so small that grinding is an unnecessary expense. The results presented here suggest that, if N is the only element being studied, grinding is unnecessary as part of the sample preparation routine; in fact, grinding would appear to contribute to increased variance of replicates during N analysis.—P.O. Salonius, C.C. MacDonald, and R.A. Fisher, Maritimes Forest Research Centre, Fredericton, N.B.

MENSURATION

Computer Graphics Display of Topographic Data.—Computer graphics systems have been used for investigating the visual effects of proposed landscape modifications. Some applications in forestry, such as in the visual impact of clearcuts, are given by Kojima and Wagar (J. For. 70:282-285, 1972). Additional applications are indicated for the MOSAIC system of the U.S. Department of Agriculture Intermountain Forest and Range Experiment Station (Anon., MOSAIC — a system for displaying a proposed modification before its impact on the environment, Intermt. Forest Range Exp. Stn. Pam., 1977). Many data bases related to topography have no visual impact; yet a visual display in relation to the topography would aid communication about the data and facilitate their subjective analysis. This paper describes some uses of a computer graphics system developed to display the relationship of data to topography.

A square grid is superimposed on a topographic map of the area of interest, and the elevation at each intersection is recorded. The scale of the grid is determined by the complexity of the surface and the desired accuracy of its reproduction. A FORTRAN-based computer program has been developed to draw the topographic surface, defined by the intersection elevations, on the screen of a graphics terminal. A permanent record of the display could be obtained by photography of the terminal screen. The purpose of the program is the display of data; thus, perspective effects are not included, as reduction of grid size owing to such effects obscures the shading intensity used to represent the data values within the grid.

A small grid size relative to the scale of topographic variations is required to give a good reproduction of the topography. In the examples provided, data were specifically obtained for each grid cell. Data, however, are often available only on a larger scale than is required for drawing the topography. If the scale of the data base is different from the grid scale of the topography, the program will compare the scales and shade in the block of squares of the topographic grid that corresponds to the area covered by a single datum value. In addition, once the topography and data for an area have been coded, any subsection can be selected for display.

The surface may be viewed from any rotation or elevation angle. This allows the production of stereo pairs of photographs, which may be viewed through a stereoscope. For display purposes, a stereo-projection method may be used. One view is produced as a red slide; the other as a blue or green slide. By the use of two projectors, the images are superimposed and viewed through a red filter, and a blue or green filter. A stereo picture is then observed on the screen.

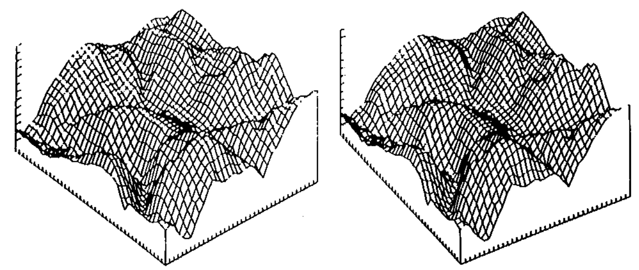

Figure 1. A stereo pair of computer-generated pictures illustrating the topography of the mountains lying between the Fraser River and Anderson River Mountain, in the vicinity of Yale, B.C.

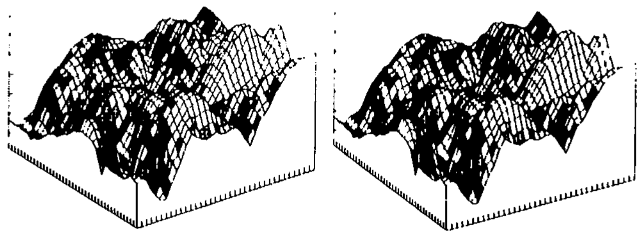

Figure 2. Percent cover of each grid for Douglas fir, as defined by the British Columbia Forest Inventory map based on 1973 photography, in the area indicated in Fig. 1. The increase in the density of shading corresponds to the increase in percent cover.

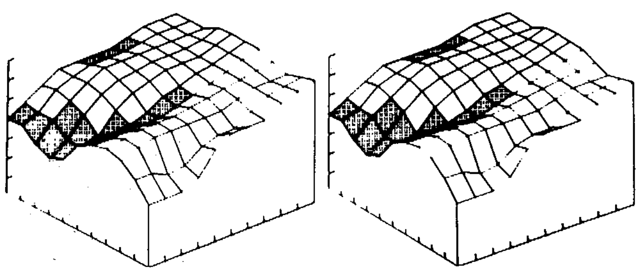

Figure 3. The shaded grids are completely in shadow when the sun is in the south at an elevation of 5°.

Fig. 1 illustrates the view from the south-southwest of the mountains lying between the Fraser River and Anderson River Mountain in the vicinity of Yale and Spuzzum, B.C. The vertical scale is exaggerated by a factor of 2.15 to facilitate the subjective evaluation of the topography. For full effect, the figure pairs should be viewed through a stereoscope.

One of the major data bases available to foresters in British Columbia is the British Columbia Forest Inventory, which records the size, species, composition, age, and height of each "type island" of trees in the province. Maps showing the boundaries of these type islands may be obtained. One problem, however, is that they do not illustrate topography. The use of the graphics system for data display was exemplified when the grid used to obtain the elevations depicted in Fig. 1 was superimposed on the forest cover maps of the same area (British Columbia Forest Service, Forest Inventory Division, forest cover series, maps nos. 92-H-11-c,d,e,f) and the percent cover of each grid cell for Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) was coded on a scale of 0 (0-20%), 1 (21-40%), 2 (41-60%), 3 (61-80%), and 4 (81-100%). The intensity of shading of each grid cell in Fig. 2 reflects the percent cover for Douglas-fir. The program has also been used to display the limits of defoliation of the Douglas-fir by the western budworm, *Choristoneura occidentalis* Freeman.

While the topographic and data files are being combined for the graphics, records may be kept of the combination of the topographic information and data values in each grid cell. From these records, the proportion of data values, within specified limits, at a given aspect or elevation may be extracted, and the program may thus be used for analysis as well as display of data in relation to topography.

Besides positioning the observer's viewpoint at any angle, it is possible to simulate the position of the sun at any orientation and record which grid cells are completely in shadow. For this analysis, the vertical scale should not be modified as in Fig. 1. However, only the shadows of the hills included in the area will be drawn. Shadows that might be cast by hills on the edge of the area are not included. This effect is easily allowed for by inclusion of a buffer area around the area of interest. An example of the use of the program to generate shadows is given in Fig. 3.

A computer stereographic system for the display of data in relation to topography has been presented. The program may also be used for analysis of the data in relation to topography, and for the determination of the limits of the shadows of the mountains with the sun in a given position.

While the method has been used only with observed distributions (Douglas-fir and defoliation by western spruce budworm), the generation of the data values within each cell by computer simulation models facilitates the interpretation of the effects of parameter changes on spatial distributions.—A.J. Thomson and S.M. Moncrieff, Pacific Forest Research Centre, Victoria, B.C.

Tree Length Volume Equations and Tables for Major Pulpwood Species in Northern Ontario.—Although tree length harvesting has been employed by most major pulp and paper companies for several years, no published tree length volume equations or tables have been available for the major pulpwood species of northern Ontario. The Ontario Paper Company Limited, Manitouwadge, Ont., undertook to prepare such tables. From 300 to 500 trees of each of the following five species were cut, sectioned, and measured: black spruce (*Picea mariana* [Mill.] B.S.P.), white spruce (*Picea glauca* [Moench] Voss), jack pine (*Pinus banksiana* Lamb.), balsam fir (*Abies balsamea* [L.] Mill.), and balsam poplar (*Populus balsamifera* L.).

TABLE 1

Tree length volume regression equations for major pulpwood species in northern Ontario[a]

Species	Regression equation	R^2	Standard error	Percent bias
Black spruce	$Y^b = .000273\ X^{2.276}$	0.94	2.1	0.6
White spruce	$Y = .000259\ X^{2.296}$	0.91	6.8	0.4
Jack pine	$Y = .000261\ X^{2.304}$	0.92	3.1	0.4
Balsam fir	$Y = .000146\ X^{2.427}$	0.92	2.2	0.1
Poplar	$Y = .000898\ X^{1.961}$	0.86	5.1	−0.1

[a]Based on Ontario Paper Company's data.
[b]Where Y = tree-length volume (m^3) and
X = dbh (cm).

The measurements taken and recorded were as follows:

a. Butt diameter inside bark was measured to the nearest 2.5 mm for volume calculation, but the actual measurements were grouped by 2.5 cm diameter classes.

b. Diameter outside bark at breast height was measured to the nearest 2.5 cm for diameter class allocation.

c. Trees were cut into 2.5 m long bolts, and the inside bark diameters at both ends of each bolt were measured to the nearest 2.5 mm for volume calculation.

d. After the last full bolt (2.5 m), the length and volume of the fractional bolt to the merchantable top, i.e. that part of the top larger than or equal to 8.9 cm in diameter, was measured. Total merchantable length of the tree was also measured to the nearest 3 cm.

e. The volume of each bolt was calculated according to Smalian's formula and summed to provide the total merchantable volume for each tree.

Although the volume calculations were based on actual measurements, the data were recorded by 2.5 cm diameter classes. For each species there were 23 to 50 trees per 2.5 cm diameter class. The data were sent to the Great Lakes Forest Research Centre for analysis by the author. The company required two sets of volume tables, one based on butt diameter and the other based on dbh classes. The tables were prepared in both English and metric units as follows: