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Letter to the Editor

MEASUREMENT OF TREES: A REJOINDER

Sir,

I appreciate your affording me the opportunity to clarify points raised by Mr McDonald (1971, this issue, pp 240-4) on my paper on sectional measurement of trees (*N.Z. Jl For. Sci. 1 (1):* 74-9). Your policy of encouraging discussion on papers is most welcome.

Mr McDonald is, of course, quite correct in identifying the misprint in line 4, page 75, but I understand you are noting this elsewhere [Corrigendum, p246]. He is correct, too, in observing the inappropriateness of my formula for interpolating diameters within a paraboloidal or neiloidal frustum with two positive, non-zero diameters. The formula used in my paper is correct, for cones, but for the other two curves only when the small-end diameter is zero, and not when frusta with small-end diameters greater than zero are being considered. I apologise for my error and am grateful to Mr McDonald for pointing it out.

Luckily, this error does not effect the important theses, that the greater the difference in end diameters, given any one small-end diameter, the greater is the difference between interpolated diameters among the three curves, and also the smaller becomes the percentage error as small-end diameter increases, for a given difference in end diameters. But, this need to assume a certain shape along any part of the tree stem in order to interpolate diameters may well be superseded by techniques such as those being developed in North America by, for example, Kozak *et al.* (1969) as explained in a previous paper (Whyte, 1971). Thus, it is much more important, with the methods of processing and analysing data now available, to have reliable, representative, and consistent measurements of diameter at known heights in a tree and to use least-squares regressions such as:

$$d = D \sqrt{b_0 + b_1(h/H) + b_2(h^2/H^2)}$$

to predict diameters at any chosen height (*see* Kozak *et al.*, 1969, p.280) in a given population of trees, where d is diameter inside (or outside) bark at any given height, h, above ground; D is diameter at breast height over bark; H is total height of tree and b_i are computed least-squares coefficients.

I am convinced that this approach is eminently more promising, as it dispenses with the need to make any assumption about the form between two heights on the

bole. It is this same need which led Grosenbaugh (1966, p.446) to conclude that, despite the vast amount of work done by many others, he had "pessimistic views on the possibility of achieving a simple analytic description of form".

Again, it is this same need which commends regulating drops in diameter rather than length, and collecting reliable measurements at representative points. There may be, to some extent, the disincentive, referred to by Mr McDonald, to economy of sampling within a tree, but this is likely to be more than offset, for reasons explained in my paper, by the economy effected in numbers of sample trees needed. What should influence our standards of determining total stem volume is the consistency in estimating the volume (it is only an index, anyway) of any one individual, necessary to make efficient use of techniques such as least-squares regression that are commonly employed in analysing and manipulating data, and necessary to permit the taking of sound decisions from the results so obtained.

It is this same regard for consistency of estimating that detracts from the utility of Newton's formula to compute volumes of frusta in that only two out of the three points of measurement in a frustum can be allocated freely; the third is fixed.

These aspects merely serve to underline Grosenbaugh's conclusions about traditional approaches to defining tree form, which he aptly summarises in a continuation of the previous quotation.

"Be that as it may, the last 15 years have seen revolutionary developments in instruments, in computers and in sampling, that encourage a fresh look at the problem."

Mr McDonald's last sentence and his fig. 2, by the way, misrepresent what is meant in my paper, as the differences cited refer to differences between estimates from any two curves, and not to differences in any one curve as he infers. This technicality is, of course, irrelevant for the modified results.

14 September 1971

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