Radiocarbon, Vol 64, Nr 3, 2022, p 501–506 DOI:10.1017/RDC.2021.65

MEYER RUBIN—A RADIOCARBON PIONEER

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Meyer Rubin (1924–2020). Photo courtesy of Harvey Belkin.

MEYER RUBIN'S RADIOCARBON LEGACY

Meyer Rubin (February 17, 1924–May 2, 2020) was a pioneer in the field of radiocarbon. In 1950, after serving in World War II, he began his career as a geologist at the United States Geological Survey (USGS). He joined the survey's radiocarbon laboratory on December 1, 1953, under Hans Suess (Suess 1954a). Suess constructed an acetylene gas ^{14}C beta-counting laboratory that extended the age limit of the Libby ^{14}C solid graphite method by several half-lives (Suess 1954b; Flint and Rubin 1955). After Suess left, Meyer became the director of the USGS lab. In 1956 he completed his PhD degree from the University of Chicago (Rubin 1956) and pursued his radiocarbon research at the USGS with great industry. By the end of the 1950s Meyer had reported ^{14}C results from 38 U.S. states, 26 countries around the world, the Atlantic Ocean, Antarctica, and the stratosphere (see references in Table 1). Meyer was also a seasoned field geologist, and during the 1950s alone, he collected samples from over a dozen states.

Meyer published date lists to provide a record of his efforts. These reveal a careful approach to analysis, with special attention to background measurements, error propagation (Rubin and Suess 1955), pretreatment methods, and $\delta^{13}C$ corrections (Rubin and Alexander 1958). In addition to the radiocarbon age results, each entry provided a description of the site, its geographic coordinates, collector and submitter names and affiliations, and the rationale for making the measurement. Comments on particular samples explained the significance of the result, often with citations. In the early 1960s, Meyer began to report calibrated ages, based on early tree-ring datasets.

Meyer's earliest radiocarbon applications followed the theme of his PhD dissertation, the timing of continental glaciation in North America (Rubin 1956). His radiocarbon dates

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Table 1 USGS date lists

I) Suess 1954a	IX) Ives et al. 1967
II) Rubin and Suess 1955	X) Marsters et al. 1969
III) Rubin and Suess 1956	XI) Sullivan et al. 1970
IV) Rubin and Alexander 1958	XII) Spiker et al. 1977
V) Rubin and Alexander 1960	XIII) Spiker et al. 1978
VI) Rubin and Berthold 1961	XIV) Kelley et al. 1978
VII) Ives et al. 1964	XV) Kelley et al. 1979
VIII) Levin et al. 1965	

paved the way for a refined understanding of glacial advances and retreats across the continent (Flint and Rubin 1955; Wright and Rubin 1956; Ruhe et al. 1957; Fries et al. 1961; Detterman et al. 1965; Frye et al. 1968). As time passed, this work evolved into a broader effort to understand paleoclimate, as manifest for example, in the history of Lake Bonneville (Scott et al. 1983; Spencer et al. 1984) or catastrophic floods across the Columbia River basalts in the northwest United States (Mullineaux et al. 1978). Meyer's dates allowed for quantitative sea level estimates through time (Redfield et al. 1962; Upson et al. 1964; Emery et al. 1965; Merrill et al. 1965; Schmoll et al. 1972), as well as changes in flora and fauna (Daniels et al. 1963; Repenning et al. 1964; Ray et al. 1970; Sirkin et al. 1977; Carrara et al. 1984, 1991). Radiocarbon chronologies of geomorphological and sedimentological changes in various settings completed the picture (Whitney et al. 1983; Reneau et al. 1986, 1989, 1990; Benson et al. 1995; Markewich et al. 1998).

A second theme of Meyer's research focused on dates of volcanic eruptions, essential to hazard mitigation. He began dating volcanoes early in his career (Rubin and Suess 1956). In collaboration with USGS scientists he would go on to date eruptions from Alaska, California, Colorado, Hawaii, Idaho, Montana, Oregon, Washington, and Wyoming (Rubin and Suess 1956; Rubin and Alexander 1960; Rubin and Berthold 1961; Levin et al. 1965; Ives et al. 1967; Marsters et al. 1969; Crandell et al. 1962; Hopson et al. 1962; Kuntz et al. 1986; Buchanan-Banks et al. 1989; Dzurisin et al. 1995). After decades of effort, Meyer produced an almanac with over 300 dates from the island of Hawaii (Rubin et al. 1987a). Further afield, Meyer's work included dates of eruptions from Taiwan (Ives et al. 1964); Japan (Stern et al. 1984); Iceland (Rubin and Berthold 1961); Italy (Lirer et al. 1991); Germany, Kenya (Rubin and Alexander 1960); the Azores (Moore and Rubin 1991); Java (Newhall et al. 2000); and Lake Nyos maar, Cameroon (Lockwood and Rubin 1989).

A paper Meyer co-authored in 1975 successfully predicted the imminent eruption of Mount St. Helens, WA (Crandell et al. 1975), which erupted five years later, on March 27, 1980. Meyer also contributed to a white-knuckle, short-turnaround international effort to mitigate hazards associated with the impending eruption of Mt. Pinatubo, Philippines, in 1991. He worked with USGS and Filipino volcanologists to provide geochronological data that facilitated a successful evacuation of a strategically important U.S. Air Force base (Clark Air Base) located on the flanks of the volcano. This effort no doubt saved lives.

Meyer participated in field trips to remote sites in Alaska for many years. After the devastating M 9.2 Great Alaska earthquake (March 27, 1964), work in Alaska focused on understanding

https://doi.org/10.1017/RDC.2021.65 Published online by Cambridge University Press

the cause of the disaster and assess risks of future earthquakes. Radiocarbon-based sea level estimates were used to determine sea level/uplift histories to identify large earthquakes in the past, and radiocarbon chronologies made it possible to determine their recurrences over long timescales (Plafker et al. 1978, 1992; Plafker and Rubin 1978).

Throughout his career, Meyer employed cutting-edge techniques. He adopted an acid-alkali-acid pretreatment method in the 1950s (for example: Solecki and Rubin 1958), and he made $\delta^{13}C$ corrections for specific samples (for example, sample W-350; Rubin and Alexander 1958). Meyer also made numerous age comparisons between diverse sample types, such as wood and shell (Rubin et al. 1963), and considered site-specific effects, such as the sample proximity to volcanic vents (Rubin et al. 1987b) and dates from large, oligotrophic lakes (Colman et al. 1996). He used ^{14}C as a geochemical tracer of industrial organic pollutants in water (Rosen and Rubin 1964, 1965; Spiker and Rubin 1975). He measured groundwater ages using both dissolved inorganic carbon in his counter lab (Thatcher et al. 1961; Hanshaw et al. 1965, 1967; Back et al. 1983) and dissolved organic carbon by accelerator mass spectrometry (AMS) (Purdy et al. 1992). Nearly thirty years into his career, Meyer began to make AMS measurements, first at the University of Rochester (Gove et al. 1980), and later at the University of Arizona, Lawrence Livermore National Laboratory, and Woods Hole Oceanographic Institution. He recognized the advantages of AMS and wasted no time in taking advantage of the technique.

Although Meyer's work at the USGS was focused on geology, he had a keen interest in archaeology as well, and he made his laboratory available for archaeological samples. He dated Native American sites in Arizona, California, Colorado, Maryland, New Mexico, New York, Columbia, Ecuador, Guatemala, and Mexico. He dated Jomon sites in Japan, and Neolithic to Paleolithic sites in Iraq, France, and Germany. These results are reported in the date lists (Table 1).

MEYER RUBIN THE PATERNAL BOSS

Meyer's management of the lab was decidedly paternal. He was a devoted father and husband, married to Mary Louise Tucker for 72 years (his high school sweetheart). His personality and boundless energy were infectious, both inside and outside the laboratory. Despite always having technicians to help him, he would don his lab coat every day, jump in to print out the results of the overnight runs, turn stopcocks, or give a sample "the business," his code for making sure it was handled efficiently and thoroughly. He would tell us jokes and sing old crooner songs as he worked, and in this easy-going fashion he coaxed us to spend the next several decades of our lives studying radiocarbon. At the same time, he taught us about life, because behind every anecdote he told was a lesson for our benefit. He was a master of parable.

No account of Meyer's career at the USGS would be complete without mention of his good friend Harvey Belkin. Meyer forged lifelong friendships with many colleagues at the USGS. Scientists who in their early career submitted samples to the lab in the '50s and '60s were familiar names to us in the '80s and '90s—Crandell, Miller, Schmoll, Plafker, Friedman, Hanshaw, Back, and Chao, to name a few. It was easy to work for decades on end with Meyer, he was more than a colleague, he was a friend.

https://doi.org/10.1017/RDC.2021.65 Published online by Cambridge University Press

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