CHEMURGY AND THE LAND GRANT COLLEGES: BRIDGING AGRICULTURE, INDUSTRY AND CHEMISTRY IN THE 1930S AND BEYOND (1)

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Since the Morrill Act was passed one hundred and fifty years ago, one of the creeds of the land grant universities has been the promise to deliver on an adage that first appeared in *Gulliver's Travels* in 1724, to "make two ears of corn, or two blades of grass, to grow upon a spot of ground where only one grew before" (2). By the 1930s, this goal had been achieved, as the yields for many crops had indeed more than doubled over the previous 75 years; by most measures, the application of science and technology to American agriculture had proven triumphant. But these production successes brought unintended consequences for American farmers, as continuous surpluses caused lower prices and an agricultural depression that began almost a decade before the Wall Street crash of 1929. Meanwhile, the rapid growth of the American chemical industry seemed to promise yet another jump in farm productivity, but also additional potential problems for rural America. Thanks to the apparent triumphs of American chemistry, optimists boasted that vast quantities of useful products could now be produced where *none* had grown before: indoors, in chemists' laboratories and in massive factories that produced rayon, synthetic rubber, and other items that had little connection to the soil (3). Thus two threads came together in the 1930s: the crisis on the farm, and the emerging power of American chemistry.

Important debates about these trends and their implications took place on the campuses of the nation's land grant colleges and universities. Land grant university presidents and agricultural college deans found themselves as negotiators in these deliberations, forced to balance the competing claims and interests of applied chemists, farmers, government officials, and their own university constituencies. By the late 1920s, agricultural economists on both sides of the issue lobbied land grant university leaders for support for one of two opposing positions: pull farmers off of marginal lands, reduce production, and contract the size of the farm population, or expand production, with the aim of keeping farmers prosperous through the conquest of new and untapped markets. That the land grant schools were in such a position is not such a surprise, for debates about the role of chemistry at the agricultural colleges has had a long and complicated history. Since their founding in 1862, the land grant institutions had been tasked with building the bridge between farming and the mechanic arts through practical and democratic forms of postsecondary education. But the foundation of that bridge often stood on shaky ground. Agricultural scientists had fought for their own research facilities, agricultural experiment stations, and funding, which made them relatively independent of farmers' wishes and demands for specific kinds of applied research. Major discoveries in soil chemistry, bacteriology, nutrition and other disciplines emerged, but their benefits to practicing farmers were not always so apparent. These scientific successes notwithstanding, there could be little doubt by the 1920s that agricultural prosperity was in decline. The farm depression also brought enrollment drops, reductions in state funding, and other crises for the deans and presidents of the land grant institutions (4).

Meanwhile, the American chemical industry rose along a somewhat divergent track. For good and ill, World War I has been dubbed "The Chemists' War," as four years of naval blockades and trench warfare demonstrated that artificial fertilizers, the base chemicals for explosives, and poison gases all were crucial factors on the modern battlefield. Chemistry was also a decisive issue in the postwar peace, as Article 297 of the Treaty of Versailles guaranteed the signatories' "free use of German patents" (5). Although the United States did not ratify that treaty, it nevertheless organized the seizure of about 4500 German patents and chemical know-how through the Chemical Foundation, a vast quasi-public organization formed in 1919. For nearly two decades, the Chemical Foundation distributed patents and other privileges to many emerging American chemical corporations. These developments also brought new clout and publicity to the American Chemical Society (ACS). The Chemical Foundation's longtime head, Francis Garvan, provided the ACS with an endowment of $20 million, launched the *Journal of Chemical Education*, and sponsored essay contests in which over two million school children wrote on the importance of chemistry in the modern world (6). Chemists also lobbied for tariff legislation that helped protect to the nascent dye, explosives, and other industries. Such moves had geopolitical importance, as other nations responded with their own efforts to develop and protect the chemical sector of their economies. Many authors seized upon these political implications, warning that the United States risked falling behind the nations like Fascist Italy and Nazi Germany that were blatantly committed to autarky, or self-sufficiency, through applied chemistry (7).

The chemists' newfound power and prestige also brought them into closer engagement with agricultural issues. In 1921, for instance, former ACS President Charles Holmes Herty urged his colleagues to get "into the farm problem" as an adjunct to their systematic promotion of organic chemistry (8). In 1926, the Chemical Foundation published *Chemistry in Agriculture*, a celebration of the "hives of activity" on the agricultural college campuses and experiment stations that were helping solve "one of the greatest problems of all time"—feeding the human race (9). Then in October of that year, William Hale, Director of Research at Dow Chemical Company, published "Farming Must Become a Chemical Industry" in Henry Ford's newspaper, *The Dearborn Independent*, which boldly called for new "agricenters" in rural America, massive chemical factories that bore little resemblance to the traditional farm. The Chemical Foundation appreciated this proposal and sponsored a press run of 500,000 article reprints. That same month, Wheeler McMillen, editor of the journal *Farm and Fireside*, published an editorial that took a slightly different tack, stressing the non-food uses of existing farm products as a promising solution to farm problems. Hale, McMillen and Herty soon met one another in Washington, where they agreed to further publicize their program of using renewable resources as the basis for both industrial growth and farm relief (10). Some of this research, often funded directly by the Chemical Foundation, had impacts at the land grant universities. Orland R. Sweeney and his colleagues at Iowa State College, for instance, found that cobs, corn stalks, sugar beet pulp, sugar bagasse, and similar farm wastes could yield chemicals useful in the production of plastics, paper products, dyes, feeds, films, and fuels (11). On the whole, many agreed with the notion that applied chemistry could be part of the answer to the agricultural depression.

Federal policy went in another direction during the early years of the New Deal, however. Through the Agricultural Adjustment Administration (AAA), Secretary of Agriculture Henry A. Wallace launched production control policies designed to artificially reduce the supply of crops and livestock as a way to raise farm prices. Research funds dedicated to the industrial utilization of farm products languished. In contrast to the protectionist leanings of the young American chemical industry, New Dealers were eager to reduce tariffs and expand international trade. Washington officials' interest in social programs and investments in rural America also diverged from the industrialists' priorities. For the most part, New Deal programs were popular among farmers, and also with land grant institutions, which had benefited from student aid programs that staunched the bleeding of declining enrollments and through the hundreds of public works projects that funded new buildings on the campuses, which countered the collapse of state-level appropriations (12).

Thus the New Dealers and many chemists stood on the opposite side of the political divide. These conflicting visions came into clear relief in May 1935, when—after some planning meetings held at the ACS meeting (13)—Dow Chemical's William Hale and other industry leaders came to Dearborn, Michigan, to found what came to be known as the chemurgy movement. As explained in his 1934 book, *The Farm Chemurgic*, Hale had coined the word chemurgy (from the root words for chemistry (*chemi*) and work (*ergon*)), to describe the large-scale industrial utilization of agricultural products (14). As suggested by one of their oft-repeated statements—"the

human stomach is inelastic, but the human demand for the products of manufacture is never satisfied," chemurgists believed that the growing of farm products to serve industry—in massive quantities, at ever lower prices—should replace the growing of edible crops as American agriculture's primary objective. Chemurgy's enthusiasts promised full employment, national economic independence, and new scientific solutions to the farm crisis. Their program was bold and wide ranging, rooted especially in the promise of power alcohol (i.e., biofuels derived from grain surpluses) and other applications of farm products (15).

The Dearborn meeting prompted widespread public discussion of the chemurgists' and New Dealers' approach to the farm crisis, as well as a heated and fundamental debate about the proper place of chemistry in the academic research conducted at public universities. As one dean of engineering reported immediately after the Dearborn meeting, he may "wish it were true," that fuel from plants would be cheaper than gasoline, but that he "cannot make it so." Pointing to the politically charged rhetoric of the chemurgists' program, C. C. Williams of the University of Iowa stressed that chemical research has "no favorites, it works for everyone impartially;" sometimes it may help agriculture, sometimes it may hurt it, but academics needed to follow the facts of nature; not what "we might wish them to be" (16). Other scholars promptly objected to the chemurgists' call for an overhaul of the rural economy. Within days of the Dearborn meeting, Iowa State's chemical engineer Orland Sweeney dismissed out of hand the chemurgists' promise that power alcohol would make the nation free from imported petroleum. Scientists' first priority, Sweeney insisted, must be the utilization of existing agricultural surpluses. Above all, he wanted a program that realistically considered the farmer's need to make a decent living, not industrialists' interest in cheap raw materials (17). Meanwhile, another circumstance also brought new attention to the land grant colleges: Congress passed the Bankhead-Jones Act in June 1935, which called for expanded investment in agricultural research at the land grant schools, particularly research on new agricultural crops that might be adapted to industrial utilization (18).

It is significant, then, that leaders of the new Farm Chemurgic Council (FCC) understood that winning the support of agricultural school deans, experiment station directors, and chemical engineering professors would be essential for the promotion of their agenda. In the words of Harry E. Barnard, the FCC's Director of Research, regardless of Sweeney's antipathy toward power alcohol, "it is only though men such as [him] that we will get at the real facts" (19). As a result, within weeks of the Dearborn meeting, chemurgy's supporters approached the land grant institutions to spread their message. In July, FCC Vice President Wheeler McMillen wrote to the deans of each of the nation's forty-eight agricultural colleges with an offer of a fellowship program for research on chemurgic topics. Like Barnard, McMillen also toured several of these campuses. At the University of Georgia, for example, he explained that it was "tremendously important that we insist," that the land grant colleges and experiment stations work on agricultural research projects that served industrial markets (20).

Even more significant, the FCC's Managing Director Carl Fritsche also sought the cooperation of the land grant schools, signs that he regarded them as influential and essential to his mission. Fritsche's highest priority and first stop was to see the University of Kentucky president, Frank L. McVey. McVey was also the sitting president of the National Association of Land Grant Colleges and Universities (NALGCU), and committed to raising the stature of the land grant schools and their access to research dollars. Fritsche dined at McVey's home, explained the FCC's program and agenda, and appointed McVey to the FCC's Education Committee. He also secured his two specific objectives: he won McVey's support for the FCC's research fellowship program and the promise that chemurgists would have a place on the agenda at the next NALGCU convention in November (21).

Fritsche then embarked on a tour of more land grant campuses across the Midwest and Rocky Mountain states. At each place, he preached the gospel of chemurgy and sought the "ammunition which can be acquired only by personal contact" (22). In many cases, his message found a ready audience. Few deans could turn down the offer of fellowship funds for student research, and many were desperate for any program that could offer some relief from the long farm crisis. Some also agreed with the chemurgists' ideology. For instance, Christian Larsen, the Danish-born dean of agriculture at South Dakota State College, was convinced that the next war would be fought over access to food and other resources. In fact, he had already been in regular contact with Italian officials who shared his commitment to "national economic independence" (23). Dean E. P. Sandsten at the University of Colorado, another native of Scandinavia, agreed with the chemurgists' call for autarkic policies and fears of geopolitical conflict over agricultural resources (24). Some Mormon leaders in Utah concluded that the chemurgic

message was in tune with their denomination's values of independence, perseverance, and self-sufficiency. Moreover, chemurgy offered potential practical benefits, because many Mormon leaders owned beet sugar mills that were idle much of the year, and thus were attracted to the chemurgists' enthusiasm for power alcohol (25). Dean H. L. Walster of the North Dakota Agricultural College was also receptive, suggesting that his state needed chemurgic ideas more than any other. North Dakotans, Walster explained, were very interested in new crops like safflower and also sought new ways to utilize existing crops like flax and durum wheat (26).

But Fritsche also found that several land grant college deans were skeptical of the chemurgists' program. In Wisconsin, for instance, agricultural college officials expressed "absolutely no" interest in power alcohol message, arguing that biofuels were a boondoggle that put corporate interests ahead of those of farmers. Indeed, at least one University of Wisconsin dean proposed tax policies that would discourage the production of grains for non-food uses. In Minnesota, Fritsche found that supporters of power alcohol had been silenced by the university president (27). In Montana, Fritsche met with F. B. Linfield, Dean of the Agricultural College, who embraced the widely held notion that rapid, excessive, and inhumane adoption of new technologies lay at the root of the depression's unemployment crisis. Linfield had no interest in what the chemists had to offer, and instead blamed the "wealthy few" for bringing new hardships to the American farmer (28).

Meanwhile, it is clear that the Secretary Wallace and his allies also saw land grant colleges as essential for the dissemination of their message. In the fall of 1935, USDA officials hosted meetings on the campuses of Utah State College, Iowa State College, the University of Connecticut and the University of Georgia to present new developments in New Deal farm policy. When his tour took him to Logan, Utah, Fritsche snuck into one of these meeting uninvited. Fritsche later said his "blood boiled" as he heard the presentation; the New Dealers, he reported, were attempting a "fascist political campaign" to inculcate land grant college officials with an anti-industrial message. The USDA, he continued was bringing an "almost religious flavor" in support of the expansion of Washington's power, all part of a slide toward "Russian collectivism" (29). In short, the land grant college campuses were on the front line of battles over chemists' proper role in agriculture.

Similar discussions took place in the mainstream of American society as well. In an article entitled "Chemistry Wrecks the Farm" that appeared in *Harper's Magazine* in August 1935 (and soon was reprinted in the even more widely read *Reader's Digest*), authors Wayne Parrish and Harold Clark touted chemistry's "invasion into agriculture" as a triumph. The authors embraced what might be called the "synthetic narrative," or the assumption that synthetic substitutes for the natural ensured consumers access to products uniform in quality, unaffected by seasonal trends in availability, and less dependent upon a skilled labor force. Parrish and Clark further explained that thanks to chemical triumphs like the Haber-Bosch process of producing synthetic ammonia, soil fertility soon would be ensured and four-fifths of American farmers could be eliminated. The authors also suggested that with synthetic substitutes for scarce imported commodities, the United States could free itself from foreign trade and achieve national self-sufficiency through farming. Particularly because of its successes in generating domestic agricultural sources of raw materials, the authors asserted, chemistry "has practically doomed large foreign trade" (30).

In this context, the 1935 meeting of the NALGCU proved an important locale for discussions of the place of chemistry and chemurgy on the college campus. In his presidential address, Kentucky's Frank McVey did not mention the FCC directly, but he did speak of the vital role land grant colleges played in the modern world and hinted that he opposed outsiders trying to shape their research agendas (31). Meanwhile, Chemical Foundation head Francis Garvan arranged a private meeting with McVey, in another attempt to sway the land grant college leader and convince his association to create a committee to study the chemurgic project. This effort seems to have failed. According to his diary entry, McVey dismissed these efforts as "nationalistic propaganda," for he did not accept Garvan's proposition that "national isolation was the only policy to follow" (32).

The next day, the director of Iowa State's agricultural experiment station, Robert E. Buchanan, took the stage to deliver a bold rebuttal to the *Harper's* magazine article and the chemurgic message in general. In a talk entitled "Chemistry: Friend or Foe?" Buchanan directly attacked the Chemical Foundation as the "mouthpiece of organized industrial chemistry," and that it had the potential of "developing into one of agriculture's greatest enemies" (33). "One is indeed astonished and perturbed," Buchanan charged, "when one reads of some of the economic reasoning sponsored by the Chemical Foundation … and occasionally even those of the editors of some journals of the American Chemical Society." Buchanan

then dismissed the "synthetic narrative" point by point: 1) the chemurgists' focus on an autarkic, self-contained economy flew in the face of widespread evidence of the necessity of international trade; 2) natural products like sugar, wool or others natural products were synthesized "many million times" more efficiently than the tedious labors that went into making synthetic substitutes in the laboratory; and 3) farmers were the true producers of useful products, and for just pennies a pound. Buchanan conceded that chemistry might help the farmer in some ways, but he pleaded for his land grant college colleagues to "call the chemist our friend, but agree to keep an eye on him" (33).

The next day, the FCC's Wheeler McMillen delivered a speech at the NALGCU convention that attempted to salvage the chemurgic program. Indeed, although he baldly asserted that the FCC had "no concern with political questions," his talk had an agenda of its own. In an attempt to distance himself from Garvan and the Chemical Foundation, McMillen denied the charge that chemurgy would only serve the interests of the American chemical industry. As McMillen put it, he wanted land grant colleges, experiment stations, and extension agents—not those from "non-agricultural groups"—to lead the chemurgists' search for "new markets capable of unlimited expansion, unrestricted by the capacity of the human stomach and immune to the costly vagaries of foreign commerce" (34).

Both speeches generated plenty of attention, and the tensions surrounding them made it difficult for land grant college officials to know how to proceed (35). Dean Edward Johnson of Washington State College, for instance, said he would be happy to accept funds for chemurgical research if it supported his school's research priorities and the famers' interests. He was "not at all interested," however, to simply follow new research threads because of the media "ballyhoo" that the chemurgists had generated (36). Johnson was also under pressure to host a meeting on chemurgic issues for the northwestern states, but he was quite leery of having any connections with the FCC. In March 1936, then, Johnson wrote to colleagues at land grant colleges around the nation asking for their "frank" assessment of the movement. A few admitted that industrialization of farm products could be a useful thing; others warned Johnson to keep his distance. But tellingly none of these replies were enthusiastic, some asked not to be quoted, and one—the agricultural dean at McVey's University of Kentucky—asked to discuss the matter only by telephone (37).

Nevertheless, by May 1936, when the chemurgists held their second national meeting in Dearborn, it was apparent that several scientists at the land grants had been active in research on the industrial applications of agricultural products. ACS president and University of Illinois chemist Roger Adams served on the chemurgic council's Governing Board. Scholars from Iowa State, Nebraska and Illinois helped lead research on the Jerusalem artichoke as a potential source of power alcohol or levulose sugars. Researchers from Purdue and Illinois led work on soybeans, and those from universities in Florida and Texas served on committees for tung oil, a promising paint and varnish ingredient. By 1936, the FCC's research and education committees included scholars from land grant colleges in Idaho, Nebraska, Kansas, Pennsylvania, New Jersey, Ohio, Kentucky, Georgia and California (38).

Political pressures also helped to reduce tensions between the land grant colleges and the chemurgic movement. As chemurgy threatened to become an issue in the 1936 presidential campaign, Agricultural Secretary Wallace sent a somewhat conciliatory letter to Chemical Foundation head Garvan, promising healthy cooperation with the chemurgic movement (39). Thanks especially to the Bankhead-Jones funds, Wallace could point to several examples of the chemurgic research already underway within the USDA and on the land grant college campuses. Yet Wallace also questioned the fundamental goals of chemical research: "By the very nature of his work," Wallace explained, "the chemist cannot help destroying as well as creating farm markets." Just as synthetic dyes decimated production of indigo and similar crops, and the automobile put horse breeders and oat farmers out of business, chemistry would have similar impacts in the future. Thus while Wallace promised support for the chemurgists' agenda of linking science, agriculture, and industry, he predicted that advances in chemistry offered no real solution to the Depression in rural America (40).

Yet compromise was coming. Under continuing political pressures, the USDA threw its support behind a bill that would create new research laboratories devoted to the industrial utilization of crop surpluses (41). The idea for the government's own laboratories dedicated to chemurgic projects emerged from Mississippi Senator Theodore Bilbo, who in 1935 led the call for a new federally-funded laboratory devoted to the utilization of cotton surpluses. Hearing warnings that the United States had fallen behind Japan, Italy and Germany in the utilization of chemical expertise, this idea became widely accepted by 1937. According to one proposal,

Congress might create as many as forty new crop utilization laboratories across the country, most to be located near the campuses of the land grant colleges. Eventually, Congress appropriated funds for four Regional Research Laboratories (RRLs), each one a million dollar research facility with an annual research budget of a million dollars per year thereafter. Each was dedicated to finding new ways to utilize the crop surpluses of four regions in the United States (42).

The prospect of millions in federal funds set off a frenzy among chambers of commerce and university presidents' offices across the nation. Nearly one hundred and fifty cities submitted bids for the RRLs, with many in land grant college towns among the most eager to stake their claim. Alabama's boosters, for instance, claimed that Auburn was the "best agricultural school in the world," and Tuskegee the "greatest negro school in the world," part of an extensive lobbying campaign that inundated USDA offices with pleas on Auburn's behalf (43). Similar campaigns came from Ames, Iowa, Athens, Georgia, and Urbana, Illinois, just to name a few (44). In the end, however, USDA officials decided explicitly to make these facilities "entirely independent of … the Land Grant Colleges" and to locate them in Philadelphia, New Orleans, Peoria, and Albany, California. The latter site was approved only after President Roosevelt himself concluded that this East Bay city was far enough away from the influence of the Berkeley campus (45). This attitude might seem surprising, but a confidential memorandum sent to Agricultural Secretary Wallace reveals one of the real reasons: a study of voting results in the 1938 Congressional elections proved that precincts closest to the land grant college campuses voted largely for Republican candidates. The Roosevelt administration decided to not "feed the hand that bites it" (46).

The government's creation of the RRLs signaled that the battles were coming to an end by the late 1930s. Both chemurgists and New Dealers had to abandon their focus on farm surpluses as world demand for American farm products returned. In all, as World War II approached, Americans' enthusiasm for bio-based raw materials was on the wane. The most controversial political aspects of the chemurgy movement also changed, and some of its most strident members had died or otherwise left the limelight. Others returned to the land grant campuses: for instance, Leo Christensen, a chemist who had left Iowa State in 1935 and threw his lot with the FCC, launched a new state-funded Chemurgy Project at the University of Nebraska in 1941. During the war, chemurgy was less of an activists' issue, but participants on all sides of the issue could claim they had come together, as research at the RRLs, on the land grant campuses, and in the private sector had contributed to innovative applications of agricultural products in the war effort.

After the war, however, geopolitical battles rarely centered on the products of agriculture, and much of the chemurgists' message began to seem out of touch. Postwar developments, meanwhile, helped to engrave the "synthetic narrative" into American culture, as nylon replaced silk, DDT proved more effective than natural pesticides, and synthetic rubber contributed to the Allies' victory. Few chemurgic products successfully competed with non-renewable feedstocks as the basis for the paint, detergent, industrial alcohol, and other chemical industries. For several decades, American accepted the rhetoric that synthetic products were inexpensive, uniform in quality, and not subject to the fluctuations of agricultural markets (47).

So the chemurgists may have lost some battles in the 1930s, but perhaps they won the war thereafter. Postwar farm policy became guided more by the interests of large corporations and industrial food processors, and less by those of individual and small family farmers; similar shifts took place with the research agenda on college campuses. Just as agricultural policymakers chipped away at New Deal production control policies, land grant university research also embraced a paradigm that made maximizing farm production its highest priority. University presidents also promoted the postwar aims of using the distribution of food surpluses as tools for world peace, even if it meant low prices on the farm. Actual farmers became increasingly distant from the aims of those who funded research in applied chemistry (48).

Generally speaking, research on bio-based materials at the land grant colleges shifted focus from the macro-level search for simple agricultural substitutes to the micro-level search for valuable components within agricultural products. The case of soybeans illustrates this trend. Researchers no longer touted the soybean as simply a component of animal feeds and vegetable oils, but now also as a source of lecithin, glycerin, alkyd resins, proteins, and the like, products that became raw materials for plastics, adhesives, fire retardants, and ingredients in various prepared food products. Further, most land grant schools participated actively in the Green Revolution, helping to export the entire package of American industrial agriculture to many parts of the developing world.

Now there are signs that new definitions of chemurgic concepts—now better labeled as biotechnologies—

may be making a comeback, and perhaps supported by a different political agenda. The "synthetic narrative" has been called into question, for it seems that applied organic chemistry has not always delivered on its promises. Green chemistry, organic farming, and sustainability are new buzzwords in the hunt for research dollars. A recent ACS publication suggests that two areas of research may become increasingly significant: 1) the search for value in the byproducts of food production, and 2) research on plants specifically grown as non-food sources of biomass and raw materials (49). Moreover, many citizens are now embracing a broader view of agricultural research, one that suggests that the goal of rural and dietary improvement can outweigh that of simply increasing farm productivity. Some observers wonder if we may have gone far enough in our search for ever more emulsifiers, binding agents, flavor extracts, and manipulated sugars and proteins from corn and soybeans. Once again, questions about how farm products are to be used, who is to profit from their production, and who decides, are issues at the center of popular and political debates over science policy.

Thus the history of the chemurgy movement offers a useful illustration of the challenges involved in the integration of science, agriculture, and industry on the land grant college campuses. The debates that took place in the 1930s suggest that chemurgy was not a minor movement dominated by a few idiosyncratic personalities in the chemical industry, but something that land grant university presidents and college deans needed to carefully consider. Also, questions over the fate of chemurgy at the land grant institutions addressed fundamental questions regarding the place of chemistry and other sciences at the public universities, and they therefore remain pertinent today. Nowadays, with the land grant schools enrolling nearly five million students and landing nearly two-thirds of the federal research dollars, these institutions are again at the center of the links between agricultural and scientific research (50). In today's political climate, with public funding for higher education hanging from an ever thinner thread, it might be worthwhile to reconsider the original aims of the Morrill Act, to respect the healthy discussions over chemurgy and related issues of the 1930s, and to hope that there may be ways to keep the interests of chemists, farmers, and other constituents in some kind of balance in the future.

Acknowledgements

I would like to thank Scott Randolph, Becky Jordan, Mark O'English, Matthew Harris, David E. Hamilton, and Stephen Weininger for their help with this project.

References and Notes

1. Presented at the 244th National Meeting of the American Chemical Society, Philadelphia, PA, August 20, 2012, PRES 3.
2. J. Swift, *Gulliver's Travels* [online], http://www.literaturepage.com/read/gulliverstravels-110.html (accessed Dec. 27, 2013).
3. W. W. Parrish and H. F. Clark, "Chemistry Wrecks the Farm," *Harper's*, **1935**, *171*, 272-282.
4. A. I Marcus and E. Lokensgard, "Creation of a Modern Land-Grant University: Chemical Engineering, Agricultural By-Products and the Reconceptualization of Iowa State College, 1920-1940," in A. I Marcus, Ed., *Engineering in a Land Grant Context: The Past, Present, and Future of An Idea*, Purdue University Press, West Lafayette, IN, 2005, 27-48. On the depression's impacts upon land grant colleges see E. D. Ross, *A History of Iowa State College*, Iowa State College Press, Ames, 1942; E. A. Moyen, *Frank L. McVey and the University of Kentucky: A Progressive President and the Modernization of a Southern University,* University of Kentucky Press, Lexington, 2011.
5. J. A. Johnson and R. MacLeod, "The War the Victors Lost: The Dilemmas of Chemical Disarmament, 1919-1926," in R. MacLeod and J. A. Johnson, Eds., *Frontline and Factory: Comparative Perspectives on the Chemical Industry at War, 1914-1924*, Springer, Dordrecht, 2006, 221-245.
6. D. J. Rhees, "The Chemists' Crusade: The Rise of an Industrial Science in Modern America, 1907-1922." Ph.D. diss., University of Pennsylvania, 1987, 286-97; and G. M. Reed, *Crusading for Chemistry: The Professional Career of Charles Holmes Herty*, University of Georgia Press, Athens, 1995, 219-256.
7. K. Steen, "Patents, Patriotism, and 'Skilled in the Art': *USA v. The Chemical Foundation, Inc*., 1923-1926," *Isis*, **2001**, *92*, 91-122; K. Steen, "Wartime Catalyst and Postwar Reaction: The Making of the U.S. Synthetic Organic Chemicals Industry, 1910-30." Ph.D. diss., University of Delaware, 1996. For more on autarky in the United States, see O. W. Willcox, *Nations Can Live at Home*, Allen & Unwin, London, 1935.
8. W. Hale to W. McMillen, May 27, 1938, Box 2, Folder 12, William J. Hale Papers, Michigan State University, East Lansing.
9. J. F. Chamberlain, Ed., *Chemistry in Agriculture: A Cooperative Work Intended to Give Examples of the Contributions Made to Agriculture by Chemistry,* Chemical Foundation, New York, 1926.

10. W. J. Hale, "Farming Must Become a Chemical Industry," *Dearborn Independent*, Oct. 2, 1926; W. McMillen, "Wanted: Machines to Eat Up Our Crop Surplus," *Farm and Fireside*, Jan. 1927, pp 10, 30; G. M. Rommel, *Farm Products in Industry*, Henkle, New York, 1928; and H. G. Knight, "Training in Chemistry to Meet the Needs of the Present Agricultural Situation," *J. Chem. Educ.*, **1929**, *6*, 886-893. See also M. R. Finlay, "Old Efforts at New Uses: A Brief History of Chemurgy and the American Search for Biobased Materials," *J. Ind. Ecol.*, **2004**, *7*, 33-46; A. B. W. Effland, "'New Riches from the Soil:' The Chemurgic Ideas of Wheeler McMillen," *Agric. Hist.*, **1995**, *69*, 288-297; and Ref. 6 (Reed), 220.
11. Ref. 4 (Marcus and Lokensgard).
12. Ref. 4 (Ross), 362-364. For New Deal agricultural policy, see T. Saloutos, *The American Farmer and the New Deal*, Iowa State University Press, Ames, 1982.
13. On the role of the spring 1935 ACS meeting, see Hale to W. McMillen, Jan. 23, 1946, Box 2, Folder 12, Hale Papers.
14. W. Hale, *The Farm Chemurgic: Farmward the Star of Destiny Lights Our Way*, Stratford, Boston, MA, 1934.
15. *Proceedings of the Dearborn Conference of Agriculture, Industry and Science, Dearborn, Michigan, May 7 and 8, 1935*, Chemical Foundation, New York, 1935. See also A. W. Giebelhaus, "Farming for Fuel: The Alcohol Motor Fuel Movement of the 1930s," *Agric. Hist.*, **1980**, *54*, 173-184; D. E. Wright, "Alcohol Wrecks a Marriage: The Farm Chemurgic Movement and the USDA in the Alcohol Fuels Campaign in the Spring of 1933," *Agric. Hist.*, **1993**, *67*, 36-66; R. Beeman, "'Chemivisions:' The Forgotten Promises of the Chemurgy Movement," *Agric. Hist.*, **1994**, *68*, 23-45; D. R. Duke, "Leo Christensen: A Biography of the Founder of Ethyl Alcohol in the United States." Ph.D. diss., St. Louis University, 1992.
16. Williams to H. E. Barnard, June 4, 1935, Box 407, Folder 5, Francis P. Garvan Papers, American Heritage Center, Laramie, Wyoming (hereafter Garvan Papers).
17. O. R. Sweeney to C. B. Fritsche, May 27, 1935, Box 407, Folder 5, Garvan Papers.
18. C. W. Purcell Jr., "The Administration of Science in the Department of Agriculture, 1933-1940," *Agric. Hist.*, **1968**, *42*, 231-240.
19. Barnard to W. W. Buffum, June 7, 1935, Box 407, Folder 5, Garvan Papers.
20. W. McMillen, "New Work for Agriculture," Speech at Athens, Georgia, Aug. 13, 1935, Box 6, Folder 1935, Wheeler McMillen Papers, University of Oregon Library, Eugene.
21. C. B. Fritsche to F. P. Garvan, July 31, 1935, Box 408, Folder 3, Garvan Papers; and F. L. McVey, Diary entry of 8 July 1935, Frank L. McVey Papers, University of Kentucky Archives, Lexington (hereafter McVey Papers).
22. Ref. 21 (Fritsche to Garvan).
23. C. B. Fritsche to W. W. Buffum, [undated notes from a visit to South Dakota, Aug. 19, 1935], Box 408, Folder 4, Garvan Papers.
24. C. B. Fritsche to W. W. Buffum, [undated notes from a visit to Colorado, Aug. 24, 1935], Box 408, Folder 4, Garvan Papers.
25. C. B. Fritsche to W. W. Buffum, [undated notes from a visit to Utah, Aug. 27-28, 1935], Folder 4, Box 408, Garvan Papers.
26. C. B. Fritsche to W. W. Buffum, [undated notes from a visit to North Dakota, Sept. 2-3, 1935], Folder 4, Box 408, Garvan Papers.
27. C. B. Fritsche to W. W. Buffum, [undated notes from a visit to Wisconsin and Minnesota, Aug. 16-17, 1935], Folder 4, Box 408, Garvan Papers.
28. On technological unemployment, see A. S. Bix, *Inventing Ourselves Out of Jobs? America's Debate over Technological Unemployment, 1929-1981*, Johns Hopkins, Baltimore, MD, 2000.
29. C. B. Fritsche to W. W. Buffum, Sept. 11, 1935, Folder 4, Box 408, Garvan Papers.
30. Ref. 3. Reprinted and excerpted in *Reader's Digest*, **1935**, *27*, 31-35.
31. F. L. McVey, "The High Obligation of the Land-Grant College and University," in *Proceedings of the Forty-Ninth Annual Convention of Association of Land-Grant Colleges and Universities*, Cann, Wilmington, DE, 30-36. Agricultural Secretary Wallace also understood the political significance of this meeting, choosing it to unveil the government's new emphasis on soil conservation, rather than direct production controls, as a way to limit total production. See H. A. Wallace, "The States, The Regions, and the Nation," in *Proceedings of the Forty-Ninth Annual Convention*, 38-46; and R. S. Kirkendall, *Social Scientists and Farm Politics in the Age of Roosevelt*, Iowa State University Press, Ames, 1966, 138.
32. F. L. McVey, Diary entry of Nov. 19, 1935, McVey Papers.
33. R. E. Buchanan, "Chemistry: Friend or Foe?" Paper delivered at the November 1935 meeting of the National Association of Land Grant Colleges and Universities, in Box 51, Dean of Agriculture Files, Washington State University, Pullman (Hereafter Dean of Agriculture Files).
34. W. McMillen, "The Program of the Chemurgic Council," in *Proceedings of the Forty-Ninth Annual Convention* (Ref. 31), 244-247.
35. C. A. McCue to W. M. Buffum, Dec. 9, 1935, Folder 40, Box 228, Garvan Papers.
36. E. C. Johnson to G. E. Thornton, Feb. 13, 1936, Box 51, Dean of Agriculture Files.
37. E. C. Johnson to R. E. Buchanan, Mar. 21, 1936; E. C. Johnson to T. P. Cooper, Mar. 23, 1936; L. E. Call to E. C. Johnson, Mar. 27, 1936; T. P. Cooper to E. C. Johnson, Mar. 28, 1936; R. E. Buchanan to E. C. Johnson, Mar. 31, 1936, all in Box 51, Dean of Agriculture Files. These letters represent a portion of Johnson's correspondence with land grant college officials in Washington, Kansas, Kentucky and Iowa.
38. D. S. Tarbell and A. T. Tarbell, *Roger Adams: Scientist and Statesman*, American Chemical Society, Washington, DC, 1981, 109-110; and various entries in *Proceedings of*

the Second Dearborn Conference of Agriculture, Industry, and Science. Dearborn Michigan, May 12, 13, 14, 1936, Chemical Foundation, New York, 1936.
39. C. W. Pursell Jr., "The Farm Chemurgic Council and the United States Department of Agriculture," *Isis*, **1969**, *60*, 307-317.
40. H. A. Wallace to F. P. Garvan, May 25, 1936, Box 518, Folder 3, Garvan Papers.
41. M. R. Finlay "The Industrial Utilization of Farm Products and By-Products: The USDA Regional Research Laboratories," *Agric. Hist.*, **1990**, *64*, 41-52.
42. *Congressional Record*, Congress 75, Session 2, Dec. 17, 1937, 1722-1729.
43. J. Starnes to J. T. Jardine, Oct. 12, 1938, Box 1, Folder 7, Luther Noble Duncan Papers, University Archives, Auburn University, Auburn, AL. See also J. T. Jardine to L. N. Duncan, Aug. 26, 1938, in ibid.
44. For instance, university officials in Georgia stated it would "be a calamity" if the station were not placed in their state. "Seeks Experiment Station in State," *Savannah Morning News*, Mar. 2, 1938, p 3.
45. H. G. Knight Diary, Dec. 7, 1938, Special Collections, National Agricultural Library, Beltsville, MD.
46. J. N. Friant to H. A. Wallace, Dec. 8, 1938, J. N. Friant Papers, National Agricultural Library, Beltsville, MD.
47. Ref. 10 (Finlay).
48. A. R. Olpin, "The Value of Chemurgic Research" *Chemurgic Digest*, **1948**, *7*, 13-14. See also H. L. Walster to W. McMillen, May 23, 1941, Box 4, Andresen–HR 4591 File, McMillen Papers.
49. G. Fuller, T. A. McKeon, and D. D. Bills, "Nonfood Products from Agricultural Sources," in *Agricultural Materials and Renewable Resources: Nonfood and Industrial Applications*, American Chemical Society, Washington, DC, 1996, 2-10.
50. C. P. Loss, "Why the Morrill Land-Grant College Act Still Matters," *Chronicle Higher Educ.,* July 20, 2012, p. A17.

About the Author: *In Memoriam*

"Mark Finlay is a Professor of History at Armstrong Atlantic State University. His publications include articles on Justus von Liebig, on the chemurgy movement, and on other aspects of the history of agricultural science. His 2009 book, *Growing American Rubber: Strategic Plants and the Politics of National Security* won the Theodore Saloutos Memorial Award as the best book published that year in the field of agricultural history." Those were the author's own words about himself, requested by the editor to put at the end of his contribution to this issue. His unexpected and untimely death in October 2013 calls for additional words of remembrance and appreciation.

Mark Finlay was born in 1960. He received his collegiate and post-graduate education in Iowa, at Grinnell College and Iowa State University respectively. Since 1992, he was a member of the history department at Armstrong Atlantic State University in Savannah, Georgia. He rose through the academic ranks, making and maintaining an impressive reputation in agricultural history. At the same time, he founded and directed the university's honors program and served as Assistant Dean of Arts and Sciences. He was co-winner of the Liebig-Wohler Friendship Prize in 1995 for his contributions to the study of the history of German chemistry. In 1999 he was selected from all of the professors at Georgia's public universities as the winner of the State of Georgia's Regents' Teaching Excellence Award. His service to the profession included the positions of book review editor of *Agricultural History* and affiliation with the National Historic Chemical Landmarks (NHCL) program of the American Chemical Society. He was killed in an automobile accident on his way back home after an NHCL meeting in October 2013.

Mark Russell Finlay was survived by his wife of 26 years, Kelly Applegate, and two sons, Greyson and Ellis. A Visiting Lecture Series has been established at Armstrong Atlantic in his memory.