THE MIDDLE-AGED MENSURATIONIST

By GEORGE W. THOMSON¹

*Youth is confident, middle age wary,
and old age confident again.*

*Martin Farquhar Tupper—Proverbial
Philosophy: Of Experience*

INTRODUCTION

Plagued by the question of the definition of forest mensuration and haunted by the probability that the teaching of forest mensuration in universities was missing *all* targets the author, with the considerable help of James Bamping, T. G. Honer, Charles Minor, A. L. VanSlyke and Kenneth Ware, sent out a questionnaire to the 225 members of the Forest Mensuration Group which had been formed as an interest group in 1961. This questionnaire solicited information on many facets of the teaching and practice of mensuration. Certain of the results of this study make up the body of this paper.

At the outset it is worth noting that the highest degrees earned by the respondents are distributed as follows: B.S. and Forest Engineer, 27; M.S. or M.F., 49; and Ph.D. or D.F., 35. While this is not a representative group of foresters in general it would appear to be a representative group of mensurationists. The average respondent to this questionnaire has been out of college since 1952 or, perhaps more significantly, earned his baccalaureate degree in 1946 and is therefore approximately 40 years old—thus the title of this paper, "Middle-Aged Mensurationist".

At any reasonable cosmopolitan meeting of foresters where a fair diversity of ages and occupations is present three opinions relative to mensuration are sure to be voiced.

Men in their fifties who graduated from forestry schools after six to ten years of fighting depression, constantly failing funds and a dubious future upon graduation might be heard to say, "Who let the danged statistician into mensuration? No one cares about correct *measurements* any more; all anyone worries about is sampling error."

At the other end of the spectrum in age, and often in background, is the young man just out of graduate school with his M.S. or possibly his Ph.D. earned, as often as not, in fewer years than it took his older counterpart to get his Bachelor's. His interest in mensuration, if he has any, will most likely be due to background work in computer science, econometrics, statistics or business administration. But being a truly thoughtful

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and coherent young man he might couch his view of mensuration as a respected acquaintance of mine recently did: "Forest mensuration involves the sampling of quantified variables (surfaces), the construction of quantitative models that satisfactorily simulate living or environmental surfaces, and the empirical extrapolation or prediction of population values at specified points in time based on these arbitrary surfaces. Its principles apply to any variable present in or related to a forest environment, but specialization is such that most mensurationists will specialize in one or two narrow fields."²

While the above badinage is going on the middle-aged mensurationist draws quietly on his pipe, volunteers nothing and considers himself surrounded by ill-trained oldsters and smart-alec kids. It is not until the later stillness of his hotel room that he faces up to the gnawing suspicion that he is far out of step and is in the untenable position of knowing he *should* be better informed but is unprepared to become so. Although such an axiom as, "Be not the first to reject the old nor the last to accept the new." has a comforting ring to it, it doesn't quite seem to balance out, "Procrastination is the art of keeping up with yesterday." The trouble lies not with obstinate hanging onto the old but in the downright pain of learning new and alien skills. How can he keep his place in the organizational pecking order when all he knows of cybernetics, data retrieval, topology and queue theory has been picked up from visiting his fourth grader's "New Math" teacher at P.T.A. meeting?

"Forty years on, growing older and older,—
What will it help you that once you were young?"

Harrow School Song

Although patently unfair to allocate the above opinions on the basis of calendar age it is probably a fair guess that opinions of about that degree of divergency would be expressed in Canada and the United States and that there has been a pronounced change of opinion relative to forest mensuration connected with time if not age.

SOME RESULTS OF THE STUDY

As opinions and attitudes toward the science of mensuration are first formed when a man is a student this paper attempts to evaluate three facets of the mensurational puzzle: What is the scope of mensuration? What is the goal of mensuration teaching? How can student attitudes toward mensuration instruction be improved? While these questions are education-based it is obvious that the implications are relevant to all professional foresters.

The Scope of Mensuration

Faced with increasing demands to measure forest-related commodities other than timber, mensurationists have become increasingly aware of possible

² Response by L. W. Grosenbaugh to the questionnaire on the teaching and practice of mensuration.

shortcomings in classic wood-oriented mensuration. To test the feelings of mensurationists on this matter, this question was asked: "Do you feel that mensuration instruction should, or could, be concerned with the measurement of *all* commodities and activities in the multiple use concept of forestry with each given emphasis more nearly equal to that usually given to timber, or is it best to deal primarily with timber?"

Inherent in the difficulty in answering such a question is the semantic one. After all, Forestry Terminology, the official glossary of the Society of American Foresters, states that forest mensuration is "a science dealing with the measurement of volume, growth, and development of individual trees and stands and the determination of various products obtainable from them". Yet the responses indicate that mensurationists themselves have either forgotten that this is the extent of the definition or have realized that any definition is temporal. To quote one biometrician: "Let mensuration deal exclusively with timber; statistical instruction takes care of commodities like recreation, range and watershed. The trouble is that 'mensuration' needs a sharp definition—the word means different things to different people." Another feels that: "Major emphasis should be on timber as a prime forest product. Other commodities might, and more logically, be assessed in other forestry courses, e.g., forest economics".

Other answers vary from the opinion that "wood" mensuration has enough unanswered parts to keep any one course filled, to the divergent opinion that the measurement of the timber is "relatively simple". Some see mensuration as timber oriented but a vehicle for indoctrination in all measurement. Another: "I am not aware of many especially useful techniques for measuring and evaluating many of the 'other uses of the forest'. Before much can be taught, there will have to be a more substantial back-log of knowledge and experience in these various (multiple use) lines."

Some avoid defining the breadth or proportional distribution of subject matter by saying, "The instruction should meet the basic mensurational needs of the forester in carrying out his responsibilities in the practice of his profession".

Many feel strongly that mensuration must be broadened. "Give all commodities more emphasis. Forestry and foresters must become broader or resign themselves to being a very small part of the land-use picture."

It is of interest to categorize the responses of the mensurationists answering this prickly question. Tabulation shows that 43 per cent favor exclusive involvement with the timber problem; 36 per cent would emphasize timber and use it as a base from which to provide illustrations of the measurement of other "commodities" while 21 per cent propose that we either teach measurement of all commodities or that we make a measurements course that is "involved with quantifiable variables" without describing the variables in physical terms.

It should be emphasized that the majority of responses indicated a recognition of need for mensurational techniques applicable to multiple-use problems.

It strikes the author that the apparent belief that a mensuration course could and should produce people capable of measuring campground use, evaporation-transpiration ratios, range condition and trend, marmot populations and tree growth and stand volumes might just as well be extended to measuring Gross National Product, iso-cost iso-revenue lines and the rate of decline of the Holy Roman Empire. We either substitute X_1 for the physical factor and become purely mathematical extrapolators or we partition our measurement problems in such a way that the specialist defines his objectives, scrutinizes his needs and develops his own body of technology of measurement. Thus we individually become timber mensurationists, range mensurationists, streamflow mensurationists or what have you. When the institution that hires a mensurationist decides on its major emphasis then perhaps *one* of these kinds of mensurationists teaches *that* kind of mensuration and illustrates the technique from *that* field primarily and thereby strives to show the mensuration of any kind of product. Obviously, the general field of statistics can be included or taught separately to develop the methodology of all forms of sampling. But to float awash in the ever changing sea of multi-management's mensurational musts can only lead to chaos, destruction of the craft and a most unsettling *mal-de-mer*.

The Goal of Mensuration Teaching

"What in your opinion, should be the major emphasis or the primary gain to a student, of a course in mensuration?"

It seems fair to state that the vast majority of respondents believe that mensuration course work should give the student the opportunity to learn to think quantitatively by teaching him basic principles with emphasis on "why" rather than "how".

While the essence of the conflict over what mensurationists are, or are to become, is imbedded in these answers it is almost impossible to say that these 111 respondents agree across the board on defining any one point of major emphasis for the student of mensuration. The answers have been quantified by listing the number of times a particular point has been identified as important by the respondents. A total of 163 items have been listed as of considerable importance in the education of the student. The distribution follows:

Item	Frequency of Listing
Relation of mensuration to all facets of management	22
Basic "principles" of measurement	22
Sampling and inventory	18
Process of quantitative thinking	17
Learn current techniques	15
Statistical inference and technique	15
Measurement of logs, trees, stands as to volume and growth	12
Analyze data properly	10
Present results properly	5
Collect data properly	4
Learn to use instruments properly	4
Apply mathematical (opposed to statistical) principles	4
Electronic data processing	3

<i>Item</i>	<i>Frequency of Listing</i>
Computational methods (non-EDP)	2
Problem definition	2
Develop new techniques	2
Operations Research	1
Learn to read technical literature	1
Miscellaneous	4

Obviously, there is much overlapping in many of these categories and certainly the answers given by the respondents have suffered in translation but perhaps the consensus is more evident than before.

As usual the individual quotations are more interesting than the raw summarizing of categorized response. (Why else do we add "art" to so many definitions of otherwise pedestrian skills?). From Japan: "Primarily, mensuration is a social tool, in broad meaning, according to my philosophy". From two graduate students: "Applied statistics with emphasis on sampling", and "Introduction to the theory of mensuration, and to as many techniques as possible, resulting, unfortunately, in proficiency in none." From a man concerned with world forestry: "To learn the methods and sufficient theoretical background so he can adapt himself and know how to get out of some of the unexpected situations life will give him." Two ways of stating the importance of mensuration to the forester: "To bring the student to a realization of the core position of measurements and sound mathematical estimates in all ramifications of forestry, that only in terms of measurements and derived values can management be carried out." Or: "No matter how perfectly one might be able to practice the art and science of silviculture to produce wood fiber, it isn't worth a **** if the same trees can't be adequately measured and analyzed as to volume, growth and mortality." And finally: "I suppose it all boils down to whether a course in mensuration should emphasize doing or thinking: personally, I would choose the latter every time. There are more than enough "doers" to go around."

Improving Student Attitude

In the minds of most teachers and students of mensuration there has been the impression that this is a course of considerable difficulty or even repugnance. Out of this impression the following question was framed: "What innovation or approach or teaching method do *you* think would stimulate student interest and activity in the field of mensuration or would reduce the distaste that so many have for mensuration class work?"

All through the answers to the questionnaire two opposing views developed: Mensuration teaching should be based on practical applications. And the obverse: mensuration teaching should be based on the mathematical, philosophical or theoretical challenges to the imagination. The responses were categorized as follows: Forty-six recommended practical application and example and personal involvement, often with student collection of data. Twelve recommended that the challenge of "why" and a theoretical approach to the problem are the best stimuli of interest. Fourteen felt that the problem of disinterest was due to poor mathematics background or aptitude of the students. Ten considered a reduction in tedious problem solving as the best way to improve the course work. Nine (mostly mensuration teachers) stated

that they did not find student distaste for the course-work. Twenty listed other miscellaneous items as being the cause of student antipathy to mensuration.

Obviously each person recalls certain objects of his disfavor or of his special interest such as wanting better tests, visual aids, better grade schools, programmed learning, more laboratories, fewer laboratories, more rigid direction, less rigid direction. But once one recognizes that foresters do generally consider that forest mensuration can be distasteful to a student, then there seemed to be five major ideas for the improvement of its teaching or learning. 1) Tie the information to practical (a variable concept) problems and activities. 2) Obtain student involvement and participation and personal identification with the mensurational problem illustrated. 3) Demand a better mathematical background of the student before he gets into mensuration course work. 4) Use the most enthusiastic, perceptive, up-to-date teachers. 5) Always be sure that the student understands why he is doing what he is told to do and where it fits into the rest of his forestry curriculum or practice. The Book of Proverbs has it this way: Wisdom is the principal thing: therefore get wisdom and, with all thy getting, get understanding.

The following seems to sum up a good share of the general feeling of many: "First of all, in my case, if hindsight could have been substituted for anemic foresight, I would not have had a distaste for mensuration class problems. I just didn't appreciate the importance of this course." And this from one of my own students!

Discussion

The author and compiler of a questionnaire has, for a brief moment, his eye to a keyhole on a secret world—the opinions, usually unspoken, of his colleagues. But he soon realizes that this is no world in microcosm and he turns away to inspect again his own ideas on the meaning of mensuration and the transfer of its tools from one generation to the next.

If we accept the premise that a forester must first do well technically, ethically and morally on his first job in order to be promoted to the second and that during these first jobs he must be intelligent in receiving instructions and disciplined yet imaginative in executing these instructions, we then have the ground work for defining needed mensurational concepts. If we recognize that his responsibilities will change from *doing* to *planning* in his second decade, then we must consider other concepts BUT I insist that the first is first and that natural growth placed on a good foundation is the best way to prepare a man for the second decade *rather* than to take the college boy, strip away all essence of practicality, and fill him with the esoteric and ambiguous. I do not think it wise to develop second rate philosophers from possibly first rate technicians. I am entirely convinced that the philosophy of quantification and the vagaries of the universe and the slipperiness of Truth are best learned in disciplined practical courses from a teacher who can illustrate that:

1. Data, x and y , come from Nature, not mathematics books nor tables of random numbers.
2. Data must be *collected, by man*, without willful or accidental *bias* so that Nature is portrayed *adequately*.
3. As Nature is *all*, we must learn what *part* we analyze so that that part may logically be expected to have bearing on our problem.
4. There is a "wisdom of the ages" that dictates certain techniques.
5. The biologic and economic laws of decrement from optimum, law of minimum, point of diminishing returns, etc. show up in mensuration in terms of models for expected response and that these take precedence over fortuitous curve fitting whether free hand or calculated.
6. Any prediction is for the unknown future and any measured response is bound around by errors in both controlled and uncontrolled variables that are thought causative or are unexpectedly causative.
7. The more variable is Nature in some characteristic the less sure we can be of predicted responses in the future or of "truth" at the moment.

Certainly there are two approaches to the training of mensurationists: one, the teaching of the how and why of measuring the rough merchantable product and two, the establishment of the statistical concepts of prediction, sampling, and analysis of variance, as being of paramount importance while letting the actual measurement be of secondary importance. Certainly our questionnaire drew forth the opinion that techniques were a bore and that theory was of much more importance. Yet it must be remembered that these were the answers of the mature professional looking back and he is a different breed from the uncommitted student looking forward with his "anemic foresight". It seems obvious that we must create in all foresters a willingness to evaluate or try to evaluate all commodities under their jurisdiction for the limitations of space, time and wealth demand that biologic effects (or, as in recreation, bio-socio effects) be broken down to their essential parts, quantified and, by subsequently learned techniques, manipulated. It is equally obvious that we must stimulate a new type of man to become a career forester—one who is as dedicated as his predecessors to the principle of wise land use, wise and imaginative in visualizing the problems inherent in government and industrial forestry and mathematically competent to truly quantify.

CONCLUSION

Let those of us with middle-aged minds be wary but unafraid when faced with the panic of new concepts. Sayn-Wittgenstein recommended that "we learn enough to laugh, loudly and confidently, when some one tries to mystify us with statistical, hocus-pocus." I am not so sure that I can do this because the world of one-up-manship has its own prestige to maintain. The great Newton admitted that he made "Mathematical Principles of Natural Philosophy" difficult and concise "to avoid being baited by little smatterers in mathematics."

It seems evident that each generation will find its own niche in an established profession and that niche will have gone unobserved or at least unaccepted by those who sought their own niche before. The connective thread that runs through all sincere developments in forest mensuration must

be anchored to the simple and forthright statement of Lord Kelvin: "When you can measure what you are talking about and express it in numbers, you know something about it . . .".

Epilogue

"Age may have one side, but assuredly Youth has the other.
There is nothing more certain than that both are right,
except perhaps that both are wrong."

R. L. Stevenson

Virginibus Puerisque

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of cellulose per acre and let someone else worry about harvesting and selling it.

I think we must learn to count all costs and balance these against all potential values. Rather than talking of crowding more trees on one acre we should become more aware of the many acres with few or no good trees and should try to get an optimum number of good trees onto them. We should try to create harvesting processes that are not linear but must live with, rather than ignore, their implications for many years to come. We should view timber production as the most important, but nevertheless just one, of many uses of forest land. The issues are complex; they deserve your attention and thoughtful consideration. In this issue our column "For the Sake of Argument" draws attention to the need to define objectives for timber production. Because the problems involved are so important, our new committee on forest policy could make a major contribution by helping to define our basic objectives.

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