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### BRIEF NOTE

## A SIMPLE DEVICE FOR MEASURING MICROTOPOGRAPHY IN ECOLOGICAL STUDIES<sup>1</sup>

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In many ecological studies the investigators have related topography to microclimate and plant distribution (Cowles 1901, Gleason 1926, Potzger 1939, Slorp 1977). Slope and aspect are two of the primary components of topography. The gradient of the slope directly effects the speed of runoff from precipitation and wind velocity. Steeper slopes generally are more eroded, have shallower soils, and are more xeric. Shallower slopes tend toward being more mesic (Daubenmire 1974). Aspect directly effects the incident radiation received by that slope and therefore also effects surface and air temperatures as well as wind speed and flow direction over the face of the slope (Kershaw and Larson 1974). Indirectly it effects the water budgets, metabolic processes (e.g. photosynthetic rates), and phenology of the resident plants (Cole 1977).

There are many studies of plant distribution which require a knowledge and description of microhabitat in order to explain species' distributions and patterning. For example, the distribution of

terricolous lichens in grassland communities is greatly influenced by light and microclimatic conditions (del Moral and Deardorff 1976). In lichen community studies, small areas are studied because lichens show optimum species-area relationships in  $\frac{1}{4}$  m<sup>2</sup> to 1 m<sup>2</sup> quadrats (Fovargue 1979). In areas of this small size, small changes in slope and aspect are an important factor of the microhabitat. In turn, changes in the microhabitat and the microclimate can effect both the photosynthetic and evapo-transpiration rates of lichens and other plants.

In such small areas it becomes impossible to measure slope gradient using of the conventional methods. Available instruments are not suitable for the needed measurements for descriptions of microtopography. A clinometer requires sighting on a distant object and then calculating the slope angle mathematically. This method ignores small rises and depressions on the face of the slope and just gives an overall view of the slope gradient. A Brunton compass combines both the compass and the sighting device, but for the most accurate results a sighting must be made on a distant object (use of trade name does not constitute endorse-

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ment of the product). It can be used for surface measurements with less accurate results. A pantometer (Pitty 1968) is a large adjustable frame and protractor designed to measure slope angle directly along a five foot line. Even when reduced in size to measure smaller areas, it is still a bulky and somewhat fragile structure to carry into the field. We have devised a small, portable, simple and accurate device to measure slope gradient and aspect in small areas.

#### DESCRIPTION AND DISCUSSION

The materials needed to construct our microangle/aspect device are: a Silva compass ('Polaris' model), a plastic protractor, a straightedge (e.g. a 35 cm wooden ruler), and a carpenter's level.

The instrument shown in figure 1 can be assembled for less than \$10 with the compass (about \$5) being the most expensive item.

The carpenter's level is cut diagonally across what will be the lower end so that, as it is moved to level the spirit bubble, it will not strike the ground. The protractor is fastened along its lower edge (on the 0°-180° line) to one side of the straightedge with a centrally located screw ( $\frac{1}{8}$ " x  $\frac{3}{4}$ ") and two small finishing nails, one at either end of the protractor. Three holes must be drilled in the plastic protractor (on the 0°-180° line) for the screw and nails. The central screw extends through the protractor, a washer ( $\frac{1}{4}$ "), and into the carpenter's level. The screw, then, serves to hold the three main parts together (fig. 1B, C, D) and

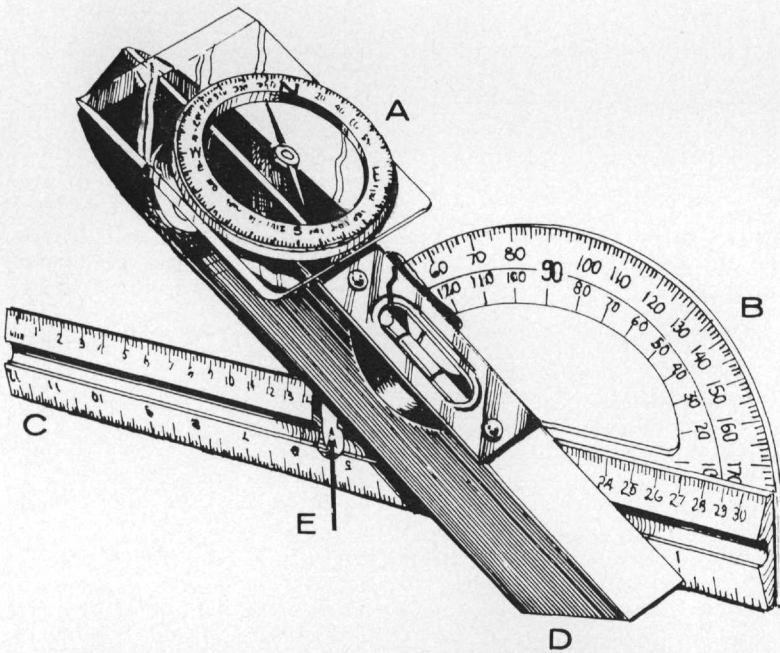


FIGURE 1. A portable device for describing angle of slope and aspect in studies of microtopography. The major components of this device are: (A) Silva compass, (B) protractor (plastic), (C) straightedge, (D) carpenter's level, and (E) notch. The Silva compass is attached to the top of the carpenter's level with two small screws ( $\frac{1}{8}$ " x  $\frac{1}{2}$ "). The protractor is attached to the ruler at the lower center of the protractor and carpenter's level with a screw ( $\frac{1}{8}$ " x  $\frac{3}{4}$ "); a washer ( $\frac{1}{4}$ ") is placed between the ruler and protractor. The level is now raised until the spirit bubble is between the marked lines (the level lines), and the angle of the slope is read from the protractor. A line painted on the side of the level next to the protractor, parallel to and level with the spirit bubble, allows an accurate reading to be obtained. Aspect is then determined by adjusting the compass dial so that the wide arrow is aligned with the compass needle while the spirit bubble is leveled.

as the pivot for moving the carpenter's level. A white sighting line extends the length of the level on the side next to the protractor and parallel to the lower edge at the height of the pivot screw which is on the 0°-180° line of the protractor. Since the protractor is fastened to the straightedge on the 0°-180° line, it is necessary to cut a notch (fig. 1) in the straightedge to read slopes of less than about 6°-8°. The compass is fastened to the top of the carpenter's level after another white sighting line has been painted on top of the level. This second sighting line is located parallel to both edges and drawn from the center spirit bubble to the top edge of the carpenter's level. The purpose of this line is to position the compass and for sighting during determination of aspect at the study site. In order to fasten the compass to the carpenter's level, two small holes are drilled in the plastic casing above the compass. The compass is then fastened to the carpenter's level with two small screws ( $\frac{1}{8}$ " x  $\frac{1}{2}$ ").

The first author (A.M.F.) used the device to correlate aspect and slope with lichen distribution in Adams County prairies (Fovargue 1979). The device was placed on the slope facing downward along the direction of the desired gradient. The carpenter's level was elevated until the "spirit bubble" stayed between the marked lines. The degree angle of the slope was read from the protractor at the sighting line on the side of the level. While the tool was held in a level position the compass dial was adjusted so that the wide arrow aligned with the compass needle. The degree of aspect was read along the top (second) sighting line. If a quadrat to be studied is multi-sloped, several readings can be taken quickly.

The microangle/aspect device is efficient in large scale ecological investiga-

tions for several reasons. Accurate measurements of slope gradient and aspect can be made with one light, small, simple, portable, and inexpensive device which can pick up deviations in gradient of just a few degrees. Because of its dimensions (13 cm x 35 cm) and 130 g weight it is small enough for field work, fitting into a small pack or a large pocket. Data collecting requires a minimum of time and effort as both readings can be taken in less than a minute.

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