INSIDE FOREST MENSURATION

By HAROLD E. YOUNG ¹

INTRODUCTION

Donald Bruce (1925) and F. X. Schumacher (1938), two of our most distinguished members, discussed forest mensuration as each saw it in 1925 and 1938. Much more recently Terry Honer and Leo Sayn-Wittgenstein (1963) and Terry Honer again at the Society of American Foresters' annual meeting (1963), certainly two of our most promising younger members, ably discussed the problems in forest mensuration pertaining to university training and research. What can there possibly be left for another paper on the same subject only a year later? In the parlance of university students my "major" for the past three years has been the Forest Mensuration Group and my "minor" has been mensuration itself. In addition during the past academic year it was my good fortune to have a sabbatical leave from my university and a Fulbright research grant in forest mensuration in Norway. In the absence of normal university responsibilities and in the magnificent scholarly environment provided by my host, Professor Hans Kristian Seip, in his Institute of Forest Inventory, Agriculture College of Norway, Vollebakk, Norway I was able to think leisurely about forest mensuration. My perspective was broadened by visits to forest schools and forest research institutes in seven European countries augmented by discussions with foresters representing as many more countries. This paper will be a distillation of these thoughts, visits and discussions for your consideration in the hope that they will be intellectually but not emotionally provocative.

DEFINITION

The time honored and widely used definition of forest mensuration is: that science concerned with the measurements and volume of standing trees and their cut products, of stands and forests and of the growth of trees, stands, and forests. With the rapidly increasing use of weight as the basic unit of measurement this definition should be amended by adding "and weight" after the word, volume. In recent years this concept of forest mensuration has been challenged as being too narrow. Some men have suggested that we consider expanding the definition to include all activities in the forest.

This does not appeal to me at all as it could result in empire building of the worst sort leading only to chaos and confusion. There is a simple solution that Bert Husch (1963) ably demonstrates in his new textbook. He devotes the first seven chapters to the principles of measurement and their application in linear, time, weight, area and volume measurements. If these are emphasized in the introductory portion of the mensuration course or taught in a short introductory course to all natural resources students then it becomes the basis for application in the various specialized fields as taught by the respective specialists.

¹ Professor, School of Forestry, University of Maine, Orono, Maine, U.S.A.

STATISTICS

Bruce's thesis was the urgent need for extensive use of modern statistical methods in forest mensuration in order to achieve scientific progress. Only 13 years later Schumacher was able to report "wholesome and rational growth". Twenty-six more years have passed and it is fitting that we again examine the use of statistics in forest mensuration. It is an understatement to say that it is widely used. Virtually every forest school requires it in some course taught within the school or as taught by the mathematics or statistics department. It is so widely used by research workers that a mensurational paper without statistical support is seldom seen. Many forest experiment stations around the world have added an individual or a group to provide statistical support to the research staff. All of this is highly commendable and in company with my predecessors I encourage the continued use of statistics.

There are several facets of statistics in forest mensuration that bear close scrutiny. Because of his fascination with statistics the professor of forest mensuration, in some instances, has become the unofficial statistical advisor to his colleagues and their students. This is flattering and stimulating but time consuming and thereby reduces regular mensurational work. The forest schools would do well to follow the leadership of the U.S. Forest Service research stations by obtaining the full time services of one or more biometricians. With most forest schools in the U.S.A. located at land grant universities that participate in state experiment stations this should be possible. The private schools in the U.S. and the Canadian schools would have to make separate arrangements. The statistical specialist at each school would fill the dual role of adviser on research and instructor of all statistical courses to be taught within the school.

Many writers have referred to the present as the age of specialization with the resulting problem of limited perspective. It seems to me that each of us should be a forester first and a mensurationist second even though all of our efforts are in the field of mensuration. It is my personal observation that some mensurationists have not only jumped completely from forestry to forest mensuration but also from there to statistics without so much as a glancing backward look. Increased statistical sophistication often yields greater accuracy, efficiency and reduced costs. However 14 decimal places in a high speed computer involving statistical manipulations may have no bearing whatsoever on such basic mensurational problems as the inherent limitations of the board foot, the cord and the cubic foot as measuring units or on the limits of present methods of volume and growth determination. For those whose hackles are rising I am making a plea for a balance between statistical sophistication and basic mensuration. Neither should be ignored and neither is sufficient unto itself. In an effort to warmly support the views of Bruce and Schumacher we have installed a high powered motor in a worn out old chassis.

LEADERSHIP

With seldom more than one mensurationist at a forest school, experiment station, government agency or private company leadership has been limited to published papers and textbooks. With annual mensuration meetings within

the CIF and the SAF it should be possible, by this direct contact, to establish more esprit de corps and to hope from this, dynamic leadership will evolve to replace frustrated silence and acceptance of status quo. This can simultaneously manifest itself in several directions.

Forestry is the only field that I know of that contains within it as a specialized area, mensuration. Should we as mensurationists agree in principle on any matter of importance of a professional and scientific nature *and make our views widely known* then we would be on the path of progress. This could be true with regard to early indoctrination of natural resources students with the principles of measurement if we feel strongly on this issue. It could be equally as true with regard to the establishment of a professor of forest biometry in each forest school. Yes, these and other changes that would effect mensuration can be brought about if we become sufficiently motivated to take group action.

In another direction we are faced with the limitations in accuracy and precision in the board foot and the cord, our two most commonly used basic units of measurement. The U.S. Forest Service has demonstrated leadership by tabulating the results of each state inventory in cubic feet with appropriate conversion factors for cords or board feet. Mensuration professors have compared and contrasted these units with cubic measurement for years but very little real progress has been made in reducing their importance in forestry. They could be reduced in importance or eliminated if we could agree on a course of action and then take such action.

Weight as a unit of measure has gained in importance as the amount of wood commercially used as chips has increased. Most of the development work in the use of weight for chips, round pulpwood and sawlogs has been by industrial foresters who are acutely aware of the inaccuracies of present scaling methods and the high cost of scaling, a service function. What is our position on weight as a basic unit and what are we doing to decrease the cost and simultaneously improve the accuracy of scaling?

Last April it was my pleasure to meet and confer with Professor dr. Michail Prodan of the University of Freiburg, Germany, one of the foremost mensurationists in Europe. He is currently completing the revision of his 1951 forest mensuration textbook so that it can be published in mid winter. He told me that he has been telling his students for some years that we will eventually use weight as the primary unit of measurement. Then with a twinkle in his eyes and by use of his hands he demonstrated that all thick mensuration books would become thin books when weight replaces volume. With this possibility facing us it would be definite leadership if we explored weight in a research sense now rather than ignoring the future while we continue with refinements of volume only to find out in the near future that we are well behind industrial use of weight as a basic unit of measurement.

Those who lecture and those who do research must provide leadership for their students, their professional audience and their immediate colleagues. There is an alarming tendency today to keep abreast of one's field while ignoring development in related fields. It is not unusual for mensuration professors to feel that their colleagues notion of mensuration crystallized with their graduate school experience — which may have been many years ago. When

Professor Schumacher first went to Duke University in 1937 Dean Korstian arranged for him to give his colleagues a series of evening lectures on statistics to acquaint them with what was considered a new field at that time. This created a good environment for the application of statistics to all types of forest research. Perhaps each type of organization having specialists should have meetings in which each of the specialists would acquaint his colleagues with the latest developments in his field. These sessions would not only be informative but would also be a means of bringing men together whose offices may be adjacent but who seldom see one another due to the pressure of work.

COMMUNICATIONS

Despite the rapid advances in the technology of communication the problem does not decrease because of the rapidly expanding professional population. In the entire world there may be as many as 1,000 people seriously concerned with mensuration. There may be 5,000 people in related areas of forestry concerned with mensurational development. In the entire world there are probably more than 100,000 professional foresters. As indicated in the section above we have not solved the problem of opening or broadening communication between men who work in adjacent offices or adjacent buildings. How do we solve the problem for the three groups listed above? First we must recognize that a problem exists. Second we must want to do something about it. Third we must take action to achieve our goals.

Worldwide communication problems occur in at least four general categories: language, space, time, and money. Forestry publications are now appearing in almost every language. To obtain them for any single library requires considerable money and then space to adequately house them. Lastly but not least both the professional man and the scientist need a reasonable amount of time to read papers of particular interest with the aid of dictionaries in most cases.

The word language immediately stirs the fires of national pride. As a general statement I suggest that all professional and scientific paper published in forestry should have the abstract in at least two other languages. English, French, and German are the most widely used languages in science with Russian growing rapidly in world wide importance. Therefore I further suggest that the abstracts should be in two of these four languages. The first draft of this paper was written in Norway and even at that time I could hear the anguished cries of cost and difficulty involved from all corners of the globe. This is established practice at International meetings. Each author knows this when he agrees to present a paper and so obtains the necessary translations. If this should become standard practice there would be a period of inconvenience and awkwardness involving translations; however, a routine would be established that could even result in a title, job description and grade for a special civil servant if such a category becomes necessary. Canada is to be commended for having so many papers with abstracts in both French and English. Extension of this to three abstracts would make it possible for more people to become directly aware of more scientific and professional studies and at the same time would make all of us more aware that other languages, other customs and other cultures exist in the world.

Forestry Abstracts, Agricultural Index, Bibliography of Agriculture and similar excellent publications render a great service. However, everybody who needs and wants these publications does not have access to them. Many who do undoubtedly fail to use them because of forgetfulness or the fact that they are in another building or in another part of the same building. Somehow we must arrange for such information to go directly to each person's desk. Such a project would involve financial problems but the results would be well worth surmounting the obstacles. Forestry Abstracts has agreed to make reprints of the forest mensuration section available from each issue at a reasonable price. My task now is to finance the project.

My recent trip to Europe made me acutely aware of the fact that it is not uncommon for many mensurationists to be completely ignorant of the work that has been accomplished in other countries and also completely unfamiliar with research work in progress in other countries. As a result there is a considerable amount of duplication of effort. Another good reason for rapid and frequent communication is the stimulation and guidance that can occur for one's own research efforts.

Let me illustrate this with an idea that occurred to me recently. While reading a recent paper by Van Soest of Holland I began to wonder about the accuracy of volume calculations by the various well known formulae. These have been compared with one another. However I wondered if they had ever been compared with the exact volume as obtained by displacement in water particularly if the bark free surface had been coated with paraffin or plastic. This would surely tell us the errors of our volume calculating formulae. Surely this must have been done many times in many places yet I cannot recall a single reference. If a literature search produces nothing and if no member of this audience or reader knows of any studies then it ought to be an interesting study for a graduate student. Even now I can see the completed study neatly printed in some Journal and someone reading it with disgust because *he knows* Professor Black n' White did the same thing back in 1885. Perhaps another six or eight will also know but why don't we all know?

It is not possible for me to discuss communications without commenting on the subdivision of the research dollar. Continual motion by the principal investigator seems to be of primary importance with a disproportionately low percentage allocated for equipment, instruments and technical assistance. These have been mentioned so often that they do not warrant more detailed discussion now. Germane to this discussion is the negligible percentage allotted to time for scholarly reading, funds for maintaining and improving the library and sufficient funds for *publication and mailing* to be certain that all interested people in the world receive a copy. It is distressing to me to hear scientists horrified at the idea of spending a thousand dollars for equipment or a hundred dollars for envelopes, stamps and reprints, for in the next breath these same men are apt to discuss research projects involving 50-100 thousand dollars. It is entirely possible that some 50,000 dollar research projects will not deserve 500 dollars for publication and distribution whereas some \$5,000 projects may easily warrant a like amount for publication and distribution. Of what possible value is any research project unless the finished report is available to the intended audience?

PERSPECTIVE

We are living in a world that not only changes constantly but at a constantly increasing rate — the second derivative of change, so to speak. If anyone had vividly described 30 years ago the harvesting and processing methods used today we would have known the man was crazy and insisted that he be locked up. There is every reason to believe that 30 years hence there will be even greater changes than in the past 30 years. Just as mathematics is the handmaiden of the science, the science of forest mensuration must always be the flexible quantitative tool of the forester. Therefore we can never afford to be behind any dynamic rapidly advancing segment of our profession. The principles of forest mensuration remain essentially the same over time but change and progress in the methods, techniques and instruments must be recognized — and all of this must be quickly available on a world-wide basis. As forest mensurationists we must be willing to support appropriate changes in mensuration so that the forestry profession can advance with modern civilization.

BIBLIOGRAPHY

1. BRUCE, D. 1925. Forest Mensuration Today. *Jour. of For.* 23:282-286.
2. HONER, T. G. 1963. Mathematics and Mensuration in the Forestry Curriculum Proceedings, Soc. of Amer. For. 1963:42-45.
3. HONER, T. G. and L. SAYN-WITTGENSTEIN. 1963. Report of the Committee on Forest Mensuration Problems. *Jour. of For.* 61:663-667.
4. SCHUMACHER, F. X. 1938. New Concepts in Forest Mensuration. *Jour. of For.* 36:847-849.