

CANADA  
Department of Northern Affairs and National Resources  
FORESTRY BRANCH



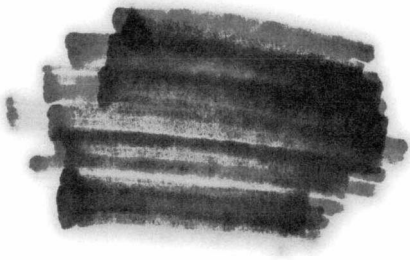
**AIR PHOTO OVERLAYS**

by  
W. U. Hardy

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**Forest Research Division**  
**Technical Note No. 46**  
**1956**



Published under the authority of  
The Minister of Northern Affairs and National Resources  
Ottawa, 1956

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# Air Photo Overlays

by

W. U. Hardy

## INTRODUCTION

Air photo overlays may be defined as transparent sheets provided with graduations or other markings for making measurements on air photographs. The purpose of this publication is to describe briefly some of the air photo overlays which have been developed by the Forest Inventories Section, Forest Research Division, and to indicate how copies may be obtained.

Two groups of overlays are described. The first group includes those which are of current application. The second group includes overlays which were developed for use with the original type of oblique photography developed in Canada (1), and those designed for use with forestry tri-camera photography (2). The former method of photography is no longer generally employed and the latter method has not yet come into common use.

Limited quantities of the overlays of Group 1 can be obtained from:

The Chief Cartographer,  
Map Compilation and Reproduction Division,  
Surveys and Mapping Branch,  
Department of Mines and Technical Surveys,  
Labelle Building,  
OTTAWA, Canada.

Orders should include the name and number of the overlay as shown hereunder. Prices depend on the size of the overlay and vary from 30 cents to 85 cents each.

The overlays of Group 2 are in many cases of considerable photogrammetric and research interest. Information regarding them may be secured from:

The Director,  
Forestry Branch,  
Department of Northern Affairs and National Resources,  
OTTAWA, Canada.

A publication has already been prepared describing certain overlays for use in the measurement of map areas (3).

## GROUP 1

*No. 20—Wedge Scale:* an overlay for determining tree heights by measuring tree images or shadows on air photographs. This scale, which was devised about 20 years ago, consists of two diverging lines approximately 12 inches in length. One of the lines is graduated in twentieths of an inch. The inter-linear separation increases by 1/1000th of an inch for each mark on the graduated line. The wedge scale may also be used to measure other detail on the photographs. (See Figure 1.)

*No. 21—Acre Scale:* an overlay for showing squares of one acre each on vertical air photographs of scales ranging from 600 to 1,600 feet to one inch (1:7,200 to 1:19,200).

*No. 39—Photo Co-ordinate Grid:* a grid divided into 1-inch squares graduated in tenths. When superimposed on a vertical air photograph it enables detail to be referenced to the principal point of the photograph by means of rectangular co-ordinates.

*No. 52—Pole Scale:* for the determination of tree heights by the direct measurement of images on vertical air photographs (4). This scale contains three rows of marks or poles suitable for measurements on air photographs taken from altitudes of 6,000 feet, 8,000 feet, and 10,000 feet, and applicable by conversion and interpolation to photographs taken at other altitudes. (See Figure 2.)

*No. 54—Shadow Pole Scale:* an overlay containing a series of pole groups, used for determining heights of trees directly from the lengths of their shadows. Each pole group represents 150 feet of tree height, based on a specific combination of sun's altitude and photo scale. (See Figure 3.) The numbers appearing under each pole group are shadow factors which express the relationship between shadow length and tree height. Shadow factors are usually determined by means of the Shadow Height Calculator (5).

*No. 86—Shadow Pole Scale:* similar to Overlay No. 54 but designed for shadow factors ranging from 1.0 to 2.4.

*No. 108—Master Scale Diagram:* a diagram from which distances in chains from 1 to 80 may be taken off directly at any scale between 330 feet per inch and 5,280 feet per inch in order to make up appropriate rules for use in measuring distances on air photographs or maps.

## GROUP 2

### Tree Height Grids

*No. 16:* for determining tree height by measuring tree images on oblique air photographs taken from an altitude of 5,000 feet at a depression angle of 20 degrees 37 minutes and a lens principal distance (focal length) of 8.16 inches. The grid contains parallel lines so spaced that the vertical distance between lines represents 100 feet of tree height. (See fold-out.) This Forestry Branch overlay was made in 1931 and the mathematical solutions developed for its construction have provided the basis for the preparation of all subsequent tree height grids, height-crown scales, and those pole scales which apply specifically to tree images in oblique air photographs.

*No. 17:* designed for oblique air photographs taken from an altitude of 10,000 feet at a depression angle of 40 degrees and a lens principal distance of 11.75 inches.

*No. 18:* designed for oblique air photographs taken from an altitude of 4,000 feet at a depression angle of 18 degrees and a lens principal distance of 8.16 inches.

*No. 19:* designed for oblique air photographs taken from an altitude of 6,000 feet at a depression angle of 40 degrees and a lens principal distance of 8.16 inches.

*No. 26:* designed for oblique air photographs taken from an altitude of 10,500 feet at a depression angle of 52 degrees and a lens principal distance of 12 inches.

*No. 31:* designed for oblique air photographs taken from an altitude of 7,000 feet at a depression angle of 57 degrees and a lens principal distance of 12 inches.

*No. 34:* designed for oblique air photographs taken from an altitude of 10,500 feet at a depression angle of 57 degrees and a lens principal distance of 12 inches.

*No. 37:* designed for oblique air photographs taken from an altitude of 8,000 feet at a depression angle of 54 degrees and a lens principal distance of 12 inches.

*No. 94:* similar to Overlay No. 37, except that it is designed for oblique air photographs taken from an altitude of 10,000 feet.

*No. 95:* similar to Overlay No. 37, except that it is designed for oblique air photographs taken from an altitude of 7,000 feet.

### **Perspective Grids**

*No. 36:* for the rectification of detail shown on oblique air photographs taken from an altitude of 8,000 feet at a depression angle of 54 degrees and a lens principal distance of 12 inches. Each subdivision represents a square on the ground covering 10 acres, the sides of which are 660 feet in length. Diagrams showing perspective grids (perspectograms) appear in standard texts on photogrammetry.

*No. 30:* designed for oblique air photographs taken from an altitude of 7,000 feet at a depression angle of 57 degrees and a lens principal distance of 12 inches.

*No. 33:* designed for oblique air photographs taken from an altitude of 10,500 feet at a depression angle of 57 degrees and a lens principal distance of 12 inches.

*No. 49:* designed for oblique air photographs taken from an altitude of 11,900 feet at a depression angle of 60 degrees 8 minutes and a lens principal distance of 14 inches.

*No. 50:* similar to Overlay No. 36, except that it is designed for oblique air photographs taken from an altitude of 7,000 feet.

*No. 58:* designed for oblique air photographs taken from an altitude of 9,680 feet at a depression angle of 60 degrees 8 minutes and a lens principal distance of 14 inches.

*No. 85:* designed for oblique air photographs taken from an altitude of 10,500 feet at a depression angle of 57 degrees and a lens principal distance of 12 inches.

## Pole Scales

*No. 42—Converging Pole Scale:* prepared as a substitute for Overlay No. 20 because of difficulty caused by the thickness of the lines of the latter and employing short lines or poles to parallel the object being measured rather than to base the measurements on the interlinear distance. (See Figure 4.)

*No. 53—Pole Scale:* an overlay containing poles representing 50 feet of tree height. The varying direction of the poles and their alignment with the tree images, which images are increasingly inclined as their distance from the principal line of the photograph increases, are illustrated by Figure 5. This scale is applicable to photographs taken from an altitude of 8,000 feet at a depression angle of 54 degrees and a lens principal distance of 12 inches. An advantage of this type of overlay is that the tree's image itself is measured instead of merely the vertical component thereof.

*No. 55—Pole Scale:* similar to Overlay No. 53 except that it is designed for oblique air photographs taken from an altitude of 7,000 feet, contains 10-foot poles in addition to 50-foot poles, and includes lines for the measurement of crown width as in Overlay No. 43. (See Figure 5.)

*No. 56—Shadow Pole Scale:* for determining tree heights by measuring tree shadows on oblique air photographs taken in a true north or south direction from an altitude of 8,000 feet at a depression angle of 54 degrees and a lens principal distance of 12 inches. The overlay contains short lines or poles of appropriate length for application at shadow azimuths ranging up to 30 degrees east or west of true north or true south and for shadow factors of from 6 to 10. This scale has been designed so that its scope in reference to shadow azimuths is doubled by turning it upside down.

*No. 80—Pole Scale:* similar to Overlay No. 53 except that it is designed for oblique air photographs taken at an altitude of 2,400 feet.

## Height Crown Scales

*No. 43:* developed from the corresponding tree height grid and applicable to photographs taken from an altitude of 8,000 feet at a depression angle of 54 degrees and a lens principal distance of 12 inches. The overlay contains 10-foot graduations of tree height, together with lines for the measurement of crown width.

*No. 47:* similar to Overlay No. 43 except that it is designed for oblique air photographs taken from an altitude of 7,000 feet.

*No. 51:* similar to Overlay No. 43 except that it is designed for oblique air photographs taken from an altitude of 11,900 feet at a depression angle of 60 degrees 8 minutes and a lens principal distance of 14 inches.

## Miscellaneous Photo Aids

*No. 69—Crown Width Scale:* an overlay for measuring crown widths on vertical air photographs at the scales of 200, 400, 583, 666, 800, 1,320, 1,600 and 2,640 feet to one inch. Crown widths up to 40 feet may be measured.

*No. 73:* an overlay resembling Nos. 20 and 42 but designed to measure objects placed in the gaps between two converging rows of lines. It has been constructed for a factor of 8 feet of tree height per hundredth of an inch of measurement.



## REFERENCES

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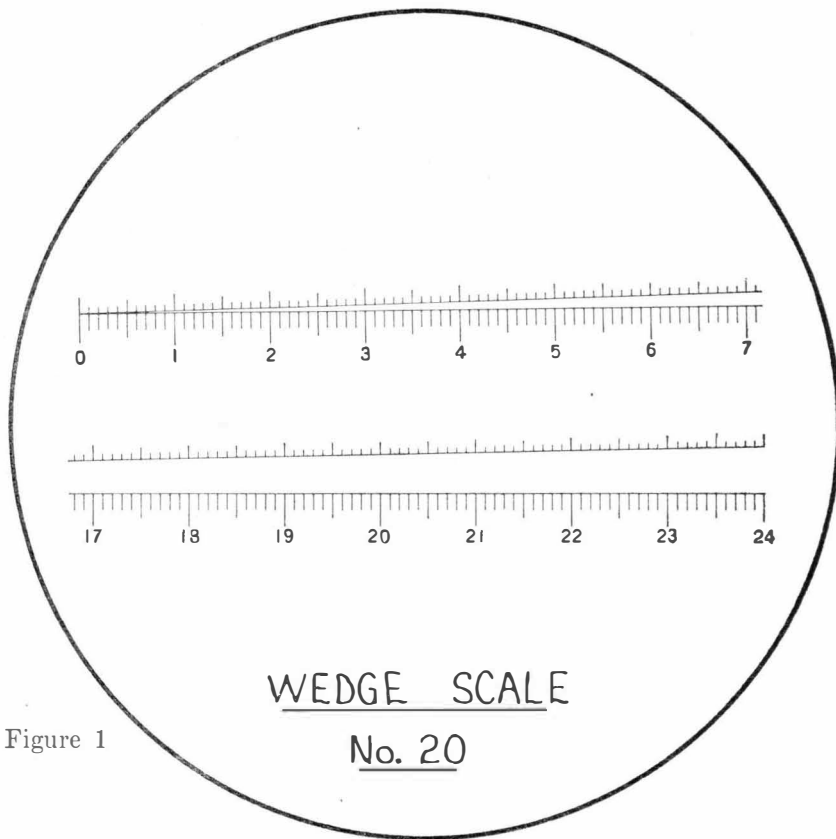


Figure 1

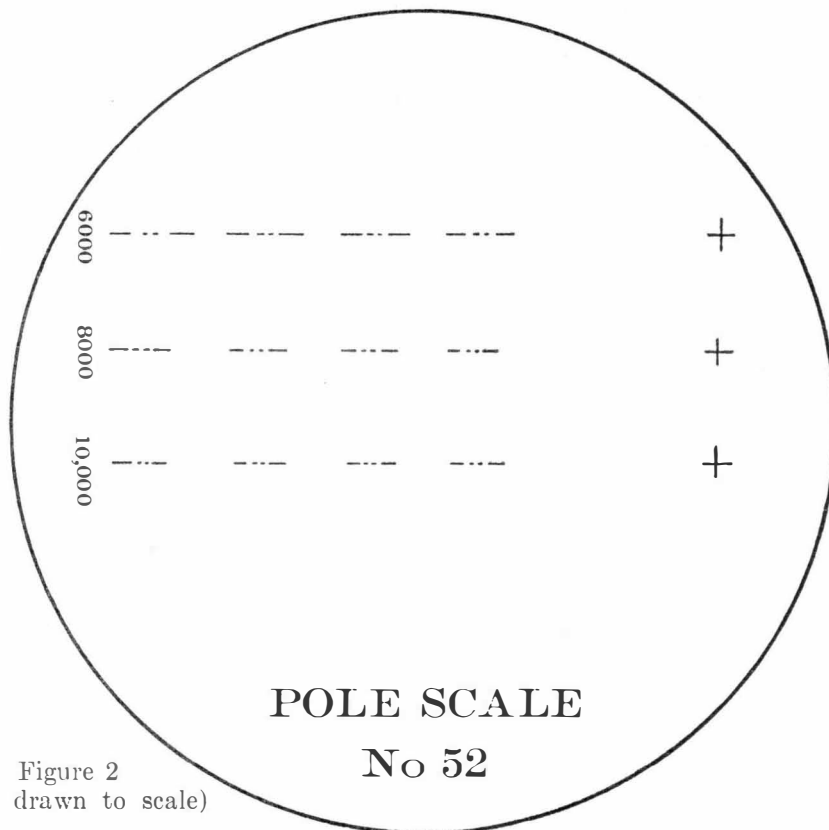


Figure 2  
(not drawn to scale)

# TREE HEIGHT GRID

Intervals represent 100 feet of tree height

Altitude 5000 feet Lens Principal Distance True Apparent	8.160 inches Horizon Horizon

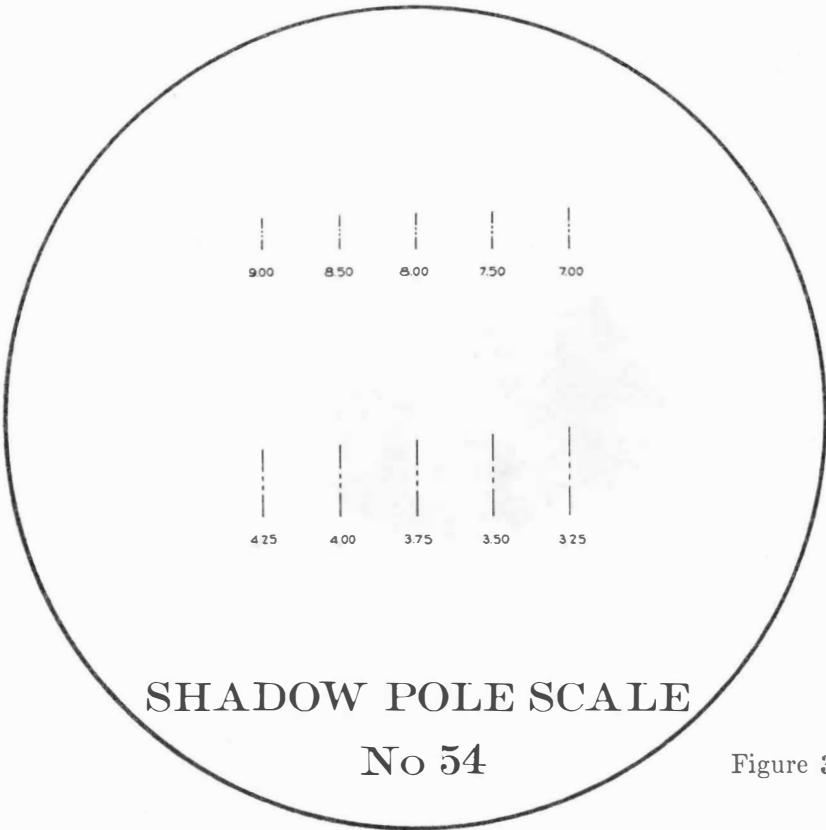


Figure 3

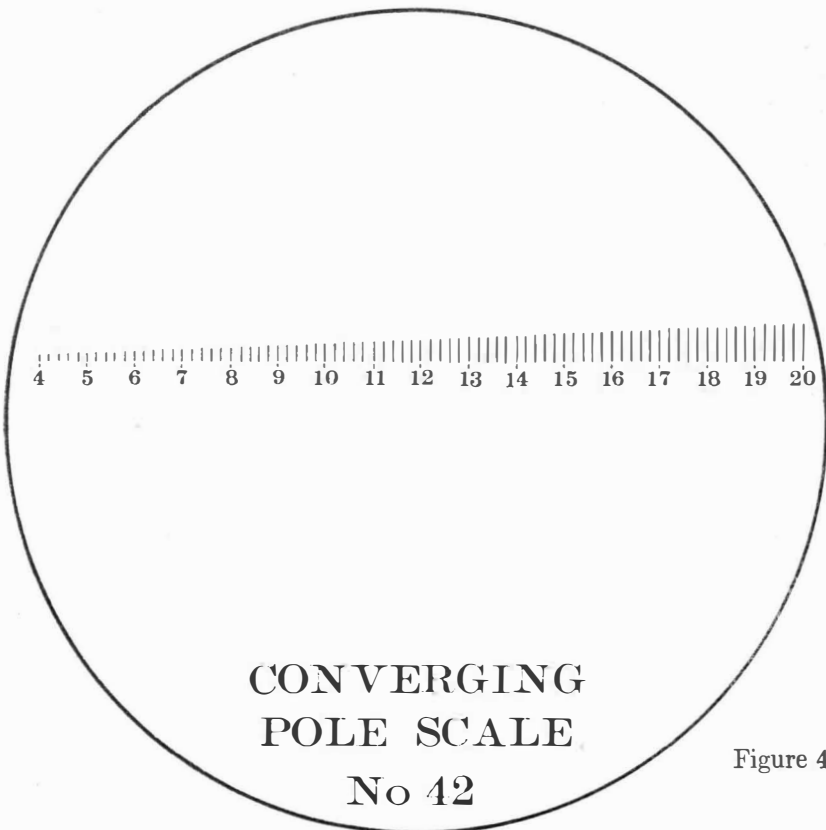
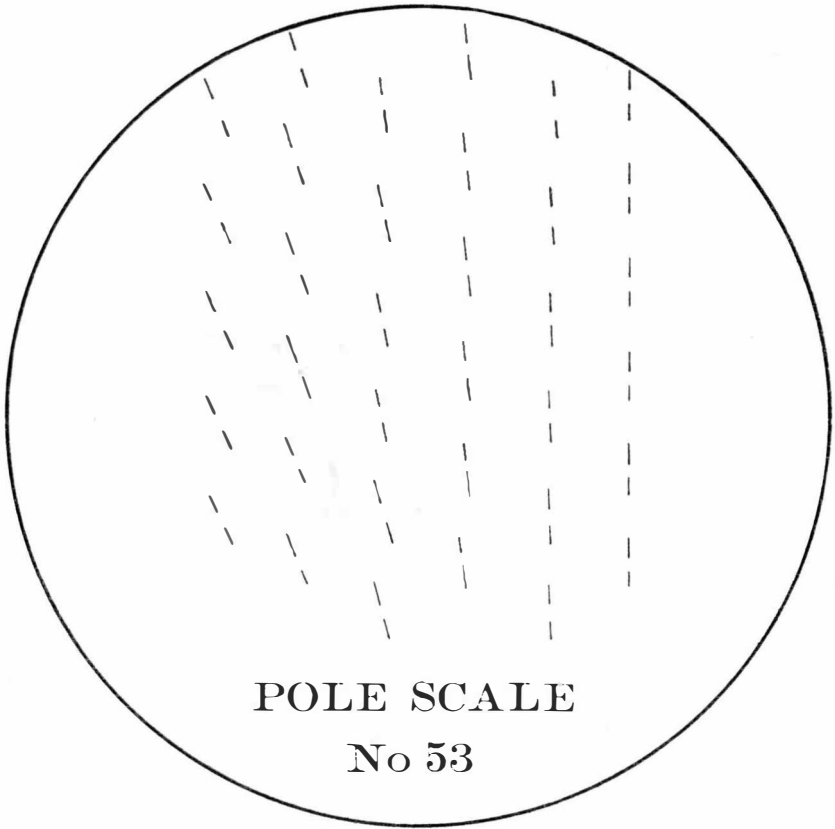


Figure 4



**POLE SCALE**  
**No 53**

Figure 5