This paper was peer-reviewed for scientific content.
Pages 1029-1033. In: D.E. Stott, R.H. Mohtar and G.C. Steinhardt (eds). 2001. Sustaining the Global Farm. Selected papers from the 10th International Soil Conservation Organization Meeting held May 24-29, 1999 at Purdue University and the USDA-ARS National Soil Erosion Research Laboratory.

The Early Soil Survey: Engine for the Soil Conservation Movement

*Douglas Helms**

ABSTRACT

The National Cooperative Soil Survey, which dates to 1899, contributed significantly to the soil conservation movement on several levels. Individuals in the survey brought awareness to the need for soil conservation. Published soil surveys identified soil types that were susceptible to erosion, and the authors sometimes recommended remedies. The early soil scientists could identify soluble salts. This ability allowed users of the surveys either to avoid such soils, or be prepared to install drainage systems.

The soil survey also had direct links to the early twentieth-century conservation movement. While on the staff of the Bureau of Soils, William John McGee organized the landmark Conference of Governors on Conservation of Natural Resources, which met at the White House in 1908. McGee has been called the "chief theorist of the conservation movement". McGee and other Bureau of Soils staff wrote bulletins on various aspects of soil degradation.

One of the early soil surveyors, Hugh Hammond Bennett, earned the title, "father of soil conservation", because of his success in publicizing soil erosion and creating the Soil Conservation Service. Bennett's success, however, was not the genesis of soil conservation and soil survey connections. Rather, he had built upon an earlier awareness in the Bureau of Soils of how the soil survey might help conserve the nation's soils.

INTRODUCTION

Soil conservation and avoidance of land degradation are only two of the interpretations found in soil surveys. Our current knowledge of soils, their use, and the ability to advise land users arose from several historic developments. First, one had to be able to identify and describe significant soil characteristics, and to classify soil bodies (at least at the lowest level). Second, land users, soil scientists, and other researchers, through a combination of empirical observations as well as scientific research, had to learn the causes of soil degradation. Finally, they needed to develop recommendations or interpretations. One interpretation might be the recognition that some soils simply were not suited to particular uses. Often the interpretations involved a range of management recommendations. Interpretations needed to be related to a particular soil type. To utilize the recommendations, one needed to be able to identify the soil type on the map and on the landscape.

In the one-hundred-year history of the National Cooperative Soil Survey, soil scientists have mapped 96 percent of the Nation's private land, 77 percent of the Native American Land, and 81 percent of the public lands. Overall, about 91 percent of the total land area of the United States has been mapped, but 40 percent of the mapped areas need to be updated. The published soil surveys consist of maps, tables, and narrative information about soils--their uses, potentials, and limitations. This paper examines the relationship of the national soil survey program to the soil conservation movement.

Soluble salts: Land use and land degradation

Cooperators in the soil survey have selected 1899 as the year in which the soil survey effort began in earnest. In 1899, the Division of Soils (which had been established in the U. S. Department of Agriculture (USDA) as the Division of Agricultural Soils in 1894) sent soil surveyors to work in four locations--Cecil County, Maryland; the Connecticut Valley; the Salt Lake Valley of Utah; and the Pecos Valley of New Mexico. At that time, there was a great deal yet to be learned about soil and its response to management. The ability to map and classify soils and to measure characteristics had to grow simultaneously with the ability of scientists to make meaningful interpretations for land users. The identification of soluble salts in the soil and water of the western states was the most valuable interpretation provided by the early soil surveyors. The information could help guide development of irrigation projects. Under irrigation in dry climates, soluble salts accumulated and crusted on the surface, through capillary action and evaporation. Often the salts also became concentrated in a raised water table. Both conditions adversely affected plant growth, but could often be corrected with a drainage system that permitted adding water to flush the salts down through the soil profile into the drainage system. Identification of the potential problem called for added expense that needed to be calculated in the cost of opening land to agriculture. By the time the soil survey began, Eugene W. Hilgard of the University of California had described most of the processes leading to white and black alkali. His prescription for reclamation through a drainage system for leaching, augmented with the applications of gypsum for the black alkali, corrected many situations (Jenny, 1961). Lyman Briggs, soil physicist for the Division of Soils, and Thomas Means and Frank Gardner, early surveyors in the West, built on the work of Hilgard in developing methods to identify soluble salts.

Local residents or land agents sometimes voiced displeasure with surveys that pointed out the limitations of soils for particular uses. Milton Whitney, first head of the soil survey, sent Thomas H. Means and Frank D. Gardner to survey the Pecos River valley area in 1899 at the invitation

* Douglas Helms, Historian, Natural Resources Conservation Service, Washington, D.C., U.S.A. douglas.helms@usda.gov

of the local land developers (Means and Gardner, 1900.). The report suggested that with a drainage system for the alkali problem, farmers could raise alfalfa to support the livestock industry, but that a combination of soil, water, and climate made the area unsuited to vegetable and fruit crops. The Pecos Irrigation and Improvement Company, which was then advertising the Pecos Valley as truck crop and orchard land, requested and received an investigation by the Office of the Secretary of Agriculture into the Pecos Valley report. The report largely exonerated Whitney (Pecos Valley Controversy).

Some of the early U. S. Department of the Interior's Bureau of Reclamation projects suffered for lack of attention to soil issues, including alkali problems. Farmers on reclamation projects actually led the call for greater attention to soil on projects, when they testified to the Fact Finding Commission of 1923-1924 that repayments should be based in part on differences in soil productivity. The soil survey was a valuable tool in selecting Western lands for agriculture (Cannon, 1997; Pisani, 1984; Gardner, 1998, Lapham, 1949).

Identifying soil erosion phases and promoting soil conservation

The early USDA Bureau of Soils (the Division of Soils until 1901) furthered the awareness of soil erosion as a problem facing American agriculture. However, the Bureau was also active in the wider progressive conservation movement through W J (William John) McGee, one of the major scientific figures in the Federal government in the 19th and early 20th centuries. When W J McGee (his preferred signature) joined the Bureau of Soils in 1907, the chief of the Bureau of Soils, Milton Whitney placed him in charge of a unit on "Soil Erosion Investigations". The largely self-taught McGee was already a man of importance in the infant conservation movement, when he joined the Bureau. At various times he listed his occupations as geologist, ethnologist, anthropologist, and hydrologist (McGee Personnel File). Indeed he had justifiable claims to all of those titles.

John Wesley Powell hired McGee as a permanent employee of the U. S. Geological Survey in 1883, where he published the first generalized geologic map of the United States (Nelson, 1999). McGee followed Powell to the Bureau of American Ethnology in 1893 when Powell became director. McGee eventually published some thirty reports on native peoples from 1894 to 1903. He was then appointed to the Bureau of Soils following a stint as director of the St. Louis Public Museum (Shor, 1999). Whitney recommended McGee to the Secretary of Agriculture on March 22, 1907, for the "purpose of enabling the Bureau to take up the important study of soil erosion or wash, and sedimentation which has not hitherto been fully investigated for inability to obtain a man with the necessary training and attainments" (McGee Personnel File). Whitney also informed the Secretary that McGee had only recently been appointed by President Theodore Roosevelt to the Inland Waterways Commission, where he would be working with the Forest Service, with the Engineering Department of the Army, and with the Hydrographic Service of the Department of the Interior. The Bureau of Soils position afforded McGee an "opportunity to push these investigations with the assistance and advice from these other branches of the Government service, whose work is really dependent upon and made necessary to a large extent, by the erosion of the soil" (McGee Personnel File). His understanding of the interrelated nature of natural resources, and of resource issues, was advanced for the time. As a member of the waterways commission, he and a few compatriots pushed for a natural resources conference. The Lakes-to-the-Gulf Deep Waterways Association planned to call together a score or more of governors for a conference restricted to waterways improvement needs and water resources development. But McGee and his colleagues won President Theodore Roosevelt's pledge to call a Conference of Governors on Conservation of Natural Resources. McGee, while employed in the Bureau of Soils, and Gifford Pinchot, chief of the Forest Service, shaped the conference. Pinchot helped organize the conference held at the White House in May 1908, but recalled that it was McGee "who pulled the laboring oar" (Pinchot, 1987, page 346). The governors were allowed to speak briefly, but the substance of the published proceedings rested on the presentations by the experts in resources, whom McGee had selected. The governor's conference, along with the published volume of speeches, which called attention to the need for conservation, was a seminal event in the history of the conservation movement (McGee, 1909). Pinchot's assessment of McGee's status in the conservation movement was unqualified. "W J McGee was the scientific brains of the Conservation movement all through its early critical stages" (Pinchot, 1987, page 359). The historian Samuel Hays, who examined what he termed the "progressive conservation movement" spanning 1890-1920, concurred, calling McGee the "chief theorist of the conservation movement**" (**Hays, 1959, page 102).

McGee acquired his interest in and concern about erosion during his studies for the U. S. Geological Survey. While studying erosion as a geological process, he became an expert in human-induced, accelerated erosion. In studying Mississippi's coastal plain, he found soils "adapted to distinct crops and special modes of tillage …differently affected by old-field erosion, which has already wrought lamentable destruction in different portions of the coastal plain, and is progressing with ever-increasing rapidity" (McGee, 1892, page 106). McGee also produced a Bureau of Soils bulletin *Soil Erosion* that was the Bureau's most complete treatment of the issue at that point (McGee, 1911). During the later part of his career McGee studied ground water or what he called subsoil water. The bulletins that were published after his death correctly identified the need to view soils and water resources as a unit. McGee is not remembered for his Bureau of Soils ground water bulletins, mainly because they set forth theories of capillary action, hydrology, and water cycle and consumption that further scientific investigation has found wanting (McGee, 1913a, 1913b). Even so, McGee remains a central figure among Federal employees in the progressive conservation

movement.

McGee's prestige brought attention to the Bureau's role in soil conservation, but he by no means originated it. Young soil scientists in the Bureau were already expressing concern about the effects of soil erosion. Published soil surveys increasingly referred to soil erosion and the need for soil conservation (Gardner, 1998, page 70). The early soil surveyors had taken notice of soil erosion from the beginning of their work, both as a factor of soil classification and of soil management recommendations. They were developing what we now call the soil type, soil bodies that share significant soil properties. Soil surveyors began seeing separations based on erosion. Clarence W. Dorsey surveyed the area around Lancaster, Pennsylvania, in 1900, and described the Hagerstown clay. "These soils may be said to be the Hagerstown loam from which the top covering of loam has been removed, exposing the clay subsoil,..." (Dorsey, 1901, page 71-72). Jay A. Bonsteel, who surveyed St. Mary's County, Maryland, the same year, noted that cultivating slopes of Leonardtown loam resulted in "scalds or washes," which needed permanent sod (Bonsteel, 1901, page 129). Bonsteel, while jointly serving as Professor of Soil Investigations at Cornell University early in the century, examined the so-called worn out soils around Ithaca. Like Whitney and others of the period, Bonsteel was among the ranks of those questioning Justus Liebig's theory that repeated cropping diminished the available plant food in the topsoil. Bonsteel believed many farmers around Ithaca cultivated a subsoil far different from the topsoil cultivated by their ancestors. Topsoil lodged against stone fences at the foot of slopes provided the evidence. Reacting perhaps too strongly to Liebig's thesis, he maintained that erosion was "one of the agencies totally destroying the validity of the hypothesis of soil deterioration by removal of crops." Further, he cited the effects of wind erosion in the Northeast as a "greatly underestimated" factor in the alteration of the soil (Bonsteel, 1905, page 103).

In 1910, the surveyors began to identify "eroded" phases of established soil types (Gardner, 1998, page 58). As the soil survey matured, it adopted a nomenclature that grouped soil types into a soil series. The series combined a place name followed by a texture designation, as in Jordan sandy loam. The 1911 surveys of Fairfield County, South Carolina, identified a large area of "Rough Gullied Land" (Gardner, 1998, page 58).

Hugh Hammond Bennett, who had joined the survey in 1903, began to relate recommendations to particular soil types. For instance, concerning the Orangeburg sandy loam of Lauderdale County, Mississippi, he wrote, "If the gentler slopes are not terraced and the steep situations kept in timber, deep gorge-like gullies or 'caves' gradually encroach upon cultivated fields, eventually bringing about a topographic situation too broken for other than patch cultivation" (Bennett et. al., 1912). Bennett's *The Soils and Agriculture of the Southern States* highlighted erosion and advised that some soil types were unsuitable for cultivation or in need of conservation measures if used for agriculture (Bennett, 1921). Later, as head of the Soil Conservation Service, Bennett and colleagues used susceptibility to erosion as a key element in the land capability classification (Helms, 1997).

In time, Hugh Hammond Bennett, who had joined the Bureau fresh out of the University of North Carolina in 1903, became the most recognizable link of the soil conservation movement to the early Bureau of Soils. Rather than being a lone voice, Bennett was in fact among believers. Though not mentioning McGee specifically, Bennett made clear the importance of atmosphere in the Bureau of Soils, created in part by McGee. Bennett, a half-century after the event, recalled that it was Thomas Nelson Chamberlain's paper on "Soil Wastage" delivered at the governors' conference in 1908 that "fixed my determination to pursue that subject to some possible point of counteraction" (Bennett, 1959, page 13). Bennett did not say specifically that he attended the 1908 conference; more likely he read the published proceedings (McGee, 1909).

One of Bennett's college classmates, Royall Oscar Eugene Davis, a chemist in the Bureau of Soils, wrote bulletins titled, *Soil Erosion in the South* and *Economic Waste From Soil Erosion*, as well as a bulletin on a different type of soil degradation*, The Effect of Soluble Salts on the Physical Properties of Soils* (Davis, 1911, 1913, 1915).

While McGee's, Bennett's, and Davis' bulletins gave erosion by water preeminence as a conservation concern, E. E. Free produced a classic treatment of wind erosion in *The Movement of Soil Material by Wind* (Free, 1911).

Franklin Hiram King's pioneering work in soil management addressed soil conservation and maintenance in a broad sense, not just halting erosion. In 1894, before joining the Bureau of Soils, he had written a Wisconsin Agricultural Experiment Station bulletin on wind erosion and its control (King, 1894). King, who had specialized in soil management for productivity, left the Bureau over a dispute with Whitney. Whitney believed most soils had sufficient fertility for continuous and undiminished crop production, while King had demonstrated the value of soil amendments to increase production (Tanner and Simonson, 1993). Whitney added a disclaimer to one of King's Bureau of Soils bulletins and King had to publish some of his soil management bulletins privately after leaving the bureau (King, 1905). King nevertheless remained a very active, innovative soil scientist and earned a reputation as one of the pioneering soil physicists in the United States (Gardner, 1977, Tanner and Simonson, 1993). He studied his favorite topic, soil management, in China where he wrote *Farmers of Forty Centuries: Or, Permanent Agriculture in China, Korea, and Japan.* Decades later, the book so impressed disciple of organic farming Robert Rodale, that his Rodale Press reprinted the 1911 publication (King, 1911, 1973).

Expanding soil conservation research

The Bureau of Soils' ventured once again into soil erosion research in the late 1920s, and unleashed the energies of some staff interested in the topic. It is probably safe to conjecture that a change in leadership partially accounted for the reinvigorated interest in soil erosion. A.G. McCall replaced Whitney as chief of the Bureau in 1927, and remained in charge of soil investigations when the

bureau was merged into the Bureau of Chemistry and Soils with Henry G. Knight as chief. Understanding and measuring the properties related to erosion held great promise for devising soil conservation practices.

Working in the laboratory in the late 1920s, the Bureau of Chemistry and Soils' H.E. Middleton analyzed soils from various points around the country and made substantial progress toward understanding the complex chemical and physical properties and processes related to erodibility (Middleton, 1930; Middleton et. al., 1932). Simultaneously, Hugh Hammond Bennett was gradually moving his campaign for soil conservation beyond the confines of the soil survey division to educate the public and politicians through writing and speaking engagements. He had identified areas where the combination of geography and agricultural systems caused serious erosion. As a first step in attacking the problem, he wanted research on erosion conditions and conservation measures. Based largely on his campaign, Congress authorized a series of soil erosion experiment stations. Bennett selected the locations for experiment stations, where interdisciplinary teams of researchers established plots to measure erosion conditions, under different types of crops, soils, rotations, and various agricultural management practices and structures (Borst et. al., 1945; Browning et. al., 1948; Copley et. al., 1944; Daniel et. al, 1943; Hays et. al, 1949; Hill et. al., 1944; Horner, et. al, 1944; Musgrave and Norton, 1937; Pope et. al., 1946; Smith et. al, 1945). A few state experiment station staff members had carried out similar experiments, but the federal impetus led eventually to building up national level data on erodibility of soils.

The origin of the erodibility data that currently supports conservation planning tools such as the Universal Soil Loss Equation and the Revised Universal Soil Loss Equation stretches back to these pioneering studies (Lyles, 1985; Meyer and Moldenhauer, 1985). With the creation of the Soil Conservation Service in 1935, with Bennett as its first chief, the interpretation of soils for soil and water conservation was firmly established and accepted. But Bennett's success was not the genesis of soil conservation and soil survey connections. Rather, he had built upon an earlier awareness in the Bureau of Soils of ways the soil survey might help conserve the nation's soils.

ACKNOWLEDGEMENT

The author thanks Faye Helms Griffin of Simpsonville, South Carolina and Patricia Durana, Natural Resources Manager, Natural Resources Conservation Service, Washington, DC, for their comments.

REFERENCES

Borst, H., A. G. McCall and F. G. Bell. 1945. Investigations in erosion control and the reclamation of eroded land and the Northwest Appalachian conservation experiment station, Zanesville, Ohio. USDA Tech. Bull. No. 888.

Bennett, H. et al. 1912. Soil survey of Lauderdale County, Mississippi. p. 733-784. *In* Field operations of the Bureau of Soils, 1910. U.S. Gov. Print. Office, Washington, DC.

Bennett, H.H. 1921. The soils and agriculture of the southern states. The MacMillan Company, New York.

Bennett, H.H. 1959. The Hugh Bennett lectures. The Agricultural Foundation, Inc., North Carolina State College, Raleigh, NC.

Bonsteel, J.A. 1901. Soil survey of St. Mary County, MD. p. 125-145. *In* Field operations of the Division of Soils, 1900. U.S. Gov. Print. Office, Washington, DC.

Bonsteel, J.A. 1905. Worn out soils. Bur. of Farmers' Institutes and Normal Institutes. Report for the Year 1904. Brandow Printing Company, Albany, NY.

Browning, G. M., R.A. Norton and A.G. McCall. 1948. Investigation in erosion control and the reclamation of eroded land at the Missouri Valley loess conservation experiment station, Clarinda Iowa, 1931. USDA Tech. Bull. No. 959.

Cannon, B.Q. 1997. "We are now entering a new era": federal reclamation and the fact finding commission of 1923-124. Pacific Historical Review. 66: 185-211.

Copley, T.L., L. Forrest, A.G. McCall, et al. 1944. Investigation in erosion control and reclamation of eroded land at the central piedmont conservation experiment control station, Statesville, NC 1930-1940. USDA Tech. Bull. No. 873.

Daniel, H., H. Elwell and M. Cox. 1943. Investigations in erosion control and reclamation of eroded land at the Red Plains conservation experiment station Guthrie, Oklahoma 1930-40. USDA Tech. Bull. No. 837.

Davis, R.O.E. 1911. The effect of soluble salts on the physical properties of soils. U.S. Gov. Print. Office, Washington, DC.

Davis, R.O.E. 1913. "Economic waste from soil erosion." Yearbook of Agriculture, 1913. U.S. Gov. Print. Office, Washington, DC.

Davis, R.O.E. 1915. Soil erosion in the south. USDA Bureau of Soils Bulletin No. 180. U.S. Gov. Print. Office, Washington, DC.

Dorsey, C.W. 1901. A soil survey around Lancaster, PA. *In* Field operations of the Division Of Soils, 1900. U.S. Gov. Print. Office, Washington, DC. P. 61-84.

Free, E. E. 1911. The movement of soil material by the wind. Bur. of Soils Bull. No. 68. U.S. Gov. Print. Offices, Washington, DC.

Gardner, D.R. 1998. The National Cooperative Soil Survey of the United States. Historical Notes Number 7. Natural Resources Conservation Service, Washington, DC.

Gardner, W.H. 1977. Historical highlights in American soil physics, 1776-1976. Soil Sci. Soc. of America J. 41:221-229.

Hays, S.P. 1959. Conservation and the gospel of efficiency: the progressive conservation movement, 1890-1920. Harvard Univ. Press, Cambridge, MA.

Helms, D. 1997. Land capability classification: The U. S. experience. p. 159-176.*In* Dan H. Yaalon and S. Berkowicz (editors) History of soil science:international perspectives. advances in geoecology 29. Catena Verlag, Reiskirchen, Germany.

Hill, H.O., W.J. Peevy, A.G. McCall and F.G. Bell. 1944. Investigations in erosion control and the reclamation of eroded land at the Palouse conservation experiment station, Pullman, Washington, 1931-42. USDA Tech. Bull. No. 859.

Horner, G., A.G. McCall and F.G. Bell. 1944. Investigations in erosion control and reclamation of eroded land at the Central Piedmont Conservation Experiment Station Statesville, NC, 1930-40. USDA Tech. Bull. No. 860.

Jenny, H. 1961. E. W. Hilgard and the birth of soil science. Collana Della Rivista "Agrochimica," Pisa, Italy

King, F.H. 1894. Destructive effects of wind on sandy soils and light sandy loams: with methods of protection. Wisconsin Agr. Exp. Sta. Bull. No. 42. Univ. of Wisconsin, Madison.

King, F.H. 1905. Investigations in soil management. Bur. of Soils Bull. No. 26. U.S. Gov. Print. Office, Washington, DC.

King, F.H. 1911. Farmers of forty centuries; or, permanent agriculture in China, Korea and Japan. Mrs. F. H. King, Madison, Wisconsin

King, F.H. 1973. Farmers of forty centuries; or, permanent agriculture in China, Korea and Japan. Rodale Press, Emmaus, Pennsylvania.

Lapham, M.H. 1949. Crisscross Trails: Narrative of a Soil Surveyor. Willis E. Berg, Berkeley, CA.

Lyles, L. 1985. Predicting and controlling wind erosion. Agricultural History 59: 205-214.

McGee, W.J. (William John). 1892. Report of Mr. W J McGee. *In* Thirteenth annual report of the U. S. Geological Survey to the Secretary of the Interior. 1891-1892. Part 1. U.S. Gov. Print. Office, Washington, DC.

McGee, W.J. (William John). 1909. Proceedings of a conference of governors in the White House, Washington, D. C., May 13-15,1908. U.S. Gov. Print. Office, Washington, DC.

McGee, W.J. (William John). 1911. Soil erosion. USDA Bur. of Soils Bull. No. 71. U.S. Gov. Print. Office, Washington, DC.

McGee, W.J. (William John). 1913a. Wells and subsoil water. Bur. of Soils Bull. No. 92. U.S. Gov. Print. Office, Washington, DC.

McGee, W.J. (William John). 1913b. Field records relating to subsoil water. Bur. of Soils Bull. No. 93. U.S. Gov. Print. Office, Washington, DC.

McGee Personnel File. W J McGee Personnel File, Selected Personnel Files, Records of the Office of the Secretary of Agriculture, RG 16, NA, College Park,Maryland.

Means, T.H. and F.D. Gardner. 1900. A soil survey in the Pecos Valley, New Mexico. p. 36-76. *In* Whitney, Milton. Field operations of the Division of Soils, 1899. Report No. 64.. U.S. Gov. Print. Office, Washington, DC.

Meyer, L.D. and W.C. Moldenhauer. 1985. Soil erosion by water: the research experience. Agricultural History 59, 2: 192-204.

Middleton, H.E. 1930. Properties of soils which influence soil erosion. USDA Tech. Bull. No. 178.

Middleton, H.E., C.S. Slater and H.G. Byers. 1932. Physical and chemical characteristics of the soils from the erosion experiment stations. USDA Tech. Bull. No. 316.

Musgrave, G.W. and R.A. Norton. 1937. Soil and water conservation investigations at the soil conservation experiment station Missouri Valley Loess Region, Clarinda, Iowa. USDA Tech. Bull. No. 558.

Nelson, C.M. Toward a reliable geologic map of the United States, 1803-1893. p. 51-74. *In* Carter II, Edward C., edited. Surveying the record: North American scientific exploration to 1930: American Philosophical Society, Philadelphia, PA.

Pecos Valley Controversy. 1900-1902. Secretary of Agriculture James H. Wilson to J. H. James, Carlsbad, New Mexico, January 29, 1902; Milton Whitney to the Secretary of Agriculture, September 28, 1900, Papers relating to the Pecos Valley Controversy, 1899, Reports on Soil Surveys, Records of the Bureau of Plant Industry, Soils, and Agricultural Engineering, RG 54, NA, College Park, Maryland.

Pope, J.B., J. Archer, P.R. Johnson and A.G. McCall. 1946. Investigation in erosion control and reclamation of eroded sandy clay lands of Texas, Arkansas and Louisiana at the Conservation Experiment Station. USDA Tech. Bull. No. 916.

Pinchot. G. 1987. (Originally 1947) Breaking new ground. Island Press, Washington, D. C.

Pisani, D.J. 1984. From the family farm to agribusiness. Univ. of California Press, BerkeleyCA

Shor, E.N. 1999. William John McGee. In American National Biography. Volume 15. 47-48. Oxford Univ. Press, New York, NY.

Smith, D.D., D.M. Whitt, A. Zingg and A.G. McCall. 1945. Investigations in erosion control and reclamation of eroded Shelby and related soils at the conservation experiment station Bethany, MO, 1930-42. USDA Tech. Bull. No. 883

Tanner, C.B. and R.W. Simonson. 1993. Franklin Hiram King -- pioneer scientist. Soil Sci. Am. J. 57: 286-292.