WISCONSIN AGRICULTURAL GEOLOGISTS: AHEAD OF THEIR TIME

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INTRODUCTION

Agricultural geology was the study of the origin, nature, composition, and distribution of soil from a geological viewpoint (Tandarich, 1998). It developed as an interest and eventually a subdiscipline of geology. Although it was named in the nineteenth century, it has origins reaching back much further. Tandarich and Sprecher (1994) and Tandarich (1998) discussed the origin and development of agricultural geology from its roots in classical mineralogy. Because this area of geology is little known, I shall trace the path of its development that led to its use in Wisconsin during the nineteenth century.

AGRICULTURAL GEOLOGY FROM EUROPE TO WISCONSIN

In northern Europe, the influence in the late eighteenth and early nineteenth centuries of Abraham Gottlob Werner of the Bergakademie Freiberg in Saxony is well documented by Ospovat (1971) and Laudan (1987). In particular, Werner's concept of geognosy is pertinent here. Geognosy *(Geognosie* in German) was defined by Werner and translated by Werner biographer Alexander Ospovat literally as "the abstract systematic knowledge of the solid earth" (Ospovat, 1971, p. 101). Werner's geognosic writings about agriculture, although unpublished, were the foundation of what came to be called *Agrikulturgeognosie* in northern Europe and Russia, *geologie agricole* in France, and agricultural geology in the United States in the nineteenth century.

Although he did not study directly with Werner, William Maclure credits Werner for the geognosic framework of knowledge that he used in his study of the geology and soils of the eastern United States (Maclure, 1809). Maclure, a native of Scotland, was directly influenced by a student of Werner's, Robert Jameson at the University of Edinburgh, and by a French friend, Comte de Volney, who had published a treatise about the soils of the United States (Volney, 1804).

Subsequent efforts of American geologists in the study of soils relied on the foundation laid by Maclure. Some of the people influenced by this developing academic tradition were Benjamin Silliman at Yale and his students, Amos Eaton and Edward Hitchcock. Although agricultural geology was occasionally taught elsewhere, Yale University in New Haven, Connecticut, developed the first systematic curricula in agricultural geology.

Eaton went on to teach geology at Rensselaer Polytechnic in New York. Many of Eaton's students became notable agricultural geologists—for example, George Hammel Cook, Edward Hitchcock, and Ebenezer Emmons. They were hired to work in the newly established state geological surveys that became active in the early to mid-nineteenth century. The geology of agriculture was considered part of the domain of study of the state surveys.

Eaton student Ebenezer Emmons co-founded the *American Quarterly Journal of Agriculture and Science* in 1844. In this journal he published articles about agricultural geology in 1845 (Emmons and Prime, 1845) and 1846 (Emmons, 1846). His 1845 article served to define this subdiscipline of geology and its practice in the United States.

Students of Eaton as well as those of other individuals and institutions staffed the state geological surveys and worked actively in agricultural geology during the nineteenth century. Many of these scientists were also associated with colleges and universities. Some of these investigators who were connected with Wisconsin were David Dale Owen, Increase Allen Lapham, and Thomas Chrowder Chamberlin.

Owen's agricultural geologic work extended to eight states, including Wisconsin, during the period from 1837 to 1860, although he is best known for his soil analyses in Indiana and Kentucky (Corgan, 1982; Zabilka, 1982). Nelson (1976) discussed his survey work in Wisconsin.

Lapham (1850, 1851) discussed the geologic aspects of the agricultural potential of Wisconsin.

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Figure 1. *Chamberlin (1882) map of the soils of Wisconsin.*

Agricultural considerations, particularly regarding an assessment of the composition and quality of soils of the state, were among the purview of the geological surveys of Wisconsin that preceded the Wisconsin Geological and Natural History Survey. This was not lost on Lapham's colleagues and successors, most notably Thomas Chrowder Chamberlin.

THOMAS CHROWDER CHAMBERLIN AND HIS LEGACY

The agricultural geologic work of Chamberlin is little known today, but is noteworthy in the history of geology, soil science, and particularly pedology. A native of Mattoon, Illinois, Chamberlin attended Beloit College, graduated in 1866, and returned to teach there from 1873 to 1882, while concurrently working for the Complete Geological, Mineralogical and Agricultural Survey, the immediate predecessor to the Wisconsin Geological and Natural History Survey. He studied for a year (1869–70) with Alexander Winchell at the University of Michigan.

Winchell's work on the agricultural geology of Michigan (Winchell, 1865) no doubt influenced Chamberlin, for while at the Wisconsin Survey Chamberlin published several treatises on the agricultural geology of Wisconsin starting in 1874 (Chamberlin, 1874a, 1874b, 1877, 1883). His view of agricultural geology is stated in the 1883 survey report:

> *Only a portion of the complicated questions that are involved in the highest utilization of the soil fall within the field of the geologist…. The geological aspects relate mainly to (1) the origin and nature of the soil, (2) to its waste [erosion] and reproduction by natural means, (3) drainage, and (4) natural fertilizers (Chamberlin, 1883, p. 678).*

Chamberlin produced two maps based on physical properties of soil, one of eastern Wisconsin in 1876 (Chamberlin, 1876) and another of the entire state of Wisconsin in 1882 (Chamberlin, 1882; fig. 1). In his map philosophy, Chamberlin anticipated the detailed soil maps of today:

> *There are few natural formations more difficult to map than soils. There is an almost infinite gradation of varieties between which there are no hard-and-fast lines, and it is nearly or quite impossible to represent these gradations on a map. Moreover these gradations run through more or less of their minor changes on almost every farm, and to attempt to represent these for the more than 50,000 square miles of land embraced within the limits of Wisconsin would be an undertaking of no small magnitude, and would require maps of very large scale and elaborate execution, and when executed, while extremely valuable for certain uses, the very confusion of details would be a source of inconvenience in the more general studies (Chamberlin, 1882, p. 657).*

These two maps are noteworthy and were recognized early in this century as being "modern" in approach by George N. Coffey, the first director of the national soil survey program in the U.S. Department of Agriculture (Coffey, 1912). In addition, the 1882 general soil map is the first large-scale state soil map of its type produced in the United States. The map units (fig. 2) of both maps were based on a soil physical property, that of texture (a term used more qualitatively than today's concept) (fig. 3). Chamberlin's ap-

Figure 2. *Southeastern portion of Chamberlin (1882) map showing soil delineations.*

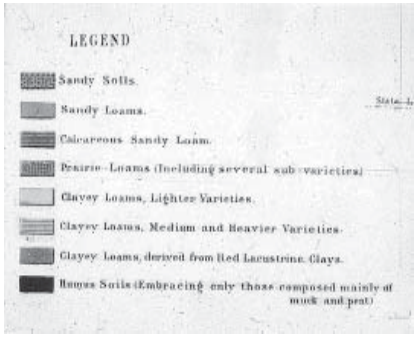

Figure 3. *Chamberlin (1882) map legend.*

proach was a departure from the practice of considering soils merely as a geologic unit.

Chamberlin was also interested in the problem of soil erosion (soil "wastage" as he called it) as early as 1876. He recognized that farmers in eastern Wisconsin were beginning to farm newly exposed subsoils and produced the 1876 map showing the textural groups of the subsoils. Later in his career, Chamberlin delivered an address on soil wastage in 1909 (Chamberlin, 1909) and published on the subject in the journal *Science* in 1911 (Chamberlin, 1911). The 1909 public address caught the attention of soil scientist Hugh Hammond Bennett, who afterwards decided to make soil conservation his life's work, which ultimately led to the establishment of the U.S. Soil Conservation Service.

Chamberlin worked for the U.S. Geological Survey from 1882 to 1887 as head of the Glacial Geology Division and taught at the Columbian (now George Washington) University from 1885 to 1887. While employed at the U.S. Geological Survey, he guided W.J. McGee and Frank Leverett toward agricultural geologic work.

When Chamberlin was appointed president of the University of Wisconsin–Madison in 1887, he returned to Wisconsin and remained there until 1892. In 1889 he established the Department of Agricultural Physics that later, in 1905, was renamed the Department of Soil Science—the first such department established in the United States (Beatty, 1991). Chamberlin's former assistant at the Wisconsin Survey, Franklin Hiram King was installed as professor and head of this new department (Beatty, 1991). King is best known for his pioneering work in soil physics and soil fertility and management (Tanner and Simonson, 1993).

In 1892, University of Chicago President William Rainey Harper persuaded Chamberlin to leave his post as president of the University of Wisconsin and assume the chair of the geology department at that newly organized university. According to Fisher (1963), the first faculty members of that department were Chamberlin, Joseph Paxson Iddings, Richard Alexander Fullerton Penrose Jr., Rollin D. Salisbury, and Charles Richard Van Hise.

Some University of Chicago geology students who became involved in Wisconsin agricultural geologic–Quaternary geologic–soil studies were William C. Alden, Allen David Hole (fig. 4), and Andrew Robeson Whitson. Alden, originally from Iowa, received his M.A. in 1898 and Ph.D. in 1903. One of his most notable works was his tome about the Quaternary geology of southeastern Wisconsin, which included a section on soils (Alden, 1918).

Hole, a native of Indiana, worked with Alden (1918) on his study of southeastern Wisconsin. He re-

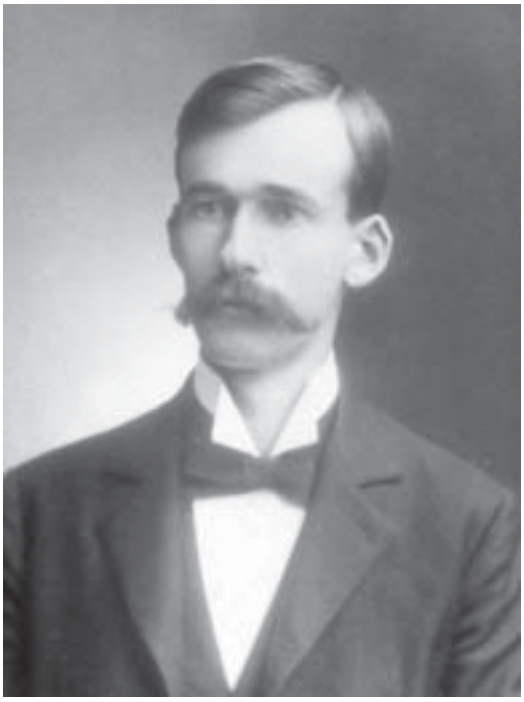

Figure 4. *Allen D. Hole, circa 1905. (Photograph courtesy of Francis D. Hole.)*

turned to teach at his alma mater, Earlham College, and trained several agricultural geologists, including his son Francis Doan Hole, now professor emeritus of the University of Wisconsin–Madison (Tandarich and others, 1988a, 1988b).

Whitson was a student of Chamberlin and Salisbury at the University of Chicago. He completed his B.S. under them at Chicago in 1894 and continued in graduate study there from 1894 to 1895 and 1899 to 1900, specializing in soils and crop production (Beatty, 1991; Hole, 1991). After returning to the University of Wisconsin–Madison, Whitson became the head, in 1901, of the Department of Agricultural Physics and then the head of the Department of Soil Science in 1905.

When the Wisconsin Geological and Natural History Survey was established in 1897, one of its missions was to study the soils of the state (Ostrom, 1988). Thus, the Survey published a general soil and agricultural report in 1903 (Weidman, 1903). Subsequent soil survey reports were published until the 1950s by the Survey in cooperation with the U.S. Department of Agriculture and the University of Wisconsin Soils Department (Beatty, 1991).

SUMMARY AND EPILOGUE

Agricultural geology is an important antecedent discipline of soil science. In Wisconsin, the agricultural geologic legacy of T.C. Chamberlin is particularly significant. Chamberlin's students directly and indirectly have been responsible for the development of several subdisciplines of soil science in the state and beyond, including soil physics, soil chemistry, soil fertility, and pedology. Chamberlin's innovations in conceptualizing a soil map and soil survey foreshadowed the national soil survey program established in 1899. The Wisconsin Geological and Natural History Survey and its predecessors published works on agricultural geology that, during the twentieth century, were known as soil surveys.

Internationally, a scientific society of agricultural geology or agrogeology had formed and held its first meeting in 1909 in Budapest (Szabolcs, 1997). That society of agrogeology changed its name to the International Society of Soil Science in 1924 and in 1999 became the International Union of the Soil Sciences. By the time of the First Congress of Soil Science held in Washington, D.C., in 1927, the practitioners of soil science no longer used the name agricultural geology.

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