Michigan's Swamplands and Michigan Agricultural College: Paul M. Harmer's Career and Legacy in Muck Soils Research on the Corey Marsh

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In January 1945, the *Michigan State College Record* ran an article, "Muck Yields Wealth," about the Michigan State College (MSC) Muck Soils Research Farm on the Corey Marsh, located in Bath Township, twelve miles northeast of Lansing. Ten years earlier, the article claimed, the 200-acre plot had been "considered virtually worthless," but by 1945, it was "worth millions of dollars to Michigan's muck land farmers in the wealth of experimental findings it is spawning."[1]

The Muck Soils Research Farm was located on a parcel that was part of the swampland acreage transferred to Michigan ownership by the federal government through the Swamp and Overflowed Lands Act of 1850, which was later given to Michigan's fledgling agricultural college. At the time of its passage, proponents of the 1850 law echoed the view that "worthless" swampland might be redeemed through drainage and reclamation. According to the *Congressional Globe,* "the passage of this bill and the donation of these scraps of land, injurious as they exist to the States, and utterly valueless to this Government, is but the beginning of the work of reclamation; the State Legislatures must follow, appropriate money, and redeem them from the water—and the sooner the better for the health of the people and the prosperity of the country."[2]

The benefits of draining swamplands were further described in a 1907 federal bulletin that provided an inventory of swamplands deeded to the states and a description of the feasibility of reclaiming the lands for productive use.

[1] "Muck Yields Wealth," *Michigan State College Record* (East Lansing, MI), January 1945, The M.A.C/M.S.C Record Dataset, Michigan State University Libraries Stephen O. Murray and Keelung Hong Special Collections, https://www.lib.msu.edu/macmsc.

[2] *Congressional Globe,* quoted in Mary R. McCorvie and Christopher L. Lant, "Drainage District Formation and the Loss of Midwestern Wetlands, 1850-1930," *Agricultural History* 67, no. 4 (1993): 24.

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> Swamplands, when drained, are extremely fertile, requiring but little commercial fertilizer, and yield abundant crops. They are adapted to the growth of a wide range of products and in most instances are convenient to good markets. While an income of $15 to $20 per acre in the grain-producing States of the Middle West is considered profitable, much of the swamp lands in the East and South would, if cultivated in cabbage, onions, celery, tomatoes, and other vegetables, yield a net income of more than $100 per acre.
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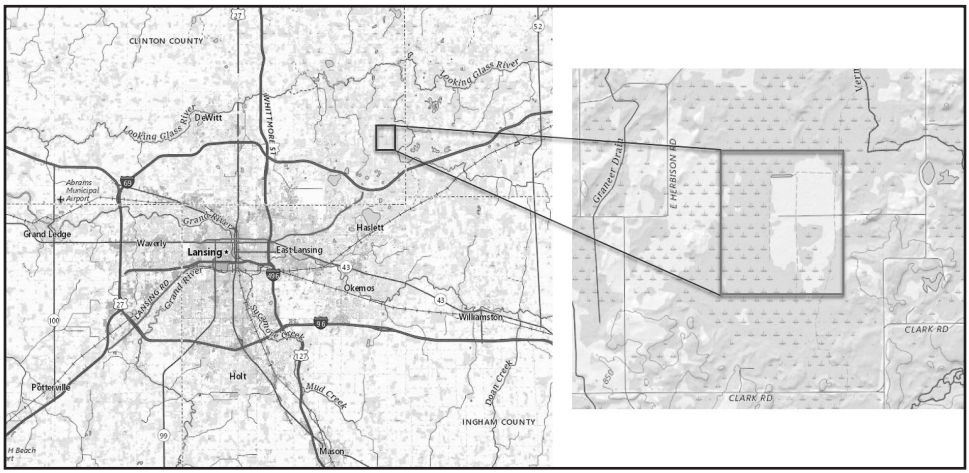
> In addition to the immediate benefits that accrue from the increased productiveness of these lands, a greater and more lasting benefit would follow their reclamation. The taxable value of the Commonwealth would be permanently increased, the healthfulness of the community would be improved, mosquitoes and malaria would be banished, and the construction of good roads made possible. Factories, churches, and schools would open up, and instead of active young farmers from the Mississippi Valley emigrating to Canada to seek cheap lands they could find better homes within our own borders.[3]

The land on which the MSC Muck Soils Research Farm was located was unused by the college until Michigan's Muck Farmers Association pressed MSC to expand agricultural research on muck soils. The college responded by creating the Muck Soils Research Farm in 1941. Paul M. Harmer, MSC muck soils specialist, was the first director of the farm. By 1945, the *Record* reported the muck farm was producing "1,000 bushels an acre in onions, and fantastic yields of mint, spinach, lettuce, dill, carrots, parsnips, cabbage, and other crops. Experimental findings by Dr. Harmer have enabled the state's muck farmers to convert many acres of mediocre land into high producing soil."[4]

In 2012, Michigan State University (MSU)—formerly MSC— closed the Muck Soils Research Farm because of financial and hydrological challenges that made continuing research there problematic. The land—the only state land grant to MSU that has remained in continuous ownership of the university—is now the MSU Corey Marsh Ecological Research Center (CMERC). Changing social views about the value of swamplands in their natural state are reflected in plans for CMERC. As the vision for the CMERC evolves, exploring the history of the land and its use figures prominently into plans for ecological restoration

[3] J. O. Wright, "Swamp and Overflowed Lands in the United States: Ownership and Reclamation" (USDA Office of Experiment Stations Circular 76, Washington, DC, 1907): 23.

[4] "Muck Yields Wealth."



Aerial View of the Corey Marsh Ecological Research Center Location.
Source: Created by J. Owen using ArcGIS Pro.

on the site; studying that history has uncovered the legacies of Paul Harmer, his Department of Soil Science at MSU, and the Muck Soils Research Farm.

Harmer's Life and Career Before Michigan State University

Paul M. Harmer was born to Elizabeth and Herbert Harmer on March 6, 1888, in Dodge Center, Minnesota. He had four siblings: sisters Pearl and Velva, and brothers Earl and Clifford. Harmer earned his bachelor's degree from Carleton College in 1911 and his MS (1915) and PhD (1920) from the Minnesota College of Agriculture (now the University of Minnesota). As he worked his way through graduate school, he taught chemistry and physics at nearby Mankato High School from 1911 to 1913. From 1914 to 1915, he was an instructor in the Soils Department at the Minnesota College of Agriculture. In 1917, he was appointed head of the Chemistry Department at Nebraska Wesleyan University in Lincoln.

Harmer's work at Nebraska Wesleyan was interrupted by World War I. On July 25, 1917, he sailed from New York City to Europe on the troop transport ship *Adriatic* to join the US Chemical Warfare Service through 1918. Upon returning home in 1919, Harmer took a position as an assistant professor in the Soils Department at Wisconsin Agriculture College. In September 1921, he joined Michigan Agricultural College (MAC) as a research associate and extension specialist in the Soils Department. He was then thirty-three years old and recently married to Gladys Johnson, originally of New Hampshire. Harmer would spend the rest of his career at MSU, retiring in 1953 as a full professor.[5]

[5] "Biographical Note," Paul M. Harmer Collection, UA 17.366, Michigan State University Archives and Historical Collections [hereafter Harmer Collection]; Genealogy data from Ancestry.com provided by Dr. Nolan Singleton.

The State of "Soil Science" as Harmer Began Work in the MAC Soils Department

Soil studies (not yet designated a science) was still a young field when Harmer arrived in East Lansing. It grew from two separate roots in the nineteenth century: chemistry and geology. Its origins in chemistry emerged in the 1830s and 1840s with Justus von Liebig (1803-1873), considered one of the pioneers in organic chemistry and the father of fertilizer chemistry. Soil chemists generally confined their studies to tilled topsoils. According to the US Department of Agriculture (USDA), these early scientists held "a 'balance-sheet' theory of plant nutrition. Soil was considered a more or less static storage bin for plant nutrients—the soils could be used and replaced."[6] Liebig identified nitrogen and various trace elements as essential plant nutrients. His "law of minimum" held that plant growth was limited by the scarcest of necessary nutrient resources rather than the total amount of resources.[7]

The geological contribution to soil studies began in the United States with Milton Whitney (1860-1927), the first director of the USDA Division of Agricultural Soils, created in 1894.[8] Whitney saw soils as the result of rock weathering and therefore geological in origin and nature. As scholars have noted, his soil classification scheme "was based on the idea that the soil minerals found in the different soil *provinces* did not materially differ in character, but that the soil peculiarities characteristic of the different provinces are the result of the operation of different agencies in those provinces" (e.g., heat metamorphism; ice, rushing glacial water, and wind attrition; rivers; and volcanoes).[9]

Historians mark the period of 1899-1930 as the beginning of the institutionalization of soil studies in the US. The USDA Bureau of Soils (originally a soils office in the USDA Weather Bureau) was organized in 1901, while the American Society of Agronomy was founded in 1907 and its journal began publication the following year.[10] A leading historian of soil science, Eric C. Brevik, observed how "even as the organized national study of soils began in the USA, there were no academic programs of study devoted exclusively to soils. Rather, the early leaders in US soil science were trained in related fields."

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[6] Soil Survey Staff, "Soil and Soil Survey," in *Soil Survey Manual USDA Handbook 18* (Washington, DC: US Department of Agriculture, 2017), https://nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054251.

[7] Erick C. Brevik, Thomas E. Fenton, and Jeffrey A. Homburg, "Historical Highlights in American Soil Science—Prehistory to the 1970s," *Catena* 146 (2016): 111-27.

[8] Douglas Helms, Anne B. W. Effland, and Patricia J. Durana (eds.), *Profiles in the History of the U.S. Soil Survey* (Ames, IA: Iowa State University Press, 2002).

[9] Emphasis added. Brevik, Fenton, and Homburg, "Historical Highlights," 117.

[10] R. J. Willis, *The History of Allelopathy* (The Netherlands: Springer Dordrecht, 2007): 209-10.

The Bureau of Soils strove to address this deficit by helping form the first university-based soils program at Cornell University in 1903.[11]

Six years later, MAC reorganized its omnibus Department of Agriculture to form seven distinct departments, including the new Soils Department.[12] Initially, the new department housed just three faculty members. This is not to say that MAC students had not previously had the opportunity to study soils. As a 1988 departmental history noted, "The 1861 annual catalog of the agricultural college outlines some of the subject matter in *agricultural chemistry* as follows: 'Formation and composition of soils, composition of plants as determining the chemical condition of the soil . . . nature and sources of food for plants, chemistry of the various processes of the farm as plowing, draining, etc., exhaustion of soils, methods of chemically improving soils by mineral manures, vegetable manures, animal manures and rotation of crops.'"[13]

By 1915, Soils Department faculty were conducting research on the use of fertilizers on both muck and mineral soils. By the time Harmer joined the department in 1921 there were eleven faculty members, a new course on commercial fertilizers was required of juniors, and a new course on muck soils was offered to seniors.[14]

As Harmer began work at MAC, the young field of soil studies was undergoing a major conceptual transformation. Up to that point, Whitney's geological paradigm that soils were simply the product of rock weathering had been dominant. By the mid-1910s, however, that paradigm was being challenged in the US by several scientists, chief among them geologist and geographer Curtis F. Marbut. When Marbut joined the Bureau of Soils in 1911, Whitney assigned him leadership of the Soil Survey section.[15] Broader and more generally useful concepts of soil had already been developed in the US by E. W. Hilgard and G. N. Coffey.[16] Coffey, for example, saw soil as "a natural body having a definite genesis and distinct nature of its own and occupying an independent position in the formations constituting the surface of the earth."[17] As the USDA noted, these new American concepts followed work that had been going on in Russia for some time: "Beginning in 1870, the Russian school of soil science under the leadership of V.V. Dokuchaiev and N.M. Sibertsev was developing a new concept of soil . . . as independent natural bodies, each

[11] Brevik, Fenton, and Homburg, "Historical Highlights," 120.

[12] L. S. Robertson et al., "The Michigan State University Soil Science Department 1909-1969: A Historical Narrative" (East Lansing, MI, 1988): 5.

[13] Robertson et al., "The MSU Soil Science Department," 3

[14] Robertson et al., "The MSU Soil Science Department," 13.

[15] Brevik, Fenton, and Homburg, "Historical Highlights," 116.

[16] Eric C. Brevik, "Charles Nelson Coffey, Early American Pedologist," *Soil Science Society of America Journal* 63, no. 6 (1999): 1485-93.

[17] Brevik, "Charles Nelson Coffey," 1488.

with unique properties resulting from a unique combination of climate, living matter, parent material, relief, and time."[18]

Between 1913 and 1922, Marbut's concept of soils—which had previously followed Whitney's closely—was changing because of his exposure to various soils surveyed in the US and his introduction to the Russian concept of soil genesis.[19] The Russian ideas became available in the West through K. D. Glinka's textbook *The Great Soil Groups of the World and Their Development* (1914). Marbut read the book in German shortly after its publication and ultimately published an English translation in 1927.[20]

In January 1922, Marbut published his seminal article "Soil Classification" in the journal of the Soil Science Society of America. He dismissed Whitney's classification scheme. "We have all assumed," he wrote, "that all we need to know about soils is whether they are granite soil, sandstone soil, limestone soil, etc. Scientific history will probably record no greater mistake, none with more profound effect in delaying advent of the period of real investigation, than this one."[21] Marbut introduced the (Russian) concept of *soil profiles* and discussed in detail the requirements for a rigorous classification scheme.

When he hired Paul Harmer in September 1921, Soils Department chairperson M. M. McCool had already adopted the soil profile concept Marbut was advancing. While a student at the University of Missouri, McCool had worked under Marbut from 1906 to 1908 on Missouri cooperative soil surveys.[22] They corresponded after McCool became chair of the Soils Department at MAC in 1914; Marbut sent McCool material on Glinka's book and the soil profile concept. In May 1920, the MAC Agricultural Experiment Station entered into a cooperative agreement with the Bureau of Soils and McCool's MAC Soils Department for soil surveys in five Michigan counties that would use soil profile analysis—although it was unlikely that Whitney knew of this when he approved the project.[23] In 1923, McCool and a colleague, J. O. Veatch, published the results of that work in "Soil Profile Studies in Michigan," an article in Soil Science that described their use of the soil profile method that united soil survey work with laboratory analysis of soils.[24] McCool and Veatch presented their innovative work at the Soil Science Association meeting in

[18] Soil Survey Staff, "Soil and Soil Survey."

[19] Soil scientists now use the term *pedogenesis*.

[20] Brevik, Fenton, and Homburg, "Historical Highlights," 118.

[21] C. F. Marbut, "Soil Classification," *Soil Science Society of America Journal* B3 (1922): 24-32.

[22] D. M. Merkel, "The Curious Origins of *Podology:* The Story of a Milestone Paper" (Unpublished manuscript, 2013): 5, https://www.lssu.edu/wp-content/uploads/2017/06/Merkel_Sabbatical_Report-Addendum_Podology_2013.pdf.

[23] Merkel, "Curious Origins," 7.

[24] M. M. McCool, J. O. Veatch, and C. H. Spurway, "Soil Profile Studies in Michigan," *Soil Science* 16 (1923): 95-106.

1922. Marbut was in the audience and commented favorably. Their project was underway when Harmer joined the department.

One of the reasons McCool found Harmer appealing for a faculty position in his department was Harmer's demonstrated expertise on muck soils, including in his 1915 MS thesis, "A Study of the Chemical Constituents of Thirty-Seven Peat Bogs of Southern Minnesota." At that time, interest in peat or muck soils was growing in the US. The American Peat Society established its journal in 1908. Its first editor, Charles A. Davis, was a faculty member at the University of Michigan as well as a former field agent for the Michigan Geological Survey and a current field assistant for the US Geological Survey. In the journal's inaugural issue, Davis published the first of a three-part essay summarizing a much longer, 361-page illustrated work (*Peat: Essays on its Origins, Uses and Distribution*) that the Michigan State Board of Geological Survey had published the previous year.[25]

Davis published the second part, "The Peat Industry and Its Possibilities in America," in the following issue. He reviewed the uses of peat for fuel (heating), gas for illumination, fertilizer, uses in paper making and production of fabrics, for "sanitary purposes" in towns and cities, and finally—"and by no means of least importance"—in agriculture. For Davis, drainage and proper cultivation methods could make soils once considered "untillable" Productive again, but he concluded that the history of trying to develop the peat industry in the US "is not encouraging . . . when one goes over the field and counts the plants that have been established, run for a short time and then closed down indefinitely."[26] He argued that agriculture was an afterthought in the early enthusiasm for building a peat industry, while the early uses of peat for heating fuel and gas for illumination were marginally economic, at best. Leaders in the peat community realized that what could be made from peat in terms of fuel could be made from other sources. In the early twentieth century, many thought their main competition was coal; however, the peat industry was soon wiped out by the rise of another fossil fuel: oil.

Thus, by 1920, the focus was shifting away from a peat industry to *farming* on peat or muck soils. There were some early enthusiasts. For example, farmer Paul H. Todd of Kalamazoo spoke to attendees at the American Peat Society meeting held there in 1911 on the topic of "Peat in Agriculture," extolling the virtues—and profitability—of muck farming: "Few of us realize that the black bogs or swamps that are covered with dense vegetation and yet are so miry

[25] Charles A. Davis, "The Peat Industry and Its Possibilities in America—Part I," *Journal of the American Peat Society* 1, no. 1 (1908): 1-3, and *Peat: Essays on its Origin, Uses, and Distribution in Michigan* (Lansing: Wynkoop Hallenbeck Crawford Co., State Printers, 1907).

[26] Charles A. Davis, "The Peat Industry and Its Possibilities in America—Part II," *Journal of the American Peat Society* 1, no. 2 (1908): 27-29.

as to be impassable through most of the year, that are the breeding places for mosquitos and for malaria, can be converted through dredging streams or digging canals into the most valuable of all our farm lands, into lands which will produce the largest and most valuable crops, and which will sell at the highest prices per acre."[27]

Todd's statement was aspirational boosterism rather than a claim supported by market data. In Michigan, scientific exploration of muck farming was still in its infancy. MAC extension specialist Ezra Levin wrote in 1921 that there were four million acres of muck soil in the state, yet "less than one percent of this area is under cultivation." The underdevelopment of muck farming stemmed in large measure from "serious skepticism among reliable agricultural observers as to the value of these soils" due to their marginal profitability and frequent crop failures. Michigan's muck farmers had relied too much on specialty crops (celery, mint, onions), Levin concluded. But a rigorously researched and "diversified farm management plan" would make muck farming "as safe and profitable as highland farming."[28]

MAC had been engaged in muck soils research and extension work under Levin's direction for a few years. Levin and the Soils Department had helped found the Michigan Muck Farmer's Association in 1918. Furthermore, the department's chair (McCool) was committed to this work. He coauthored a report by a Soil Science Society of America committee on "the classification of organic soils."[29] Harmer's PhD dissertation advisor at the University of Minnesota, F. J. Alway, was the first author of that report. Both Alway and McCool were on the editorial board of *Soil Science Society of America Proceedings in 1923*.[30] So, when Levin left MAC in 1921, it is unsurprising that Harmer—Alway's student who had studied Minnesota's muck soils for his master's thesis—was chosen to replace him.

Further, in his PhD dissertation, "A Glacial Soil Study: Uniformity of the Late Gray Drift of Minnesota," Harmer had moved well beyond Whitney's mineral soils province scheme.[31] While not using the term "soil profile" specifically, Harmer conducted rigorous chemical analyses of soils, including humus.

[27] Paul H. Todd, "Peat in Agriculture," *Journal of the American Peat Society* 4, no. 3-4 (1912): 164.

[28] Ezra Levin, "Muck Farm Management in Michigan," *Journal of the American Peat Society* 13-14 (1920-1): 279.

[29] F. J. Alway et al., "Report of the Committee on the Classification of Organic Soils," *Soil Science Society of America Journal* B4, no. 2 (1923): 113-14.

[30] *Soil Science Society of America Proceedings* became *Soil Science Society of America Journal* in 1976. Citations of *Proceedings* articles now refer to the *Journal*, and this approach is used for citations in this article.

[31] Paul M. Harmer, "A Glacial Soil Study: Uniformity of the Late Gray Drift of Minnesota" (PhD diss., University of Minnesota, 1920).

Paul M. Harmer (1888-1959).
Source: J. F. Davis and R. E. Lucas, Organic Soils: Their Formation, Distribution, Utilization and Management *(Department of Soil Sciences, Agricultural Experiment Station, Michigan State University, 1959).*

Alway was a recognized expert on muck soils and an advocate of chemical soil analysis. Harmer demonstrated in his dissertation the union of the chemical and geological roots of soil studies that presaged a more integrated, maturing scientific field. Significantly, the USDA Bureau of Soils was reorganized as the Bureau of Chemistry and Soils in 1927.

In summary, the young field of soil science was maturing conceptually in the early 1920s, and the MAC Soils Department played a significant role in this development. Key faculty members, led by McCool, were active in the Soil Science Society of America and partnered with the Bureau of Soils and key researchers such as Marbut. The emerging subfield of muck or peat soil studies was in an even earlier stage of development because neither the traditional techniques of mineral soil analysis nor the newly developed soil profile analysis techniques worked well on organic soils, especially those greater than forty-eight inches in depth (the muck on Michigan's Corey Marsh was estimated to be more than twice that). The 1923 Soil Science Society committee on which Alway and McCool served recommended that "the profile of organic soils be given careful study" so that an appropriate "scheme of classification" of organic soils could be developed—one that would consider such attributes as the "depth of the organic layer" and the "degree of decomposition of plant residues."[32] Thanks to Alway, McCool, and Levin, MAC was becoming one of the country's leading centers of muck soils work. Newly arrived muck soils specialist Harmer, well-trained by Alway and personally selected by McCool, would become the leader of the college's muck soils research and extension program.

Harmer's First Decade of Work at MAC: 1921-1930

Paul and Gladys Harmer's first decade in East Lansing involved not only setting up a household and starting Paul's work in the Soils Department but

[32] Alway et al., "Report of the Committee on the Classification of Organic Soils."

also starting a family. Marjorie E. Harmer was born in 1922, the year after the Harmers arrived in East Lansing. Paul M. Harmer Jr. was born in 1927.[33]

The Soils Department was home to seven faculty members in 1920. The next year, after Harmer joined the department, it grew to eleven members. Harmer inherited stewardship of the Michigan Muck Farmers Association (MMFA) after Levin left in early 1921. The 1,800 muck farmers on Harmer's MMFA mailing list urgently needed research from their agricultural college to make their farms profitable.

During the 1920s, muck research at MAC was conducted on a fourteen-acre plot of land on the main college campus. Soils Department faculty had been engaged for some time in fertilizer studies on both mineral and organic (including muck) soils. Harmer picked up that work immediately, publishing with his boss, McCool, an article titled "Some Results from Fertilizers on Muck Soil" in 1921. He followed that with another article on liming acid muck soils in 1922, a general article on fertilizing muck soil crops in 1923, and an article on economical fertilization of muck crops in 1924.[34] Harmer's publications and talks contained advice, often in the form of guiding principles, for muck farmers. Although muck soils had historically been derided as poor quality, they were highly productive if properly managed, Harmer taught, and the first principle of proper management was fertilization. "The Michigan Muck Farmer cannot afford to not fertilize," he wrote again and again.[35]

Harmer conducted muck soils research with Soils Department colleagues, often through the college's Agricultural Experiment Station, and disseminated results to farmers through the station's bulletins and MMFA meetings and publications. The department's history notes that, from the beginning, Harmer divided his muck soils work into five phases: (1) work with county agents and farmers, (2) field demonstrations and meetings, (3) winter meetings (which became mini college courses), (4) MMFA meetings (and publication of their annual proceedings with research articles and talks), and (5) the *Muck Farmers' News Letter.* Harmer's chairperson and colleagues commented in 1923 that "this system of producing data and then rapidly disseminating it was never better than when Dr. Harmer used it."[36] Harmer's early success at MAC and recognition by his colleagues nationally led to his election in 1925 as president of the American Peat Society, further establishing MAC's (and Harmer's) leadership in the field.[37]

[33] US Bureau of the Census, Fifteenth Census of the United States, 1930.

[34] "Some Results from Fertilizers on Muck Soil," "Liming An Acid Muck Soil," "Fertilization of Michigan Muck Soils," and "Economical Fertilization of Muck Land," listed in "Biographical Note," Harmer Collection.

[35] Harmer Collection.

[36] Robertson et al., "The MSU Soil Science Department," 14.

[37] Robertson et al., "The MSU Soil Science Department," 15.

Harmer's initial position title was research associate and extension specialist. As noted by his colleagues in 1923, he successfully connected the two roles. Accordingly, Harmer's research agenda was utilitarian. The results were intended for immediate application by muck farmers on their lands. To ensure this, he formalized and grew the MMFA so that its members would not only be early adopters of his research but also proselytizers and, eventually, innovators in best muck farm practices. Although the MMFA had existed for about three years when Harmer arrived in East Lansing, it had apparently not been formally organized. At the 1925 annual MMFA meeting, held in early February at MSC, Harmer presented the MMFA constitution to the membership and oversaw elections for the organization's president, vice-president, and secretary-treasurer. Harmer was himself elected "permanent" secretary-treasurer, assuring that the operating control of the MMFA was vested in the college for continuity and continuing success.

That 1925 annual meeting set the format and tone of the meetings that followed for at least the next two decades—the period for which the association's records survive. In discussing the MMFA constitution, Harmer explained that the organization's purpose was to "work in connection with Soils Department at MSC in collecting information on handling muck soils and crops adapted to them, and any other information on profitable use of muck lands."[38] The annual meetings generally lasted two and a half days. There were presentations by association members (on celery and onion growing problems, for instance), presentations by MSC faculty from various agricultural departments, and typically at least two presentations by Harmer himself. One of his first lectures was on "formulating plans for the economical distribution of muck soil crops." At the 1925 meeting, he also reviewed the publications and bulletins he had written at MAC and offered those free of charge to members. He asked them to pay a $1 annual fee to support the work of the MMFA—and likely to establish them as stakeholders in the organization.[39]

At these MMFA meetings, in its publications and newsletters, and in related Agricultural Experiment Station bulletins, Harmer led a continuous seminar on the care and uses of muck soils. He taught that because "it is scarcely seventy years since [German researcher Theodor] Rimpau secured the first really satisfactory results ever obtained in muck farming," muck research was "still in

[38] Paul M. Harmer. "Taking the Gamble out of Muck Farming" in *Proceedings for the 7th annual MMFA convention*, February 1925, Michigan Muck Farmers' Association Records, Collection 00249, Box 1, Folder 1, Michigan State University Archives and Historical Collections [hereafter MMFA Records].

[39] *Proceedings for the 7th annual MMFA convention.*

its infancy."[40] Because muck farmers of all levels of experience and education attended these seminars, joining and dropping out as their lives required, Harmer faithfully included a recitation of the basics. In a talk titled "Taking the Gamble Out of Muck Farming," he advised new farmers to choose land with high-lime muck and good drainage. Muck farmers were advised to choose crops adaptable to muck soils. Crops such as tomatoes and cucumbers were to be avoided because of their susceptibility to frost in typically low-lying Michigan muck plots. And, of course, he continually emphasized that the muck farmer could not afford to skip fertilizing.[41]

By 1929, Harmer had 2,000 Michigan muck farmers on his mailing list and increased the MMFA's slate of officers to include four vice presidents. His how-to seminar on the use and care of muck lands included talks on "Dairying and Livestock Farming on Muck Land," "Grain Varieties for Muck Land," "Increasing Onion Yields on Michigan Muck Land," "Use of Corrosive Sublimate to Control Maggots on our Experimental Plots," and "Recent Studies in Row Fertilization of Cultivated Crops."[42] To further cement the ties between the MMFA and MSC research, the 1929 meeting also included talks by nine other college faculty pertinent to muck soils farming. The next year, the association considered (and would eventually award) a prize for Michigan's most successful muck farmer: "Michigan's Master Mucker."

Harmer, MSC, and Muck Farming in the 1930s

Whereas the 1920s had been a decade of continuous growth for the Soils Department and Harmer's program, the 1930s were challenging for the department and tragic for Harmer. The 1929 stock market crash that presaged the Great Depression resulted in budget cuts, salary reductions, and increased staff turnover. Then, in late March 1933, the Harmers' son, Paul Jr., was diagnosed with a severe staphylococcus infection of the throat and died on March 29.[43]

Through it all, Harmer persisted with his work, which continued to focus on serving Michigan's muck farmers by providing them, in multiple formats and venues, his latest research and that of his MSC colleagues. He persisted in urging muck farmers to fertilize but noted at the 1936 annual meeting that fertilizing muck was considerably more complicated than assumed just a few years earlier. It was important to match the fertilizer to the kind of muck (i.e., the pH of the muck) and to the crops under cultivation.[44] In his annual meeting presentations,

[40] *Proceedings for the 11th annual MMFA convention*, February 1929, Box 1, Folder 2, MMFA Records.

[41] *Proceedings for the 11th annual MMFA convention.*

[42] *Proceedings for the 11th annual MMFA convention.*

[43] Michigan, US Death Records, 1867-1952, Ancestry.com.

[44] *Proceedings for the 11th annual MMFA convention.*

he discussed using not only lime but also sulfur, manganese sulfate, copper sulfate, and sodium chloride in muck land fertilization, depending on the kind and pH of the soil. He reviewed the crops that grew best on high, low, or average pH muck and the fertilizers best suited to each. He predicted that trace elements and "other materials" would soon be added to muck fertilizers.

At the 1930 MMFA meeting, Harmer illustrated these teaching points in a lecture titled "Reclaiming a Burned Over Muck Soil."[45] He advised farmers to begin by testing for alkalinity and to classify their soils as (a) low lime (strongly acidic), (b) high lime (not acid to strongly acid), or (c) very high lime (alkali muck). He told farmers that "if the soil is just slightly alkaline [they could] raise satisfactory yields of cabbage, carrots, mangels [a type of beet usually used for livestock feed], sugar beets, Swiss Chard and table beets." Farmers were advised to treat highly alkaline soils with sulfur—up to five hundred pounds per acre depending on depth of muck and alkalinity. Acidic soils were to be treated with lime.

Harmer and his colleagues increasingly discussed plant diseases, pests, and their treatment in the 1930s. This was partly due to the knowledge acquired on the MSC experimental muck plots in the 1920s but also due to the growth of new chemical tools to treat those problems. The 1920s and 1930s were decades of major growth in chemistry, including agricultural chemistry. According to one scholar, "research with inorganic chemicals as herbicides was begun in the 1890s in Europe and in a few states and provinces and was increased at a rapid pace until the early 1940s."[46] The new pesticides were initially by-products of coal-gas production and other industrial processes. Chemist John Unsworth notes how "early organics such as nitrophenols, chlorophenols, creosote, naphthalene and petroleum oils were used for fungal and insect pests, whilst ammonium sulphate and sodium arsenate were used as herbicides. The drawback for many of these products was their high rates of application, lack of selectivity and phytotoxicity. The growth in synthetic pesticides accelerated in the 1940s with the discovery of the effects of DDT, BHC, aldrin, dieldrin, endrin, chlordane, parathion, captan and 2,4-D. These products were effective and inexpensive. . . ."[47]

At the 1936 MMFA meeting, the faculty discussed specific pesticide treatments (i.e., nicotine sulfate with sulfated higher alcohols for thrips and dust with one-fourth to one-half percent rotenone for cabbage worms). Harmer

[45] *Proceedings for the 12th annual MMFA convention*, February 1930, Box 1, Folder 5, MMFA Records.

[46] F. L. Timmons, "A History of Weed Control in the United States and Canada," *Weed Science* 53 (2005): 748.

[47] John Unsworth, "History of Pesticide Use," website of the International Union of Pure and Applied Chemistry, May 10, 2010.

discussed crop "blights" and noted that these were more severe on dry muck soils. However, he also noted that insect control was difficult on muck soils due to their inherent wetness, their high organic matter contents, and the surrounding uncultivated or wild lands. The use of herbicides and pesticides on muck soils would be the subject of an ongoing conversation led by Harmer, his MSC colleagues, and their eventual successors as new chemicals were developed and various immediate and long-term human and environmental health problems associated with these chemicals and their residues were discovered.

Rather than cut back his integrated research and extension program for muck farmers because of the Great Depression, Harmer intensified his efforts to broaden the horizons of MMFA members scientifically, socially, and politically. At the 1930 annual MMFA meeting, he reported that in the previous summer, he had been chosen as one of fourteen representatives from ten US university experiment stations to spend two months in Europe examining farming practices. In Germany, he met with Bruno Tacke, the director of the Muck Museum in Bremen and a pioneer in muck research. He toured the museum and reported to MMFA membership on the different kinds of muck soils and products he examined. He visited Groningen in the Netherlands, an area of low-lime muck soils of considerable depth, where rye and potatoes were being grown successfully. In neighboring Vriesland, he saw Holstein dairy cattle raised on muck pastures.

Back home, Harmer organized several social and professional events for muck farmers and, in some instances, their families. The first of these were three- to four-week short courses for muck farmers held at MSC between Thanksgiving and Christmas. At the 1936 annual MMFA meeting, association president King Serviss (from Owosso) reviewed the previous fall's short course. He was one of thirteen farmers who enrolled. Four fellow enrollees grew onions as their principal crop, two peppermint, two celery, one potatoes, and the others mixed crops. They spent the first two hours of every day in the Soils Department, then two in Agricultural Engineering, and then one each in Horticulture, Entomology, Botany, and Farm Management. In addition to learning about the best crop varieties to grow on muck soils, they also reviewed muck crop diseases and pests and control measures. As always, Harmer taught fertilization, drainage, and irrigation. Serviss told the membership that the curriculum included too much information for a short course (he recommended adding more days of instruction) but concluded it was a very valuable experience.[48] Moreover, the cost for the four-week intensive course was modest, even by the period's standards: the 1940 tuition was three dollars.

[48] *Proceedings for the 18th annual MMFA convention*, February 1936, Box 1, Folder 5, MMFA Records.

Harmer also taught farmers during the growing season. He instituted annual "Muck Farmers Association Field Days," held on campus in August. His invitation to farmers for the 1936 Field Day read, "Bring your picnic dinner and come and spend the day and see the results of our experimental work." Because of the Depression and high unemployment, more people moved from cities to rural areas, where cultivating large gardens and some limited animal husbandry (e.g., chickens) were possible.[49] For these people, and muck farmers who could not afford the time or money to travel to East Lansing, Harmer opened a set of test plots around the state—although just how many he operated is not clear from his records. Harmer also traveled the state conducting muck soil tests for farmers. He told the membership at the 1939 annual meeting that "during the past three years [he and his colleagues] have had between 15 and 20 all day muck soil testing meetings" in counties around the state.[50]

Beyond teaching techniques for productive agriculture on muck soils, Harmer used the MMFA annual meetings to acquaint farmers with larger political issues affecting agriculture. For example, he invited MSC President Robert S. Shaw to address the 1935 annual meeting on the importance of Michigan's three to four million acres of muck lands ("a little less than one-ninth the land area of the state") and the college's service to muck farmers. Harmer invited College of Agriculture Dean E. L. Anthony to the 1936 meeting to discuss the economic crisis in agriculture and the New Deal Agricultural Adjustment Administration (AAA). Anthony told members that the AAA would create "a definite voice for the farmer in the economic councils and the future affairs of the American people and nation."[51] After Congress created the Soil Conservation Service in 1935, largely in response to the Dust Bowl and the massive loss of topsoil throughout the plains states, the Michigan State Board of Agriculture created a Conservation Institute on May 20, 1937, and placed it under the supervision of Anthony. In response, Harmer published two articles: "Conservation of Michigan's Muck Soils" and "Methods of Conserving Michigan Muck Soils."[52]

Harmer impressed college administrators with the productivity of his research and extension program and the importance of the approximately 4,000 active muck farmers (Harmer's 1936 estimate) as constituents. An estimated 500 of these farmers attended the 1935 annual meeting at which President Shaw spoke. That year, Harmer moved the banquet from Agriculture Hall to

[49] Robertson et al., "The MSU Soil Science Department," 22.

[50] *Proceedings for the 21st annual MMFA convention*, February 1939, Box 1, Folder 6, MMFA Records.

[51] *Proceedings for the 18th annual MMFA convention.*

[52] "Conservation of Michigan's Muck Soils" and "Methods of Conserving Michigan Muck Soils," listed in "Biographical Note," Harmer Collection.

the Union building for the first time. Members and guests were served products of muck agriculture prepared by the Home Economics Department.

Thus, during the troubling years of the 1930s, Harmer worked to keep the MMFA active and growing. He told attendees each time that every annual meeting was the "best ever" but also pressed members to pay the $1 annual dues to support the printing and distribution of the annual proceedings, including the talks by MMFA members and MSC faculty. He published Agriculture Experiment Station bulletins on fertilizer (1932, 1935); preventing frost damage to muck crops, a persistent problem on typically low-lying muck soils (1933); and muck specialty crops (onions, 1932, 1936; celery, 1938). Yet Harmer also encouraged muck farmers to diversify and not depend solely on specialty crops. He frequently reviewed the varieties of fruit, vegetables, grains, and grasses that could be grown successfully on muck.

The 1940s, the MMFA, and the New Muck Soils Research Farm at Corey Marsh

Despite the Depression and resulting budget challenges, the Soils Department continued to be productive. The department grew slightly from seventeen faculty in 1930 to twenty in 1940. During that decade, the faculty published 198 articles in addition to their teaching, extension, and other professional duties. Soil science also continued to mature as a scientific discipline in the 1940s. In 1941, Hans Jenny, a Swiss scientist who had appointments at the University of Missouri and, after 1936, at the University of California, Berkeley, published his landmark textbook *Factors of Soil Formation: A System of Quantitative Pedology.* According to Eric C. Brevik, "Jenny's unique contribution was to regard the factors of climate, organisms, relief, parent material, and time as state factors in an equation [explaining soil formation]."[53] Because of the complexity and variability of the elements in the equation, it proved very difficult to solve mathematically. Nevertheless, because in principle it allowed isolating and studying quantitatively one variable in the equation, the equation was regarded as a major contribution to the maturation of the discipline. Jenny's work looked forward to a systems approach that emerged fully in the late 1940s and 1950s.[54] In recognition of the progress of the discipline over the previous two decades, P. E. Brown of Iowa State University had written in 1930: "Soil Science or Pedology is coming to be recognized as a true applied science. Even the 'diehards' . . . the pure scientists, are being forced to an appreciation of the fact that the Science of Soils is not Chemistry, nor Physics, nor any other

[53] Brevik, Fenton, and Homburg, "Historical Highlights,"121-22.

[54] James W. Jones et al., "Brief History of Agricultural Systems Modeling," *Agricultural Systems* 155 (2017): 240-54.

of the so-called pure sciences but a scientific discipline, of and in itself."[55] That new appreciation was complete by the early 1940s. Harmer's department changed its name in 1942 from the Department of Soils to the Department of Soil Science.[56]

The sophistication of Harmer's work and his organizational efforts with the MMFA increased as well. For example, his continuing recommendations for fertilizing muck crops became more complex in terms of ingredients, including trace elements, and more targeted to specific crops and soil conditions. The MMFA expanded its annual meetings to include participation on the last day by the Onion Growers Association and the Essential Oils Association of Michigan. The Michigan's Master Mucker and Michigan Onion King awards were bestowed. Harmer conducted studies for the first time on muck fields in Gun Swamp, in the Grant District, and in the Imlay City District. John A. Hannah, the newly appointed MSC president, addressed the muck farmers at the 1942 Field Day. There were shows of muck farm crops (begun in the 1930s) in Jackson and Imlay City. Harmer's work was again recognized nationally. In 1942, Selman A. Waksman, in a New Jersey Agricultural Experiment Station bulletin, cited Harmer as an authority on muck soils and described the MSC Experiment Station as one of three leading muck soils research sites.[57]

Among the most important developments of the decade was the fruition of Harmer's long-term campaign to grow the MMFA and use its influence to win more resources for muck soils research within the college and the state. Anthony addressed the 1941 MMFA annual meeting on the topic of "The New Experimental Muck Farm." He said that interest had been growing in the four million or more acres of muck soil in Michigan, which could now be more successfully cultivated thanks to Harmer's fine research and extension work. He reported that the MMFA had asked for more acreage on which to conduct research. Accordingly, Anthony exclaimed, "last year a special committee representing the MMFA met with members of the State Board of Agriculture and College officials. After a full discussion of the problem and their needs for assistance, the State Board of Agriculture approved the expansion of this work and set aside the sum of $5,000 for 1940-41 to be used in starting a new experimental muck farm."[58]

MSC had only limited muck land on its main campus, continued Anthony, but

[55] P. E. Brown, "The Value of Research in Connection with the Soil Survey," *Soil Science Society of America Journal* B11 (1930): 15.

[56] Robertson et al., "The MSU Soil Science Department," 30.

[57] Selman A. Waksman, "The Peats of New Jersey and their Uses" (New Jersey Agricultural Experiment Station Bulletin 55, Trenton, 1942).

[58] *Proceedings for the 23rd annual MMFA convention,* 5, February 1941, Box 1, Folder 8, MMFA Records.

> fortunately . . . the college has had in its possession since 1855 over 200 acres of undeveloped, excellent muck land, located in the Corey Marsh near Bath in Clinton County. The land is the last of the original grant of land made when the College was first established.[59] It is located in a larger body of excellent muck of better than 1,000 acres which forms the Corey Marsh. It is quite uniform in character, running from four to twenty feet in depth, with a large proportion more than twelve feet deep, and it can be drained without difficulty.[60]

A committee—including Anthony, Harmer, James J. Jackway of the State Board of Agriculture, V. R. Gardner (director of the experiment station), C. E. Millar from the Soils Department, and Glenn Wortley representing the MMFA—was formed "to get the work of development started."[61]

By early 1941, when Anthony announced creation of the Muck Soils Research Farm, 25 acres of land had been cleared, with an additional 175 acres available for the future. "Electric power has been brought to the site of the pumping station which is being installed," Anthony told the farmer group. "Arrangements are being made to tile drain at least twenty-five acres this year, with more to be cleared and tiled as needed. Large leader drains are being laid which will serve for the entire farm. An improved road is being constructed to the center of the operations. It is planned to also build a house for the farm foreman and necessary tool sheds and other buildings to house the equipment."[62] Anthony further described plans to prepare the twenty-five acres of cropland in the spring of 1941 and begin detailed experiments in 1942. With the transfer of the college's muck soils research program to Corey Marsh, the old muck experimental plots on the main campus (totaling fourteen acres) were assigned to other projects in the fall of 1941. Harmer informed the MMFA membership at the same meeting that infrastructure planning at the new muck farm would increase the sophistication and scope of research: "We hope to have at least three different water levels under control, so that we will be able to see what are the effects of different amounts of moisture on the response of various crops to such plant food elements as nitrogen, phosphate and potash, as well as to several minor elements."[63]

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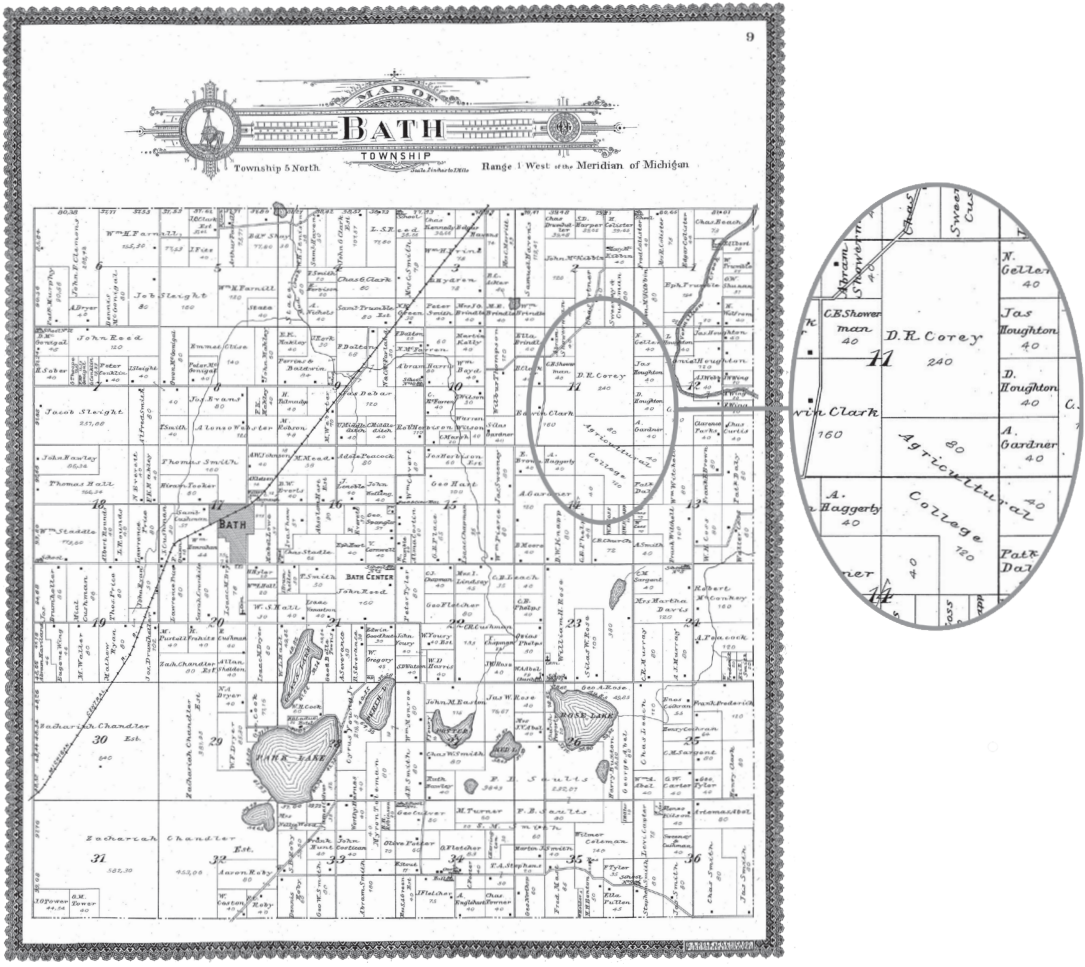
[59] The swampland was granted to MSC in 1858 as part of the state's efforts to support the college financially. However, the Corey Marsh land was not part of the original land grant of 1855. Herbert Andrew Berg, *Financial Support of Michigan Agricultural College during Formative Years with Emphasis on the College Swamp Lands* (East Lansing: Michigan State University Press, 1966).

[60] *Proceedings for the 23rd annual MMFA convention,* 5.

[61] *Proceedings for the 23rd annual MMFA convention,* 5.

[62] *Proceedings for the 23rd annual MMFA convention,* 5.

[63] *Proceedings for the 23rd annual MMFA convention.*



1896 plat map showing "Agricultural College" ownership of site of future MAC Muck Soils Research Farm. *Source: Clinton County Historical Society, modified by J. Owen.*

O. E. Robey from the Department of Agricultural Engineering gave a detailed lecture on drainage at the 1942 MMFA annual meeting. He explained in part that "the purpose of drainage is to get spring water off and to maintain the water level at the right height in summer. The latter may require a damming system to keep water in during summer. Another problem is where to drain the water to, as muck is often the lowest lying land. In this circumstance electric pumps are important. Drainage system should be able to remove one-fourth of an inch of rain in 24 hours, meaning 7,500 gallons per acre or five gallons per minute."[64]

The executive committee of the MMFA voted to buy thermometers adapted to recording temperature on the muck surface. This was a cooperative effort with the US Weather Bureau. In 1942, H. M. Wills, director of the East Lansing

[64] O. E. Robey, "Drainage of Muck Land," in *Proceedings for the 24th annual MMFA convention,* 8, February 1942, Box 1, Folder 9, MMFA Records.

bureau office, spoke to the membership on "The Weather Bureau and its Service for the Muck Farmer." Principal among these services were frost warnings, as frost, according to Harmer, was a threat even in the summer on the typically low-lying muck plots.[65]

However, Harmer's program of expanded research on the new Corey Marsh muck farm ran into serious headwinds. After dealing with severe budget and salary cuts due to the Great Depression in the 1930s, Harmer had to cope in the early 1940s with the impact of World War II and the severe shortages of labor and parts it produced. The short courses, which had not met enrollment goals since 1939, were abandoned. A 1941 muck crop show scheduled to be held in Jackson was canceled due to labor shortages; Harmer told the MMFA membership he would inform them "if and when the show is held again." The 1944 Field Day was held at Corey Marsh for the first time with the MMFA, joined by the Onion Growers and the Essential Oil Growers, which included a picnic lunch on the lawn of the new Corey Marsh farmhouse. However, the 1945 Field Day was canceled due to labor shortages and it is not clear whether they ever resumed.

Further, the drought of the 1930s was replaced in the early 1940s with wet, violent weather and flooding, causing devastating damage to Harmer's infrastructure. The spring of 1943 was very wet; Harmer could not sow onions until May 13 on the drier west side of the farm and not until June on the east side. On May 31, the motor on the farm water-level control pump burned out. Then, on the night of June 1, a tornado touched down near the Lansing airport and moved east to Perry (about twenty miles), cutting a swath one-half mile to one mile in width and passing over the north edge of the muck farm. Crops on the north side of the farm were destroyed. Three inches of rain fell in two hours. The ten- by sixteen-foot fertilizer shed on the muck farm was destroyed. "Our weather observation shelter and thermometers were carried away and not found for several months," said Harmer. With the motor on their pump burned out, there was no possibility of getting rid of the three inches of rain. The shed housing the electrical controls for the pump was "dumped into the reservoir."[66] Due to a shortage of electricians it took months before they could get the pump working again.

Harmer told the membership, "We are now building a concrete blockhouse on the top of the concrete dam and will try to dike and improve the outlet so we can start pumping sooner after we have a heavy rain. Our chief problem lies in

[65] Paul A. Harmer, "Frost Occurrence on Muck and Its Control," in *Proceedings for the 24th annual MMFA convention.*

[66] Paul A. Harmer, address to membership, in *Proceedings for the 26th annual MMFA convention,* February 1944, Box 1, Folder 10, MMFA Records.

Research plots at MSU Muck Soils Research Farm, 1954. *Source: Brochure for Muck Farmers 50th Annual Meeting, compiled by Robert Lucas and Willah Weddon (Michigan State University, 1968).*

the need of a cleaning out of the Vermillion Creek but that cleaning was blocked by the [nearby] City of Laingsburg," which was afraid it would cause flooding in the town.[67] The MMFA needed to remove a bottleneck in the Looking Glass River (into which Vermillion Creek flowed) before Vermillion Creek could be cleaned out. The next year (1945), the MMFA passed a resolution asking the Michigan legislature to pass a bill authorizing the state to control, improve, or assist in the improvement and control of rivers, streams, and water levels.[68] The legislature passed the bill but required that the measure be approved by popular vote before taking effect. It was, and the work was scheduled.

Harmer continued to serve as the superintendent of the muck farm until 1948. Thereafter, he remained active in research and publishing, producing the following articles: "Economic Fertilization of Muck Lands" (1946), "Muck Soil Management for Head Lettuce Production" (1950), "The Nutrition of Muck Crops" (1952), "Muck Soil Management for Hay and Pasture Production" (1953), and "Muck Soil Management for Onion Production" (1955). Harmer retired from MSU in 1953 and moved with his wife, Gladys, to Jefferson, Wisconsin.[69] Still active in his field, he returned to East Lansing in May 1959 for a soil science conference and stayed at the university's Kellogg Center hotel. On the morning of May 12, he discovered that his car would not start and set off walking to a gas station on the north side of Michigan Avenue

[67] Paul A. Harmer, address to MMFA membership, *Proceedings for the 26th annual MMFA convention.*

[68] Paul A. Harmer, address to membership, in *Proceedings for the 27th annual MMFA convention,* February 1945, Box 1, Folder 12, MMFA Records.

[69] "Biographical Note," Harmer Collection.

(about two blocks away) to get a tow truck. He was crossing Michigan Avenue when he was struck and killed by an MSU freshman who was driving to class. Harmer was 71.[70]

During a productive career at MSU that spanned more than three decades, Harmer's overarching accomplishment, noted earlier by his Soils Department colleagues, was uniting his roles as researcher and extension specialist in three especially effective ways. First, he built a large community of Michigan muck farmers and specialty crop subgroups (e.g., the onion and celery growers). Those farmers used his research and extension programming and became an effective lobbying group to promote muck soils research and serve as exemplars of best muck soils farming practices. Harmer was recognized nationally as a leader in his field. Second, he created educational and leadership opportunities for muck farmers by holding winter short courses at the college, by organizing summer Field Days to highlight new techniques and crops, and by inviting innovative farmers and those coping with farming problems (such as insect damage or plant diseases) to speak at the annual February meeting and publish their talks in the MMFA annual meeting proceedings. Third, Harmer built momentum through MMFA lobbying for an expanded muck farm research operation at the college, which led to the opening of the Muck Soils Research Farm at Corey Marsh in 1941. Shortly after his death, the MSU Experiment Station published a bulletin titled *Organic Soils*.[71] The introduction included a picture of a young Harmer along with this statement: "Dr. Paul M. Harmer was credited with much of the research that made 'muck' farming a multi-million dollar annual industry in the midwest [*sic*]."

The Closing of the Muck Soils Research Farm and Creation of the Corey Marsh Ecological Research Center

The seventy-year history of the Corey Marsh Muck Soils Research Farm began when Harmer installed electric pumps that allowed sophisticated control of water levels for more complex experiments. This new technological capacity made muck farming a hot area of research, drawing a new cadre of applied crop scientists to the field. However, that generation of scientists was retiring by the end of the twentieth century. By then, subsidence (i.e., settling of low-density native soils) had become an anticipated problem. MSU researchers estimated that the muck farm had subsided by five feet since 1941.[72] The subsidence,

[70] "Auto Kills Soils Man," *Lansing State Journal,* May 12, 1959.

[71] J. F. Davis and R. E. Lucas, *Organic Soils: Their Formation, Distribution, Utilization and Management* (Department of Soil Sciences, Agricultural Experiment Station, Michigan State University, 1959).

[72] Daryl Warncke et al., "Review of the MSU Muck Research Farm" (Report to Dr. J. Ian Gray, Director, Michigan State University Agricultural Experiment Station, East Lansing, MI, 1999): 6.

extreme rain events, and a neighbor's damming of an adjacent stream led to the flooding of the farm's crop experiments on several occasions. Extensive new drainage projects would have been needed to address the flooding problem during a period when the MSU College of Agriculture and Natural Resources was making program reductions because of financial stress.

The MSU Muck Soils Research Farm ceased operation in 2012. The college decided not to invest in another muck research site, even though a 1999 report to the MSU Experiment Station director noted that the MSU muck farm was one of only three organic soil research facilities operating in the US. Agricultural science had moved on to other problems—many of them environmental—addressed by techniques and methods not unique to muck soils.

The evolution of soil science and muck farming on the Corey Marsh is an important chapter in agricultural research at MSU. However, MSU's connection to the property almost ended in 2018 when its sale was arranged. Weeks before the transaction was to go through, Associate Professor Jennifer Owen was seeking housing for the seasonal field crew that worked at her bird-banding station, where it monitors and conducts research on migratory birds. In her discussions with MSU AgBioResearch leadership, Owen learned about the house on the muck farm property. Administrators invited her to take a look at the house and promised to retain it if it met her needs, while the remaining property would be sold.

In February 2018, Owen looked at the house on the muck farm and explored the 320-acre property. What she found was much more than an abandoned research farm: she discovered an opportunity. The flooding that ultimately led to the closing of the farm had returned the marsh to a wetland ecosystem. Within one year of its closing, water levels at the property rose and it became an important migratory stopover site for hundreds of species of birds. Further, the wetland and surrounding wet prairie offered a breeding habitat to sensitive

Site of previous muck soils research farm plots on Corey Marsh, May 2020. *Source: Still photo from J. Ross drone video.*

species, such as the previously critically endangered trumpeter swan (*Cygnus buccinator*), the currently endangered Blanding's turtle (*Emydoidea blandingii*), and the Michigan-listed endangered prairie vole (*Microtus ochrogaster*). Yet the years of intensive agriculture and human disturbance resulted in an ecological community of primarily nonnative and invasive terrestrial and aquatic plants, such as reed canary grass (*Phalaris arundinacea*) and narrow leaf cattail (*Typha angustifolia L*).

This ecological change is not unique to the Corey Marsh property; it is being observed across many previously farmed muck areas as investments in water control and fertilizers required to maintain productivity of muck soils are abandoned. Consequently, the changes at the Corey Marsh site offer opportunities to investigate how these wetland ecosystems can be revitalized and restored. This is a task of immense importance. Consider migratory birds as just one example of the flora and fauna at Corey Marsh. A recent study documented that since 1950, about thirty percent of breeding birds in North America (2.9 billion) have disappeared, the majority of which are migratory species.[73] The leading cause of population declines is loss and degradation of habitat.

With Owen as its champion and first center coordinator, the Corey Marsh property became the Corey Marsh Ecological Research Center (CMERC) in 2018. CMERC's goal is to foster research on how to effectively restore and rehabilitate the wetland and restore ecosystem function. The research will be used to help and guide landowners and land managers with best practices for land stewardship. Additionally, it will provide MSU students opportunities to gain skills in field-based research while taking classes. The center is also envisioned as an important resource for public engagement, science communication, and the involvement of community members in research activities. One example is the Michigan State Bird Observatory (MSBO). In 2014, Owen and her students decided to take a step uncommon to bird-banding research stations when they opened their operation to the public—providing opportunities to experience science in action, see birds up close, and learn about migratory birds. They created the MSBO, which quickly became a destination spot each fall and has subsequently attracted thousands of visitors. Additionally, schools and community groups began requesting organized visits. What also emerged from the public interest was the opportunity for students in science disciplines to engage with the public and learn how to communicate science effectively. These activities have continued since CMERC has become the location for some of MSBO's activities, and they exemplify the type of public engagement envisioned for CMERC going forward.

[73] K. V. Rosenberg et al., "Decline of the North American Avifauna," *Science* 366, no. 6461 (2019): 120-24.

High school visitors to CMERC, July 2019. *Photo credit: J. Owen.*

CMERC will focus on such issues as how to best control and eradicate reed canary grass to rehabilitate and restore wetland prairie ecosystems.[74] The center will host native prairie and wildlife habitat demonstration gardens to provide members of the public ideas for enhancing their own backyards, offer interpretive trails to showcase both the agricultural history and the natural resources future of Corey Marsh, and make those resources accessible with trails and signage that accommodate people with varied abilities. Work done at CMERC will further enhance and restore wetlands for migratory waterfowl and shorebirds. The center will also be the site of initiatives to create and enhance undergraduate experiential learning opportunities.

There is continuity as well as change in MSU's stewardship of the Corey Marsh from the Muck Soils Research Farm to CMERC. Soil science is the foundation of all the historical agricultural research—and future ecological research—conducted on the property, helping understand soil chemistry, physics, and hydrology. Significantly, MSU soil scientist Daryl Warncke and colleagues recommended in 1999 that the university not sell the muck farm but instead repurpose its use: "There is good potential for use of some of this area for wetland restoration and ecology studies."[75] MSU's operations on Corey Marsh have served the public interest and will continue to do so, transitioning from expanding the food supply beginning in the years

[74] Researchers will investigate whether, and the extent to which, residuals of legacy pesticides are present in the soil and water at CMERC and the implications for ecosystem remediation actions.

[75] Warncke et al., "Review of the MSU Muck Research Farm," 6.

surrounding World War II to restoring and protecting ecological health in the era of climate change. As a model of the land grant mission, Owen's combination of research, extension to landowners, and public engagement continues Paul Harmer's engagement, training, and support of Michigan's muck farmers.