Some Early Developers of Statistical and Mensurational Techniques at the Southern Forest Experiment Station

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The early forestry research of the Southern Forest Experiment Station (SOFES) emphasized searching for, observing, and describing conditions as an approach to producing sound results. While this produced numerous and useful results and improved our understanding of forests and forestry, without a true application of replication and control, this approach could only take science so far. Unfortunately, it was virtually all that was available when the Station first opened. In 1921, most sampling, experimental design, statistics, and mensuration[1] techniques had not yet been developed for forestry.

Within a decade, this shortcoming started to be addressed. Over the years, there were many men and some women in the Station who helped advance the science of applied statistics and forest mensuration, not just regionally but nationally. In addition to their contributions towards advancing southern forest science, Station staff worked hard to make these complex concepts both simple and useful for practitioners. Note that the people featured in this paper—Chapman, Grosenbaugh, Mesavage, and Freese—are only some of the most prominent contributors.

ROY A. CHAPMAN

Roy A. Chapman was recruited as a temporary field assistant by the SOFES in 1926 and given a permanent appointment in 1929. Chapman graduated from the University of Minnesota in 1927 and worked for a while for the U.S. Department of Agriculture Forest Service in the Western United States and Minnesota. Chapman was always ready with a good story or an amusing comment. When he transferred to the SOFES in 1929, the temperature was -40 °F as he left the cruising camp in Minnesota. When he arrived in New Orleans, the temperature was 85 °F. Chapman was quoted (Wakeley and Barnett 2016) as saying he "nearly got up and took off his long underwear right in the dining car." Much of his early work with the SOFES related to silviculture, and Chapman proved to be a very independent but generously helpful man.

Roy Chapman was an early statistician and did much to improve the Southern Forest Experiment Station's research program.

[1] In forestry, mensuration is defined as the branch of mathematics dealing with the measurement of trees or stands, including their products (Helms 1998).

Chapman was a statistician and an intensely practical one. Philip C. Wakeley, a pioneering SOFES researcher in reforestation techniques, described Chapman's first several years on the staff as a strong and stimulating influence on mensuration techniques, experimental design, and analytical procedures. In 1931, Chapman was detailed to Washington, DC, to train under Francis X. Schumacher. The assignment lasted for a full 3 years. During that period, Chapman met and formed a friendship with R.A. (later Sir Ronald) Fisher, the father of modern statistics. Fisher's published works on statistics and experimental design did much to shape Chapman's own later career. Chapman returned to the SOFES when numerous new studies and projects were getting underway as a result of President Franklin Delano Roosevelt's Great Depression-era relief program. With enthusiasm, know-how, and personality, he incorporated sound statistical but practical procedures into this new research (Wakeley and Chapman 1937).

Chapman was never a prolific scientist, with only a limited number of SOFES publications over the years (and mostly as a junior author). But he did contribute on several fronts, including work on refining tree volume derivations and a statistical test (Chapman 1938a, 1938b). He also played an important role in developing studies and ensuring their proper analysis. Indeed, Wakeley considered Chapman to be the SOFES's real director for scientific work during this period. Wakeley believed that Chapman's work saved the Station's statistical reputation, making the SOFES one of the foremost in incorporating statistics on such a scale (Wakeley and Barnett 2016). Furthermore, Chapman's influence on forestry research was much broader than his work for the SOFES. For instance, a prominent book on statistics and sampling that arose from his earlier collaboration with Schumacher did much to bring forestry research into a new era of competence (Schumacher and Chapman 1942). By January 1948, Chapman had left the SOFES for a position in the Washington Office in Research's Division of Forest Economics (as a biometrician), where he would continue working on mensuration issues.

"Lew" Grosenbaugh was a very creative scientist and did much to simplify stand measurements.

LEWIS R. 'LEW' GROSENBAUGH

The assignment of Lew Grosenbaugh after World War II continued to make the SOFES a leader in this field. Grosenbaugh earned a degree from Dartmouth College in 1934 and received a master's degree in forestry from Yale University in 1936. He began work with the Ozark National Forest in Arkansas. In 1946, he was reassigned to the SOFES in New Orleans where he served as a silviculturist and a mensurationist before becoming the Station's chief of the Division of Forest Management Research between 1951 and 1960. In 1961, Grosenbaugh was transferred to head the Forest Service's first pioneering unit in mensuration reporting directly to the Deputy Chief of Research and Development. The first headquarters of the unit was at the University of California, School of Forestry with fiscal and clerical services provided by the Pacific Southwest Experiment Station (Grosenbaugh 1999); the unit was moved to Atlanta in 1968. Grosenbaugh retired in 1974 as chief mensurationist. Upon his retirement he moved to Gainesville, FL, where he became an adjunct professor of the University of Florida's School of Forest Resources and Conservation.

As a researcher, three of his major accomplishments include:

- Introducing Bitterlich point-sampling to the United States, which is a technique for measuring timber stands that eliminated the need for laboriously measuring and marking plot boundaries (Grosenbaugh 1952a)
- Publishing a revolutionary concept of determining volumes of standing trees by measuring the length of the bole between changes in diameter (Grosenbaugh 1954)
- Devising a system of tree measurement (3P sampling) which can multiply the efficiency of field foresters on such work threefold (Grosenbaugh 1955, 1958)

Grosenbaugh was so brilliant that most foresters had difficulty in understanding his new concepts and related technologies. His mind simply operated at a higher plane than most of his contemporaries. A common joke at forestry group meetings was "you cannot understand his forestry ideas until he had three beers" (Anon. 1959). Yet he constantly sought opportunities to aid those who lacked his acuity. A good example of this is his publication *Shortcuts for Cruisers and Scalers* (Grosenbaugh 1952b).

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Grosenbaugh also provided SOFES researchers with invaluable statistical support in the design and analysis of their studies. As mentioned earlier, the proper development of hypothesis tests, critical experiments, rigorous mensurational techniques, and appropriate consideration of the results using robust statistical designs was only a relatively recent development in science during the early years of the SOFES. The efforts of Chapman, Grosenbaugh, Freese, and other SOFES biometricians helped many researchers avoid poorly designed studies or inappropriate analyses and added considerable credibility to Forest Service research.

For his efforts, Grosenbaugh received many awards and recognitions over the years. While with the SOFES, he received the Superior Service Award of the U.S. Department of Agriculture in 1959 in recognition of his notable contributions in forest management and mensuration, and for excellent leadership in the conduct of forest management research. At a presentation in Grosenbaugh's honor in 1954, Philip A. Briegleb, President of the Society of American Foresters, said that

> *… his creative contributions to forest management are in daily use throughout the profession. The prestige of American forestry, at home and aboard, has been heightened by his accomplishments. In forest mensuration it would be difficult to name an individual whose work has had greater impact …* (Bell 2020b).

John Bell, a well-known biometrician, said of Grosenbaugh and several others highly regarded in this field, "If biometrics was a ladder Kim [Iles], Grosenbaugh and [George] Furnival would be standing on the top two rungs – then there are seven or eight empty rungs and the rest of us are scattered out all the way down" (Iles 2018). One of his former SOFES supervisors, Charles A. Connaughton, said of Grosenbaugh,

Along with Lew's ability to 'think ahead', he has almost limitless mental and physical energy. I'm concerned at times because Lew is spoken of only as a mensurationist. He's a well-rounded forester in field and office skills alike. In addition to the outstanding traits which I've described without many superlatives which are justified, Lew is a 'regular' fellow. He's liked by his associates and his company is sought after when the day is done, and relaxation takes the place of business. (Barnett 2016)

Clement Mesavage was a practical and innovative field forester, researcher, and administrator.

CLEMENT MESAVAGE

Clement Mesavage arrived in New Orleans in 1943 to work with Inman F. "Cap" Eldredge's Southern Forest Survey staff (Bragg 2023). World War II had led to a push by the Federal Government to improve upon its approach to the regional and national assessment of forest conditions and wood production (considered vital to the war effort). Mesavage worked on a series of major improvements to how the SOFES would design and conduct a new round of large-scale forest inventories across the South (Mesavage 1944). He was particularly well placed to contribute to these improvements, given his work on tree form since graduating in 1936 with a forestry degree from Penn State University. In the late 1930s and early 1940s, Mesavage worked with noted timber cruiser James Girard (who was then the Forest Service's Assistant Director of the national Forest Survey program) to formalize and publish Girard's approach to tree form class, which was a novel improvement on tree volume estimation (Mesavage 1947, Mesavage and Girard 1946).

Mesavage accepted an assignment to lead the forestry research program of the SOFES in the Ozarks of northern Arkansas in 1947. In the years he served in this capacity (he held this position in Harrison, AR, until 1962), Mesavage worked on several topics, some with more of a silviculture focus, and others with more of a mensuration angle. He worked closely during this period with Grosenbaugh to improve upon timber cruising and sampling, a critical need in the complex hardwood-dominated forests of the rugged Ozarks. Their collaboration produced a number of useful outcomes, including a paper on cruising forests (Mesavage and Grosenbaugh 1956) and the development of technology and techniques for better timber estimates (Mesavage 1967, 1969a, 1969b). For instance, his support (Mesavage 1966) of the work of Grosenbaugh on the development of 3P sampling was of considerable value and led Grosenbaugh to later call Mesavage one of the "foresters who grasped the potentialities and acted as exponents" of his pioneering mensuration (Grosenbaugh 1974: 5).

In 1963, Mesavage administratively moved (his duty station remained in Harrison) from leading the Ozark Branch Station to running the SOFES's new mensuration unit based out of Hot Springs, AR. This work had occurred under the forest management part of the SOFES for a number of years prior to this point, largely as a more informal collection of scientists (such as Mesavage, Grosenbaugh, and Freese) who were working on various quantitative aspects from growth and yield and measuring technology as well as other topics (such as silviculture). A reorganization structured the Station's research into "specialized project assignments," which included the mensuration of southern pines and hardwoods as a more discrete unit under the broader forest management research

project (Brieglab 1963). As such, the mensuration unit continued their work on developing quantitative tools and technology for forest managers. This suited Mesavage well. Although not a developer of sampling theory and methodology or advanced measuring techniques like Grosenbaugh, Mesavage helped both practicing foresters and forest researchers (Anon. 1970). Over his career, he developed or assisted in the development of methods and tools that made the implementation of quantitative silviculture easier and more reliable (e.g., Mesavage 1967, 1969a, 1969b).

Mesavage continued his work with the SOFES mensuration project until June of 1966, when he became a forester in the Division of Timber Management in the Forest Service's National Forest System. In this new job for the Washington Office (but still stationed in Arkansas), Mesavage continued to work on practical applications of mensurational techniques (especially for national forest managers) until his retirement from the agency in 1970.

FRANK FREESE, JR.

In a period when there were few foresters who had statistical training, Frank Freese, Jr. provided practical and simple publications that allowed foresters to use statistics in their research. A graduate of Yale University, Freese served as "a ground pounder" (infantryman) in World War II, and sweated through some tough campaigns, like the Battle of the Bulge. He emerged with a Silver Star, an ability to dig in frozen ground, and a practical approach to life (Bell 2020a). Freese was hired in 1954 to work in Grosenbaugh's forest management project in the SOFES. By 1958, Freese's position in the SOFES was as a biometrician under the station director's office. He remained there until 1962, when he moved to Hot Springs, AR, as a part of a new mensuration-focused unit. In 1966, Freese moved on to the Forest Service's Forest Products Laboratory in Madison, WI, where he spent the latter part of his career.

Frank Freese's publications did much to improve study design and analysis.

Like Chapman, Freese was not a prolific author. He did occasionally publish scientific articles while working for the SOFES (e.g., Freese 1960). More importantly, Freese wrote several short volumes that unraveled the complexity of statistics. The first, *A Guidebook for Statistical Transients* (and later updates and supplements, including Freese [1962, 1967]), was meant to teach the basics in a readable and simple style (Freese 1956). This publication became the text for researcher training sessions at the SOFES in the 1950s and 1960s. In an era when statistics and experimental design were rarely taught in forestry schools, Freese's books filled the gap. Not only did they convey in simple language the nature and use of statistics, they provided examples on how to conduct statistical analyses.

Compared to many largely unreadable (at least for non mathematicians) statistical texts, Freese's books are fondly remembered by those who used them. Indeed, the popularity of his original offering was reflected some 40 years later when *A Guidebook for Statistical Transients* was reprinted for everyone attending the 1997 Lake Tahoe meeting of a western mensuration group (Bell 2020a). Freese always had a modesty and genuine respect for people that came through in his writing. His books have been reprinted numerous times and are still commercially available.

OTHER QUANTITATIVE PEOPLE OF NOTE

In addition to these men, there were other noted mensurationists who passed through the SOFES on their way to further accomplishments. For instance, David Bruce ended up at the Pacific Northwest Experiment Station, but he started his career at the SOFES doing fire control work. He is the inventor of the wedge prism used in forest point sampling (Iles 2018). Another mensurational contributor, Thomas Eugene Avery, would eventually become well known for his books on forest measurements and aerial photography (Iles 2018), which have been updated many times (a revised version of his *Forest Measurements* is still in use today).

While the early years of the SOFES did not have any women mensurationists, various programs in the Station had numerous people who worked in supporting technical positions where they "crunched" the numbers. For example, according to the 1938 Forest Service Directory, the SOFES had as a part of the Forest Survey program a branch called "Mensuration, Computing and Tabulating" led by Philip R. Wheeler, with assistance from William S. Stover, Martha E. Nelson, Elmire A. Even, and Honora W. Cassens. At that time, the SOFES also employed Mary R. Craig and William G. O'Regan as "statistical clerks." Indeed, much of the work that SOFES scientists were able to complete and publish was *only* possible because of the unheralded contributions of many different people who worked behind the scenes.

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