be emphasized too much where aerial photos are used: there is more to photo interpretation than meets the eye; the miniature stereo image of a forest has a complex but fascinating story to tell to those who have the training, experience and mature judgment to read it and understand it, which is unfortunately not always the case with novice interpreters.

Many foresters remain skeptical of photo information because of exaggerated claims of accuracy made by over-enthusiastic novices. In advocating site-mapping from photos it should be understood that stereo-vision alone is not the only pre-requisite.

HIGH SOIL SURFACE TEMPERATURES RECORDED ON A MODERATELY WARM DAY

By F. W. VON ALTHEN¹

A practising forester can collect useful bits of field information as part of his daily work and without the use of special research facilities. As an example of such a small scale experiment, the writer recorded soil and soil surface temperatures on 25 July, 1959, in the MacKenzie-Cariboo Tree Farm Licence Number 5, which is situated between the towns of Quesnel and Prince George in the northern interior of British Columbia.

Temperature readings were taken in a six acre clearcut, logged in the summer of 1955 and broadcast burned in the autumn of 1956. The original forest stand consisted of 250 year old Douglas fir, with Engelmann spruce and alpine fir in the co-dominant and intermediate crown classes. The soil was a heavy clay loam with a moderate number of rocks throughout the profile and a fair to good drainage. The elevation of the site was 2,600 feet.

Three soil pits were dug to a depth of 16 inches in the following locations: Pits number 1 and 2 were established 20 feet apart near the center of the clearcut, exposed to full sunlight during the day. The ground at pit number 1 was covered with 2 inches of organic material, of which one and one-half inches had been heavily scorched during the slash-burning. The lowest one-half inch had not been affected by the fire. No regeneration and little ground vegetation was present in the vicinity of this pit. At soil pit number 2, the organic material had been removed during the logging operation and the mineral soil was fully exposed. Few Douglas fir and Engelmann spruce seedlings were present near the pit, but had grown mostly under the shade of ground vegetation. The third pit was dug fifty feet inside the timber stand, which was identical to the original stand. This pit was always shaded, with only an occasional sun ray passing over it for a short time.

All temperature readings were taken with standard 15 inch long "hot bed" soil thermometers. The range of these thermometers was 30°F. to 180°F. Temperatures were recorded at two hour intervals, from 10 a.m. to 4 p.m., and readings in all pits were taken at the surface and at depths of 1 inch, 2 inches, 5 inches and 12 inches. Additional readings of surface temperatures were taken at hourly intervals at pits 1 and 2, and also under the shade of ground vegetation in the vicinity of both pits. Air temperature was measured

¹ Since April 1961 the author has been employed by the Federal Department of Forestry. He now is working at the Ontario District Office, 4 Yonge St. South, Richmond Hill, Ont.

in the clearcut area near pits number 1 and 2 at a height of 4.5 feet above the ground. This was accomplished by tying a thermometer to the shaded side of a 6 foot snag.

The results are recorded in table 1. The maximum air temperature at 4.5 feet above the ground did not exceed 74°F., while at the same time the surface temperature of the burned organic litter rose to 136°F., and that of the mineral soil to 126°F. When shaded, the maximum surface temperatures of the burned organic litter and the mineral soil were 88°F. and 82°F. respectively. At the 12 inch depth, the temperatures remained nearly constant, regardless of any changes in surface temperatures. The slight rise at this depth may have been the result of a gradual warming of the soil pit during the day.

An example of the poor heat conducting quality of the organic material is the large temperature difference between the surface and the first inch in depth of the organic material of soil pit number 1. At 2 p.m. this difference was 52°F. for pit number 1. The difference between the surface and the first inch in the mineral soil of pit number 2, on the other hand, was only 48°F. Most of this difference between the two pits can be detected in the reversed form at the 2 inch level, where pit number 2 is now 3°F. warmer than pit number 1. The heat, has therefore been conducted to a greater depth in the mineral soil, resulting in lower temperatures at the surface. (Gregory 1956; Vaartaja, 1954).

TABLE 1
SOIL AND SOIL SURFACE TEMPERATURES OF VARIOUS
SURFACE CONDITIONS IN DEGREES FAHRENHEIT

Time of reading	Air temperature at 4.5' above ground	Pit No.	Surface shaded	Surface full sunlight	Depth of Soil			
					1 inch	2 inches	5 inches	12 inches
10 A.M.	62	1	62	88	60	60	59	59
		2	62	84	60	60	59	59
		3	60	—	56	54	50	50
11 A.M.	62	1	64	102	—	—	—	—
		2	64	96	—	—	—	—
12 Noon	64	1	68	110	64	60	59	59
		2	67	102	65	60	60	59
		3	62	—	56	54	53	52
1 P.M.	70	1	76	117	—	—	—	—
		2	74	109	—	—	—	—
2 P.M.	72	1	84	130	78	66	64	60
		2	78	122	74	69	62	59
		3	66	—	57	56	53	52
3 P.M.	74	1	88	136	—	—	—	—
		2	82	126	—	—	—	—
		1	76	112	76	66	64	60
4 P.M.	72	2	76	102	73	68	62	59
		3	66	—	58	56	53	52

This experiment shows that even on a moderately warm, but clear summer day the soil surface temperature may reach a maximum which can endanger or even prevent the establishment or survival of regeneration. Experiments have shown that succulent coniferous seedlings are killed at temperatures of 135°F. (Baker 1929). Dark surfaces result in higher temperatures than light coloured surfaces, (Daubenmire, 1943, Geiger, 1959), and a layer of organic material will increase the temperature near the soil surface, due to poorer heat conducting qualities of the litter. Scorched organic material produces the highest surface temperatures and is therefore, in regard to maximum temperatures, the poorest medium for seedling establishment and survival.

BIBLIOGRAPHY

- BAKER, F. S. 1929. Effects of excessively high temperatures on coniferous reproduction. *Jour. For.* 27: 949-975.
- DAUBENMIRE, R. F. 1943. Temperature gradients near the soil surface with reference to techniques of measurement in forest ecology. *Jour. For.* 41: 601-603.
- GEIGER, R. 1959. The climate near the ground. Harvard Univ. Press, Cambridge, Mass.
- GREGORY, R. A. 1956. The effect of clearcutting and soil disturbance on temperatures near the soil surface in Southeast Alaska. *For. Res. Center Sta. Paper* 7.
- ISAAC, L. A. 1956. Factors affecting establishment of Douglas fir seedlings. U.S. Dept. Agric. *Circ.* 486.
- VAARTAJA, O. 1954. Temperature and evaporation at and near ground level on certain forest sites. *Can. Jour. Bot.*, 32: 760-783.

LETTERS TO THE EDITOR

(In a lighter vein)

Dear Sir:

After reading the June issue of your eminent scientific magazine I would like to form a committee interested in saving our trees from smoke damage by steam locomotives. I am also very concerned about the introduction of a Planting Gun and Bullets; supposing one of these weapons fell into the hands of a child?

Signed: Mrs. Doogood.

Dear Madam:

I wish to point out that with the replacement of steam engines by diesel ones, this is no longer a problem. In reply to your other question, this gun will probably be more dangerous in the hands of a forester than of a child.

Signed: D. F.

FOR THE SAKE OF ARGUMENT

Whilst attending a C.I.F. meeting recently, I overheard an eminent professor of forestry at Toronto say that "the trouble with foresters is that they don't know *how* to grow trees." Well?