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Source: Tree-Ring Research, 68(2):81-89. 2012.
Published By: Tree-Ring Society
DOI: http://dx.doi.org/10.3959/2012-5.1
URL: http://www.bioone.org/doi/full/10.3959/2012-5.1

TREE-RING RESEARCH, *Vol. 68(2), 2012, pp. 81–89*

HISTORICAL PERSPECTIVE

REFLECTIONS ON THE FOUNDATION, PERSISTENCE, AND GROWTH OF THE LABORATORY OF TREE-RING RESEARCH, CIRCA 1930–1960

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ABSTRACT

On the occasion of the 75th anniversary of the Laboratory of Tree-Ring Research, it is appropriate to reflect on the origin of the LTRR and the oft overlooked early period of its history. The period from the "Bridging the gap" event in 1929 to the semi-retirement of A.E. Douglass in 1958 was a crucial time in the development of the LTRR. Although this paper focuses on the history of the LTRR between those events, at points the history of the LTRR is, essentially, the history of the field, making a holistic understanding all the more important. The information presented here is rooted in a series of transcribed historical lectures delivered in 1992 and 1993 by Director/Professor Emeritus Bryant Bannister, and several historical reports composed by him between 1963 and 1998.

Keywords: history, dendrochronology, A.E. Douglass, Edmund Schulman, Terah Smiley, Emil Haury.

INTRODUCTION

The Laboratory of Tree-Ring Research (LTRR) at The University of Arizona was established by the Arizona Board of Regents on December 4, 1937: seventy-five years ago. On the occasion of the LTRR's 75th anniversary, the authors thought reflection might be cast on what was a dynamic time in the laboratory's history. Although several excellent histories exist for the field of dendrochronology as a whole or certain periods (*e.g.* Bannister 1963; Dean 1978; Baillie 1982; Nash 1999; Čufar 2007; Eckstein and Schweingruber 2009), for subfields or geographic regions (*e.g.* McGinnies 1963; Fritts 1976; Robinson 1976; Fletcher 1978; Robinson *et al.* 1990; Nash 2000a, 2003; Hughes 2002; Sass-Klaassen 2002; Towner 2002; Eckstein 2003; Billamboz 2004; Jansma 2006; Dean 2009), methodologies (*e.g.* Haury 1935; Douglass 1941; Studhalter 1956; Stokes and Smiley 1968; Ferguson 1970; Fritts and Swetnam 1989; Kromer 2009; Creasman 2011), or regarding prominent individuals or events (*e.g.* Glock 1934; Haury 1962; Webb 1983; Liese 1978; Bannister *et al.* 1998; Nash 1998, 2000b; Schweingruber 2009), related works discussing the core institutions, including the LTRR, are conspicuously absent. As the history of the field in the early years often paralleled the history of the LTRR, it is especially important to understand the people and events that shaped the LTRR, and thus the discipline.

In a series of recorded and transcribed lectures delivered by Bryant Bannister in 1992 and 1993, the history of the LTRR was divided into three eras: Foundational (1906–1929), Premodern (1930–1958/60), and Modern (1960-present). After the founding of the LTRR, there was a flurry of activity and excitement, with research programs being established in at least four other countries, and as many laboratories in the US (Dean 2009), but this growth was impeded by the onset of World War II (WWII). Not surprisingly, most of the European programs were shuttered, or nearly so. In the US, available resources were directed to the war effort, including research funds and even the researchers themselves. After the

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war, most practitioners or supporters of the discipline were engaged in other professions. This worldwide reduction in skilled dendrochronologists and places that might have employed them was a crucial blow to the field, imposing a "dendrochronological Dark Age" (Dean 2009). Fortunately, the LTRR was the only institution surviving as refuge for the field of dendrochronology, though severely hindered by staff and budget cuts. By 1960, the LTRR was reenergized and branched out into new directions, despite the untimely death of a critical figure, Edmund Schulman, in 1958. The 1960s brought recovery and healthy growth for the LTRR, primarily associated with dendroclimatology, but also saw the end of an era with the death of Douglass in 1962. The Modern era of the LTRR (post-1960) is best characterized by vast interdisciplinary links and geographic and temporal bloom, but is not discussed here.

The focal period of this manuscript, from "bridging the gap" in 1929 (Douglass 1929) to the "semi-retirement" of Douglass and death of Schulman in 1958, was crucial in the development of the LTRR (Bannister 1968). In discussing the activities of the LTRR, this Pre-modern era can be divided into two periods: Foundation and Growth (1930-WWII) and Persistence and Resurgence (World War II-1960), of which each will be subject to further exploration. Much of the text below is excerpted from Bannister's unpublished lectures and reports, placed in context and adjusted as best the authors can to reflect facts, precise dates, and names.

1930 TO WWII – FOUNDATION AND GROWTH OF THE LTRR

The foundation and growth of the LTRR between 1930 and WWII revolves around two significant early events: 1) "bridging the gap" in 1929 (see Douglass 1929), which excited a generation, set archaeological dendrochronology on firm scientific ground, increased demand for archaeological dating, and thus increased support and employment or training opportunities; 2) Douglass offered formal courses in dendrochronology, beginning in 1930. Through these formal courses and student assistantships or internships directly related to the course, Douglass communicated a method that was previously his exclusive purview. Through most of the 1930s and 1940s, Douglass was the gatekeeper of tree-ring time, as codified at the First Tree-Ring Conference (Glock 1934): "Dr. Douglass kindly consented to the requests of the assembled scientists that he take sufficient of his time to check all dates before they are published with finality." These events shaped the field many significant ways, perhaps none more so than through the dissemination of knowledge, training, and experience.

Although 1929 is the seminal year in the history of dendrochronology, it cannot be discussed without referencing the preceding decades, if only briefly. As brilliantly detailed by Nash (1999), "bridging the gap" on June 22, 1929, was a culmination of more than 25 years of effort by Douglass, and 15 years of collaboration between Douglass, numerous archaeologists and other scientists. As described by Robinson (1976), "bridging the gap" was a watershed event. More than 40 significant prehistoric sites and 1,200 years of history in the U.S. Southwest went from being relatively dated, to absolutely dated— the singular strength of dendrochronology was demonstrated. Tree-ring studies began at The University of Arizona in 1906, when astronomer A.E. Douglass joined the faculty as an Assistant Professor of Physics and Geography (later Professor of Astronomy, Dendrochronology, Geography and Physics; Founder and Director of the Steward Observatory and the LTRR; Interim University President, *etc.*), but bridging the gap and thus creating the first annually resolved continuous chronology into the prehistoric past represented a significant *beginning*.

It is critical to the history of the LTRR and field of dendrochronology that Douglass was employed by a university. In the spring semester of 1930, he taught the first ever course in dendrochronology: "Astronomy 211 – Tree Ring Interpretation"— and the course portended the immediate future. The class roster (see Nash 1999: 73) was a veritable "Who's Who" of important future figures in the field. By 1941, the course was amended to "Anthropology 160: Introduction to Dendrochronology" and although the department and number have changed, a course by the same name is taught in the LTRR today.

John C. McGregor, a student in the 1930 class, soon after went to the Museum of Northern Arizona (MNA) and founded a tree-ring operation under the auspices of Harold S. Colton. MNA was primarily an archaeological enterprise via which McGregor conducted many excavations near Flagstaff, Arizona. Importantly, MNA built a sizeable collection of tree-ring specimens from that area, primarily derived from archaeological sites. These materials were accessioned by the LTRR in 1950, as WWII aborted McGregor's career in dendrochronology. Later, he went to the University of Illinois-Urbana and fostered numerous students in archaeology/anthropology versed in the utility of tree-ring dating.

Also in the 1930 class was W. S. ''Sid'' Stallings, who, while employed at the Laboratory of Anthropology in Santa Fe, New Mexico, developed a dendrochronology division there. He collected specimens all over the Rio Grande Valley, built chronologies from living trees and old churches, and went through the same process that Douglass did with the Central Pueblo area. In an archaeological enterprise, Stallings built another tree-ring laboratory. Unfortunately, Stallings' tree-ring program too was arrested by WWII, not to be resumed, and the tree-ring collection was accessioned by the LTRR in 1950.

Florence M. Hawley (also known at times as F. Hawley Senter and F. Hawley Ellis) was another member of the first dendrochronology course. Soon after, she received her doctorate from the University of Chicago, based on materials from Chaco Canyon (Hawley 1934). During the late 1930s, she conducted extensive exploratory work in the Mississippi Valley (*e.g.* Hawley 1938, 1941), established the University of Chicago's dendrochronological program, and produced perhaps the initial second generation of doctoral students trained in dendrochronology—that is, those not mentored directly by Douglass or in Tucson (*i.e.* Robert E. Bell, Ph.D. conferred 1947 [see Dean 2006]). She later moved to the University of New Mexico where she taught dendrochronology and funneled graduate students to the LTRR. Lacking a successor, the Chicago dendrochronology program shuttered in the late 1940s and its specimens were rescued by Bell. Bell brought the materials with him to the University of Oklahoma, probably in 1947 or 1948, where he remained personally responsible for their care for nearly three decades. The combined Hawley/Bell collection was accessioned by the LTRR in the 1970s, on the eve of Bell's retirement.

Finally, Emil W. Haury, again a member of that class, was perhaps the most impactful. Haury worked with many pioneering Southwestern archaeologists and scientists, including A. V. Kidder, and as the assistant to Byron Cummings and Douglass. Perhaps Haury's best known contribution to dendroarchaeology was as one-half of the discoverers of HH-39 (''Hargrave and Haury'' 39 [Nash 1999; Haury 1962]): *the* specimen that bridged the gap. In 1930, Haury went to Globe, Arizona, and set up yet another tree-ring laboratory with the collaboration of Harold S. Gladwin, director of the Gila Pueblo Archaeological Foundation (Nash 1999)— who attended some of that first course. In 1937, Haury returned to Tucson as the Head of the then Department of Archaeology (which he changed to ''Anthropology'') and became Director of the Arizona State Museum (ASM) in 1938. His research established Hohokam and Mogollon chronologies and cemented his legacy. As a result, he was elected a member of the National Academy of Sciences in 1956. Around the same time, the dendrochronology branch he founded at Gila Pueblo ceased work. The tree-ring specimens there were ultimately accessioned by the LTRR in 1957, after a brief respite at California Institute of Technology. Haury directed the ASM until 1964, and supported the LTRR throughout his life (d. 1992). It was Haury's passion, manifested decades after his death, via the generosity of his widow Agnese Nelms Haury, which has made the LTRR's future brighter as the Bryant Bannister Tree-Ring Building will open in December 2012/January 2013 (see Anonymous 2012). The LTRR is in many ways indebted to Emil Haury.

The 1930s were not without controversy, however. Waldo Glock, initially a student of Douglass', began to criticize Douglass' skeleton plotting method, the bulk of which appeared in the 1950s. His critiques were primarily based on a perception that dendrochronologists, mostly Douglass at that time, did not sufficiently understand

tree biology or physiology, and thus, the entire concept of dendrochronology was impossible. Combined with Gladwin's insistence that dating become more quantitative and statistical, the criticisms were serious. Douglass did not directly respond to Gladwin's critiques—he allowed former students, such as McGregor, to fight that battle. Neither did he respond directly to Glock's criticisms (primarily addressed by Harold Fritts in the 1960s and 1970s; *e.g.* Fritts 1976), but subsequently published more detailed descriptions and photographs of ring series.

Another critical event in the 1930s was the founding of the Tree-Ring Society, and its flagship journal, the *Tree-Ring Bulletin* (now *Tree-Ring Research*). The Society and *Bulletin* were the result of the First Tree-Ring Conference held in Flagstaff, Arizona, June 11–12, 1934 (Glock 1934). A specialized publication outlet facilitated communication with other scholars, especially a growing group outside of Tucson. Indeed, some researchers (*e.g.* Harry Weakly and George Will) learned dendrochronology without taking Douglass' class and attempted to develop long chronologies for areas such as the Great Plains. Their 1930s-era articles in the *Tree-Ring Bulletin* documented efforts to expand the field beyond the semi-arid U.S. Southwest. The *Bulletin* provided an avenue for growth, a place for the exchange of scholarly ideas, and through the 1940s, reinforced Douglass' singular influence on the field: virtually all who published in it were his students or assistants at one time.

The above activity primarily occurred before the formal establishment of the LTRR in 1937. However, the LTRR had, in effect, carried out its educational and research mission as a unit since at least as early as 1923 with the First Beam Expedition (see Haury 1962; Nash 1999), and was referred to as the "Laboratory of Tree-Ring Research" at least as early as 1935, possibly as early as 1933. Prior to the LTRR's establishment as an independent department (initially, an autonomous department reporting directly to the President of the University), financial support for tree-ring studies was patched together from other campus units with vested interests in tree-ring research or direct affiliation with Douglass, not coincidentally Astronomy, Steward Observatory and to a lesser degree Archaeology/Anthropology. Funds for fieldwork, equipment and analysis came primarily from external sources, especially the Carnegie Institution of Washington and the National Geographic Society.

It is likely that the founding of LTRR in 1937 resulted from a confluence of opportunities. It was in the same year that two of Douglass' protégés, Haury and astronomer Edwin F. Carpenter, were hired in administrative positions in academic departments with which tree-ring research had long been affiliated. Haury was appointed head of the Department of Archaeology (later expanded and renamed Anthropology) and Director of ASM, while Carpenter was appointed head of the Department of Astronomy (1936/1937 academic year). Together, the three founded the LTRR: Douglass served as Director, while Carpenter assumed the same position at Steward Observatory, vacated by Douglass. Both Haury and Carpenter retained various directorial positions until after Douglass' death, at times playing critical roles in supporting and ensuring the LTRR's survival. The support of the ASM/Department of Anthropology and Steward Observatory/Astronomy was integral to the LTRR's early viability. It was not until 1939 that the LTRR had its first University budget: a modest $1,300 (equivalent to approximately $21,000 in 2012).

It was not until the founding of the LTRR that dendrochronology found a permanent physical space to call its own. When Douglass arrived in Tucson in 1906, his research was housed in the Science Building (later replaced by the Humanities Building), but was then transferred to Steward Observatory in 1916, where Douglass became the founding director. Delays in the construction of the Observatory's telescope building caused by WWI, and continued growth of both programs resulted in the tree-ring operations being moved at various times to the men's gymnasium (now Bear Down Gym) and to the baseball grandstand facility, located where the Main Library now stands. Ultimately, in 1936 the tree-ring program was transferred to "temporary" quarters in the West Stadium building. The LTRR remains in these quarters today, but within weeks of its 75th

anniversary late in 2012 it will move into a new, custom-built home.

After the bridging of the gap, overseeing growth of tree-ring research by way of several independent laboratories, and concurrent with the founding of the LTRR, Douglass pursued a passion for replicating dendroarchaeological successes in other parts of the world, specifically the Near East. His personal correspondence before WWII explores this prospect. The idea of being able to establish tree-ring dates especially for ancient Egyptian material was a very exciting, even romantic prospect. Douglass, while consulting with James Henry Breasted of the University of Chicago, the father of Egyptology in the US, and other prominent Egyptological institutions, developed a feasibility study of ancient Egyptian wooden sarcophagi. The initial study went well. Haury, while pursing his doctorate at Harvard University, even obtained several specimens from the Boston Museum of Fine Arts. Yet, before the specimens could be properly analyzed and substantial progress towards a chronology achieved, WWII intervened, and this prospect remains unrealized.

With so many resources, in funds, materials, and manpower dedicated to the war effort, the abandonment of the Egyptian project is representative of many such endeavors. Even after the war, demands in the workforce and on funds for peacetime recovery around the world reduced dendrochronology to only a few dedicated individuals and the LTRR (Dean 2009). The trend can perhaps best be demonstrated in the pages of the *Tree-Ring Bulletin*. Beginning in 1940, noticeably fewer manuscripts were being published annually and by a shrinking pool of contributors. From 1940 to 1949, 37 of 68 total manuscripts (54%) were contributed by Douglass (18) or Edmund Schulman (19), who became editor in 1939. The remaining manuscripts were contributed by an average of only two other people per year, virtually none of whom were publishing in the field/journal for the first time. Between 1942 and 1949, 24 of 30 issues contained only one (18 issues) or two (6 issues) manuscripts. Reflecting the state of the field and the LTRR, the journal did not rebound in volume or breadth of contributors until the 1960s, but the critical point is that both survived.

WWII TO 1960 – PERSISTENCE AND RESURGENCE OF THE LTRR

Among the casualties of WWII were the careers of many potential contributors to the field, especially those who would have been the second generation of dendrochronologists. The few scholars and students who remained, however, had ample experience in tree-ring dating, most with a decade or more by the end of the war. Virtually all members of the LTRR in the late 1940s were handpicked and supported by Douglass. The war reduced the LTRR to Douglass (who spent most of his time post-war involved in his sunspot or cycles research and did little new dendrochronology during the decade), Edmund Schulman, and Terah L. Smiley— each retaining one assistant, usually a student. Many of these assistants would go on in the 1960s to become faculty or research staff of the LTRR (*e.g.* Bryant Bannister [M.A. 1953; Ph.D. 1960, dissertation filed 1959], Thomas Harlan [M.A. 1962; after Schulman's death, revived his bristlecone pine research], Marvin Stokes [employed on the Navajo Land Claim project beginning 1953; M.S. 1965] assisted Smiley, and C. Wesley Ferguson Jr. [Ph.D. 1959] assisted Schulman). Yet, bridging the gap and related exercises were a pre-war endeavor; the new world that emerged was joined by new intellectual pursuits.

Dendrochronology at the LTRR in the 1950s is then the story of two men and their research programs: Schulman and Smiley. Their work and thus all new work at the LTRR could be divided into two camps: nonarchaeological and archaeological dating. Their energies combined with the foundation and growth of many funding entities that would support tree-ring research (*e.g.* National Science Foundation [est. 1950] and National Aeronautics and Space Administration [est. 1958]) resulted in an expansion of the applications of tree-ring research.

Terah Smiley came to the University in 1946 and pursued a master's degree in Anthropology chaired by Haury (conferred 1949). In lieu of continued doctoral studies, he served as Curator of Archaeological Collections in the LTRR until his appointment as Director of the Geochronology Laboratories in 1956 (Davis 1997). Shortly after,

with Douglass' semi-retirement (at age 91) and the death of Schulman both in 1958, Smiley was appointed Acting Director of the LTRR, a post he held until July 1960. It was during this time that the University faced a choice whether to assimilate the LTRR into another department or unit on campus, specifically Biology or Geochronology (which itself later merged with Geology to form Geosciences), or permit it to stand alone. Largely because of the vehement support of Emil Haury and Smiley's guidance, the LTRR remained independent.

Intimately engaged in dendroarchaeological analysis, Smiley is perhaps best known in the area of tree-ring research for his eighteen years invested in the Navajo Land Claim project (Stokes and Smiley 1963, 1969). It is also apparent that he had a skill for identifying, recruiting, grooming and supporting productive dendrochronologists, which may be his most enduring contribution to the LTRR (*e.g.* Bannister, Harlan, and Stokes in the late 1940s and early 1950s, and many others after, including mentoring current LTRR faculty in Katherine Hirschboeck). However, his primary interests were in the broader areas of radioactive, geologic and other dating methods (Stokes and Smiley 1968), which he was better able to pursue through the Geochronology Laboratories. After his stint as Acting Director, Smiley invested the majority of his time in the development of the Geochronology Laboratories/Geosciences and was less involved with the LTRR through the years, at least directly.

Schulman was very likely the first person in the world to be trained, employed and work full time in dendrochronology: the first professional dendrochronologist. His affiliation with the LTRR began in the early 1930s. He received a B.S. from the University of Arizona in 1933, was then made an assistant astronomer at the Steward Observatory by Douglass (while he pursued a M.S., awarded in 1935), and spent most of the next decade analyzing archaeological samples and refining a methodology for climatological analyses of tree-ring specimens (Schulman 1936, 1944, 1956; Straka 2008). Between 1935 and 1941 he divided his time between employment at the LTRR, pursuit of a master's degree in climatology (awarded by Harvard University in 1939), and a pair of fellowships at Harvard. During WWII, Schulman worked at Scripps Institute of Oceanography, where he researched Colorado River flows as the basis for his dissertation. His doctorate was awarded by Harvard University in 1945 in the field of geology (dissertation filed 1944). Thought by many to be Douglass' natural successor, Schulman was hired at the LTRR in 1945. As a Dendrochronologist (1941-d.), Assistant Professor (1945–1947) and Associate Professor (1947-d.), Schulman was free to pursue the work that interested him most: dendroclimatology (Anonymous 1958; McGraw 2007).

After WWII, Schulman was driven to locate long tree-ring records for climate analyses (Schulman 1954, 1958). The extant 3,200-year sequoia chronologies were deemed mediocre climate proxies, because of their semi-humid habitat (McGinnies 1963). Schulman's first trip to the White Mountains in California, home to the bristlecone pine grove that now bears his name, came in 1953. In less than two years 10 trees exceeding 3,000 years in age had been identified, include three more than 4,000 years old (Ferguson 1969). Schulman had his long record and made great use of what he had before his untimely death (8 January 1958) and in many ways after. The materials he identified and collected have been used to build the careers of numerous subsequent scholars and have been employed in innumerable research projects. A *National Geographic* manuscript published two months after his death touted bristlecone pines as the ''oldest known living thing'' and garnered worldwide attention for the trees, dendrochronology and the LTRR (Schulman 1958; Ferguson 1969).

Schulman's contributions to the LTRR in the post-war period were of paramount importance. Foremost, his approach to dendrochronology was systematic, meticulous, and quantitative—the hallmarks of quality work today. These traits were impressed upon the subsequent generation of dendrochronologists, apparently with great effect. As stated in his *magnum opus*, unfortunately his swan song (Schulman 1956), he took great care and responsibility for all data that he used, personally checking and crossdating every specimen. Considering the large volume of data that

was presented or analyzed in his later works — without the benefit of computers — the practice represented a substantial commitment to quality. Additionally, he conducted fieldwork every summer between 1938 and his death, without exception: another lasting trait still evidenced at the LTRR. Simply explained, Edmund Schulman is the father of dendroclimatology and dendrohydrology, but those in other subfields owe him much as well.

It was a gradual transition, culminating in the late 1950s and early 1960s, but dendrochronology was beginning to be regarded as a legitimate scientific enterprise. The NSF's support of bristlecone pine research, initiated by Schulman, was critical to the development and rebirth of the LTRR. The search for the oldest trees excited academe and the public alike. Critically, the bristlecone pine projects exposed tree-ring research to a broader scientific audience, the ''hard'' sciences and did more to add ''dendrochronology'' to the scientific lexicon than perhaps any other research program or result. Similarly, Smiley's Navajo Land Claim project and work in geochronologies exposed larger and more diverse groups to the ''real-world'' applications of such research. The continuation of the LTRR following WWII relied on these two people: Schulman and Smiley.

The possibilities and promise of dendrochronology as practiced by Schulman and Smiley inspired a third generation that was desperately needed. The war robbed the discipline of critical mass in the second generation. The second generation that never fully materialized was needed to continue the first generation's research programs, or develop new ones, and manage the laboratories founded during pre-war growth, but without successors, programs rapidly shuttered. By the conclusion of WWII, most of the first generation dendrochronologists that remained in academe had transitioned into administrative roles or other fields and taught few students. If not for the innovative research and effective recruitment by Schulman and Smiley, the LTRR likely would not have survived Schulman's death. Dendrochronology at the LTRR in the 1960s and beyond is then the legacy of the pair.

POST-1960 DIRECTORS OF THE LTRR

Though not within the primary scope of this manuscript, a list of directors post-1960 is included here in recognition of their guidance after the initial period of foundation and growth.

In August of 1960, William G. McGinnies assumed the role of Director as a new hire. He actively tended the position while a promising student in the Douglass line (Bannister, a longtime assistant to Douglass, formally advised by Haury and Smiley) completed his doctorate and conducted archaeological fieldwork. In four short years, McGinnies, who was highly regarded by the administration, consolidated support for the LTRR and placed it on stronger footing. By 1964 McGinnies was ready to pursue work more closely aligned with his own research interests in arid lands studies, so Bryant Bannister was appointed Director. From November of 1964 to 1982, Bannister guided the LTRR. Having met his goal of growing the LTRR to 10 faculty positions, Bannister retired and William J. Robinson directed the Laboratory for four years. Malcolm K. Hughes was hired in 1986 and led the LTRR through December 1999. Current Director Thomas W. Swetnam took the helm January 1, 2000. In addition, several members of the faculty have served as Interim Director during sabbaticals by the above, including Jeffrey S. Dean and Steven W. Leavitt.

ACKNOWLEDGMENTS

Such a brief recounting of some 30 years of history cannot, of course, acknowledge all of the people and events that made the LTRR what it is today. The authors hope that this paper might encourage a more comprehensive study of the period. The authors wish to acknowledge the following people for their contributions to and reflections on this work, or the unpublished Bannister lectures on which much is based: Rex Adams, Gregg Garfin, Henri Grissino-Mayer, Tom Harlan, Dave Meko, and Steve Nash.

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Received 12 May 2012; accepted 23 May 2012.