DEBORAH FITZGERALD

EVERY FARM A FACTORY

The Industrial Ideal in American Agriculture

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Every Farm a Factory

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To Eric and Jake

Contents

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Introduction

In the mid-1980s, a disturbing phenomenon began occurring in rural America. In the preceding decade or so, many families had been counseled by farm advisers and agricultural business dealers to enlarge their farms, increase their herds, and purchase bigger, more sophisticated machinery so that they could take advantage of an exploding world market for American farm products. Many families were happy to oblige, taking out sizable loans to expand their operations. After a few years, however, market slowdowns became contractions, and many families ultimately found themselves unable to sell all that they had produced on the farm, at any price. This "farm crisis" was devastating to many families who had long prided themselves on their conservative business dealings and good judgment. Caught in an impossible financial bind and facing public humiliation, a number of farmers lost their farms, and many lashed out at those in their communities who seemed blameworthy, particularly bankers. Quite a few farmers committed suicide. Those of us in the cities could only wonder what had gone wrong. Why would farm families overextend themselves so dramatically? Why would they take out loans that they could not live long

enough to repay? Why were they investing in expensive livestock confinement systems or sophisticated field machines when they were already in debt?[1]

For the rural historian, this tragedy and the crazy logic it represented seemed to echo an earlier collapse, the farm crisis of the 1920s. Although the 1910s marked a period of rural stability and general market expansion, particularly of foreign markets during World War I, the years immediately following the war brought thousands of farm bankruptcies and extreme turmoil to the countryside. Consumer prices climbed while farm incomes dropped, and farmers who had bought land at high prices during the good years found themselves in dire straits by 1921. Then, as more recently, city people in particular shook their heads: What were those farmers thinking when they paid so much for land and equipment, and why didn't they plan for the inevitable future downturns? Were they simply incompetent, in which case perhaps their farm failures were really for the best, or were they speculators who knew little about farming practice and would simply move on to the next investment, or were they sensible farmers who had somehow gotten in over their heads?

Our understanding of what happened to farm families, and what was going on in agriculture generally, has been shaped by several lines of reasoning. Until recently, economists have dominated the literature that links twentieth-century agricultural production with its socioeconomic consequences. This approach tends to view farmers as rational actors who make informed, if sometimes foolish, choices. In this framework, farmers are seen as abstract producers rather than particular people in particular circumstances. Economists can explain what happened in large agricultural categories quite nicely—why, for instance, dairy farmers continue to produce too much milk even when prices are low, or why contour farming fell out of favor in the 1970s. The economist, however, is less concerned outside of a quantitative frame with why these things happened. But why do farmers behave in ways that economists would consider not in their own best interests?[2]

Another, more compelling approach comes from social scientists interested in political economy, particularly in the logic of capital. For example, in trying to account for the uneven pace of agricultural industrialization in the twentieth century, David Goodman, Bernardo Sorj, and John Wilkinson argue that because agricultural processes are biological and therefore somewhat unpredictable, capital was unable to completely industrialize the agricultural sector in one fell swoop. Instead, industry took over and remade discrete elements of agricultural production: tractors replaced horses, synthetic fertilizer replaced manure, and so forth. Discrete activities were thereby transformed into industrial prac-

tices and reintroduced onto farms as inputs, an operation these scholars call appropriationism. This description of rural transformation seems to capture the piecemeal way in which much of agriculture has been changed, but it, too, fails to address the larger ideological framework within which such operations occur.[3]

Many historians have told such stories of agricultural success and disappointment in the early twentieth century from the perspective of farm families themselves. How have farm families dealt with the market changes, technological innovations, and demographic shifts that have characterized modern rural life? Historians such as Mary Neth, Hal Barron, Jane Adams, and Ron Kline have tried to explain how farm families both resisted change and accommodated themselves to transformations that threatened to either destabilize their worlds or provide welcome relief and support. The introduction of the automobile, rural free delivery of mail, telephones, electricity, and farm machinery all presented opportunities and challenges, some of which were immediately apparent to rural people and some of which were discovered only later. These stories are fascinating and sobering accounts of transformation and persistence in which rural families relied upon their personal relationships with others in the community for guidance and support. Connections among immediate and extended family members, community leaders, neighbors, and religious and school groups combined with a community's traditions, preferences, and history, binding people together and giving them a reference point from which to evaluate prospective changes and make sensible choices.[4]

But it seems to me that these approaches miss a fundamental feature of twentieth-century agriculture, and that is the emergence of an industrial logic or ideal in agriculture. Beginning in the 1920s, farmers and their families had to contend with a new set of opportunities and constraints, most of which grew out of the new industrial production systems. These systems, epitomized by the modern mass production factory and industrial boardroom, linked capital, raw materials, transportation networks, communication systems, and newly trained technical experts. Interconnected and often sprawling, these systems of production and consumption functioned like grids into which fit the more identifiable components of industrialization—the tractors, paved roads, bank credit, migrant labor, and commodity markets. In 1925, Benton MacKaye referred to an "industrial web" and a "physiology of industrial empire" to describe the flow of raw materials, products, markets, and resources that tied American sectors and regions together. It was this system that farm families were resisting and accommodating. It was the source of their concerns, apprehensions, jubilation. It was

the matrix within which a family in Nebraska bought their first tractor, or an investor in Kansas bankrolled the purchase of land and combines for growing wheat on a large scale, or fruit growers in California created and maintained a national system for transporting and marketing pears. It was this system within which farmers were persuaded to buy extra land or begin raising hogs in confinement sheds in the 1980s. My argument is that although individual technologies, particular pieces of legislation, new sorts of expertise, and the availability or disappearance of credit opportunities are all key to understanding what happened in twentieth-century agriculture, it is essential to grasp the overarching logic of change that was taking place in bits and pieces and the industrial system that was being constructed across the country. In spite of the genuine differences farmers and growers faced from one part of the country to another and the individual choices they made, the systemic issues were the same.[5]

I am using the term industrial to describe this process for several reasons. This may seem a peculiar definition to some readers. After all, there weren't really any factories in agricultural production, nor were there assembly lines, time clocks, union dues, or mass production. There wasn't much iron or steel, either. Or was there? Indeed, over the course of the twentieth century, large parts of agricultural production have taken place in factories (for example, confinement poultry and hogs), assembly lines have been developed in harvesting virtually all crops in which the product is stationary and the humans and machines move, and time clocks in the form of mileage recorders were installed on tractors and combines by 1921. "Union dues" have been paid by many generations of farm workers, whether to the Non-Partisan League or the Farm Bureau, and mass production has been around as long as wheat has been poured into sacks or oranges into crates and shipped out across the country. Many rural and urban leaders at the time also referred to this change as industrial, likening the changes taking place in American agriculture to the British Industrial Revolution: "The hand weavers of England," noted H. A. Wallace, "a little over a hundred years ago, tried to burn the new-fangled factories which were forcing them to adopt a different method of living. As a matter of fact, the early English factories were terrible places. Nevertheless, the outcome was inevitable. Machinery won. The problem was to keep the human values from being damaged any more than possible . . . . It is evident that there are tremendous readjustments to be made in our agriculture during the next fifty years, which will affect each one of us. Those of us who misunderstand what is coming to pass will get hurt."[6] Business and agricultural leaders, many of whom classified agriculture as one of the "sick

industries" of the postwar period, recommended that agriculture should modernize in just the same way as modern factories and business enterprises. Timeliness of operations, large-scale production sites, mechanization, standardization of product, specialization, speed of throughput, routinization of the workforce, and a belief that success was based first and foremost upon a notion of "efficiency"—all these principles were drawn directly from the factories and businesses only recently declared successful. Henry Ford's production facilities, for instance, stood as a dramatic example of the efficacy of rational management techniques, which many felt should now be applied to farming. As an International Harvester promotion exhorted, "Every Farm a Factory."[7]

This process should also be considered industrial because the most prominent and often unnerving elements of this transition were technological and scientific innovations. Indeed, the dramatic changes in twentieth-century farming were usually described as stemming from the twin forces of science and technology, in the form of tractors, hybrid seeds, pesticides, electrification, and so forth. Yet no single innovation created the revolutionary context; rather, each was located within a matrix of technical, social, and ideological relationships that both created and sustained the change. Each innovation depended on other technologies, credit systems, transportation systems, family relationships, tax base, and legislative support, to name a few. When a farmer adopted a tractor, for example, he tacitly adopted a whole host of other practices and entered into a new set of relationships. He had a financial relationship with the banker who loaned him the money for the machine and with the tractor manufacturer whom he paid. He worked with the closest tractor dealer when something went wrong and often needed the help of local hardware dealers, handymen, and mechanics. Because his tractor would not run on oats as did his horse, he needed a ready source of gasoline or, more likely, kerosene, as well as lubricating oil. Now that he did not need oats, he needed to do something else with his oat fields, which may have entailed more innovation. Farmers with tractors often recalibrated their working relationships with sons and hired men, nervous about letting them drive this expensive and temperamental piece of equipment. These farmers also found themselves in new relationships with neighbors, who kept close tabs on the machine's potential for their own fields. Finally, tractor-owning farmers may have found themselves suddenly more interested in other community issues, such as whether to pave the roads, or raise taxes, or agitate for railroad reform, both because it would affect them differently now and because their financial obligations and potential were changed.[8]

Science, technology, and the spirit of rationalism that characterized indus-

trial agriculture were created and maintained by a new class of people and institutions whose principal purpose was to modernize the whole agricultural enterprise. To a large extent, these were the same people who Ellis Hawley refers to as the emergent business organizers and associationists of the postwar period, those who, as Hoover put it, would "synchronize socially and economically this gigantic machine that we have built out of applied science." In the 1920s, those who carried this message most effectively were economists, farm managers, employees of agricultural colleges, and particularly farm and home demonstration agents, rural banks and insurance companies, and agricultural businesses such as those centered on farm machinery and seeds. These agents of industrialism were scattered around the country relatively evenly; insofar as every state had an agricultural college and most towns had a bank, one could readily find "modernizers" in the countryside. Some parts of the country, however, were richer in effective agents than others because local conditions affected both the size of a college and that college's outreach efforts. In the deep south, for example, the spirit of industrialism was much less prominent than it was in the midwest or far west, and agricultural transformation did not happen in the south as early as it did in Montana. Similarly, although the eastern market farms were older and more established than, say, the California orchards, these two regions differed substantially in their industrial potential and followed different paths at different rates.[9]

Likewise, connections among the various components of industrialization developed in different places at different times in the twentieth century, although these relations did follow a fairly regular pattern. Several scholars have used the notion of "gridded spaces" to describe the combination of a quantitative logic with a material anchoring of space that characterized these patterns. Railway lines, cadastral maps, and roads that created rural "sections" all represented the states' efforts to make space legible, manipulatable, and tamed. In her provocative comparison of Montana and Kazakhstan, Kate Brown shows how "the grid evolved just as the territories were being swept into the larger industrial and agricultural economies of the two expanding states in eras of superlative industrial and bureaucratic expansion." Frequently the opening wedge of industrialization was mechanization of farm work, and in the 1920s most of this activity centered on the development of reliable farm tractors and combines. In turn, farm mechanization occurred first where it was easiest to accomplish, and throughout the world this happened to be on wheat farms. In America, too, it was in the wheat-growing regions of the Dakotas, California, and the Great Plains that industrialization first began, and if the agricultural revolution con-

sisted only in mechanization, the process may have stopped there, at least until another machine was developed for other crops. But enthusiasts of this new industrial logic, the engineers, bankers, economists, and federal agents, saw the industrialization of wheat not just as a solution but as a breakthrough. Now the lessons learned with wheat could be applied to other crops, in other places. A recipe for modernization seemed written in the very process. The great success of mechanizing the wheat harvest led manufacturers to develop machines to harvest other grains, vegetables, and fruits, and new machines were developed to mechanize planting and cultivation. Those who raised crops other than wheat began to wonder if they could achieve the same gains as wheat farmers by emulating their practices, whether that be mechanization, expansion, cost accounting, or specialization. Corn farmers followed a different path than wheat farmers, but within about twenty years of the first industrializing efforts they ended up in the same industrial system. And so it went for other farmers and other crops and livestock.[10]

In this book I trace the diffusion of industrial agriculture by looking closely at the main components of this process in its first generation, between 1918 and 1930. The story begins in 1918 because a number of new, large-scale farms began operation then and were described in the national press as bellwethers of a new industrial farming era. The number of these farms continued to grow through the 1920s, peaking in 1929. Although my examination concludes at 1930, this is an artificial break, reflecting the end of the first phase of industrial agriculture. The Depression and New Deal mark phase two, a period in which the transformations of the 1920s, for the most part, were strengthened through new federal programs. In Chapter 1, I will set the stage by exploring the contextual gridwork on which this transformation from traditional to industrial agriculture hung. First, I discuss the great diversity of American rural landscapes and the farm products that came from them, as well as their amenability to the industrializing push; second, I examine the role of World War I in destabilizing both farm production and rural expectations; and third, I turn to the intriguing and ultimately irresistible attraction of new factories and businesses that promoted rational management and mechanization and that seemed a fitting model for agriculture. In Chapters 2 and 3 I discuss the development of two metrics that were used to frame and maintain the industrializing impulse: quantification and mechanization. Chapter 2 centers on the emergence of agricultural economics as an academic discipline and on farm management as its practical application in farm communities and federal agencies. Although some farmers had kept close track of their costs and income for many years preceding the 1920s, it was

in the early part of the period that this practice was first vigorously promoted by federal and state agencies as well as by rural banks. This emphasis on quantification and efficiency paved the way for what experts called a more rational and businesslike farming system. Chapter 3 then looks at the professional growth of agricultural engineering and the emergence of farm machines in the 1920s. Here again, not only did tractors and other machines become available, but a professional group was created and maintained whose goal was to mechanize agriculture more generally. Chapters 4, 5, and 6 move on to the consequences of this industrial logic, offering more detailed examples of how this played out in the country. In Chapter 4 I consider the emergence of corporate or large-scale farms, the most visible example of the changes. Not all such farms were industrial in exactly the same way, but all were considered unusual for their grasp of modern techniques and approaches to production. Chapter 5 examines one of these farms in detail. The Campbell Farming Corporation in southeastern Montana was a clear exemplar of this industrial logic and was one of the most successful of these farms. Finally, in Chapter 6, I consider the international dimensions of early industrial agriculture, as ideas and techniques developed in America were used in establishing the collective farms in the Soviet Union, where the seemingly universal components of industrial agriculture were explored as if place, politics, and history were trivial details of agricultural practice, easily ignored in the interests of an industrial order.

My argument has two layers; one is general and the other is specific to one locality. I maintain that an agricultural leadership emerged in the 1920s—composed of business leaders, government agents, agricultural college professors, demonstration agents, and bankers—and that this leadership developed an industrial logic for agriculture. This logic functioned as a matrix of ideas, practices, and relationships that persuaded farmers to change the way they did things. This set of practices and relationships was explicitly modeled on factory and business practices that were familiar to this leadership and that were being trumpeted in the press during the postwar period. Although this industrial logic was successful in transforming rural America, this change did not occur exhaustively and all at once. It was, in fact, the foundation on which modern agribusiness was built. The local part of my argument could have been drawn from several places, most notably the Kansas wheat fields, the Louisiana rice fields, the California fruit industry, or the Montana wheat fields. I chose to focus on Montana for several reasons. First, wheat was to the industrial revolution in agriculture what textiles were to the industrial revolution in factory production. Wheat was the first agricultural product to be successfully industrialized,

and it served as a model for all other farm products. Montana was in many ways typical of the new wheat territories both in the United States and abroad, in that it was fairly isolated, dry, flat, undeveloped, and of marginal utility for traditional farming. Second, one of the most successful industrial farms—the Campbell Farming Corporation—was located in Montana. As one of the longest-lived industrial farms (it survived until Campbell's death in the 1960s) and as one explicitly operated along factory lines, it deserves a closer look. Third, one of the agricultural college economists most devoted to the problem of land use and mechanization, M. L. Wilson, was located in Montana, and while he was there conducted an important experiment on the problems associated with industrial farming. Thus, Montana is a good base camp for this story. Readers are reminded, however, that just as Manchester, England, was not the sole site of the British Industrial Revolution, nor Lowell, Massachusetts, the only site of the American Industrial Revolution, so rural Montana was not the only place where the details of agricultural industrialization were worked out. All these places happened to have the right ingredients—geography, climate, capital, entrepreneurs, laborers—to sponsor the first volleys of their respective revolutions. Although they were not uniquely suited to this task, they are the places we must investigate more deeply in order to understand the iconic shape of the changes that followed.

Chapter 1 The Industrial Ideal in American Agriculture

It is ridiculous to assert that agriculture is too tough a nut for the corporation to crack in this day of consolidation of railroads, factories, bakeries, milk distribution, cleaning and pressing, and even beauty parlors.
—*E. G. Nourse,* 1929

When people travel from one part of the United States to another, one of the first things they usually notice is the change in landscape. Flying over the great middle of the country, one sees the checkerboard pattern of farm fields, most with glints of metal in one corner marking the house and outbuildings. In the western part of the country, the irrigation circles paint an oddly modernist picture. The Great Lakes, so much bigger on first sight than one expects from geography class; the northern woods and southwestern desert; and everywhere houses sitting by themselves in the countryside, surrounded by meadows, crops, and livestock. In spite of all the things humans have done to the American landscape over the years, the diversity is genuine. Although all midsize towns, regardless of landscape, can support a Gap or a McDonald's, they can't all grow peaches, or timber, or soybeans—not even chickens can be raised everywhere. The spread of mass culture may

seem to be homogenizing the experience of Americans, but there are limits. Climate and landscape still matter in agriculture and agrarian life, and these differences across the country still account for the diversity of food and fibers Americans enjoy.

And yet, thanks to the food-processing industry, the transportation network, and energetic capital flows, most people in America can eat whatever they want, whenever they want, regardless of their location. A dozen kinds of chile peppers can be found in Des Moines, fresh salmon in Amarillo, fresh-squeezed orange juice in Wisconsin, pork in San Francisco, avocados in Boston. The physical limitations imposed by nature have been circumvented by the endless possibilities of technology and science, and these in turn have transformed both farmers' and consumers' experiences. That has been the paradoxical story of American food and agriculture in the twentieth century: fewer people than ever before produce all the food. Whereas not so long ago most farmers grew a variety of crops, now most farmers grow just one or two. And although farmers have become more specialized in what they grow, consumers have become more diversified in what they eat. As a result of increasingly elaborate transportation and communication systems, food travels in a seemingly uninterrupted stream. The fact that so much of the produce that Americans eat now originates in southern countries is further testament to the powerful reach of a scientific and technological ethos.

The sheer diversity of landscapes and climates in America, as well as the diversity of crops and livestock and humans, discredits the idea of a monolithic American agricultural aggregate. The secretary of agriculture's *Annual Report* from 1924 is hundreds of pages long, mentioning nearly everything that had happened of moment during the year: Cotton production is down due to late planting, but the acreage is higher. American farmers can't grow enough raw cotton for domestic and foreign demand. Potato production is up although acreage is down; sugarcane is yielding less than before; an excess of beef cattle on the market is depressing prices; prices for sheep and wool are high owing to low world supplies; tax delinquency has increased; egg standardization is being introduced; cooperative marketing is on the rise, which the USDA approves; radio broadcasts of weather forecasts have been introduced, offering farmers their first up-to-date weather information; more truck crops are being grown in California; because of a wet spring, less corn was planted; Black labor is drifting away from the South.[1]

But it was this very diversity, in fact, that made some people so keen to organize, rationalize, and *industrialize* American agriculture. It was not something that happened because some farmers bought tractors, or some financiers raised

money for an experimental farm. In American agriculture, industrialization began as a logic of production, almost a philosophy. For some it was a principle that unified a disparate collection of observations, practices, and problems. For others it was a road map that offered directions from old-fashioned traditionalism to modernity. For still others it was a mantra that promised far more than it could deliver. Like all futurist philosophies, the logic of agricultural industrialism ran up against certain natural realities: oranges don't grow in Duluth, not all kinds of farms should get bigger, farmers often know more than bankers. For those who believed in this new production logic, however, it was important to push this approach just as far as possible. Surely it would work better in some places, with some kinds of crops and certain kinds of farmers, than with others; this was true of industrial production in general, so why should agriculture be any different? Their point was to try, to push, to rationalize as if it would succeed. And often it did.

Before we can understand how this worked, we need to consider three things. First, the hard realities of American agricultural diversity presented many challenges to those who would industrialize the country's productive efforts. Why did some crops and regions industrialize while others did not? A brief regional tour will help explain this. Second, World War I had a powerful effect on American farmers, both during the war and especially in the years immediately following it. We will take a closer look at the way in which the war set the stage for the growth of an industrial web in the 1920s. Finally, we will consider the historical context in which industrialization seemed like such a good idea, focusing particularly on the factory system and the industrial logic that grew out of successful factories. These were the principles that informed the most rudimentary efforts to "make farming modern."

THE AGRICULTURAL LANDSCAPE

Although farmers in most of the colonial regions of early America grew whatever conditions would allow and although most settlers moving west and south tried to grow what they liked best, there were some practical reasons for abandoning certain crops and livestock and taking up new things along the way. To begin with, New England was never likely to be a land of large, monocultural farms. The region's short growing season, rocky soil, irregular topography, and early-developing population centers all contributed to a different outcome. By the late nineteenth century, most New England farmers were producing for urban markets, concentrating on dairy products and then on fruits, vegetables,

and nuts. The middle Atlantic and "Delmarva" states followed suit, shifting from grains and other staples toward the vegetables, fruits, dairy, and poultry that growing urban centers demanded. By the late nineteenth century, it made no sense to try and compete with the grain and livestock farmers of the upper midwest and far west, whose gigantic acreages and use of machinery made eastern-style grain farming uneconomical. What came to be called the Atlantic Coast truck farming belt, stretching from Maryland to Maine, was thus created by a combination of urban necessity, climatic opportunity, and emerging competitive challenges from newly opened land further west. This region, as we shall see, was among the last to be industrialized.[2]

In the middle southern states of Kentucky, North Carolina, and Tennessee, pockets of commercial production of tobacco, cotton, and grain were surrounded by small, less productive farms. In the hill country, where soil was poor and eroded, farming was difficult and uncertain, even for subsistence farmers. The main crop in these parts was corn, used locally for food and feed. Farther south, in Florida, Georgia, Alabama, Mississippi, Arkansas, Louisiana, Texas, and South Carolina, there were also pockets of commercial production. Citrus and sugarcane in Florida, rice in Louisiana, and nuts, fruit, and corn in Georgia were especially successful in certain areas, but again most farmers were not self-sufficient because of the pressure to produce for the market.[3]

Of course, cotton was the primary crop in the deep south; in 1920, 74 percent of the farmers in this area grew cotton. Certainly the soil and climate were suitable for cotton, but the persistence of cotton's dominance can't be explained by this alone. One significant reason, according to Gilbert Fite, was landowners' insistence that their tenants grow cotton rather than other crops, because there was always a cash market for cotton and because tenants could not eat those potential profits. After World War I, when agricultural promoters began to push for more industrialized farm methods, cotton growers did not mechanize or in any way industrialize the cotton fields. As late as 1937, a visiting researcher would write, "Moses and Hammurabi would have been at home with the tools and implements of the tenant farmer. There is nothing complicated about one-horse gears, single-stock plows, long-handled hoes, double-blade axes, and a long sack to drag through the field at picking time."[4]

Although growers were interested in developing a cotton-picking machine, it turned out to be a frustrating and elusive goal. One disincentive was the large supply of cheap labor. Cotton was a labor-intensive crop, not only during picking time at the end of the season, but also during planting and cultivating times. Because growers needed labor for picking—the most laborious task of the sea-

son—they had little incentive to invest in machines to help with the easier, and earlier, tasks of cultivating and planting; as growers figured it, laborers needed something to do while waiting to pick at season's end. In addition, southern banks traditionally did not offer credit to farmers interested in mechanizing or expanding, and there was not much capital around in any case. This began to change in the 1930s, when federal programs offered lower-priced credit, but by the late 1930s most farmers still used a one-horse planter.[5]

There was no lack of research on picking machinery. In the 1920s, a picking machine was developed in Texas that stripped the bolls from the plant, but unfortunately it also collected what most growers considered an unacceptable amount of dirt and trash, and it was not adopted outside of west Texas. Two independent researchers as well as the company International Harvester were experimenting with a spindle-type picker; Mack and John Rust began this work in the 1920s, and International Harvester developed a machine in the late 1930s, but its production was interrupted by the war. In postwar years, sales of the machine were slowed by the need to further develop and largely redesign the cotton production process: new types of cotton were necessary to carry bolls at higher, machine-pickable levels on the plant; gins had to be redesigned to accommodate the new cotton types; and herbicides had to be used in large quantities so that the new machines would be protected from the debilitating effects of trash and weeds in the works. Clearly, when cotton picking was mechanized, it was also industrialized, as the basic process was modified and elaborated to accommodate the new capabilities and requirements of the machinery.[6]

In contrast, rice production followed an industrial path relatively early and in many ways resembled wheat in its adaptability to mechanization and labor organization. Pete Daniel explains that there were two kinds of rice farmers in the south in the late nineteenth century: those who grew river rice in the traditional way and those who grew Providence rice on the prairie. Providence rice growers dominated the American market, and when midwesterners moved south to grow rice, they quickly adapted their experience in growing wheat to Providence rice culture. By draining the rice fields before the grain ripened, they could use large mechanical harvesters to bring in the crop, relying at first on the steam traction engines and binders, and by 1914 on the gasoline tractor. As Daniel says, "The highly mechanized state of rice production separated it from other southern crop cultures," such as those for cotton or tobacco. This rice culture also demonstrated the secondary effects of mechanization: rice growers saved considerable time with these methods, freeing entire families from arduous field work and enabling growers to keep their farms in good repair, raise

other crops, and participate in more genteel pursuits such as community work and gardening.[7]

The midwestern states were considered prime farm country; because the soil was rich, the climate temperate, and the rainfall generally adequate, farmers could grow lots of crops. Although traditionally most farms were diversified, with farmers growing a wide variety of grains, fruits, and vegetables, as well as keeping livestock such as cows, hogs, and chickens, by the early twentieth century farmers were concentrating on corn and hogs; by 1939, 80 percent of the farms raised corn, most of which was fed to hogs. Some parts of the midwest did specialize in other commodities. In Wisconsin dairy farming predominated, and in Michigan, Ohio, and Illinois fruit production took hold. It was the midwestern farm that often stood in people's imaginations as the quintessential American farm, and this has led to the erroneous assumption that innovation originated in the midwest. In the case of large farm machines, midwestern farmers generally followed the lead of western farmers, who were in fact the earliest adopters. The relative affluence of farmers in the midwest and the generally flat landscape encouraged these farmers to mechanize once machines were developed. By the end of the 1920s, for instance, 30 percent of farms in Iowa and Illinois had tractors. These farmers were quite different, however, from farmers in the Plains and far west, whose farms were much larger and more "industrial" than those in the midwest. Not coincidentally, farmers in the midwest tended to think of themselves as traditional yet progressive and often boasted of their rural genealogy. Farmers farther west were more often new at farming and tended to see themselves as businessmen.[8]

On the western prairies and Great Plains, farming was a less certain proposition than in the midwest due to the erratic climate, frequent drought, and thin soil. Much of the Plains was considered suitable only for grazing livestock, and this view characterized Texas as well as the mountain states. Corn was the main crop in eastern Nebraska and southeastern South Dakota, but wheat was king in North Dakota, Kansas, Oklahoma, and Montana, all of which had the climate, soil, and most importantly, the topography for large-scale industrial farming in the 1920s. Lured west in the 1870s by cheap land, favorable weather, consistent market demand for wheat, and, especially, promotion by the Northern Pacific Railroad, immigrants to the Red River Valley established the largest farms ever seen in the northern plains. The most successful of them—the Dalrymple Farm, the Amenia and Sharon Land Company, and the Grandin Farm—were between fifty thousand and one hundred thousand acres in size and depended on steam-powered machines to get the crops harvested and threshed. Such large

farms also relied on skillful management; historian Hiram Drache calls them the first factory farms. Although these bonanza farms did not ultimately succeed and were brought down by the region's twin problems of drought and price instability, they were important in shaping the next generation of farming. As historian William Robbins points out, the bonanzas "advertised the agricultural potential of the West, they helped stimulate a large population movement to the northern plains; they speeded up the mechanization of wheat production; and they made the two great rail systems through the country—the Northern Pacific and the Great Northern—paying propositions." Farther west there were pockets of commercial agriculture—sugar beets in Colorado and potatoes in Idaho—but generally the mountain states favored livestock, and few of the Plains or mountain states stayed with diversified agriculture for long.[9]

In the far west, agriculture was characterized by both great diversity and great concentration. In Washington and Oregon, as in parts of the east coast, urban markets generated their own sources of support with dairies and truck farms nearby. In the arid land east of the mountains, farmers focused on wheat and cattle, often on large ranches, and many of these wheat farms resembled the bonanza farms in the Red River Valley, with their substantial acreages and their use of large machinery. But it was in California that farm machinery was first developed on a grand scale and the earliest notions of industrial farming were first cultivated. It was not coincidental that the first large-scale crop was wheat, because wheat was the favorite grain of the mass-production advocates.

Like in the Red River Valley, many of those who grew wheat in nineteenth-century California were land speculators rather than yeoman farmers. As Steven Stoll describes, some of the early "farmers" were actually bankers and investors who, in the 1850s, saw that mining gains were coming to an end and were looking around for new investment opportunities. They began buying land in the Central Valley, leading to a speculative bubble that peaked in the 1870s. Wheat was their crop of choice for several reasons. First, wheat was an ideal crop for absentee landlords because, unlike most other crops, it did not require much tending between planting and harvesting. Second, it grew well in sunny, semiarid climates and needed no expensive and, in California, politically complicated, irrigation system. Third, when planted as a monocrop, wheat's low market price led growers to plant as much as possible, which meant that fields tended to be very large. Fourth, these large fields, located on flat, featureless plains, were wonderfully amenable to mechanization. Donald Pisani points out that growers also favored wheat because it could be shipped great distances without refrigeration, a technology not available until the 1880s. But again, as in the Dakotas, the wheat

boom was pretty much over by 1900. Why? In California, wheat growers were not troubled by drought, but they did suffer from their own overproduction, particularly once Russia, Argentina, Canada, India, and Australia began growing and exporting wheat themselves. In addition, California growers did nothing to improve the fertility of their land, and when wheat yields began to decline, growers moved on to other pursuits such as fruit growing.[10]

Looking at American agriculture overall, then, one sees little technological or industrial activity before 1920. Most farm families, whether owner-operators or tenants, performed all the work themselves, often with the assistance of mules, horses, or hired hands. Wheat and rice production stood out because in those cases large-scale mechanization had been successfully implemented. Fruit production in California also began to operate within the web of industrialization, as growers adopted first the refrigerated railroad cars to move fruit east and then around 1910 developed pre-cooling plants in which fruit was dried and cooled in ammoniated chambers before its trip. As we will see later, the internal combustion engine and especially Henry Ford's mass production approach led to a great flurry of inventive activity in the late 1910s; there were even some tractors available by 1915. But it was not until the 1920s that a serviceable tractor was on the market, at which point farmers began using them in earnest. This, in turn, led to more machinery and more industrial behavior on everyone's part. But generally speaking, industrial activity in the period before 1920 was limited to those crops with growth characteristics amenable to scale, mechanization, and rationalization. As the 1920s unfolded, this situation would change dramatically.[11]

THE EFFECTS OF WORLD WAR I

The years leading up to the war have been called the "golden age of agriculture," because farmers experienced the unusual combination of high prices for their products as well as encouragement to expand their productive capacities. Fueled primarily by the growth of urban centers and the resultant demand for more food, farmers were happy to oblige. Although the price of farmland rose by an astonishing 70 percent between 1913 and 1920, most farmers and lenders threw themselves into the business of abundant production. The war in Europe, and then America's entry into the war, only increased this commitment to expansion. Rural banks and life insurance companies financed real estate loans to farmers who expanded their landholdings to accommodate larger fields and feedlots. There was a nearly insatiable appetite both in America and abroad for American farm products, particularly wheat and meat. More product meant

more cash in farmers' pockets because the market was at once vast and time sensitive. The increased European demand continued for about eighteen months after the war, and American farmers continued their abundant production until 1920.[12]

The war reshaped the logic of agriculture in other ways, too. Young men who might otherwise operate farms were fighting in the war, and the shortage of able-bodied men led equipment manufacturers to begin developing machinery for small farms. The familiar rationale for mechanization—that there were not enough humans to perform the necessary labor—seemed literally true. The war also affected agriculture because the unprecedented demand for farm products induced farmers to push farther west in their search for cheap land that could support both sustainable commodity farming and the extractive, go-for-broke farming often associated with extreme and temporary market demands. Such farmers usually discovered fairly quickly that western farms were not just generic farms in an unusual landscape, an Iowa farm in Montana, for example; these farms were fundamentally different in every way and required a new approach. Aridity was the main concern, but the isolation of the farmsteads, the great distances to railheads and thus markets, the high cost of shipping grain and livestock to markets, as well as the cost of buying things from afar, the lack of schools, churches, and communities, a new set of crop and livestock threats, such as grasshoppers, unknown in the east as a crop pest, and a host of other difficulties meant that farmers who moved to the west had to completely readjust their thinking if they were to succeed.[13]

If the war encouraged farmers to count on short-term gains, the end of the war proved a lesson in long-term losses. In May of 1920, the government price guarantee for wheat ended, and by the following November the price for wheat was 33 percent lower than it had been the year before; by the following July, the drop was a full 85 percent. And while the prices farmers received for crops declined, the prices they paid for nonfarm goods continued to climb. Theodore Saloutos and John Hicks quantify the shift this way: in 1919 farmers could buy a gallon of gasoline for one-fifth a bushel of corn; in 1921 that same gallon cost two bushels. Similarly, in 1919 a farmer paid six bushels of corn for a ton of coal; in 1921 it cost sixty bushels. The "farm crisis" that resulted from the closure of those markets had a profound and lasting effect on the way Americans thought about farming. This was true not just for farmers, but also for many city people such as bankers, insurance executives, and politicians, who had never spent much time thinking about farming before the war. Following the war's end, Europeans gradually returned to normal farming routines as soldiers returned

home and farmland was recovered, trying to meet their own food needs as much as possible. With the reopening of sea lanes, agricultural producers such as Argentina and Canada offered commodities such as wheat to Europeans at much lower prices than the Americans were asking. And many people, accustomed to doing without meat and wheat during the war, did not resume their prewar consumption, contrary to what many authorities had hoped. Farmers thus found themselves with a great excess capacity for production. Farmers who had paid highly inflated wartime prices for land were stuck with huge bank notes that they could not pay. The taxes farmers paid were almost entirely based on land ownership rather than income, and these taxes continued to increase.[14]

The result was not hard to predict. In Montana between 1919 and 1925, farmers vacated two million acres, roughly eleven thousand farms, and more than half the state's commercial banks failed.[15] For farmers who lost their farms, this was a tragedy. Secretary of Agriculture Henry C. Wallace captured the mood in this way:

> In times such as these the problems of farm management on most farms are reduced to the simplest terms and can be stated very briefly. . . . Produce as much as you can and as cheaply as you can of what you can produce best; spend as little as you can; do without everything you can; work as hard as you can; make your wife and your children work as hard as they can. Having done this, take what comfort you can in the thought that if you succeed in doing what you set out to do, and if most other farmers also succeed, you will have produced larger crops than can be sold at a profit and you will still be under the harrow.[16]

It was no accident that such radical organizations as the Non-Partisan League found receptive audiences in states like Montana and North Dakota that had been especially hard hit by the farm crisis and persistent drought.[17]

Of course, there were many years in which farmers produced too much or too little or were otherwise caught in an economic vise. But what was different about this farm crisis was the magnitude of the tragedy and the way in which nonfarmers were both implicated in its creation and, paradoxically, perfectly positioned to benefit from its resolution. Urban lenders and business leaders, as well as many small-town bankers, were implicated in the creation of the farm crisis because they encouraged farmers to buy expensive land to expand production. Many critics pointed out that the speculative bubble of wartime expansion was sure to burst at war's end, and bankers should have known better. Deservedly or not, bankers and lenders found themselves holding hundreds of bankrupt farms when farmers were forced out in 1919 and 1920. These financial institutions did

not want to own these farms in a dead market, especially because many of the farms were in sorry shape. Farmers had lacked the capital to make necessary repairs and to continue cropping and raising livestock; these farms would have been difficult to sell even in a good market. But the number of farms and financial institutions involved combined with the dramatic timing of the crisis brought this problem to the attention of people in the cities as well as in the countryside, to those in the United States Department of Agriculture (USDA) as well as on Wall Street. One of the effects of this attention was the creation of a new type of dialogue, carried on both by people experienced in farming and by people who knew nothing about it, regarding what should be done to stabilize farming, farmers, and commodity production. The crisis was thus not only an economic crisis in the barest sense, but a psychological and social crisis as well. It was a time of soul-searching and reflection, by people with different perspectives and roles within and outside of agriculture, some of whom were sincerely interested in coming up with a new approach to agriculture and some of whom were cynically trying to make a buck or grab a moment of fame through their cleverness.[18]

Those who discussed the farm crisis, both in public and in private, tended to blame farmers themselves for the whole thing. Some felt that farmers as a class were not smart or capable and concluded that farming had gotten too complex for such people to manage. One Harvard farm economist pointed out that many farmers were illiterate and argued that illiteracy correlated strongly with feeblemindedness and abnormality. If most farms were operated by "subnormal" individuals, he suggested, it was no wonder that agricultural production was out of kilter. Economist John Black elicited similar views when he sent out a questionnaire in 1925 asking farm leaders what they thought should be done about the massive exodus of rural people to the cities. The editor of a midwestern farm paper was not so sure he wanted those people to stay in the country, blaming "the scum of southern European countries" who made up the "irresponsible, ignorant, criminally inclined class who do not care for citizenship." Such xenophobic tirades were popular within eugenic circles in the early 1900s, in which many well-bred and professional people located the demise of American culture in the immigrant groups who had settled in the countryside, where, so the thinking went, they could be as isolated and strange as they wished with little opposition. Another agriculturalist felt that there were far too many people trying to operate farms in the first place, and it would be great if one could get "those who have not the training nor ability nor capital nor cooperative instinct" to get off the farms. In addition, farmers were blamed for using inefficient methods, for

being stuck in old-fashioned practices and attitudes, and for being undercapitalized and overconfident.[19]

THE INDUSTRIAL IDEAL

Those who were casting about for a solution to this crisis, especially those who were inclined to read the world through the lenses of economics, were fairly unanimous in their beliefs. The overwhelming consensus was that farmers needed to become more businesslike, more like economists, in conducting their affairs, and less like miners who simply extracted value from the land before moving on to more productive areas. Farm managers conducted studies demonstrating that farmers could evaluate their chances for success by asking several key questions: Were they growing those things best suited to the farm's soil and climate? Was their farm big enough to support a family? What was the character and cost of equipment? Was labor distributed across seasons or just lumped at harvest? Was there enough diversity of work and product to ensure a safe margin of error in case of weather or market problems? Are the yields high enough from crops and livestock? Does the farmer have the right combination of "brains and brawn"?[20]

The business model that critics pointed to was the factory, which may seem a curious model for farmers. After all, factories in 1920 were located in cities, they produced all kinds of standardized objects by means of assembly lines, interchangeable parts, and mechanization, they were staffed largely by immigrants and low-skilled people who worked for modest but regular pay; in short, they had little in common with fields, livestock, dirt, or fresh air. What urban observers saw, however, when they looked at farms and factories was not what farmers saw. In 1920, urbanites saw that factories marked the triumphant ascension of the businessman-engineer over the chaotic, inefficient, worker-controlled, aggravating world of the shop floor. Engineers, in this view, had brilliantly "taken back" the industrial process from workers by introducing rational and standardized procedures that, in a Foucaultian sense, "disciplined" the workers and that enabled engineers and factory owners to keep the work process on an even and reliable keel. In contrast, what urban observers saw when they looked at farms were the last vestiges of chaos, inefficiency, and waste remaining in a major productive sector. If farmers wanted to live like animals, work themselves and their families to the ground, subsist on inadequate food and material goods, accept a lack of educational and recreational opportunities for their children, that was fine. At least, it was until the farm crisis. With the postwar depression,

however, the farmers' problems became the bankers' problems, and the insurance companies', and the USDA's. Suddenly, everyone was interested in helping the farmer become modern.[21]

Of course, the rationalization of agriculture did not come about solely as a response to the farm crisis. The notion that agriculture in general, and farmers in particular, should be modernized came from particular groups of people. Some were the same bankers, insurance executives, and federal agents mentioned earlier. This group also included some self-taught community members who operated small businesses and served as general rural leaders. But just as significant as these leaders were the new professional groups coming out of the agricultural colleges, in particular the agricultural engineers and agricultural economists. These experts were the first to argue that the status quo in farming was unsustainable and undesirable, a view they developed by studying farms surrounding the land-grant colleges where they had gone to school. But these professionals also came to this conclusion because they learned the theoretical and abstract approaches of their disciplines, especially engineering, science, and economics. This was the first generation of college-educated agricultural experts in America, and their educations pointedly did not train them how to be good *farmers*; it trained them how to be good analysts and evaluators of farmers and their farms. This is a crucial distinction. What set this first generation apart was this training in scientific method and theory, which provided tools for analyzing nearly anything agricultural.

In addition, ideas for improving agriculture and particularly for modernizing it had been in vogue long before the 1920s. Most of the elements of industrialization—large-scale, commodity production, machines, management—had appeared in the nineteenth century. The most visible examples of industrialized agriculture before 1900 were the bonanza farms in California and the Red River Valley in the 1870s. In spite of all this activity, however, it was not until the 1920s that the industrial ideal could be considered the dominant theme in agriculture. It was only after the war that agricultural problems seemed severe enough to warrant new approaches and innovations, only then that urban investors had the money and the interest to promote agriculture, only then that agricultural experts were generating credible quantitative reports and forecasts that lent these experiments the respectability and reliability that they would not have otherwise had.

If we look at the emergence and stabilization of American manufacturing as these agricultural promoters did, using it as the template for agricultural indus-

trialism, we find five components that characterized nearly every successful factory: large-scale production, specialized machines, standardization of processes and products, reliance on managerial (rather than artisanal) expertise, and a continual evocation of "efficiency" as a production mandate. These components were tangled together in most factories and even in the abstract are difficult to discuss separately. And all of them are more understandable in terms of what they replaced. That is, factory principles and practices were not just created from whole cloth in the nineteenth century, but were developed to replace existing, preindustrial production practices. Before the Civil War, most material goods in America were made either by ordinary people who had use for them or by artisans who made their living through their craft. Goods made by artisans included shoes, clothing, leather, glass, metal, and wooden tools, instruments, guns, clocks, and so forth. Throughout the nineteenth century, each of these crafts was gradually changed by innovations in mechanization, management, and labor practices. In some trades the changes were slow and piecemeal, and in others, rapid. The first craft to be industrialized was, famously, textiles, following the British example. Before the Industrial Revolution, textiles were the province of women and men who had learned the skills from their families or from apprenticeships with masters. Generally women raised the sheep for wool, sheared them, treated the wool, spun it into thread or yarn, and wove it into various articles of clothing or bedding. The process was similar with cotton, although it was purchased rather than grown. In England, turning bolls of cotton into fabric sheeting was a complex process that was mechanized in stages before 1790, with the invention of the spinning jenny and the water frame and the introduction of the mule.[22]

By 1822, when the textile mills in Lowell, Massachusetts, were opened, the entire process had been not only mechanized, but also subjected to managerial principles, rationalization, an increase in scale, and standardization of process and product. Each mill was now "integrated," meaning that the entire process was conducted on site, from opening bales of cotton to dyeing and sizing vast quantities of fabric; each mill was staffed by unskilled "operatives" who tended machines, fixing broken threads and replacing bobbins; each concentrated on producing one basic thing, or several related things, which allowed the company to standardize machinery, belting, marketing, and training; each factory was the largest of its kind to date, employing hundreds of women and producing miles of cloth; and each factory created a hierarchical labor system in which managers made all production line decisions and laborers followed instructions. This was

a far cry from the "homespun" practice of cloth making still being practiced in rural parts of the world, including in America, and the transition soon took place in other sectors.[23]

In general, the process of industrialization was promoted not by the artisans themselves, but by the financiers and business owners whose interests were primarily economic. They were inspired by several incentives. First, they were interested in generating more goods because the more they sold the more money they would make, at least in theory. If a machine or mechanical process could make more goods than a person could with hand tools, in the same amount of time, then the financier was very interested. Second, some financiers were interested in and willing to pay for perfection. Firearms were a case in point. The process of gun making was mechanized not only because it was possible, but because the federal government was willing to pay extremely high prices for guns that could be repaired in the field—that is, guns that had interchangeable parts. The creation of specialized machines to accomplish this, such as Thomas Blanchard's lathe, was soon applied to other goods for which interchangeable parts were desired. Typewriters and bicycles, for example, benefited enormously from the spread of armory practices. Even though not every subsequent manufacturer needed perfect goods or parts, because the technology was available, it was adopted. Third, many manufacturers were drawn to industrialization because of labor problems. In a preindustrial, artisanal system, artisans held most of the power over the production process. They made all decisions regarding when to work and when to stop, what materials to use, how much the final product would cost, how long it would take, how many and what type of assistants were necessary, and they made general design decisions as well. Highly irregular work hours were a routine aspect of the work culture, because artisans and their helpers took days off for feasts, weddings, holy days, and harvest chores and because frequent rum breaks were often the norm. Many factory owners grew intolerant of this situation, feeling that the artisan was too powerful and difficult to control. Owners were drawn to mechanical processes that would either undermine the integrity of the artisans' authority or replace them altogether.[24]

Nearly every industrializing process happened because someone thought outside of the artisanal logic and broke down complicated processes into multiple, discrete, isolated actions. The process of making a shoe, formerly done by a lone shoemaker, was divided into tanning, cutting, fitting, sewing, and so forth, and each could be done by a separate person under a manager's direction. The process of making a gun, previously done by a highly skilled armorer, was turned into a series of semiskilled tasks. There were few jobs that could not be reconceptual-

ized and divided, turning one big, complicated job into many small, simple jobs. Although in theory these jobs could have been done by anyone, including the artisan who had formerly done everything, in reality the artisan—and the entire concept of the artisan—was eliminated from the process. It was not only the artisans' physical abilities that were undermined, but their experience, knowledge, and judgment. The physical tasks were much easier to mechanize than the latter intangibles. When a financier learned in some measure what an artisan knew, the first step toward deskilling occurred. It was then a matter of teaching less skilled or unskilled workers to perform one small action from the larger process, and in most cases another small step was necessary, sometimes occurring many years later, to mechanize even that small action. Once this distributive logic was conceptualized, the rationalizing and mechanizing processes generally followed as soon as finances allowed.[25]

One of the most fundamental elements of factory production was machinery, both the literal machines on the shop floor and "the machine" so poignantly identified by Lewis Mumford. Mumford's machine encompassed not only the actual tools used to fashion and repair things, but as important the organizational structure so essential to large engineering endeavors. "The machine" resulted from the systematic coordination of economic, political, social, and technical forces, all driven to solve one problem. For Mumford, the pyramids offer a key example of such a machine; for us, the factory, or the collective farm, offer others. Obviously, machines were not limited to factories, but have been around for millennia in many contexts. In a basic sense, all machines have performed tasks that humans had previously done for themselves. They have been designed to replace human and animal labor or, in some cases, to multiply labor. One specific context in which machines were developed, the factory, was extremely important in turning machine logic toward the repeated reproduction of complicated, artisanal tasks. Early-twentieth-century factories featured two kinds of machines. On the one hand, a specialized machine was designed to do one particular task that was a part of a larger process. In metal or woodworking factories, such a machine generally featured jigs and fixtures that enforced a particular position for the piece of metal or wood, and the laborer would then fashion a part following specific directions. A specialized machine was good for just one thing. A general machine, on the other hand, was good for many things. In early factories, skilled artisans used general machines, such as milling machines, to help cut complex parts. The artisans' knowledge, as David Noble would say, was multiplied by the machine, because the machine allowed them to do something faster, or more complicated, than they could otherwise do. But

specialized machines had the opposite effect. They were used not by skilled artisans, but by semiskilled or unskilled workers who lacked the artisans' knowledge and judgment and who acted literally as "operatives," that is, operators of machines that did the same thing over and over. Rather than multiplying skill, such machines appropriated it, mimicking one action that a skilled worker would have done on a general machine or by hand. This is why many machines are considered "deskilling" and threatening to artisanal labor and one reason why factories have so often been the sites of labor unrest.[26]

A second element, standardization, was likewise not limited to factories, but was a crucial component of all factory production. Without standardization, which simply means making everything in a given category the same, mass production was impossible. A standardized product is one in which each part can be easily replaced with another, identical part; for instance, a modern washing machine features exactly the same parts made in exactly the same manner so that the parts are interchangeable.[27] When parts are standardized, people can repair their machines quickly and easily because manufacturers make lots of these parts for use in both new machines and machines that need repair. Often it means that the exact same part can be bought in two geographic locations a thousand miles apart—the principle that enabled chain stores to operate nationally. When parts are standardized, one can be substituted for another; when humans are standardized, the same holds true. When factories were mechanized with specialized machines, the operative made none of the careful judgments the artisan had made and held none of the special knowledge either. The few tasks such a worker did could be done by anyone; they were simple, mindless, and easily learned. It was in this sense that workers became standardized, as easily replaced as a worn bolt. They were caught within an industrial web.

Standardization and mechanization led to the third element: large-scale production facilities. Alfred Chandler describes the combined effect of these elements in terms of "throughput," that is, the movement of a product through the factory, changing form as it goes. Products such as petroleum and liquor are the most easily understood and visualized in this regard; they move through tubes and pipes nearly untouched by humans, getting heated up and cooled down as they move through the plant. A large-scale production facility enables the manufacturer to connect all the processes together in one place, each small action tied to the next through the whole process, in an almost "liquid" exercise of transformation. Henry Ford's automobile factories were classic examples of large-scale production based on mechanization, standardization, and continuous movement of the product through the facility. The increase in size and scale

of facility was intimately tied up with economic notions of efficiency, an essentially thermodynamic principle based on trying to get the most output for the least input of energy. This was a concern, again, not of artisans or factory laborers, but of owners and financiers, who viewed the profit margin as a function of efficient operation of both machinery and humans. A large, integrated factory, in which all the component parts of a thing were produced and then combined, was in this sense more efficient than many small factories, with each producing their one part and then sending everything to yet another factory to be assembled. An integrated factory, by combining all these things under one roof, saved time, labor, machines, and money by reducing duplication and routing costs. But large-scale production only worked in factories that had mastered all the components first. A large factory in which processes were not standardized, or perhaps not yet fully mechanized, would be less efficient.[28]

Engineers were the first to fully grasp this difficulty, because in the late nineteenth century they went into factories as the perceived experts, only to find skilled artisans who actually held all the power and knowledge. The tussle between these two groups led engineers to come up with a way to bypass and ultimately get rid of skilled artisans, through "systematic" or "scientific management." Made famous around 1911 by Frederick Taylor, scientific management was designed to increase the efficiency of factory production by standardizing and routinizing all tasks and processes. All jobs were subdivided into their smallest components and then routinized and clocked by time and motion experts who determined how long a particular task should take. Belting that connected machinery and the speed at which machines were operated were standardized, materials were carefully controlled through inventories and routing cards, and different levels of managers replaced the artisan-manager who had ruled the shops. "Taylorism" came to refer to activities both within and outside of factories in which a hyperrational hand had reorganized tasks and in which mind-numbing efficiency and nearly robotic human movements characterized labor processes.[29]

The triumph of the modern factory system in the years leading up to World War I was perhaps nowhere more evident than in Henry Ford's Highland Park and then River Rouge factories. Here the various components of modern factory production, of industrialization, came together in dramatic display. This system encompassed not only the physical handling of materials, the moving assembly line, and the mechanization of small tasks, but also the unprecedented managerial interest in workers' personal lives and the aggressive attempt to mold each worker into a perfect, Americanized cog in the Fordist machine. From a

businessperson's point of view, Ford achieved what no one else had: the rational, sensible, integrated production of a consumer good, which meant that the consumer was no longer a slave to labor, or to chaos, or to whimsy. Ford's accomplishment was both honored and ridiculed by critics, from Charlie Chaplin's entrapment in the cogs and gears of the machine in *Modern Times,* to Charles Sheeler's cool and uninhabited watercolors of the factory, to Diego Rivera's stunning and chilling murals of River Rouge workers and machines. It seemed as though all America, from business executives to schoolchildren, avidly followed Ford's empire-building activities with a mixture of admiration and bewilderment, certain that Ford was doing something big, but unsure where it would lead.[30]

Taylor and Ford were only the most obvious examples of the sea change occurring in America in the years leading up to World War I. In businesses, schools, homes, government offices, factories, cities, and towns, even in the arts, the unmistakable trajectory was from the chaotic to the controlled, from loose to tight, from spontaneous to planned, from curved to straight. New expert groups emerged, for example, engineers, scientists, economists, and sociologists, and by the 1910s were beginning to speak with a unified voice and weigh in on such subjects as urban planning, the federal budget, nutrition, housing, and science policy. Engineers and other scientists became a dominant influence on American culture, including the economic culture, and especially so in government offices, businesses, factories, and banks. Where decisions were made, the framework of choice was distinctly economic: What was the most efficient and rational solution?[31]

Many of these approaches were ultimately applied to agriculture. By the mid-1910s, agriculture was beginning to look like the last great nest of chaos in American productive enterprise. Factories, railroads, financial institutions, cities, and the government had all been subjected to modernizing, rationalizing principles. Yet agriculture, which was so essential to the nation's health and which played a leading role in the country's mythic autobiography, was much as it had been one hundred years earlier. Farmers raised crops and livestock with little attention to far away and mysterious markets; they used techniques and practices that were frequently deficient or grossly out of date; housing was substandard; women were overworked, haggard, and unrewarded; rural children were inadequately educated and often overworked as well and could look forward to a bleak future on the same poor farm; farmers were unschooled in business practices and budgets and unaware of recent discoveries in scientific agriculture. So went the litany of ills that many observers found in farming communities. One of the more

high-profile responses to these concerns was the Country Life Movement, a group of businessmen, scientists, and social reformers who wanted to investigate the drift of farmers to the cities and figure out how to keep good farmers in the country. In 1907, President Roosevelt made the group into an official commission, which interviewed farmers and rural leaders in an effort to address the issue. These problems, as well as the perception that there was a problem, were persistent, however, and by the end of World War I they had become mixed up with postwar tensions.[32]

One problem centered on farm demographics. As land values increased, according to one Treasury Department official, farm size increased as well. New tax laws in states across the country increased taxes on land, which put an unsustainable burden on many farm families who sold their land and either left farming for good or moved to less expensive areas. Those who stayed in high-priced areas did so by increasing their land holdings, resulting in fewer but bigger farms. Even for those who relocated, particularly to the northern plains and northwestern states, farms were getting bigger, with fewer 160-acre farms and many more 640-acre farms. This drift to the northwest was strongly encouraged by the railroads, which began promoting these regions to homesteaders around the turn of the century, suggesting that the land that had been used primarily for grazing could now be used for farming. The increasing installation of irrigation systems by the federal government further supported this claim, although many of the irrigation districts were not well situated in other respects and not all crops performed well with irrigation. Several good years of rain in the region in the mid-1910s lulled many new farmers into thinking that the climate was not so bad, an impression that was sharply negated by the droughts that began in 1919. Hardy Campbell, an evangelical promoter of dry-land farming, was supported by the railroads and by regional boosters who wanted to attract settlers, but his "system" was not a guarantee of farming success.[33]

AN INDUSTRIAL WEB

As the war began to recede from view, it became apparent that the agricultural *system* was in serious disrepair. No longer could one speak of a few desultory farmers who lacked ability; now even good farmers were caught in the industrial web. Ironically, the fruits of early industrial society seemed to be the cause of much rural dislocation, yet urban and rural leaders alike saw these consequences as necessary and, to many, desirable. One example of this paradox was pointed out by a banker attending a conference on Farm Life Studies at the USDA.

Speaking about the opening of land in the far west he said, "There are evils which follow that sort of thing. . . . That has destroyed our schools. The intelligent man will not go out in an isolated district where his children cannot have educational advantages. We cannot blame him. It has made rural churches practically impossible." Similarly, such demographic shifts encouraged the building of more roads in less populated parts of the country and seemed to increase the sale of automobiles and trucks. These improvements led to their own pernicious effects, as one New Englander reported: "The macadam road, the Ford automobile, the eight-hour day, and the pay envelope on Saturday noon is a quicker and more deadly poison to farming operations in New England states than the competition from other areas has ever been." Increasing farm size could also lead back to an increase in farm tenancy, because fewer farmers could afford to own such big farms, and more farms were actually owned by absentee landlords whose investment was strictly economic. Some economists worried that "the dice are loaded against the untrained man with small capital and moderate ability, who wishes to become a farm owner," and, after learning that about 1.2 million farmers left the countryside in 1922, the secretary of agriculture warned that those leaving constituted a "large percentage of the more intelligent and ambitious young farmers" than ever before, a troubling trend.[34]

A more vexing problem had to do with the surplus in farm products. Farmers grew too much grain and food and raised too much livestock to ensure a reliable and reasonable return for their work. Although this problem stemmed partly from the persistence of high wartime production and the collapse of the markets, it also resulted from the practical advice and ideological stance of the USDA, which promoted agricultural abundance above all else. Wallace was again quite blunt in his observations, "Had we in the past given as much attention to the economics of agriculture as we have to stimulating production, . . . some of the troubles which now beset us might have been anticipated and avoided." Economist Henry C. Taylor felt that the fixation on "making two blades of grass grow where but one grew before" came from the fact that the earliest experts in the USDA were scientists and technicians for whom efficiency and its corollary, high production, formed the primary goal of production advice. But what was efficient for an individual farmer may not have been efficient for all farmers as a group. H. R. Tolley gave the following example:

> This is the problem faced by a county agent or an extension specialist when a grain farmer or a cotton farmer asks if it would pay to keep some cows and chickens and sell some cream and eggs or to raise a few acres of potatoes for sale. In deciding, the farmer is not concerned with whether he will be able to obtain as much milk per unit

> of feed as is obtained on specialized dairy farms, whether his hens will lay as many eggs per year as they do on commercial poultry farms or whether he will be able to produce his potatoes with as little labor per bushel as does the man with 40 or 50 acres. His concern is 'Will I have more money at the end of the year, or ten years, if I do this?'[35]

Agriculture could be discussed from the point of view of the individual farmer, or the commodity market, or the national welfare, to name but three vantage points. What was in the best interests of farmers in general was not always in the interest of any farmer in particular; and which practices were "good for agriculture" depended on whether the practice would help or hurt the different participants. One economist quipped that "it is very lucky that not more than five per cent of our farmers take the Department of Agriculture seriously," because, of course, then the abundance problems would be completely overwhelming. Another insight from economist E. G. Nourse: "The outlook for agricultural production is so good that the outlook for agricultural prosperity is distinctly bad."[36]

This "paradox of plenty" became a source of considerable debate among economists in the mid-1920s. Some argued that efficiency per se was good for agriculture, while others contended that the consequences of real efficiency were perhaps too severe. As one economist expressed to John D. Black, "Efficiency doesn't consist in myriads of economic units competing in hopeless ignorance of what the other fellow is doing," and he blamed the USDA for continuing to urge farmers to produce ever more material when the evidence for the danger of this was mounting. E. G. Nourse attacked fellow economists whom, he felt, were hewing to an excessively abstract and out-of-touch view of agricultural modernization. As described by both Nourse and Black, George Warren and Benjamin Hibbard believed that as farmers became more efficient, they would be able to weather economic storms more easily, as well as make more money and produce goods more sensibly. Warren and Hibbard asserted that farmers who could not take advantage of efficiencies, as they called modern machines and techniques rooted in science and technology, would leave the farm and find a new livelihood. Nourse, however, was much less sanguine, in part because he viewed what was going on as comparable to the Industrial Revolution:

> 'A little knowledge is a dangerous thing,' and this is true also of a little industrialization. . . . The first half of the journey toward industrialization, taking place under the circumstances that it has, carries the farmer so far into the red ink that he cannot go the rest of the way and arrive at the clearly discernible goal of such a development. He is constrained to save at the spigot so constantly as to induce serious waste at the bung-

> hole. He must practice the boomerang economies of wearing out obsolete machinery, or getting by with a high percentage of scrub sires, and of operating under the direction of jacks-of-all-trades instead of employing the best of both technical and managerial ability.[37]

It was clearly a risky business to correlate agriculture with other productive enterprises too quickly, because the correlations were not always apt. Like Wallace, Nourse saw problems where other colleagues saw only opportunity. Nourse and Wallace could see that industrialization was occurring in agriculture, but felt that the consequences of that shift would be painful for many people for a long time. Although they were helpless to stop the industrial web from growing and in fact were ambivalent about the long-term, macroeconomic outcome, they continued to voice concerns about the short-term, microeconomics of farm families and businesses getting routed in the process.

Chapter 2 By the Numbers: Economics and Management in Agriculture

Statistics are very much better than opinions.
—*George Warren,* 1914

Observers of the American agricultural landscape have long struggled to develop a pithy and panoramic characterization of the scene, only to be stymied by the vast diversity of farming experiences throughout the fifty states. The size of the country itself is noteworthy, and this alone would prevent easy pigeonholing. Different landscapes blend with different crops, livestock, climates, and cultural traditions, rendering a single, generalized identity almost impossible. The notion that cotton farmers in Texas share a fundamental identity with strawberry growers in New Jersey or poultry farmers in Maryland seems problematic; surely they have more in common with other blue-collar workers in their own neighborhoods than with men and women thousands of miles away who spend their working lives digging in the dirt. But, however dissimilar any two farmers may be in the details of their daily lives, they do face quite similar problems. All farmers worry about the weather, if there will be too much or too little rain, excessive wind

and cold, or badly timed aberrations; they all worry about money, and whether there will be enough to buy seed, livestock, and equipment, to hire farm laborers, to make necessary repairs to barns, houses, and machines, and to pay taxes; and they all worry about regional and international markets as well as the political maneuverings that might open or close crucial markets, or inhibit farmers' access to these markets.

When the United States Department of Agriculture was established in 1862, some of its most difficult and subtle tasks were to coordinate these diverse agricultural practices, to consolidate the amassing agricultural research, and to extract from all the information the themes and issues common to most American farmers. The first problem, however, was how to understand it all. What did farmers do? When did they do it? Why did they do it? How could it be better? And did they make any money at it? How could the federal government learn what was going on agriculturally in the far-flung states? The second problem was what to do about it. How could the government change farmers' practices to be more "efficient," productive, predictable, marketable, and reliable? How could the government collect, both on the things that farmers produced and on the knowledge that they held? And how could the government control it all, in the name of what has come to be called "food security"—that is, the need of the state to feed its people and to raise revenues for both economic and military purposes by selling excess food abroad.[1]

The offices, bureaus, and departments in the USDA, designed to serve as conduits between the state and its farmers, were also the means to quantify, rationalize, and standardize farm activity so that it could be understood and controlled from a distance. Federal workers in the states, usually at the land-grant colleges, could both monitor farm activity and try to change it if it seemed contrary to state interests. But even this was hard to do without a standardizing language with which to weigh and evaluate different products, practices, and ideas. Here it became important to decide which unit of analysis was most important for the state to employ. At the end of the day, what kind of information was more important to the state: The amount of wheat harvested in Kansas in 1910 or the names of the Kansas farmers whose wheat had failed due to drought? The tonnage of pork that could be exported or the decision of hundreds of Iowa farmers to not raise any more hogs because the price continued to fall? Just as the census had demonstrated, the state needed numbers—how many, how few, how big or small, how much, how old, what amount. And as the collection of such information became more scientific, and thus more rationalized, it also became

more abstract, less about people and their problems and more about processes and products.

Within the USDA, bureaus and divisions multiplied quickly in the 1870s and 1880s after agricultural colleges also began to emerge as conduits, and the Hatch Act, which gave money to states for research in agriculture, was passed in 1887. With these fixed structures in place, the quantifying function of federal bureaucracies kicked in, and state agricultural workers were asked to report on how many phone calls they fielded, how many visits they made to farms, and how much money they spent on notepads and pencils. The seemingly simple effort to comprehend the range of farmers' experiences was governed by a reliance on quantifying and ordering. Thus it was numbers, not narrative, that became the dominant language of agricultural knowledge. And it was numbers that allowed the abstraction of particular experiences and the subsequent linkage of experiences across regions and states; numbers made hog farming in Iowa and North Carolina seem more similar, in the eyes of the USDA, if not in the eyes of farmers themselves.

Between 1910 and 1930 the quantitative spirit came to fruition in American agricultural industrialization, as evidenced by the emergence of sustainable institutional venues for its development. At both federal and state levels, agriculturalists formed associations and institutions devoted to generating a public persona as well as a scientific program of research and development. In the USDA, the Office of Farm Management began to pursue economic work in 1905, and similar activities were conducted in other pockets of the USDA such as the Bureau of Markets and the Division of Statistics. These scattered efforts were consolidated in 1922 with the creation of the Bureau of Agricultural Economics (BAE), one of the largest and most powerful agricultural agencies in the federal government. Also at the national level, economists interested in rural matters and college teachers of farm management each organized professional organizations, in 1908 and 1910 respectively, which merged in 1919 as the American Farm Economic Association. In the states, the land-grant colleges began teaching classes in agricultural economics and farm management around 1909, often in the school of commerce or sociology at first, before emerging as a unique field by about 1920.[2]

Although individuals had been quantifying things agricultural for a long time and the census had been collecting data since the 1840s, these organizational efforts marked an entirely new level of seriousness. This was because the quantitative work, for the first time, was consolidated and hierarchically linked to other

work like it—made into a web, in other words—and it was all directed by the federal government. By 1922 (and one could argue that it happened a decade earlier), research and practice in the states were entirely defined and condoned by the USDA and were made similar across states. When the BAE decided that each state should figure out what the overall cost of production was for grain crops, all the states generated programs to find this out, and many did so in ways nearly identical to one another. When the BAE decided to launch its Outlook reports in 1923, it promoted a national system in which the states forecast how many acres of grain or pounds of milk their farmers would produce that year, hoping that farmers would adjust their plans if it looked like a glut or a shortage was in the making. Indeed, the whole purpose of a federal agricultural agency was to coordinate and control what farmers did. But it bears emphasizing that this was the historical moment when agriculture in America was made rational and legible to the state, when it became national policy to ensure that farmers operate in as standardized and routine a manner as possible. This was an essential tool of the industrializing effort, a way of standardizing farm practices, farm products, and federal projects all at once.[3]

ORGANIZING FOR THE COUNT

Many colleges first began collecting information about the rural life in their states around the turn of the century. This effort was driven in part after 1862 by the creation of the land-grant colleges in each state, institutions that emphasized the teaching of agricultural and engineering subjects. Many states were highly ambivalent about these colleges; rural voters often felt that agricultural pedagogy was best left to farmers who were already, presumably, expert on such topics as soils, livestock breeding, and crop selection. In addition, many farmers were concerned that agricultural colleges were yet another modernist assault on rural prerogatives and self-sufficiency, and they worried that their youth would be seduced away from the farm by the more worldly attractions of college life and eventual jobs in the city. Legislators, however, could not help but be attracted to the federal money involved ($35,000 per state per year) and the chance to build an institution befitting their grand state. But once the triumphant groundbreaking for these colleges had taken place and the dignitaries had gone home, many state officials realized that the farmers were partly right. There were few people trained to teach academic agricultural subjects because colleges had not taught agriculture before, and those trained in such ancillary subjects as chemistry, botany, or zoology had little idea how to apply that knowledge to

rural concerns and practices. In this sense, the first group of professors hired to teach agriculture struggled to combine their formal training with their gradual introduction to local and regional expertise. And professors were not alone. In 1840, the federal census began to collect factual information regarding farmers and their products, but these numbers were most often used in aggregate as generalizations and told little of practices in any particular place. "Corresponding farmers," that is, farmers asked to report on local circumstances, occasionally wrote to the federal workers with data regarding their own crops, but such figures were far too particular and widely scattered to be of much use to anyone else.[4] There were few indicators and little hard information regarding what farmers actually did, including what kinds of crops they grew and in what quantities, what kinds of livestock they raised, how much money they spent on seed for crops and feed for livestock, and how many of them engaged in secondary pursuits such as beekeeping, growing and cutting firewood or lumber, or renting out large equipment.[5]

Around this time, experts from the colleges also tried to persuade farmers of the benefits of keeping accounts. In his "Farmer's Business Handbook" of 1903,

[To view this image, refer to the print version of this title.]

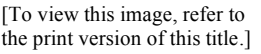
Agricultural field demonstration, 1910–1924. State Historical Society of Wisconsin. (X3)30861.

Professor Isaac Phillips Roberts showed farmers how to keep basic accounts and offered a few pointers on rural law. Roberts noted that "few farmers, or indeed, small dealers or merchants in towns, have ever taken stock or inventoried their belongings," a practice he considered essential for a profitable farming venture. The Home Correspondence School offered a course in farm accounting that covered single- and double-entry bookkeeping specifically designed for farmers. Although it is difficult to guess how many farmers took the trouble to learn these methods, it is clear that there was a growing sentiment that farmers should pay closer attention to the numbers.[6]

As Winifred Rothenberg points out, rural Americans actually had a long history of enumerating their possessions, sales, and other transactions and of keeping track of work and food exchanges. Of course, the state followed tabulating practices with the census and with the production of probate inventories. Other attempts to figure out what farmers were doing in the United States were the independent surveys undertaken in the eighteenth and nineteenth centuries by innovators of various sorts. George Washington, Jared Eliot, and Edmund Ruffin, for example, were interested not only in farming, but also in improving the countryside more generally. Their accounts were more the flavor of travel writing than of tabulation and assessment. As professor of horticulture at Cornell in the late nineteenth century, Liberty Hyde Bailey conducted numerous surveys of fruit growers in western New York state, and as chairman of Theodore Roosevelt's Country Life Commission, Bailey used the survey method to learn more about the assets and liabilities of rural life in America. Bailey advocated a scientific method in agricultural work, by which he meant "to determine the exact facts, and then to found the line of action on these facts." Agricultural surveys were thus a means to obtain the details of local farming practices, and this information would then be combined with the principles developed by the scientific departments. The more impressionistic method of data collection continued to attract students of agriculture into the twentieth century. Henry C. Taylor went on a two-month bicycle tour of Great Britain and Ireland in 1899, talking to farmers, landlords, and estate agents about farming practices as well as land tenure. In 1903, Thomas N. Carver traveled about a thousand miles in the Corn Belt writing his impressions for *World's Work* and the following year took a horseback tour through New England. A few years later, he rode a bicycle around Europe visiting farms and speaking with farmers. These tours demonstrated little that could be called systematic or quantitative but succeeded in calling attention to the variety of farming experiences and the rules of thumb followed by farmers to ensure successful farming.[7]

As the new agricultural colleges began to organize themselves along departmental lines in the late nineteenth century, many started collecting information from farmers regarding how much it cost to produce different crops and livestock. These early cost-accounting studies built on the more haphazard surveys as they tried to determine not only what farmers produced but also whether it paid farmers to produce one thing rather than another. Minnesota was one of the first states to reach out to the countryside for enlightenment, both to tell university economists what Minnesota farmers did on their farms as well as to provide a means of comparison for farmers in choosing more economical crops and practices. The information that was gathered was meant to be a snapshot of current practice and was funded by the USDA's Bureau of Statistics, which also had an interest in retrieving information from rural Minnesota. So in 1901, Professors Willet Hays and Andrew Boss located fifteen dairy farmers who agreed to participate in a university study, and they hired an agricultural college student to collect the information. The student boarded on each farm for two days a month, watching and recording the farmer's activities and discussing his expenses and receipts with him before moving on to the next farm. The student was acting as a chronicler rather than an expert: he was not allowed to offer any sort of advice because "correct" farm or dairy practice had not yet been determined by the "experts." The student merely described what farmers did. This project was the first cost-accounting route study, distinctive in its heavy investment of college personnel, its emphasis on face-to-face interaction with farmers, and the purely descriptive character of the information retrieved. In 1912, the Illinois agricultural experiment station adopted the Minnesota cost-accounting approach, and it became one of the longest running accounting studies in the country.[8]

Other states soon followed suit. In Ohio, L. H. Goddard started taking inventories of farms in 1905 by corresponding with farmers; his interest was largely in figuring out the labor costs of crop production. In Wisconsin, H. C. Taylor was less interested in ordinary cost accounting and focused instead on finding correlations among farm enterprises—that is, finding which crops, livestock, and other farm activities could be combined throughout the year so that the farmer was fully employed in activities that were both productive and lucrative. At Cornell University in New York, survey work of the western part of the state was first undertaken in 1888. When Liberty Hyde Bailey became dean of agriculture at Cornell, he hired Thomas Hunt and economist George Warren to develop the cost-accounting work in 1906 and 1907, focusing particularly on Tompkins County. Warren's project differed from the Minnesota work in that



Henry C. Taylor standing in front of a hay pile with another man. State Historical Society of Wisconsin. (X3)52695.

Warren preferred a statistical approach, an attention to averages, rather than the route study and attention to farmers. "Usually," he wrote, "results are not based on opinions but on figures. We do not ask farmers what they think about tilling orchards. We learn the tillage practice and the yields, and find the results. Farmers are likely to draw conclusions from exceptional cases, just as are all other persons. Statistics are very much better than opinions."[9]

The college experts who collected local agricultural facts and figures were clearly accomplishing several things at once. At the most basic level, they were intent on "the development of a large body of definite and reliable farm facts," which until then only the local farmers held. It was important for these experts to have the facts, not only so they would have material to teach in their agricultural courses, although this was important, but also because those facts were the constitutive basis for farm experts' credibility. Knowing what was going on in the surrounding countryside was essential for new professors of agriculture, es-

pecially if they hailed from another area. Farmers were often aware of this mixed purpose, and some "had a feeling that it was being conducted because of the information which the college wished to secure from them rather than to give them any considerable amount of help in the operation of their farms." Indeed, as we have seen in regard to the early work in Minnesota, this was often true. But as time passed, farm experts used the material in more advanced demonstration work and to establish a gauge of "best practice" in the area. Following World War I, one Nebraska agent suggested that farmers learn to keep accounts in self-defense; he asserted that when urbanites began arguing for a decrease in the cost of living by lowering farm prices, farmers needed to be able to demonstrate that prices were already plenty low.[10]

As university experts began to accumulate material over the next ten years, many schools began offering courses and establishing departments of farm management and farm economics. In 1910, students at the University of Wisconsin, for example, could take advantage of a field course in farm management, which was a four-week class conducted in several parts of the state. The students lived in tents and took meals with the farm families they were studying, a method intended to give students "direct contact with the vital problems connected with the management of farms" and to allow them to "see how these problems have been worked out by some of our most successful farmers." In addition, advanced students with farm experience could enter the accredited farm system program, which placed them with "successful progressive farmers" for one-year periods. Much like the highly successful cooperative engineering courses that placed advanced engineering students in industrial laboratories, this agricultural course functioned as "[a] stepping stone for securing positions as farm managers." At University of Missouri, a course in farm administration was "devoted to the making of a practical farm plan, and working out in detail a farm work schedule, rotations, the use of crops, the development of stock, the necessary steps in buying, feeding, and selling." Courses in farm organization focused more generally on evaluating farms and farmers, with attention to comparing different types of farms, figuring out how to keep labor employed year-round on a farm, learning how to choose a farm, and understanding how diversified farming works. At Minnesota, Andrew Boss persuaded the college administration to rent abandoned farms in the area, where farm management students could practice their craft. In California, agricultural work was conducted at Berkeley's Farm School at Davis starting in 1909, and the types of courses were quite similar to those offered elsewhere, with students being trained as estate superintendents and managers of the newly emerging agricultural factories.[11]

In the United States Department of Agriculture, William J. Spillman began work in farm economics in 1902 and in 1908 began cooperative projects with agriculturalists in the states through the new Office of Farm Management. One of Spillman's projects, which focused on correlating successful farming with immediate economic results rather than abstract principles, nicely suggests how plainly pragmatic early economic methods were. Spillman divided the country into farm management districts, and in each one he appointed an investigator whose job was to study the most successful farmers in that district. The investigator would try to figure out exactly what made these farmers so successful while their neighbors struggled, and he would then try to persuade all the farmers to emulate the successful ones as a way to generally improve the district. The "model farms" that Spillman and his agents located were then promoted as true models for other farmers to follow, a promotional technique used frequently in years to come. Another economic pioneer was Willet M. Hays, who introduced cost accounting in Minnesota and then went to Washington as assistant secretary of agriculture in 1905, later serving a year in the Bureau of Statistics. One of his main contributions as a leader in the effort to coordinate state and federal work in cost accounting was to shift the burden of data collection back to farmers themselves. It was better, so the thinking went, for farmers to actively generate their own cost figures rather than for state and federal workers to assist them. The object, after all, was not merely to collect figures for the edification of economists, but to encourage farmers to begin thinking like economists.[12]

It was apparent shortly after the turn of the century, however, that those experts who wanted farmers and agricultural leaders to become more quantitative did not all share the same background or point of view. In general, they had all been trained in classical economics, mostly at the land-grant colleges. But one group—the agricultural economists—was primarily interested in economic theory and principles, while the other group—farm management experts—was more interested in farming practice and farmers themselves. The distinctions between the two groups can be seen in the professionalizing strategies of each. On the one hand, the agricultural economists directed most of their attention to one another or to those "up the ladder" in Washington. They were interested in developing economic models that could influence public policy decisions. The farm management experts, on the other hand, tended to direct their attentions "down the ladder" to farmers themselves. They were keen to change farm practice based on proven demonstrations of successful methods. Although many of the farm management experts were trained in economics, it was the application of theory to farm practice that intrigued them.

Both groups began organizing themselves into professional associations around 1907–1908, but again, there were differences. The agricultural economists professionalized largely by announcing their distinctive mission within economics and focusing their economic work on agricultural questions. At their annual meeting in 1907, the American Economic Association (AEA) recognized agricultural economics as "an independent science," and a small group within the AEA focused increasingly on emerging problems in agricultural marketing.[13] The farm management experts, however, professionalized by trying to distinguish themselves from the economists, but also by attributing to their field higher status and visibility than most farming groups possessed. In 1908, when the USDA's Graduate School of Agriculture held its annual summer meeting at Cornell, George Warren called together those who taught farm management to form a new organization devoted to the specialization. When the Graduate School met at Iowa State University two years later, W. J. Spillman joined Warren in establishing the American Farm Management Association (AFMA). From the beginning, the AFMA centered its activities around the interests of those engaged in "the investigation and teaching of farm management," that is, those located at the agricultural colleges and in the USDA; founding members were drawn almost entirely from this cohort. Their concerns were different from those of classical economists as well, although there was some overlap. Among the topics that the AFMA Committee on Teaching deemed essential to school curriculum were capital and its distribution, the marketing of farm produce, and farm record keeping and cost accounting. But the committee also included as important topics the size, location, and layout of farms, the management of labor, the comparison of different types of farming, and cropping and feeding systems. As a discipline, farm management shared with factory-based scientific or systematic management an orientation toward work processes and labor processes. Managers across disciplines could agree that management was the most important element in successful production practices, whether in the field or the factory, and that the efficient manipulation of elements within an agricultural system was key to understanding the general pattern of production, whether of corn, or sheep, or hay, or any other farm product.[14]

Farm management experts were similar to those in other emerging professional groups in additional ways. Just as Frederick Taylor had gotten his knowledge of the shop floor from his youthful employment in factories and his subsequent promotion up the ladder of factory management, most of the farm management professionals had rural backgrounds, often hailing not just from the countryside but from farms. For them, it was a bit of a balancing act to main-

tain their scholarly credentials while drawing on their experience in the field, because their work and their identity were split between the two sites on a day-to-day basis. Yet in general they were quite clear that one needed to have a visceral understanding of farm problems to be a successful farm manager and referred frequently to the tacit knowledge that students must have. As H. W. Jeffers put it, "This is no time for the untrained theories advanced by many highly trained, well meaning men." In his 1913 presidential address, for example, George Warren claimed that "only those persons who have grown up on farms or who have lived on farms long enough to be thoroughly familiar with farm work are likely to succeed in survey work. . . . They must know 'farm etiquette.'" Similarly, in describing what sort of education farm managers would need, one educator suggested that "while the successful farm manager should and must be familiar with scientific principles, he must necessarily approach his subject from the standpoint of farm experience. He must be a genuine farmer in thought and experience and must know what it means to come into intimate and direct contact with the soil. He must know from experience what constitutes a day's work on the farm. . . . With the influx of students from the city the need of this advice becomes more and more apparent." This is no surprise, because sociologists have shown that throughout history most American agriculturalists grew up on farms, yet one should note that the emphasis on farm experience was never a big component of agricultural economists' training or of their education and later experience. In this regard, the agricultural economists were more like economists and less like farmers; for the farm management experts, the opposite was often the case.[15]

Within roughly a decade of the initial formation of their professional groups, both the agricultural economists and the farm management experts began to see that although their professional outlooks were somewhat at odds, their interests were deeply intertwined, and they decided to join forces both organizationally and institutionally. This was not to say that the principles of each group were clearly defined; according to one advocate in 1917, "Farm management is still in its infancy." And two years later the secretary of agriculture could still claim that "there is in many minds, more or less haze as to the field of farm management and farm economics." Nonetheless, in 1919 the two groups united within the Farm Economic Association, which began with a healthy membership of 350 and published a quarterly journal. In the USDA, work was also underway to consolidate the different lines of work in farm management and economics. Also in 1919, G. I. Christie organized three conferences at the USDA that would define the field of inquiry and establish categories of research and activity for this

new organization. His experience with interdisciplinarity was not all positive: "We do not know how to cooperate," Christie complained. "When someone proposes a project, it seems to be a signal for everyone else to oppose it." Nonetheless, Christie endeavored to bring these different interests together. The conferences were on the subjects of land economics, farm life studies, and farm organization and equipment. During the course of these meetings, participants voiced in various ways the real difficulties and ambiguities then facing farm families and bureaucrats alike. As Christie put it, "The idea of it all is that we want to have a planned and organized farm of that character which is not only giving a man returns but is going to make country life a satisfying and happy one . . . such as will retain our people on the land." Christie here alluded to the postwar paradox facing everyone in agriculture. Economists felt that farmers needed to be brought in line with other modern industries, and that would entail mechanization, rationalizing farm operations, and routinizing agricultural practices. Due to the high capital cost of this transition, it would chase some, mostly older and less affluent farmers off the farms, while attracting others, mostly young men returning from the war, to make lives on farms. But at the same time, economists continued to invoke the mythic, Jeffersonian farm so deeply embedded in urban imaginations and so patiently awaited by farmers themselves.[16]

Relationships between the agricultural economists and the farm management people, and also between the agricultural and classical economists, were often characterized by disdain and suspicion. In spite of their similar training, members of each group were apt to find those in the other groups wanting. The farm management group was miffed that the economists had not included anyone with their perspective in the roundtable discussion of farm economics that led to the formal organization of the Association of Agricultural Economists in 1907. H. C. Taylor, who was a member of both groups as well as the first chief of the Bureau of Agricultural Economics in the USDA, was critical of the limited educational accomplishments of most researchers in agricultural economics, particularly compared to those of other professional groups in the social and natural sciences. By his count in 1928, only 21 percent of the researchers in the field held doctorate degrees, 50 percent held master's degrees, and nearly 30 percent had only a bachelor's degree. More damning, Taylor found twenty-two institutions in which not a single agricultural economist had a Ph.D. This pattern was characteristic of the early BAE staff as well. Reflecting in part the emergent nature of the field, most staff in agricultural economics had only a bachelor's degree, although many of them were probably visiting the BAE as part of their advanced training. In addition, turnover was high. Classical economists were

thought to be "city-minded," a pejorative coming from an agriculturalist. Liberty Hyde Bailey made a clear distinction between the various interests in his advice to H. C. Taylor in 1903. Bailey responded to Taylor's concern about where to publish his book by saying, "If you wish first of all to make your reputation with the economists then, of course, it should go in Professor [Richard] Ely's series. If you wish, however, to reach the farmers then perhaps it might better go in mine. . . . They are the ones least able to work these things out for themselves." Henry A. Wallace compared economists unfavorably to mathematicians and felt that their formal reasoning led to "the perpetuation of a state of society in which the farmer is somewhat at a disadvantage." John Black tended to be critical of both economists and farm management experts. When Black moved to the University of Minnesota in 1918, he was the first one in the Bureau of Research in Agricultural Economics who was trained in agricultural economics rather than classical economics. But years later, when he was a professor of economics at Harvard University, he urged one potential student to attend Harvard rather than Columbia or Chicago, because the latter two offered no instruction in agricultural topics, but also rather than Wisconsin or Cornell, where "they would force you to spend a lot of your valuable time and energy in learning how to figure the cost of production." Yet by the mid-1920s, the emerging leadership could look back and see economists and management professionals alike as a single institutional force, in which farm economists such as George Warren, W. J. Spillman, and Andrew Boss were aligned with classical economists such as Richard Ely and Thomas Carver. All of them constituted the first generation responsible for training such early agricultural economists as M. L. Wilson.[17]

MAKING FARMERS ACCOUNTABLE

In most states, professional farm management work began in earnest between 1914 and 1922. During this period the first group of farm economists began publicizing their experiences and results, and workers in the other states began to take up the task. One reason farm economics accelerated in the early 1920s was that the war had persuaded many government workers that there was "a lack of comprehensive, conclusive data" related to agricultural production. The combination of the unprecedented amount of food production for the war effort and the need at the same time to fix commodity prices to stabilize markets magnified the poor quality of agricultural data and re-emphasized the need for a single federal bureau to oversee matters. Still, in those intervening years much new

work had been started. As the North Dakota farm management leader (often called a demonstrator) expressed in 1925, "Five years of research and education have apparently borne some fruit." More than half the research work in agricultural economics in 1926 was in farm management. Cost accounting became more popular because of the income tax. In many states, extension workers spent a good part of the fall and winter helping farmers figure out their accounts and complete income tax forms.[18]

States varied quite a bit in their ability in and enthusiasm for the farm account work. One difficulty was that county agents and farm management demonstrators tended to change jobs frequently, moving into other work in the agricultural college or at the USDA, going back to college for advanced study, leaving college work altogether for the better-paying private sector, or taking their accumulated organizational skills to start programs in other states. When H. C. M. Case toured the states in 1919, he found that in the west, many states had not yet started farm account projects, in the northeast, many states either had no one to do the work or had just hired someone, while in the midwest, farmers were beginning to keep accounts but often the colleges were handicapped by lack of money and, as in the east, lack of farm management experts. But over the next two years, most states had a farm management demonstrator working with farmers on keeping accounts and on thinking about how to increase productivity and efficiency on the farm. For example, learning how to keep farm accounts would teach the farmer to think quantitatively, solving the vexing problem of how to persuade farmers to consider their own interest—and that of their agricultural neighbors and merchants—in economic rather than merely political or social terms. Getting farmers to care about the numbers was key to this transformation.[19] In Montana in 1914, extension workers distributed accounting books that asked the farmer for opening and closing inventories, records of receipts and expenses, and a business summary category was meant to figure out what was called labor income. Because on most farms the labor of both the farmer and the horses was the most intense and expensive part of farming and because it was just this factor that farmers were apt to ignore in figuring out whether they were making or losing money, economists invented the category of labor income to help farmers understand the big picture. It was not a complicated notion. Labor income, according to a Montana extension specialist, was determined by first figuring the farm income, which was farm receipts minus farm expenses. This elemental number was what most extension workers focused on in teaching farmers how to think quantitatively. Labor income was

then farm income minus the interest on farm capital, which, in effect, was the debt load farmers carried from year to year. A good labor income occurred when a farmer's income was high even after expenses and debt repayment.

Several examples from Montana will illustrate this approach. Beginning in 1914, extension expert F. Josiah Chase began teaching farmers in a dozen counties how to keep farm records, and in Missoula County he obtained records for forty-six farms. On receiving all these records and in cooperation with the county agent for Missoula County, Chase figured out the labor income for each farm and highlighted the top dozen farms. The other thirty-four farms were then evaluated in the context of these higher-rated farms, and each farmer was shown a detailed comparison and was offered some thoughts on the reasons for the outcome. For example, farm number 2 was told: "Your labor income is rather low, but do not feel discouraged about it. Your crop yields are high and your receipts from cows and the number of animal units are good. Your size of business is a little too small. If possible it might be well for you to rent some land so as to increase your crop area, also increase your livestock and total number of animal units. Maintain your present quality of business and you will have a very good labor income."

Chase also entered a parenthetical comment for the county agent and perhaps for the federal extension worker which provided a personal assessment. For one farmer Chase wrote: "This farmer is quite an elderly Frenchman and not very well. He is interested in the work done. He cannot read or write English and can hardly understand it. I could not do much with him except treat him kindly and get him interested." For farm number 17, the prospects seemed a little brighter. Chase wrote to the farmer, "Your labor income is a little too low and I expect you realize this as well as anybody else. If possible it would be well to increase your crop yields as they are unusually low. Also increase the quality of the livestock by disposing of your poor cows and keeping only those which are returning good net earnings. . . . I notice that you have a large number of sheep and you realized a large loss from them, perhaps from the fact that the weather was too severe. This might account for your low labor income. . . . If I were you I would raise more cash crops, increase the number of acres of wheat and oats, and by so doing you will raise your chances of increasing your labor income." Parenthetically Chase noted: "This farmer keeps sheep. These were a big loss to him, but he has sold the old ones and will keep selling more of them. He will also sell off the non-productive cattle and keep only the good ones. He will keep farm accounts."[20]

For Chase, as for other farm management demonstrators, the account book

exercise was a crucial part of the campaign to persuade farmers to act more like businessmen and less like old-fashioned peasants. And his comments on whether or not a farmer seemed "interested in the work" pointed to a real difficulty facing the agents and demonstrators—that is, persuading farmers to understand that keeping records, writing down purchases, saving receipts, and then reporting these private transactions to an outside expert would actually increase farm profits. Although it is difficult to say with certainty how many struggling farmers kept such records before the advent of this farm account program in the mid-1910s, anecdotal evidence suggests that few did. Farmers with a fatalistic temperament may have felt that it mattered little whether they wrote down their meager earnings or their pitiful expenses—it all added up to the same disappointing sum. And they may have been painfully aware that other farmers in their neighborhood were more successful with better yields, larger fields, and newer equipment. The prospect of being unfavorably compared with other farmers would not be attractive, particularly given that farmers' account books could be used for demonstration purposes in township or countywide meetings. Even without naming names, not many farmers would welcome such public attention in an area where people already tended to know one another's business. Agents in Missouri had a hard time persuading farmers to participate at first, and as the agricultural depression of the postwar years deepened, many farmers lost interest in the project. M. L. Wilson summed it up in 1922 as follows: "The attendance [at farm account schools] was rather poor and the attitude of the farmers was not good. Farmers were pessimistic in attitude and were more interested in some plan to raise prices than in reducing expenses. Some difficulty was experienced in getting farmers who had kept accounts the year previous to summarize these at the schools. They hesitated to bring their books and did not, apparently, want their neighbors to know where they stood." By the following year, many Montana farmers were even less enthusiastic and felt that with prices still low, they may get out of farming entirely.[21]

Yet in the minds of the demonstrators, such accounting was exactly the tonic most farmers needed if they hoped to ever escape from the rut of poor returns. As Chase explained to a colleague in 1916, the purpose of accounting was to teach the farmer four things: "First, to think of his farm as a business unit. Second, to measure his success by the labor income of the entire farm. Third, to know what each farm enterprise contributes to that labor income. Fourth, to have regular and profitable use of labor and capital."[22] These four goals, which formed the mantra of all demonstration agents in the states, bear close examination, for they defined what sort of advice agents gave to farmers and what kind of projects they

designed. They are important for us here, too, because these goals embodied an ideology of farm modernization that was new to northern farmers, one that offered a quantitative, quasi-industrial rubric for understanding whether or not a farm was successful. Before these principles were introduced, farmers and their families may have felt confident in assessing their success but the new approach suggested that there may have been more to it than they thought.

In exhorting the farmer to "think of his farm as a business unit," the expert was telling farmers something negative and something positive. Farmers should not think of their farms as just the place where they lived, or as a temporary job until something better came along, or as their fate. They should not think of their farms only in sentimental or romantic terms. They should not think of their farms only as supporting a rural way of life. They should think of their farms as places of business, perhaps as factories for producing things like pork and wheat, as places where productive activity was all business. It was fine for a farmer to enjoy the work, to appreciate the country air, and to have an emotional attachment to the land, just so long as this did not interfere with the business of farming. In telling the farmer to "measure his success by the labor income of the entire farm," experts were suggesting something more complex. Labor income, as we have seen, was a calculation based upon farm receipts, expenses, and interest on loans. But the calculation could be further influenced by other factors. For example, the overall size of the business was important to securing a good labor income. The number of crops per acre was in some ways just as important as yield per acre; the number of livestock that were really productive was as important as the overall number of livestock that was expected to produce well; and the number of workers employed on the farm might well be more or less, depending on other production issues—more was not necessarily better or worse. The USDA noted that there was great variation from farm to farm in the number of person-hours necessary to produce crops, and this difference frequently came from the many other factors that impinged on farmers.[23] Similarly, until the late 1920s it appeared to be important to have a diverse farm business, that is, to have a number of different enterprises contributing cash to the farm. This was so not only because it seemed to offer protection from a crop or livestock failure—if all a farmer raised was beef cattle, and the market for beef fell apart, then the farm would be ruined—but also because economists felt that having more enterprises on the farm distributed the farmers' labor more evenly throughout the year. This notion of full employment was a favorite of economists as well as of some urban observers, many of whom felt that farming was insufficiently productive in terms of time and money. Even Henry Ford, the

"farmers friend," felt that most farmers only worked hard about thirty days a year, spending the rest of the time just fooling around on their farms. Indeed, this was the basis for his "village industry" system, in which he moved some groups of workers out of the big Detroit factory and into small industrial sites where they could farm on a small scale as well as work part-time in the factory. Because farmers, unlike industrial workers, were wedded to their work sites, some economists felt that they should work as consistently throughout the weeks and months as possible, and not just when planting and harvesting, for example. Thus, the goals of "balancing the farm enterprise" referred to keeping the farmer busy on lucrative projects all the time. A grain farmer who did most of his work at planting and harvest had, theoretically, lots of time in between to raise sheep, tend an orchard or beehives, or repair equipment for neighbors. Any farmer had spare time, so the logic went, that could be productively filled.[24]

In some states, however, farmers were so interested in learning business methods that it was difficult to offer all of them personal assistance. In Illinois, for instance, farmers began keeping accounts in 1915, and farmers in several counties agreed to keep records for a number of years. This project was so popular that by 1924 the College of Agriculture could no longer manage it alone and developed a program called the Farm Bureau–Farm Management Service Project. Working with the more commercially oriented Farm Bureau, college officials signed up sixty farmers who paid about seventeen dollars per year and kept detailed records of all their farm operations. In return, these farmers received personal attention and advice from agricultural experts, who would evaluate each one in the context of the others in the county. At the season's end, each "cooperator" received a fifteen-page report listing how that farm compared with the 42 most profitable farms in the county, the 42 least profitable, and the average of 210 farms, in such categories as land investments livestock types, crop and off-farm work receipts, and labor and machinery expenses. The report was also packed with both narrative advice and quantitative information regarding what the agricultural experts considered best practice. The difference between this and traditional agriculture can hardly be overstated.[25]

One of the difficulties in starting farm management work in the states was figuring out how to get the message to farmers. Certainly the most obvious way was to make use of the agents located in each county of the state. These agents were responsible for communicating new information from the USDA and agricultural colleges to farmers in a given county, and they were the primary lines of communication between farmers and these entities within the state. Once the federal initiative was started, the county agents became the de facto carriers of

the message, although this task was difficult for many of them. In the early days, few agents were specifically trained for the work and thus had little understanding of or appreciation for the broader goals of farm management. In addition, agents were expected to add this work to their already full schedules, which made many of them resentful and probably less persuasive in trying to interest wary farmers in the mission. F. Josiah Chase reported that some Montana agents found the work a big time sink that took their attention away from worthier projects. In a state with as scattered a population as Montana, it wasn't easy to talk to all the farmers, many of whom asked for personal attention in getting their accounts in order.[26]

County agents and the farm demonstration leaders at the college learned quickly that trying to contact farmers one-by-one was not time-effective. By 1920 or 1921 most agents and leaders had developed a farm management school approach, in which the farm management leader, typically a professor at the agricultural college, would first teach the county agents the principles and practices of farm management and record keeping, and the agents would then gather farmers in large groups for instruction in these methods. For instance, in Maine, the demonstrator started by talking to individual farmers but, finding that approach too slow, shifted his attention to the county agent and the "farm management interests of the county," usually rural bankers, real estate agents, and other businesspeople. These two groups would together plan the county work, and the private interests would act as leaders in the effort to encourage farmers to attend meetings hosted by the county agent and demonstrator. Many states began relying on community leaders by 1924. The agricultural colleges "extended" themselves not just to farmers, but also to bankers, railroad representatives, and businesspeople who, with private farmers and college representatives, would together plan extension program activities for the state.[27] In North Dakota, four hundred farmers kept track of their accounts during 1924 and then sent their account books to the college for tabulation and evaluation. In the winter, the college demonstrator held a one-day meeting for all farmers and agents so they could go over the accounts together. Such one-day winter meetings proved popular overall, giving those concerned an opportunity to compare notes and learn both farming and accounting procedures from others.[28]

Another strategy that agents tried was to work through the secondary schools, many of which offered agricultural courses as part of their vocational training. In two Montana counties, Fergus and Flathead, schools offered farm management courses as early as 1916. In Ohio and Illinois, such courses, including in-

struction in keeping farm accounts, were offered in the eighth grade. Classes such as these were further encouraged by the Smith-Hughes Vocational Education Act, passed in 1917. The Smith-Hughes legislation was directed at rural youth from the age of fourteen and provided federal and state funds for high school instruction in agriculture, home economics, the trades, and the industrial arts. It was, in a sense, a junior Smith-Lever Act. Smith-Lever, which created the extension service in 1914, had the goal of keeping good farmers on their farms by showing them how to improve their business and farm practices. Spreading the word to farmers via their sons was also a tried and true 4-H method, first used in the southern states with the help of the Rockefeller Foundation's General Education Board. Employing this tactic, agents created boy's corn clubs and girl's canning clubs in an effort to persuade or embarrass parents to adopt more modern practices in the fields and the home. One of the most innovative of this kind of project was started by a county agent in Iowa, who developed a plan in which farm boys and girls would be "hired" by their parents to keep the farm accounts. With the promise of cash wages, eighty-two kids signed up immediately. Several years later this was incorporated into the state fair competition. Similar programs were started in North Dakota and Indiana in the mid-1920s; in North Dakota alone, more than two hundred rural schools were teaching children to keep farm account books using their own farms for data.[29]

Agents also liked to have prominent farmers take the lead in spreading both information and examples, an approach that became central to extension strategy in succeeding decades. In Nebraska, for instance, the agent in Scotts Bluff County asked successful farmers to nominate several of their neighbors to keep farm accounts in 1919, because "it was considered more desirable to have men chosen by their neighbors in this way than to ask for volunteers, as the former method gives the feeling of responsibility to the community for keeping a good record throughout the year." In Woodford County, Illinois, the agent sponsored a tour of four farms on which the farmer had been keeping accounts for at least four consecutive years. The idea—to show farmers different ways of arranging and operating a farm in that county—emphasized the fact that even in one climatic area, there were always several smart ways to choose crops, livestock, and spatial arrangements on a farm. In 1920 eighty farmers went on the tour. In North Dakota, an agent called together fifteen wheat growers who had been keeping records, and when they compared their costs and returns, they discovered great variation. Although this may have been unpleasant for some, the agent

felt that it provided a valuable lesson in record keeping, not to mention field practice, giving less successful farmers the chance to hear directly from more successful farmers just how they had done so well.[30]

The best promotional opportunities, however, were the county and state fairs, held each summer in every state. In many states with a large rural population, the fairs offered a much anticipated respite from the sometimes dreary day-to-day routines of farm life, and for many families, going to the fair was the only vacation they ever had. For children and teens, the fair promised amusements such as games and rides, dances, and the chance to show off their 4-H achievements in livestock raising, baking and cooking, sewing, and other hobbies. For the parents, the fair combined a brief vacation away from the farm with the chance to find out what was new in agricultural production and home design, two areas in which both commercial enterprises and the agricultural colleges vigorously promoted their own research and innovations. Farm management experts developed exhibits to explain and promote their ideas, and they attempted to come up with catchy and attractive displays that would spark farmers' interest. In Montana, agent Arthur Copeland proposed a display that featured a

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Farm management at the fair. State Historical Society of Wisconsin. (X3)52694.

[To view this image, refer to the print version of this title.]

Model farm stock show exhibit, 1920, Colorado. State Historical Society of Wisconsin. (X3)52693.

farmer's office; although virtually no farmers actually had an office and would find the idea laughable, Copeland thought that the display would generate desirable discussion on the topic of farm accounting, and he wanted to offer the featured desk as a prize in a raffle.

Many other farm management people designed their displays around a model farm, which was a miniature, tabletop, scaled-to-size farmstead that featured the farm house, barns and outbuildings, roads, and fields of a hypothetical farm that local farm managers considered ideal in design, efficiency of layout, choice of crops and livestock, landscaping and modernity of home and buildings. At the Indiana state fair, some of these displays showed "before" and "after" farms; the latter demonstrated the removal of bushes and timber, the arrangement of "regular" fields (which meant fields that were squared-off geographically and similar in shape to other fields), a farmstead rearranged for convenience and efficiency, and the establishment of "a definite rotation of crops." In Illinois, the farm management people set up three model farms, each twelve-feet square that illustrated three types of farming. One farm showed the "average cropping system of the county," the second showed a livestock farm on which crops were fed

to the livestock, and the third showed a mixed livestock and grain farm on which wheat was grown for the market and other crops were used as feed. Accompanying each model farm was a chart showing expenses, expected yields and receipts, and other relevant data, which encouraged farmers to compare and contrast the different choices they might make and the consequences of those choices. What really got people talking about the display, however, and probably increased attendance, was the fact that the crops were real: each field was planted a week before the fair "so that they were up in attractive condition during fair week."[31]

In an effort to heighten farmers' interest in farm management work and to take advantage of the automatic and guaranteed advertising potential of the state fair, some farm management experts created a contest. The object was to persuade farmers to keep accounts and develop a heightened awareness of their farm's appearance and productivity, all with an eye to entering a statewide contest for best farm. M. H. Overton at Purdue University proposed such a contest and suggested a scorecard for evaluating each farm. Points were given for efficiency of operation, layout, and design of farmstead, yields from crops and livestock, and attractiveness of home and grounds, for example. Although Missouri had successfully run a farm management contest, awarding prizes on strictly economic criteria, economists in other states felt it would be too difficult to judge farms operating in an area as big as a state. The differences in climate, commodity, and soil type across large states made it seem impossible to determine the winner fairly. Yet in spite of this difficulty, scorecards were popular among farm management people, because they seemed to offer the best way to assign value to the many dimensions of farm practice that economists wanted to quantify and correlate. Scorecards were used for all sorts of evaluations and were especially popular in county and state fair contests that gave prizes for the best chocolate cake, or hog, or go-cart, or home-sewn dress. Points were separated into categories, allowing the judge to offer a more nuanced evaluation than simply winner or loser. A cake might get high points for flavor, but low points for visual effect, and a hog might be impressive for its size but not for cleanliness. Corn was evaluated for color (up to twelve possibilities, each with its best variation), length of ear, diameter, and straightness of rows. Scorecards were used to evaluate master farmers in Iowa as well. But not everyone agreed that all of these qualities could be fairly weighed, and some objected to the implied effort to quantify the moral and psychological dimensions of farmers. Yet, in a sense, it was exactly those qualities that economists most wanted to quantify, because it was those that seemed most important in creating a class of modern, scientific

farmers. Henry C. Taylor's experience with this bears reviewing; he wrote to Donald Murphy at *Wallaces' Farmer,* an enthusiastic sponsor of the master farmer program, "Some of my students from foreign countries have raised questions implying that in the scorecard too much stress is laid upon clear thinking and right living and not enough upon good farming. Personally, I feel that the scorecard is not subject to criticism from this point of view. I should not want to see any man classed as a Master Farmer who thinks entirely in terms of efficient farm operations. Efficient farming is only the basis of the life of the farmer which is partly the life of the home and partly the life of the community. Unless the candidate for this great honor is highly efficient in all those phases which make up the life of the farmer he should not be called a Master Farmer." Although material efficiency, which could be taught and demonstrated and viewed, was important, to many thoughtful observers it was but a pale representation of the complete transformation farmers needed to effect.[32]

FAIRWAY FARMS AND EXPERIMENTAL ECONOMICS

In the spring of 1923, M. L. Wilson approached the Rockefeller Foundation with an unusual proposal. His idea was to create a farm management demonstration project in Montana using real farms and real farmers. The project would demonstrate the importance of proper management techniques and the role of agricultural expertise in saving derelict farms and helping tenant farmers work into farm ownership:

> A farm with good possibilities, so far as the soil is concerned, but with inadequate buildings and improperly managed shall be bought and a young man who has proved that he can earn money and save money, but who is not in a position to buy a farm although he wishes a farm, shall be secured to go on this farm as a share tenant, with the understanding that he will do the teaming, the rough work and all the work that would ordinarily be done by a farmer in the putting of the farm in shape of successful operation—the modernizing of the home and the modernizing of the barns in accordance with the needs of the farm, determining the efficient type of farming which will increase the productivity of the soil. . . . We would provide all the capital that would be needed beyond what could be borrowed under the Federal Farm Loan Act.[33]

This idea, which was actualized as the Fairway Farms, came originally from Henry C. Taylor, a professor of agricultural economics at the University of Wisconsin. Taylor also owned two farms in the Madison area, and his experience

trying to transform them from marginal into profitable farms gave him the idea for the experiment. Taylor believed that a large part of the agricultural problems of the day stemmed from the fact that tenant farmers had little opportunity to both work on shared land and save up enough money to buy a farm, a situation that led to a tenant class of farmers who had neither the means nor the prospect of investing deeply and personally in the farm community and thus did not invest in the future of agriculture. Without such a commitment, Taylor believed, farm communities would be devastated by the decreasing commodity prices, increasing mortgages, and inevitable bankruptcies so prevalent after the war. This, in turn, would lead to further rural degradation, as farm families were forced off the land and into urban areas ill-equipped to welcome rural people, and as that land was bought by outside speculators and investors.[34]

In looking for a place to situate this experiment, Taylor was especially drawn to North Dakota and Montana, two states which had been especially hard hit

[To view this image, refer to the print version of this title.]

M. L. Wilson in the Soviet Union, 1929. J. B. Davidson Collection, Iowa State University Library/University Archives.

with the postwar depression. Both were also sparsely populated, geographically isolated, and the land was cheap. While North Dakota had been settled and indeed had risen to agricultural prominence through the bonanza farming in the Red River Valley in the late nineteenth century, Montana was still a fairly wild place at the turn of the century. Until World War I, most of the farming in Montana was livestock raising, which seemed suitable to the semiarid landscape and the distance from railheads and roads. According to M. L. Wilson, this changed in the years 1915 and 1916. The war created a huge market for wheat, the climate in Montana was unusually ideal for growing wheat, and there was still a lot of land that was available for homesteading in this dry part of the country. As a result, "every barber and drug store clerk in the middle west who could not make good in his own job came to Montana . . . and commenced raising wheat." Between 1914 and 1918, most of the farm mortgages in the state were taken out by professionals or semiprofessionals from the midwest with interest rates of 8 to 10 percent but mortgage amounts of only $2,000 to $4,000. At the peak of the boom, from 1915–1917, there were 35,000 wheat farmers in Montana. But the boom turned out to be short-lived, because the notoriously unreliable rain again became scarce by 1918 and a series of drought years exacerbated the downturn caused by the end of the war-induced market opportunities. Harold Fabian, who toured the west for the Rockefeller Foundation, reported that with the collapse of the wheat market in 1920, "the barbers and clerks went back to their shops and stores. The dry farms were abandoned and rapidly were overrun with Russian thistles. Banks failed." By 1928, the number of wheat farmers fell to 14,000.[35]

The role of banks and lenders in general was always a crucial barometer of change in agriculture, and in the semiarid west their effect could be dramatic. In Montana during this period, bankers and merchants often banded together in an effort to stabilize agriculture through various land schemes and political maneuvers. Farmers who could not get a crop for several years running due to drought were not likely to get another loan from their local bank yet the bank had little incentive to repossess farms that were so utterly unproductive. As Fabian wrote, "There was built up a psychology in the local sources of money supply that was found to prove hostile to any subsequent effort to rehabilitate these farms." The Montana Development Association (MDA), a group of lenders and merchants intent on figuring out how to make agriculture profitable, was angry at the agricultural college, which it felt should have been able to either forecast the drought or come up with a scientific way to manage dry farms in the first place, and the association decided to find its own expert. Hardy

Campbell, an eccentric agricultural evangelist, was brought to Montana in 1922 in the hope that his summer fallow system of wheat growing would solve the state's problems.[36]

Perhaps impelled by the MDA's challenge and by the strong correlation between the state's viability and agricultural sustainability, the state board of education also took action by giving the agricultural college extension service an extra $10,000 to develop an agricultural plan for the triangle district. The triangle, whose apex was Great Falls and whose base was the Canadian border, had been extremely hard hit by the drought, and state leaders felt that the area was especially important to Montana's agricultural future. Agricultural college leaders decided to put the money into a study of successful farms in the triangle district, on the assumption that whoever had survived the drought and market crash must be doing something right. The resulting study concluded that farms needed to diversify for subsistence—that is, raise chickens, hogs, and dairy cows, as well as substantial garden crops, to help the family survive lean times, a practice common on midwestern farms but less so on emerging industrial farms. In addition, farmers should have larger acreages, both because land was cheap and because wheat prices were generally so low that growing more was the only way to make more money; farmers should use large teams of horses rather than tractors, a surprising observation today but sensible at a time when tractors were not standardized or reliable; poor land should be devoted to grazing, and better land should be devoted to wheat, the preferred dry-land grain; and finally, farms should use inexpensive dikes and diversion dams to catch mountain run-off wherever possible.[37]

It was in the spirit of these observations and in the atmosphere of crisis that pervaded Montana's farms, banks, and colleges that made the state so attractive to H. C. Taylor and Wilson as a farm management experimental site. Taylor, who in 1923 was serving as the first chief of the Bureau of Agricultural Economics at the USDA, for some years had been wanting to find land on which he could experiment with the various elements that constituted "farm practice," such elements as different kinds of crops and livestock, different kinds of owners, families, and tenants, different kinds of climate and soil, different ways of using animals and machinery for power, and different combinations of all of these things. He felt that an experiment, or demonstration, firmly grounded in rational and scientific facts and figures would go a long way toward helping farmers know how to select the most stable and lucrative approach. Without such experiments farmers would continue to make stabs in the dark, hoping that this crop or that farm animal was indeed the solution to their entrenched financial problems.

Wilson and Taylor came to this endeavor with slightly different purposes but the two men had a lot in common. Both were born in rural Iowa (Taylor in 1873, Wilson in 1885), both studied at Iowa State University and the University of Wisconsin at Madison, and both were economists by training. Both were drawn to public service; Taylor was chief of the Bureau of Agricultural Economics, and Wilson was on leave from Montana State University as a BAE agent. Wilson was more savvy than most academics about the realities of farming in Montana. After graduating from Iowa State University in 1906, he bought a 240-acre livestock farm in eastern Nebraska, and in 1910 he moved to eastern Montana. There he farmed an 800-acre ranch with his wife's uncle. They intended to grow flax using modern machinery, still a novel approach, and spent all their money on a J. I. Case steam engine tractor; they had to borrow operating capital. Unfortunately, the year was dry, the yields were poor, and the bank loan could not be repaid. Thus ended Wilson's farming experience.[38]

Of course, by 1923 quite a few farm economists were conducting experiments at the state colleges, but these tended to be local in character and difficult to generalize to other areas. They also did not usually juggle different farming dimensions, weighing each in relation to the others, within one experiment or demonstration, an approach that was at the heart of farm management thinking. And few state experiments were located on actual farms; most were conducted within the more controlled environment of the college farm. For Taylor, it was crucial both to find out how farming elements interacted in real time and to assist real farmers in making the changes to their farms that were necessary to create sustainability. Montana, although not in the heart of traditional American farmland, offered many advantages to those wishing to experiment with agriculture. Clearly, banks were loath to loan money on the hope that good weather and a fortunate market upturn would salvage the situation. "Only a complete and practical demonstration," according to Fabian, "with black figures appearing consistently in the net profits column, together with no little patriotism and pioneering faith, could induce bankers generally in these sections of the country to again make loans on dry farm wheat lands." For Wilson and Taylor, the Fairway project was thus interesting because it would not only advance their understanding of farm management, but also generate a more solid foundation of scientific principles. It would also solve an actual rural problem, one involving real farmers in real crisis situations. If the project was successful, it would fundamentally change the way farmers practiced agricultural production, the way they lived in the country, and the way bankers treated the farm "problem," perhaps forever. Wilson's fervor is clear in an early annual report: "The Fairway Pro-

ject assumes that there will emerge from this situation, a new type of agricultural production, a new economic unit, a new situation with reference to farm financing, etc. We believe that the Fairway Project will assume leadership in pointing the way toward an entirely new agricultural situation in the western portion of the spring wheat belt."[39]

The Fairway Farms experiment addressed one problem within land economics more generally. Wilson was interested in the fact that as tractors appropriate to American farms began hitting the market in the early 1920s, farmers were going to be faced with a new and different set of possibilities and dangers. Tractors and other machines would cost a lot, but they might enable a farmer to increase production as well, and they might move Montana farmers into a more stable economic situation. Wilson recalled it this way: "Could the cost of production be lowered so that even though—in comparative terms, or in terms of parity price—the market price of wheat might be low, nevertheless, the cost of production had been so reduced by the use of tractor power and the decrease in manual labor brought about by larger scale power implements and combines would be such that a farm that was organized to the new unit of machinery could be profitable even though the price of wheat was low."[40]

The Rockefeller Foundation got involved as a result of prodding from Richard Ely who, on behalf of his Institute for Land Economics, had urged the foundation to do something good for agriculture. This appealed to Beardsley Ruml, who in 1923 was made director of the Laura Spelman Rockefeller Memorial and who was interested in the social sciences. According to Taylor, Ruml came to him to get some ideas for things the memorial might usefully do, and Taylor realized that this was an excellent opportunity to study the question of farm tenancy. Taylor suggested that the foundation send someone out to Montana to see what the situation was and to meet M. L. Wilson, who would act as managing director of the project. In late October of 1923, Rudolf Bertheau made the trip and quickly learned that the life of a farm management demonstration agent is one of constant travel. Bertheau learned from Mrs. Wilson, "a capital person," that M. L. was traveling around the state and figured out a way to rendezvous with him, which gave Bertheau an opportunity to see firsthand what Taylor and Wilson were proposing. The interview must have gone well, because by December, Ruml agreed to finance the project up to $100,000.

With the funding in place, Wilson began putting together officers and a board of directors to oversee the project. In his naming of these officials, Wilson demonstrated a canny political sense. The president was J. L. Humphrey, who was also president of the Montana Mortgage Bankers Association, a group

deeply interested in the stability of Montana farmers and a group hard hit by the agricultural crisis in the state. Vice-president was Chester Davis, then Montana state commissioner of agriculture. Wilson asked Ruml to serve as treasurer, "inasmuch as the plan contemplates securing a loan only through you." Wilson himself was the managing director of the project. For the board of directors, Wilson chose A. Vaux, a prominent Montana landowner, farmer, and merchant, and Dean Leon Marshall of the University of Chicago, a well-known economist with whom Wilson had studied. Ever the politician, Wilson chose Marshall because "we would like to have somebody on the board who was on the inside with Ruml, that Ruml, if in the future he cared to, could get, via the Grape Vine Route [*sic*], exactly what was taking place in the business of the company." Also serving on the board were H. C. Taylor from the Bureau of Agricultural Economics (USDA), Richard T. Ely from the University of Wisconsin, and J. M. Hamilton, F. S. Cooley, and E. H. Lott, all faculty from Montana State.[41]

Next, Wilson began looking for both farmers and farms that would be suitable for the experiment. Obviously, locating abandoned or run-down farms was not a big problem—they seemed to be everywhere. But for the purposes of the experiment, Wilson wanted to acquire farms that offered certain characteristics. For instance, since parts of northeastern Montana were "under the ditch," Wilson wanted to explore what sorts of crops and livestock were best suited to an irrigated or semi-irrigated farm. Similarly, since most of the state was semiarid and had no real history of sustainable grain or diversified farming, Wilson hoped to figure out how farm families could combine productive enterprises in order to survive. A farm's distance from a creek or river, or from the rail depot, its location on reservation land—all such conditions figured into Wilson's calculus. He was also optimistic that such farms would be relatively inexpensive, both for Fairway to acquire and for prospective tenants to buy. As he explained to Richard Ely in 1924, "Several of them [mortgage companies] are willing to turn over farms and land to us at a valuation based upon their first mortgage and delinquent interest. I think they will give us a five-year option to buy it at this stated price provided we will pay them 6% interest in the meantime. . . . It would mean that we would sell the land to the tenant at about its 1912 valuation." This would also allow Fairway to use most of the money from Rockefeller to equip tenants rather than buy land, an attractive short-term prospect. In early summer of 1924, Wilson asked mortgage companies and bankers in Montana for lists of foreclosed or abandoned farms under their purview, and in the fall he began exploring farmstead candidates in earnest.[42]

Prospective farmers were also plentiful, but, as Wilson confided to Hum-

phrey, he was "very confident that our one big problem is going to be that of securing capable tenant purchasers." What Wilson was looking for was an ex-farmer from the corn belt states, maybe "a capable Iowa farmer who has limited means and yet who might make a good Fairway Farm prospect." This, of course, was close to the mythic farmer that all agricultural experts dreamed of, and expected to find, when agricultural policies and programs were established. This was the yeoman, a farmer of moderate skill, good intelligence, and high virtue, who would work hard and long, who would make sacrifices to ensure that his children were educated and that his wife did not suffer unduly, who would offer the voice of reason in civic matters. Although Wilson was not naive about farmers, he was optimistic and idealistic whenever possible and surely had this mythic ideal in mind when looking for tenants. He placed advertisements in the *Montana Farmer* and the *Dakota Farmer,* hoping to find one but, although some came close to the ideal, subsequent events would challenge even the most ideal man.[43]

The tenants Wilson finally settled on were a mixed lot. B. T. Barnes, who was hired for the Wiota Farm near Fraser (near the future site of the Fort Peck Dam), had moved to Montana from South Dakota in 1916 and bought a half-section farm that was not successful. He lost all his equipment, livestock, and belongings when his bank failed, and so he moved to Fraser and did odd jobs for a year or two. Wilson hired him because he had tenacity, honesty, and integrity; he did an adequate job with the Wiota Farm. Sven Twedt, who was in his early forties, had also been in Montana for about a dozen years and had also been farming a half-section of land. He had had much better luck than Barnes; when he moved onto the Cloverleaf Farm in the triangle area, he brought about $1,400 worth of livestock and equipment. Wilson thought that Sven was above average in both intelligence and farming ability. Similarly, F. S. Davis, fifty years old, had come to Montana in 1915 and bought 480 acres; by the time Wilson found him, Davis owned machines and livestock valued at $4,500, but he did not own land; his Fairway Farm, just northwest of Billings, was called the Davis Farm. Cornelius Vanderschaaf, who leased the Rosebud Farm in southeastern Montana, had come from Holland around 1908. He had worked as a farm laborer, tenant, and homesteader, all without much success. When Wilson found him, Vanderschaaf was a tenant for the North American Mortgage Company, which recommended him highly. Unlike Davis and Twedt, Vanderschaaf had neither livestock nor machinery, so Fairway Farms at first hired him at the rate of $75 per month. After proving himself the first year, he became a tenant-purchaser. The Taiyan Farm, also near Fraser, had a more complicated history with tenants. A. J. Cleve-

land, then thirty years old and with two years' education at the University of Nebraska, had an unusual history. He enlisted in the war after college and at the war's end took a job teaching at the Fort Peck Indian School, where he soon became headmaster. Under his direction the school farm, which had been badly neglected, was brought back into a state of productivity and beauty. Although he seemed like the perfect candidate for Fairway Farms, it soon became clear that he was "not particularly susceptible to counsel," and he broke his lease three years later. He was followed by Mr. Fore, a dry-land farmer with a huge family, and he died five years into his lease. The final tenant was Edwin Johnson, about whom little information remains. Pete Smick, who had raised sugar beets in Colorado before moving to Montana in 1916, was a tenant on the Richland Farm when Wilson bought it, and Wilson kept him on until 1931 when his contract was terminated. He was followed by a Mr. Nelson, a young man who lived in the area who became disgusted and moved to Oregon in 1936. The last farm, called Lone Warrior or the Brockton Farm, did not have a resident family but was supervised by Gordon Davis, son of F. S. Davis at the Davis Farm.[44]

The nitty-gritty realities of these farms and farmers bear a closer look, because they illuminate how complex and idiosyncratic these experiments in agricultural management were and how much distance existed between the formal experiment and the day-to-day work that Wilson did. Although Wilson and Taylor had originally intended to manage about twenty farms, they ended up with seven by early 1925. All were in the eastern two-thirds of the state: four were in the northeast corner, two were in the southeast, and one was in the triangle area of north central Montana. Each of the farms was meant to explore a specific farming problem and was chosen for that purpose. We'll examine three in detail.

The Rosebud Farm was located just off the Yellowstone Trail, what is now known as Interstate 90, the main east-west highway through Montana. Wilson's idea with Rosebud was to make it a showplace for corn growing, demonstrating that on certain parts of Montana tableland, huge fields of corn could be grown that could compete with midwestern corn harvests; whereas midwestern corn yielded more per acre on small fields, Montana corn yielded less per acre but in larger fields. The challenge was to figure out how to make corn-growing as low cost as wheat-growing had become in Montana, relying on large scale and machines to manage what small scale and humans could not. Most farmers in the Yellowstone Valley who had worked small farms failed exactly because their acreages were too small. When Wilson saw the available land, he immediately consolidated three farms to total six hundred acres. The second challenge was

to combine livestock and corn on the farm. Because the strain of corn that was most productive in Montana grew low to the ground, most farmers found it was too expensive to hire laborers to pick the corn or to purchase picking machines. Rather, they preferred to have hogs "harvest" the crop, counting their corn yield in bacon.

Vanderschaaf had a tough first year on Rosebud. Most of the fields had been abandoned, and he and a hired man spent countless weeks clearing weeds from the fields and then planting 220 acres of corn. They built four-and-a-half miles of hog-proof fencing, and in the fall bought 300 pigs to feed on the harvest. When all was said and done, after selling the fattened hogs in the winter as well as some seed corn, the farm showed a net gain of nearly $850, a fine showing. In 1926, Vanderschaaf planted 90 acres of wheat, 25 acres of oats, and 263 acres of corn, all of which failed due to a lack of rain; Vanderschaaf was forced to get a job at a mill in Bozeman to make ends meet. In 1927, he planted 118 acres of wheat, 242 acres of corn, and 33 acres of oats, plus corn, barley, and potatoes. As before he bought two traincars of pigs to do his harvesting but, due to a price drop in hogs over the fall, ended up losing money for the year; the losses from hogs cancelled the gains from crops. In 1928 the rainfall was average, but it was distributed poorly, resulting in total crop failure. In 1929, below average rain fell at just the right time and in the right places, which led to good yields but not enough to make up for the bad previous years. In 1930, poor yields and poor prices led to another crop failure, and the true drought of 1931 "put the farm on an absolute starvation basis." In 1932, the Fairway Farm board turned the farm back over to the mortgage company.[45]

This was a serious blow to Wilson, who had taken such pride in the prospects at Rosebud. But he tried to be philosophical: "This farm unit had less of a chance to make a success than any other because of the fact that its organization depended upon price fluctuations as well as fluctuations in productivity. The one good year of the series did not result in any reserve being built up and the conditions throughout the entire period were such that the unit never became stabilized. From the average production of the last 12 years, this land cannot economically stay in cultivated crops and should be restored to range land."[46]

The Cloverleaf Farm in north central Montana was located in the middle of a historically unstable agricultural area. The chief advantages of the triangle were that the land was ideal for wheat in terms of topography and soil type, the wheat grown there was usually high in protein, a characteristic that often resulted in much higher prices, and it was near the railway so shipping to Minneapolis was relatively easy. But the disadvantages of this area were equally impressive. Be-

cause the rainfall was so unpredictable, farmers would be misled by an especially good year or two, only to discover that several dry years might follow. Land prices moved from extremely high to low to high again, depending upon the previous year's rainfall. The Cloverleaf Farm's previous owner had paid the Netherlands American Land Company $60 per acre, but Fairway bought it in 1925 for $7 cash per acre. Wilson's goals with this farm were to demonstrate low-cost wheat production techniques but within a diversified farm, emphasizing a stable, sustainable balance of crops.[47]

Sven Twedt moved with his family to Cloverleaf in 1925 and, because there had been no crops on the land for five years, spent considerable time clearing fields of weeds. He bought a tractor to help and hired another helper as well. They planted more than 400 acres of spring wheat, plus some oats, barley, and corn, and summer-fallowed about 300 acres. In addition, Twedt had 28 cows for milking, 20 horses, and 10 hogs. Because of all the field preparation, the crops were planted a little behind schedule, and hot winds damaged the crops in the summer. Although the rains were average, they fell at the wrong time for these crops, and yields were poor. In addition, the barn burned down and had to be rebuilt. A much better year came in 1927, with good weather and good yields. Twedt was able to put most of his grain in storage, meeting the goal of banking feed in good years to carry livestock in the bad years, a central principle of diversified grain and livestock farming. Again in 1928 yields were good; even though average rainfall was low, it hit at exactly the right times. Twedt increased the number of hogs to 84 and cows to 32, had accumulated a good reserve of feed grains, and had all the machinery he needed. But then the tables turned. In 1929 poor weather led to poor yields. The next year was a total loss, and Twedt had to sell his hogs to raise money. In 1932 the rain was better but the effect of several dry years was slow to erase. Yields were slightly better, enough to bring hogs back into the equation, but Twedt had to sell his horse team because the wells were running dry in hot weather. In 1933 conditions improved little and Wilson wryly noted that "expenses have declined pretty well in proportion to the income"; Twedt sold his livestock to meet expenses. In 1934 the crops were a total failure all over Montana, but Cloverleaf managed a small wheat crop. What saved Twedt in 1934, and again in 1935, was a wheat allotment payment. In 1935, with no improvement in sight, Twedt began to take small jobs in the area, including that of county assessor. And yet again, 1936 was a total loss.

For Wilson, the take-home message with Cloverleaf was that it was virtually impossible for farmers in this area of the state to accumulate enough reserve feed to keep livestock for any length of time. As he put it, "It is impossible to build

up a sufficient reserve in terms of feed to carry over more than two or three deficient years; consequently, it is necessary for the whole farm organization to become more or less dormant during periods such as these."[48] This was a new idea and one that challenged any sense of traditional farming practice. How, exactly, did a farmer go dormant and still make ends meet? Wilson did not elaborate on this question. But if Cloverleaf was a model, it meant that the owner had to be prepared to find other employment when crops and livestock were not sustainable. Of course the problem was knowing what future weather and markets would bring. How were farmers to know if one bad year was the beginning of a string of bad years or only a brief irregularity? How could they plan for disaster within a context of long-term stability? Cloverleaf Farm offered verification of the fundamental farm management problems, but no easy solutions.

The third farm we will consider is the Lone Warrior Farm, also called the Brockton Farm in recognition of the nearest town. This land, located on the Fort Peck Reservation, had been part of Thomas Campbell's Montana Farming Corporation from 1917 to 1922. In the spring of 1925, Fairway Farms bought two sections from the Bureau of Indian Affairs for the bargain price of $8.43 per acre; similar land in the county sold for more than twice that much just one year later. The soil and topography were good for wheat, and this corner of the state became a hotbed of industrial farming activity in the mid-1920s for this reason. Indeed, although Fairway Farms ordered two tractors from International Harvester to begin working on this farm, orders were so backed up that the company could not deliver any tractors until much too late for the 1925 season. Fairway cancelled their order, instead hiring Mr. Cleveland from the Taiyan Farm to plow and clean the weedy fields.

This farm was the last one Fairway acquired and was the biggest piece of land. It took several years for all the fields to be prepared and organized for fallow rotations, during which time no family was found to live on the farm. Instead, a neighbor named L. A. Storm worked the land on a share lease in 1926, and in 1927, Gordon Davis was hired to supervise operations. The yields in 1927 were poor because of badly distributed rainfall. In 1928, with the land arranged as Wilson wanted it for management purposes, Fairway entered into an arrangement with Montana State University's Experiment Station in which Fairway provided the land and the university provided the labor and supervision for experimental tests of machinery use and cropping combinations. Implement dealers were asked to lend machines for experimental purposes, which many did. That year the yields were excellent. In 1929, with nearly 1,400 acres planted in wheat and nearly 850 acres in corn, flax, oats, and barley, rains and yields were poor. In 1930,

prices were so low that yields were meaningless, and Davis had to sell hogs just to pay expenses. Yields continued to be poor, with small variations, through 1936. Of the crops in 1935, Wilson wrote: "The acreage was maintained as usual, with 1,594 acres of wheat. The spring was very adverse and a good deal of courage was required to proceed with the seeding. The rainfall record for the year was not bad as far as totals go. However, the crops were beset with more difficulties than any other year in the experience of the project. Early in the season 70 acres of crop were drowned out due to a three-inch cloudburst. Late in the season the crop withered away due to six weeks of drought. A heavy storm early in August wrought considerable damage by breaking down the grain with hail and again the grasshopper losses were heavy. The net result was that very little more than seed was secured."[49]

Looking at Fairway Farms as a whole, it seems clear that the realities of farm life in Montana challenged Wilson's high-minded optimism almost as soon as the contracts were signed. Money troubles were immediate. The money that the Rockefeller Foundation promised was late in arriving in the fall of 1924, causing Wilson great anxiety as he tried to put off mortgage companies waiting for payment. In spite of $75,000 in funds provided by May 1925, by the following September, Wilson and Humphrey were worried. Although they felt that farm receipts would be strong that fall, Fairway was decidedly short of cash, and Wilson had to juggle money from one pot to another in order to avoid debt problems. As Humphrey warned Wilson, "It would be a tragedy should we be placed in a position where we have to beg for help or where we had to acknowledge poor business management. We would have absolutely no excuse and the successful hardheaded business men would simply shake their heads and say 'visionary.'" Indeed, the situation only got worse, as wet fall weather interfered with harvesting and planting. By December, Fairway owed the local bank over $10,000, twice as much as Wilson predicted in September, and he concluded that the project would have to sell one of the farms to raise money. In early January, he approached Chester Davis and asked him to buy the Brockton Farm. Wilson's thinking was that although he needed to raise cash immediately in order to take care of debts, by selling to a friend he would be able to reacquire the farm at a later, more prosperous, time. In the end, the Rockefeller Foundation came up with another $25,000.[50]

In spite of the frequent infusions of money from the foundation, ready cash was a constant problem for Fairway Farms throughout its existence. From the beginning, Wilson depended on his connections with federal agencies to help support Fairway. The state of Montana paid the expenses of Wilson's assistant,

Mr. Gilman, who personally inspected more than seventy farms and interviewed over twenty-five farmer applicants. Similarly, the Bureau of Agricultural Economics paid Wilson's expenses and "donated" him for two months to the project, the Division of Land Economics created the purchasing contracts for tenant-buyers, and the Division of Farm Management prepared plans and estimates for each of the farms. When financial problems developed in the fall of 1926, Wilson and Humphrey approached James Hobbins, a vice president at the Anaconda Copper Mine in Butte, to propose a deal involving a farm in western Montana that would be advantageous to Fairway. Efforts such as this were made not only to alleviate the ongoing problems caused by poor weather and markets, but also because Rockefeller's contract called for a 5 percent interest on their investment; as Richard Ely warned Wilson, "There is very little farming now that yields 5% or anything like it."[51]

Wilson had better luck in gaining the support—both moral and to some extent financial—of railroads and machinery manufacturers. Wilson approached the Northern Pacific and the Great Northern railroads about the same time he approached Anaconda, that is, late 1926. To Wilson, it made sense that the railroads would be interested in supporting the Fairway experiment. After all, he had chosen several of the farms explicitly because of their proximity to the rail lines and felt that what was good for Montana farms—stable, plentiful yields—was good for railroads that needed to fill railcars year-round. His first approach to the rail lines had discouraging results ("I have given up any hopes of assistance from them"), but only a year later, following a presentation about Fairway Farms at the National Farm Loan Association meeting, the railroads began to see the potential of Wilson's work. Over the next few years the railroads were enthusiastic proponents of Fairway, asking Wilson to set up a model farm near a future railhead site and providing a train car to carry Wilson's "Low Cost Wheat" exhibit around the state.[52]

The sudden enthusiasm of the railroads was matched by that of the implement manufacturers, who probably also recognized a golden advertising opportunity. International Harvester, for example, began by selling machinery directly to Fairway at dealer's prices or less, which was about 20 percent cheaper than buying machines in stores. Wilson also believed that the company would replace all parts (excluding the motor) for many years to come. In fact, after only a year, International Harvester agreed to loan Fairway new machinery so that Wilson could run experiments using different power units and studying their relation to the "economic, agronomic, and engineering features involved in me-

chanical farming." Four years later, Wilson's assistant could boast to another implement manufacturer that many international visitors had come to see the Lone Warrior Farm and had stayed for several days to inspect the machines and observe them in action.[53]

There was little question but that the role of machinery in Montana farming had moved to center stage by 1927. Although most of the Fairway Farms were demonstrating what farmers should *not* do if they wanted to survive and hopefully make money, those farms using machinery were demonstrating what farmers should do. On the Davis Farm, for instance, labor costs were 75 percent lower than those on comparable farms because Davis used the duckfoot cultivator, a new machine in wheat growing. Similar experiments at Lone Warrior convinced Wilson that the use of machinery would permanently change the way Montana farmers raised wheat. He wrote to Taylor: "If our assumption . . . to the effect that a new technique of low cost mechanical farming is coming to the spring wheat region, is true, then it follows that the farm unit will need to be changed and new farms made from the consolidation of smaller farms which do not fit in with the new technique of production. The social and economic consequences of this may be far reaching. . . . The Fairway Corporation is the only one in the entire northwest as yet that is wrestling with this new problem. The agricultural colleges and experiment stations have not yet recognized it."[54]

In a short three years, Wilson's suspicions about this trend were confirmed; indeed, he misstated the original goals of the experiment to conform to the results he was finding. Fairway Farms was no longer primarily an experiment in farm management and land ownership and tenancy, but rather a demonstration of "the economic soundness of financial and managerial supervision of re-organized and re-combined farms which take advantage of low cost production" and a test of "whether or not ownership by individual farm operators can be facilitated through the operation of corporations on the order of the Fairway as a business enterprise; if not, the feasibility of large farm units operated more or less on the factory system of production." More specifically, Wilson reached eight conclusions that challenged the thinking of most farm economists:

- small farms of 320 acres or less were doomed to failure
- substantial capital investment in acreage and machinery was necessary; a minimum farm size in Montana should be 800 acres, though 3,000 or more would be better
- successful farms should have a minimum of human labor

- the most profitable crop in Montana was spring wheat
- using minimal human power and maximum machine power, wheat could be produced for $0.50 per bushel
- the application of machine methods will drive many farmers out of the occupation
- the tenant part of the experiment was not very successful
- socially, the family-unit farm must pass out of the picture.[55]

As a research project, then, Fairway Farms was generating important findings regarding the correlations among such variables as farm size, farm finances, mechanization, and crop selection. But from the Rockefeller Foundation's perspective, Fairway was a failure as an economic experiment. "It is rather discouraging," Raymond Fosdick wrote to Ruml days after the stock market crash that led to the Great Depression, "to try to do business with people who . . . do not look upon a promissory note as a business arrangement." The foundation's efforts to collect on its loans, which it did even in the thick of the Depression and on top of staggering farm losses in Montana due to drought, was futile. Both the Depression and the drought worsened for wheat farmers, and by 1932 the foundation could not recoup losses even by selling the farms; it seemed the cycle was repeating itself less than ten years after Fairway began buying farms no one wanted. Wilson and Starch used their personal finances to keep Lone Warrior afloat in 1933, but it was to no avail. In 1937, Taylor and Starch toured all of the Fairway farms with a group of potential investors. Lone Warrior and Taiyan farms were showing the lowest yields in their history; Wiota, Yanktoni, Comanchi, and Rosebud had all been abandoned; Woanlo and Richland were going to be sold; and only Cloverleaf, although showing poor yields, was still doing fairly well under Twedt's constant attention. In that year, the Rockefeller Foundation gave the Fairway Farm notes to the Farm Foundation "as a special gift." H. C. Taylor was director of the Farm Foundation, thus effectively ending the Fairway Farm experiment.[56]

For Wilson, the Fairway project was deeply involving, for better and for worse. His early enthusiasm was winning; he once described his excitement to Richard Ely, "I presume that a physio-analyst [*sic*] would say that I have a decided Fairway economy complex." But within a few years he began experiencing considerable stress. He suffered with stomach ulcers for years, which he said were the main cause of his troubles: "We had . . . drought and crop failure and low prices, and all of those damn things. . . . If my stomach ulcers had a psychological origin, because of these problems, there were a hell of a lot of farm-

ers that had stomach ulcers too." The Fairway work thrust Wilson into the agricultural limelight rather suddenly, and an invitation to the Soviet Union in 1928 and his work with the Federal Farm Board increasingly pulled him away from Montana. The Rockefeller group worried that he would be too distracted by these professional opportunities, particularly after the discouragement of the project, to apply himself properly to the Fairway. And he seemed "already . . . weary with the work and the burdens." Hearing that Wilson was planning a consulting trip to Hawaii just after the trip to the Soviet Union, Packard told Wilson that the foundation wanted him on the farm rather than on the road, and Wilson cancelled his trip. But he found the opportunities to get involved in other activities impossible to ignore, and in late 1932 the foundation once again complained that Wilson "has been devoting a great deal of his time to the development of the new administration's farm policy. Maybe someone will be profiting by the Fairway experiment. It is fairly obvious, however, that for the last few months the corporation has not been the chief object of Wilson's concern." And indeed, Wilson was soon firmly entrenched in federal farm policy as assistant secretary of agriculture.[57]

Time was not on Wilson's side in the 1920s. Between the agricultural depression and the droughts that plagued Montana and other states, it was difficult to get any traction on new projects. Fairway Farms might have turned out differently had the weather cooperated, but of course, that was an age-old problem. Farmers don't have the luxury of dealing in averages, as economists do. Their loans come due whether or not the crops grow, or the machinery works, or financial markets collapse. Although it might all work out over the long term, no individual farmer had that sort of time. By the end of the decade, however, agricultural thinking and practice had made several decided shifts, from traditional farming to more rationalized, businesslike farming, and these changes were more or less permanent. As historian Mary Hargreaves points out, Wilson's role "both as a reflection of changing perceptions and as an influence on the adjustment process, was to be significant regionally and nationally in the 1930s." Farmers all over the country had become more focused on the quantitative side of farming, on measuring how much they grew or sold and how much they lost through overhead, another new concept. Particularly because of the new income tax laws, which required farmers to keep some sort of records and report their earnings and losses, many farmers were persuaded to take the advice of agricultural experts regarding modernization and apply it more generally. And the process was taken even further with small town bankers working alongside the

agricultural colleges to create scorecards that would help bankers evaluate farmers who needed loans. Now, the question for farm families was less whether they might want to attend a county agent's winter meeting or join in a college-sponsored project to learn if it was profitable to raise cattle. It was now nearly required for the family to interact with, if not college officials, then certainly the bank. The intersecting messages of banks, college experts, federal tax officials, and federal assistance programs made this a fairly compelling case for a family trying to hang onto their farm during a tough time. With the Great Depression coming fast on the heels of the farm depression, it is little wonder that farmers became more numerically inclined by the 1930s.[58]

Chapter 3 Agricultural Engineers and Industrialization

It is a remarkable fact that a great many people who have had no experience whatever in farming feel perfectly competent to tell farmers how to conduct their business.
—*Arnold Yerkes*

You don't know you are alive.
—*Philip Rose to fellow agricultural engineers*

It is difficult to imagine industrialization occurring without engineers. They are the ones who devise concrete and material solutions to difficult technical problems. Although many such problems, in fact, have a political, social, or economic dimension, it is an engineering hallmark to transform such delicate problems into strictly technical issues. Engineers are not so unlike economists in this regard. And like the agricultural economists, the agricultural engineers were a breakaway group from the larger discipline and carried that group's dominant message of rationality and business to the countryside.

The way in which agriculture was mechanized in the 1920s was just as complicated as the way it was quantified. Various people and groups,

including inventors and manufacturers, were intrigued by the potential of applying mechanical power, particularly the internal combustion engine, to farming operations. Other scholars have looked at these interests and found them rather uncomplicated: power is good, more power is better, let's mechanize the farm. But where did engineers fit into this mechanization equation? How did they think about the problems of farmers and their amenability to mechanization? What assumptions and values did they share with commercial interests, and where did they differ? Whose interests did engineers most identify with: farmers', bankers', or implement dealers', and how did this shape the engineers' research and practice?[1]

As carriers of cultural change, the agricultural engineers were an unlikely group. Working for the most part in the sleepy towns of the land-grant colleges or in the shops of the farm implement companies, the agricultural engineers had virtually no public profile. Unlike other engineering groups, agricultural engineers rarely showed their work in the cities; no bridges, electrical utilities, dams, or railroads stood as monuments to their brilliance and bravery. No educational institutions stood as shrines to agricultural modernity, as MIT did for civil and mechanical engineers and their trade, and until about 1929, few foreign countries invited prominent agricultural engineers to advise them on the wonders of American agricultural technology. The agricultural engineers came late to the engineering professionalization party and, once there, seemed to be defensive and ill at ease. Yet they were critical players in the revolution in American agricultural production that occurred in the 1910s and 1920s.

As the first or second group of engineers trained in the new land-grant colleges, the agricultural engineers were unusually aware of the growing divergence between urban life and rural life in America. Engineers who attended MIT, Stevens Institute of Technology, West Point, or Rensselaer Polytechnic Institute generally would join the industrial or civic leadership, working for Edison or General Electric or the growing urban centers and would not have occasion to consider rural America or its problems. The land-grant engineers, in contrast, particularly those in the midwest, were far removed from the industrial labs of the east. Many of these young men grew up either on farms or in small towns in the midwest, and they perhaps hoped to escape an agrarian fate by majoring in engineering at college. Agricultural engineers seemed to avoid self-reflection, and the historian can only surmise why they chose the career paths that they did. But maybe the sheer difference between farm and town so frequently reported in the farm press—in town, homes might have indoor plumbing, hot running water, central heating, electricity, and telephones—struck the engineers as an

undesirable difference and one easily remedied. Perhaps, having received a heavy dose of scientific problem-solving in their engineering studies, they reevaluated farm practice and found it wanting. Or, hearing the growing concerns among political leaders that farm children were abandoning farm life for the city, a concern addressed by the Country Life Commission in 1907, perhaps the young engineers decided to try reducing the farm-to-city exodus by modernizing the farm and making it a more attractive place for farm youth to settle down.[2]

Whatever their reasons for becoming agricultural engineers, these young men had as their goal, whether tacitly or explicitly, to bring agriculture kicking and screaming into the modern world. The way they did this was to apply what they knew—mechanical engineering for most, but also electrical and civil—to farm problems. In some respects this effort to engineer the farm followed an unsurprising path, especially in the farm home, where electrification and the installation of plumbing and sewage disposal systems would more or less mimic urban developments. In the field, too, one could imagine farmers adopting trucks and tractors as their urban counterparts adopted automobiles. Yet to think of farmers as mere consumers would be to miss the peculiar historical context in which, on the one hand, they found themselves and, on the other, in which others placed them.[3]

Because of the agricultural engineers, both farms and farmers began to be viewed in a new light in the 1910s. Trained in an engineering rather than agricultural tradition, the first generation of agricultural engineers were up to date on recent theories and practices within the general engineering field. One of the most provocative and apparently effective schemes was in rational management, popularized but not confined to the ideas of Frederick W. Taylor. The agriculturalists, anxious to modernize the farm enterprise, often appropriated these Taylorist ideas as perfect vehicles through which modernization on the farm could occur. The fit was not always perfect. Farms were not factories, farmers were neither machinists nor executives, and the bureaucratization of work processes in factories was simply not possible on farms. But the larger premises of scientific management and factory production were appealing to the engineers, and they were certain that farm operations were at least partly amenable to rationalization. After all, other "productive industry . . . submits itself to engineering planning and guidance." It was now time for agriculture to submit as well.[4]

Other groups also tried to carry forward this modernization effort in agriculture, and some were much more ideological and vocal than the agricultural engineers. The agricultural economists, for example, were able to articulate a

more focused program that linked farm life with modernity and that emphasized the importance for "civilization" of agricultural improvements. The economists hammered home the notion that progress should be equated with quantity and scale more than any other measure. Business leaders, too, were keen to see agriculture become more predictable from a market point of view and were likewise vocal in their boosterism. What the agricultural engineers provided was the engineers' sometimes bland confidence in order, rationalism, and control. Believing in the ability of the scientific approach to tame things that were wild and fix things that were broken, the agricultural engineers may have felt that compared to the Panama Canal or Pearl Street Station, American farms would be a snap to modernize. And without any apparent self-consciousness, this is what they set out to do.

BUILDING AN ENGINEERING NETWORK

In 1905, Charles Ocock, J. Brownlee Davidson, F. R. Crane, and William Nye met in Urbana, Illinois, and decided that the time was ripe for starting an organization "whereby there could be some general plan laid out for the new work which was then demanding considerable attention in the various colleges and universities." Davidson, who at the age of twenty-five had already received his B.S. at Nebraska, was completing his first year as an assistant professor of engineering at Iowa State College in Ames; Ocock, twenty-nine, had just completed his B.S. at Illinois and by 1906 would be chair of the agricultural engineering department at the University of Wisconsin. What these two young men were discovering was that, in the still-struggling agricultural schools of the land-grant colleges, little attention was being paid to the material difficulties faced by farmers. While these colleges might have scientists working on agricultural questions relating to crop production, livestock, or soil chemistry, there seemed to be no one working on agricultural questions regarding farm implements, irrigation, road building, or barn design. Falling under the rubric of civil or mechanical engineering, such questions held no allure for other engineers and were ignored. This was the situation that was demanding considerable attention in the colleges and that these four young men hoped to address. Two years later, Davidson, Ocock, and fifteen others met in Madison and created the American Society of Agricultural Engineers (ASAE).[5]

These seventeen charter members bore many similarities to other groups initiating professional organizations and in particular resembled young engineers and scientists who had earlier tried to distinguish themselves from less educated

practitioners. Of the original seventeen, for example, the eleven who could be identified all held college degrees, a fairly high percentage for agriculturalists, as we shall see later. Most received their degrees between 1904 and 1908, and all attended land-grant colleges in the midwest. These degrees, of course, were not in agricultural engineering or even agriculture, because one of the rationales for creating the society was to create such educational programs. Rather, it appears that most of these charter members received their degrees in engineering. Charter members ranged from twenty-four to thirty-eight years of age, with most in their twenties. And although in later years many of the charter members would enter industry, in 1907 most were either students or new professors in the land-grant colleges.[6]

A closer look at a few of the charter members illustrates the educational and career trajectories that were common also among later agricultural engineers. J. Brownlee Davidson, who is considered the father of the profession in the United States, was perhaps the most representative of the strictly academic agricultural engineers. Born in Douglas, Nebraska, in 1880, Davidson received his B.S. in engineering from the University of Nebraska in 1904. He then worked for a year as an "experimentalist" at the implement manufacturer Deere and Company, and he spent 1904–5 as an instructor in farm mechanics at the University of Nebraska. In 1905 he accepted a position as assistant professor of agricultural engineering at Iowa State College and became a full professor there in 1908. Aside from a four-year appointment at the University of California from 1915–19, Davidson remained at Iowa State for the duration of his career. He was the ASAE's first president and received the prestigious McCormick Medal in 1933. Another charter agricultural engineer, William Boss, followed a similar academic pattern. Born in Zumbro Falls, Minnesota, in 1869, Boss began his career as a carpenter, and at age twenty-three he was hired as an instructor in steam engines and power machinery at the University of Minnesota. After receiving his diploma there in 1904, he was promoted to professor of farm structures and farm mechanics and became chief engineer at the university farm. In 1910 Boss left the university apparently to become manager and owner of Specialty Manufacturing Company, but he returned in 1918 and stayed on as professor of agricultural engineering until his retirement in 1938. In 1944, at the age of seventy-five, Boss was president of Specialty Manufacturing, and although the record is rather ambiguous, it is possible that he held both the academic and the commercial positions simultaneously all along. Boss was president of the ASAE in 1928–29.[7]

Most charter members were academics at the inauguration of the ASAE, but quite a few left the academy or moved back and forth between the academy and

the commercial sector, a common practice among other types of engineers during this period. Harry Bainer, for example, received his B.S. from Kansas State Agricultural College in Manhattan in 1900, spent a few years in farm work, and then decided to go back to school. In 1906 he became the first recipient of a master's degree in agricultural engineering at Iowa State College. He taught at Iowa State for a year and then left to teach at Colorado Agricultural College until 1910 or 1911, when he joined the agricultural relations department of the Santa Fe Railroad. In this position Bainer was expected to encourage farmers to grow major commodity crops that the Santa Fe could ship to market. He left the railroad in 1918 to manage a 16,000-acre ranch in Topeka, Kansas, staying there about ten years. In 1928 he operated a wheat improvement association in Kansas City, but when the Depression hit he got a job in a bank. Eventually he returned to the Santa Fe Railroad. A straighter path was taken by Charles A. Ocock. Born in Marengo, Illinois, in 1874, Ocock received the B.S. in agriculture at the University of Illinois in 1904, chaired the department of agricultural engineering at the University of Wisconsin from 1906 to 1913, and then left the academy. From 1913 to 1925 he worked as an agricultural engineer at the Avery Company, a prominent tractor manufacturer in Peoria, then worked for two years at Convertible Door Company, and from 1927 to 1940 worked at J. I. Case Company, another leading tractor manufacturer.[8]

These brief biographical sketches suggest that early agricultural engineers followed more than one professional path. Like many other engineers, the agriculturalists included both academics and commercial people in their association. Although the charter members were overwhelmingly from an academic background, many went on to work in industry while holding officer positions within the society. The agricultural engineers also tended to have engineering backgrounds. Thus, although they were all trained in the land-grant schools, and most came from small towns or farms, their priorities were engineering first and farming second, at least in terms of professional identity.

These patterns become more varied and more pronounced when the cohort is expanded to include all the agricultural engineers who held leadership positions (executive officer or council members) within the ASAE between 1907 and 1930. Of these 78 people, 50 (64 percent) had college degrees and another 14 (18 percent) may have attended college.[9] Again, this group was almost evenly split between academics (30) and commercial people (35), with several federal employees mixed in. Only about one-third (25) gave a paper at an annual meeting, and about the same number (23) published a book at some point in their careers.

Because some of these people did both, 47 percent (37) of the leadership left no publication trail at all.

These numerical observations are particularly revealing when compared to the total number of people who gave papers or otherwise appeared on the programs published by the association during these years. If, for the purpose of comparison, we eliminate the leadership from this cohort of general participants, we find a group of 173 people. Of these, 74 percent (128) do not appear in the standard biographical dictionaries, while 24 percent (41) were found to have college degrees. But again, this group was evenly split between commercial (22 percent) and academic (22 percent); of those who could be identified, another 6 percent (11) were employed by a federal agency. A direct comparison of these two groups looks like this:

	ASAE Leaders	*Participants*
College degree	64%	24%
No bio. info. located	18%	74%
Published book	29%	6%
Mostly academic	38%	22%
Mostly commercial	45%	22%
No info. beyond conference program	13%	48%

Although these numbers are impressionistic, they do suggest several broad patterns. First, the ASAE leadership tended to be an educated, prominent group; they could be tracked through academic, publishing, or scientific contexts. Second, if those who gave papers can be thought of as representative of the more general membership, they were far less educated as a group and many left no tracks. They typically appeared on the ASAE program once, in some cases more than once, and then vanished without a trace. Because they were not identified by hometown, occupation, or place of employment, they are virtually impossible to locate. This suggests that, first, they may have participated simply because the ASAE was meeting in their city that year, and they were interested enough to participate then but not enough to attend meetings elsewhere. Second, it might mean that such participants were employed by commercial firms, civic or federal groups, or trade organizations but were without the sort of professional training that warranted inclusion in biographical dictionaries. During this period many nondegreed practitioners were highly placed and often quite keen on the subjects considered by the ASAE. Third, the prevalence of commercial men and those not engaged in research suggests strongly that the more research-oriented academic leaders of the ASAE, at the very least, had a high tolerance for

and perhaps even a real commitment to and interest in practical and commercial issues. This helps account for the agricultural engineers' willingness to embrace the manufacturers' point of view.[10]

There were plenty of other engineering societies that focused on subjects relevant to rural life, such as electrification and road building, but these groups were not particularly attentive to agricultural problems. Although mechanical engineers who taught in the agricultural colleges might have been expected to take an interest in farm implements, or civil engineers in drainage, it would seem that they did not. "Other engineers," according to one agriculturalist, "usually look askance at anything in the agricultural line." And in his presidential address to the first meeting of the society, Davidson noted a "tendency" among other engineers "to speak slurringly of our work." Although it is difficult to know exactly how prevalent such professional disdain might have been, the agricultural engineers smarted from such slights for years. This tension was probably not helped by the constant potential for overlapping research interests; territorial disputes were a frequent source of irritation among the agriculturalists. So difficult was it to disentangle agricultural from other kinds of engineering that during the early years, according to the society's historian, "there was hardly a machine or a device of any kind over which the ASAE could claim sole jurisdiction." Nonetheless, agriculturalists were happy to note that a few years after their organization began, other engineers started paying attention to agriculture: "The mechanicals are taking up farm motors; the electricals are taking up electricity on the farm; the civils are beginning to push rural architecture."[11]

The manufacturers and the commercial men, with whom the agriculturalists already had established fairly close ties, played a complicated role in the professional efforts of the agricultural engineers. Just as early electrical and civil engineers struggled with the problem of defining themselves as professional experts rather than mere practitioners, so the agricultural engineers tried to figure out how to distinguish themselves. As with nearly all professionalizing efforts, issues centered on inclusion and exclusion: if anyone could be in the club, then the club had no special distinction, but if no one could be in it, then it would be hard to consider indispensable. The agricultural engineers were no different from the other emergent groups in arguing among themselves about who should be allowed membership. As president in 1910, Philip Rose wanted to admit only "qualified" engineers, by which he apparently meant those with college degrees in engineering. This, of course, would have eliminated most of the manufacturers, something most agricultural engineers were not willing to do for several reasons. Implement manufacturers, after all, hired people with degrees or expe-

rience in academic agricultural engineering, that is, the students of ASAE members. Manufacturers themselves, who might have pursued college educations in agricultural engineering had the subject existed, were keenly interested in the field. Many of them had, in fact, studied engineering and agriculture in college but went to work in manufacturing because the pay was better and because many colleges still did not have departments of agricultural engineering and therefore had no place to pursue experimental studies. In California, most agricultural engineers were attached not to colleges, but to railroads and real estate companies who hired them as consultants. Often manufacturers gave equipment to the colleges for use in instruction as well as to see how it performed against other makes and models. At Nebraska, L. W. Chase even said that "it is the manufacturer who has brought the farmer from among the lower social levels to the higher [and] . . . who has practically forced the farmer into his present standing in the universe." Davidson at Iowa State seemed to feel the same way, and as president in 1908, he declared that members could be "those engaged in farm implement design and manufacture, architects of farm buildings, drainage engineers, irrigation engineers, highway engineers, and those who have a training for operating large interests in which these various lines of work are involved." Part of Davidson's charm and leadership ability was his openness to new ideas, but his colleagues soon challenged his way of thinking.[12]

Many of the early ASAE members were concerned with getting and maintaining authority, especially among farmers, but this could be difficult because before the colleges were well-organized, commercial people such as implement dealers, seed salesmen, and livestock breeders were the farmers' main source of expert information. Although most businesses were honest, some were not reliable, and the agricultural engineers hoped to establish themselves as the preferred authority on farming matters. But it was tricky to distinguish between bad and good businesses and to chastise some without alienating all. As late as 1927, one member warned that, if the agricultural engineer wanted to "hold a recognized place among other engineers, he must have more than the garage mechanic's conception of the tractor." But in the early years others urged that the society's standards should be so high that "its rulings would be considered final" on any relevant topic or dispute between farmers and manufacturers, and that the society's real job was to stand between the farmer and implement dealer as the only source of reliable information. And E. B. McCormick pointed out that since the farmer's goal was to "keep costs down" and the manufacturer wanted to "turn out the most efficient machine possible," the two views were "to a certain extent antagonistic." For yet another member, the true test of legitimacy

centered on rigor: "Let us rigidly maintain so high a standard that no one will be able to say that our course is easy." The tension between what Mary Furner called "advocacy" on the one hand and "objectivity" on the other was pronounced for many years; ASAE members seemed routinely torn between academic standards modeled on a scientific ethos and business standards that valued loyalty and mutual material gain. This dithering was too much for some. In 1916 engineer and farm editor Philip Rose let his colleagues have it: "This association, if it is anything at all, is an engineering association. This is a professional association. It is not a manufacturer's club. You people are here primarily to better yourselves and your knowledge of your profession. . . . Your mission is not to reform the world. It is not your purpose to go out and tell all the manufacturers what they ought to do."[13]

Yet that is precisely what many engineers wanted to do. If anything set the agricultural engineers apart from the manufacturers, it was that the engineers were trained to compare different methods and materials and to generate a standard means of evaluating such things. Furthermore, as land-grant professors, they were expected to protect farmers from dishonest merchants and promote the farmers' interests. For many agricultural engineers, then, their proper role included that of regulating the commercial people. A particularly good example of this was the Nebraska tractor test, established in 1919. The test grew directly out of the uncontrolled marketing of tractors during World War I, when there were virtually no laws regulating standards or guaranteeing even minimal quality. Introduced as a bill in the Nebraska legislature by Wilmot Crozier, the tractor test law required all manufacturers planning to sell their machines in the state to first submit their tractors to the University of Nebraska for testing and prove that the company kept an adequate supply of spare parts for repairs. This legislation is credited with setting up the first true farm implement standards in America.[14]

Another way the academic agricultural engineers used their expertise was in the tractor schools offered by many agricultural colleges in 1918. These colleges were not alone; commercial schools that trained men in tractor operation sprang up around the midwest in response to the wartime emergency. Most prominent was the Sweeney Automobile and Tractor School in Kansas City, Missouri, which offered a six-week course costing $85. Such schools were basically trade schools that gave young men a marketable skill. The manufacturers also offered tractor schools, usually lasting a day or two with company representatives who traveled around the country, and these classes were geared to both salesmen and tractor owners. The colleges' tractor schools were different from these more

commercial schools in several respects. Their intended audience was not only farm laborers but farmers themselves who felt compelled to adopt tractor farming during the war. Although it is now a common belief that farmers are mechanically inclined by nature, the first generation to confront the internal combustion engine apparently found it a less than straightforward experience. "No matter how carefully a man may be verbally instructed in advance," one writer warned, "no matter how thoroughly he may have read the instruction manual the night before he starts harvesting (which few do), he still is unable to apply the spoken and written instructions because he does not have the feel and the ear for the machine." Adopting tractors meant more than buying a machine, and learning to operate one correctly was much more complicated than farmers or implement dealers at first imagined. Considering that for most farmers, the tractor was their first brush with the internal combustion engine, and because the farmer was expected not only to drive it but to understand and repair it, it is not surprising that farmers did not quickly shift from horses to tractors.[15]

Unlike the commercial schools, the colleges offered this instruction at minimal or no cost, perhaps viewing their effort as a patriotic duty during the war. Students in these courses, however, were expected to study nearly as much and in similar detail as students enrolled in the four-year program. At Kansas State, for example, those with a grammar school education could take an eight-week tractor course that included "blacksmithing and machine work as related to tractors; metallurgy; the construction, operation, and adjustment of farm gas engines; the construction, operation, and adjustment of tractor engines; carburetion and ignition; and steam traction engines. The following related courses are also given: Mechanical drawing; concrete construction; elementary electricity; foundry; and carpentry." A two-week course at the University of Illinois, which was open to both men and women, included lessons in "magnetos, methods of wiring, carburetors, transmission systems, and hitches." Clearly, it was difficult for the engineers to figure out where the boundaries of expertise should lie. How much did a farmer or hired man really need to know about magnetos in order to drive a tractor? Was there really a set of generalized principles that could guide farmers in using and repairing whatever tractor they bought? And although some manufacturers may have applauded the colleges' efforts to spread the word on mechanization and modernization, others may have felt chagrined that the college was comparing their company's tractors unfavorably.[16]

One of the surest ways for the engineers to create an institutional identity was to establish educational programs in the land-grant colleges. Agricultural engineering barely existed as a discipline or even a college major when the ASAE was

[To view this image, refer to the print version of this title.]

Class in farm mechanics at the University of Wisconsin, 1931. State Historical Society of Wisconsin.(D487)12040.

established in 1907. Where it did exist it was often a mish-mash of ideas and strategies. In 1907, Iowa State was the only college to offer a four-year degree in agricultural engineering; by 1919, Nebraska, Missouri, Kansas, and Utah also offered degrees. In part the lack of degree programs reflected the lack of certain knowledge in the pertinent subject areas. For example, although nine colleges offered an undergraduate course in farm machinery, the subject was limited to examining the machinery on hand rather than to the larger themes of farm operations or principles of mechanical engineering. Not surprisingly, students who had been working with such machinery on their own farms were unimpressed with these lessons; one frustrated instructor was reminded that "familiarity breeds contempt." Aside from the pragmatic experiences gained by farmers and passed on to college instructors, there was little formal information available after one left traditional engineering for the agricultural arena. As late as 1919, at a small USDA-sponsored conference in Washington, D.C., Ohio State's H. C.

Ramsower reminded his colleagues, "The farmer might ask your tractor man if he should burn gasoline or kerosene, whether he should use a 3000 or 7000 pound tractor or a four-wheel type or a two-wheel type or a crawler type, and I defy any man to produce the evidence that he should do this or that. They might ask any one of a thousand questions about the use of tractors and other agricultural machinery, and we have little or no evidence on which to base definite statements in reply."[17] With no experimental data, no texts, no bulletins or reference works, it is little wonder that so few institutions were willing to offer a distinct course of study.[18]

But another reason for the lack of formal training programs lay in the complex and shifting notions of what, exactly, constituted agricultural engineering. Rather than defining their province according to a particular, specialized capability (for example, how to generate and measure electrical current), the agricultural engineer defined it according to the site in which they operated—the farm. This was a highly unusual way to define a new field. Aside from home economics, which took the home as its domain, it is hard to find a comparable science or engineering specialty, though a parallel situation might have occurred if the mechanical engineers had started a discipline called factory engineering. One of the direct results of the agricultural engineer's emphasis, however, was that virtually any technical operation that happened on the farm was fair game for study by the engineers. (See, for example, programs for annual meetings in Appendix.) Iowa State's program in 1907 required students to take courses in carpentry, blacksmithing, drawing, and horseshoeing, in addition to surveying, drainage, motors and machinery, and architecture. A few years later, a committee that was assigned the task of listing the subjects in which the students should have competence included woodwork, forge work, mechanical and free-hand drawing, farm structures, machinery, surveying, drainage, irrigation, cement work, sanitation, field practice, roads, fences, dynamite, dairy machinery, and horticultural machinery. Such a list was both understandable and impossible. It was impossible pedagogically because four years was simply not enough time. But it was understandable that the early agricultural engineers wanted to include as many interested parties as possible in their plans, even if such groups were small and specialized. Thus, while irrigation was a big topic in California, it was not in Ohio; dynamite, used for removing stubborn and large tree stumps, was more common on Michigan's Upper Peninsula than in Kansas; dairy and horticulture, which were part of all traditional farms, were increasingly practiced only by the few. By 1927 the society recognized the plurality of interests and di-

vided its meetings and the *Transactions* into the following subject areas: farm structures, power and machinery, reclamation (irrigation and drainage), and rural electrification.[19]

ENGINEERING FARMS

The idea that farms should be thought of as food and fiber factories was still rather new when the agricultural engineers formed their society. Although larger scale in the form of bigger farms, higher yields, and more livestock had long been considered a worthy goal among farmers and agricultural leaders, few had thought to model the ideal farm on the ideal factory. For that matter, few factory observers had figured out how to model factory operations on a set of principles that would bring predictability and order to the shop floor. But by the time Frederick W. Taylor's *Principles of Scientific Management* was published in 1911, most in the engineering community could grasp the potential of his proposed system of control. Because Taylor's system was rarely implemented in toto, historians have been inclined to view Taylorism as an interesting but unsuccessful stab at modernity and have overlooked its deeper impact on not just factories but on everyday life in America. In the agricultural engineering community, however, Taylorism seemed to offer a scientific solution to the mire that farm operations had become, promising instead to unify the disparate elements of crops, climates, economics, and politics into a single, industrial unit.[20]

The Taylor system, as introduced in factories, had several basic features that set it apart from more typical rationalization schemes. The main elements were: the standardization of tools, belting, machinery, and processes; the application of time studies to determine the best way to perform a task with no wasted motion; the microdivision of labor, which reduced each task into component parts that could be accomplished with little or no special skill and that could be done in a fast, repetitive manner; an increase in the number of managerial workers and a decrease in skilled workers; the introduction of a routing system, which involved both the strategic arrangement of tools and workers and a system for leaving a paper trail for each object that passed through workers' hands; the use of high-speed tool steel; and the provision of incentive pay, which linked obedience and speed with extra income. Although some of these elements were impossible to implement in certain kinds of factories, in a more general sense the system gradually made its way into manufacturing operations.

The main advocates of this system, not surprisingly, were engineers and factory managers, who felt that work processes and thus production rates had got-

ten away from them and who felt that workers ultimately held more power than they did. The drive to rationalize factory operations also coincided with the belief, common among newly professionalized engineers, that their ability to scientifically analyze and solve problems should be applied to one of the toughest factory problems: wresting control of the work process from skilled workers. The engineers tended to think in terms of throughput; the central problem to be solved was getting a product from point A to point B. Human workers, in this equation, were a nuisance; from the engineers' point of view, the ideal factory would employ few laborers. Although Taylor and his disciples were not able to completely get rid of workers, they tried to render the workers as machine-like as possible.[21]

Like their factory-based colleagues, the agricultural engineers were also bitten by the rationalization bug. As discussed earlier, the first generation of agricultural engineers had trained not in agriculture but in engineering and were educated in the climate of rational management ideas. They also shared with other engineers the spirit of Progressivism and were eager to identify problems that would be amenable to engineering solutions. For many agricultural engineers, it was not difficult to find rural applications for urban or academic lessons; especially after 1920, they found plenty of problems in rural America to rival those found in the cities.[22]

One of the clearest expressions of this sentiment was voiced in 1917, when E. B. McCormick gave his presidential address before the gathered engineers. McCormick, who had received his degree in mechanical engineering at MIT, had no difficulty in seeing the similarities between factories and farms:

> The farm in its economic sense is merely an industrial plant. Labor and machinery are employed and capital invested. . . . A successful manufacturing plant must produce its output with a minimum of waste [*sic*] labor, and great attention and study is given to routing the product through the plant so that it is always moving in one direction, and that direction [is] toward the point where the finished product is taken away. The farm buildings constitute the central manufacturing plant of the farm in which the raw materials are assembled and from which the finished product is taken away. If the farm buildings are laid out in a haphazard manner, with no thought of their relation to each other, they become a fruitful source of waste [*sic*] effort and, once they are laid out and erected, alterations are expensive.[23]

McCormick was keenly interested in this question of farm layout, because to him it predicted the orderliness of everything else on the farm. Neither raw material nor the farmer should be "doubling back upon itself," and thus wasting

motion and time, but should proceed in a direct line. Farm layout became a favorite arena for engineers, as factory layout had been for factory-based experts. Just as the rational arrangement of machinery, according to managers, could prevent the factory worker from wasting time and money by, for example, wandering around the factory, looking for lost tools, delivering materials, or visiting, so the orderly arrangement of buildings on the farm could save the farmer from backtracking. Studies were done to determine how farmers actually spent their time, both outdoors and in the barn or shop. Distances between barn and house, or house and fields, or fields and machine shed were tallied up and evaluated with an eye toward wasted movement. Models of ideal farmsteads were a favorite display at many state fairs.[24]

Standardization was also a favorite topic of the agricultural engineers, although it often seemed more difficult to manage than even efficient farm layout. For the engineers, standardization on the farm relied on a prior standardization in the factories that produced things for farmers, such as tools and machines. As mentioned earlier, there was little conformity among implement manufacturers. Indeed, it was not until World War I that manufacturers were encouraged to standardize by eliminating "excess designs and options." For instance, before the war one engineer counted 226 types and sizes of steel walking-plows, a number reduced to 39 by war's end; 47 wheel-plows were reduced to 15; and a whopping 788 corn and cotton planters were reduced to a trim 31. John Deere and Company reported that part of the difficulty was because various jobs were subcontracted to small shops that followed their own measurements. In an effort to standardize, Deere officials visited all the shops and collected 24 different wrenches, replacing them with 4 required types.[25]

For most of these engineers, the issues of standardization and farm layout centered on an emerging notion of efficiency. Although the word efficiency had been around a long time, its meaning became both more flexible and more powerful under the direction of Taylor and his efficiency experts. But what exactly did it mean for agriculturalists? For some, the word required a technical definition; according to one engineer concerned with efficiency in tractors, or "tractive efficiency," it could refer to the friction, weight, and design of a wheel, or "the relation of total weight or weight on drivers to tractive horse power or to drawbar pull," or the "percentage of brake horsepower delivered at the drawbar." Another engineer responded by pointing out that for most farmers, efficiency in a tractor is one "that will run all day" without breaking down or doing anything surprising. After J. B. Davidson gave a talk on laboratory efficiency at the 1913 ASAE meeting, one respondent recognized the similarity between

Davidson's approach and that of "factory efficiency experts"; another explained how, in his experience, students could be graded on their efficiency using the "efficiency grade system," which, "as you know, [is] a grade given for efficiency of manipulation, which is the ratio of time taken to perform a piece of work to the time that should be taken."[26]

For most agricultural engineers, it was difficult to settle on any single definition of efficiency because the work that farmers did was so variable. Measuring something as seemingly straightforward as the efficiency of tractive power was immediately complicated by the recognition that different soil types would have different effects on how much resistance the tractor encountered. It seemed that no matter how they tried to define efficiency, it would get scuttled by reality. As one engineer put it, "To establish a standard set of conditions such as are met frequently in practice is, then, extremely difficult and complicated if not practically impossible." From the Taylorist point of view, this was a problem. Although one might think that the best way to measure efficiency was in the laboratory using models—for precisely the reason that one could then set constant such troublesome variables as soil type, climate, skill and so on—in fact, even the Taylorists did their measuring on the shop floor rather than in a lab. One of the central goals of the rationalization movement was to figure out what the essential features of a particular task were, minus the extraneous motions and activities of the worker. Of course, this could not be determined in a laboratory but required on-site study. In theory this should have been possible on the farm as well, but the engineers did not actually go into the field or barnyard to measure farm tasks; they relied, rather, on common sense and intuition.[27]

The way in which labor was understood and rationalized was also problematic on the farm. Farmers were not considered skilled in a formal, guild-based sense like masons or armorers, but it was obvious that farming required some specialized knowledge and experience. Farmers did not correlate with any particular factory employee very well. Many owned their farm-factories, but this did not confer either high status or easy credit on them, and unlike factory owners, most farmers had few workers to do the unpleasant chores, to help during busy times, or to lay off when prices fell. Many other farmers were tenants who hoped to own farms one day. These tenants may have had the desire to make a long-term commitment to farming but did not possess the cash to purchase a farm. But like farm owners, most tenants were serious farmers. When engineers discussed "farm labor," they were referring to itinerant labor and hired hands, rather than owner-operators or tenants.

Like the Taylorists, agricultural engineers did not speak highly of farm la-

borers, considering them at best a necessary evil. One of the great virtues of farm machinery, according to engineers, was that such machines would help the farmer need fewer laborers. Referring to the first generation of tractors, one writer claimed that they were "doing more than any other single factor in straightening out the labor difficulties of the Western and Northwestern farmers." Even for farmers who did not have difficulties with hired help, eliminating such laborers was seen as one of the few ways to reduce costs during the postwar depression. The issue of the interrelatedness of labor, machinery, and the war was complicated. There was a demonstrable shortage of labor during the war because young men who might have worked on farms became soldiers instead. This both motivated manufacturers to advertise equipment as labor-saving and encouraged farm families to invest in such equipment. Some astute observers pointed out, however, that because tractors, for instance, were basically made by hand, manufacturers probably used more labor than was saved by farmers: "It was evident from a national point of view as a labor-saving machine that the tractor was not altogether an overwhelming success." Usually, engineers downplayed the expense of buying and maintaining machinery and emphasized instead the lower labor costs for farmers. Nonetheless, the idea of replacing laborers with machinery was never far from the engineer's mind, and most agricultural engineers who discussed the subject seemed to feel, as L. J. Fletcher did, that unless human judgment was essential for an operation, machines should replace humans throughout agricultural operations.[28]

Furthermore, until about the mid-1920s, it was unclear exactly whose labor would be saved with machines like tractors. Some pointed out that tractors would replace horses rather than humans, since tractors were designed to pull field implements. So although some laborers who had driven the horses might be out of work, generally it was the farmer's horses that would be displaced. Others pointed out that tractors did displace laborers because it was rarely the laborer but was more often the farmer or his son who "got to" drive the tractor. It was not always a question of whether the farmer trusted the hired man with an expensive piece of equipment or whether the farmer purchased the tractor in order to replace unreliable or unwanted laborers. Farmers also purchased tractors in order to keep their sons on the farm or to lure them back once the sons had gone to college.[29]

But for some, the idea of displacing farmers themselves with machines was the only rational outcome of the mechanization campaign. As Arnold Yerkes said to his colleagues, in a somewhat condescending manner: "Most of the farm work in this country is done by the farmer and his family; therefore, reducing

the man-labor on farms means reducing the number of farmers, and this is equivalent to reducing the number of farms. That is, those small farms which did not furnish profitable employment for the owners are combined so as to make farms of sufficient size to permit being farmed economically with modern implements." This, then, was the ultimate meaning of mechanization.[30]

TRACTORS, COMBINES, AND THE ROUGH ROAD TO MODERNITY

Long before the agricultural engineers began organizing themselves, implement manufacturers were designing, building, and selling a wide variety of farm equipment. By the 1920s, there were many firms in business, some quite well established. The firm J. I. Case, for example, had been around since the mid-nineteenth century and in 1869 was the first to develop a portable steam engine for grain threshing. Case had a steam tractor by 1892 and brought out a popular gasoline model in 1912. Allis-Chalmers was founded in 1860 as a milling equipment and steam engine manufacturer, and the Rumely Company built steam threshers and engines beginning in the 1850s. International Harvester was created in 1902 from the combination of six older manufacturers, including Deering and McCormick, and Caterpillar resulted from the merger of Holt and Best. Some of the most enduring agricultural implement manufacturers emerged from the steam engine producers of the nineteenth century, a striking example of civil and factory engineering being applied to agricultural production. Agricultural engineers thus merged themselves into a preexisting cadre of farm machinery enthusiasts who brought with them an industrial ethos of design and production.[31]

Although California and the northwest were unlike any other agricultural region in America, innovations introduced there tended to gravitate to wider parts of the country regardless of need. As a model, California was peculiar. Its Mediterranean climate was unique in America, the fields of the Central and Imperial valleys seemed made for machines because they were vast, flat, and uninterrupted by trees or creeks, and the growers appeared to share the pioneers' dramatic willingness to innovate. But unlike other industries, in which pilot plants and experimental installations served as models for full-scale industrialization, farm machinery had to scale down from its original, Californian size to work in the rest of the country. Some manufacturers, for example, felt that most American farms were simply too small to mechanize and preferred to build gigantic machines for California, as well as for Russia, Argentina, and Canada. This was

particularly true for combines, which were notoriously massive. By 1890 the three companies in California that manufactured combines—Best, Holt, and Houser and Haines—turned out a product that weighed ten to fifteen tons, cut a sixteen- to thirty-foot swath, and needed eighteen to forty horses to pull it. Likewise, the early steam tractors made by Holt and Best between 1886 and 1910 were far larger than the ones made in Illinois by J. I. Case; where the latter operated in the fifteen to forty horsepower range, Holt and Best operated in the forty to one hundred and ten range. They were designed after railway locomotives and were considered too complicated and temperamental for an untrained person to operate. Just keeping these machines supplied with fuel and water was considered a job for four or five workers and several horses.[32]

Californians' early approach to agriculture, which some historians have likened to the belligerent, winner-take-all attitude of miners, in some ways also characterized the implement manufacturers of the early 1910s. With no federal or state regulation, expanding markets for agricultural products in Europe and South America, and an optimistic, expansionist mentality among American farmers, tractor manufacturers sprang up like toadstools. In addition to the experienced manufacturers such as Holt and Best, hundreds of new manufacturers began putting out a small line of machines or sometimes a single model. Many of these machines were basically built from scratch, were unreliable, and without standardized parts or specifications, repairs were a big problem. And farmers whose tractors broke down during the crucial days of harvesting or planting and who had to wait days or weeks for parts to be fashioned or delivered grew fonder of their horses. Although reputable manufacturers existed, the climate of speculation and rapid mechanization at times overwhelmed them. Engineers were reluctant to make design changes to their tractors and combines because it would be expensive to replace the shop equipment and machine tools that made them. Further, the sale of spare or replacement parts could be a lucrative part of the implement business. But even when manufacturers were enthusiastic, however, farmers were somewhat reluctant to buy tractors before World War I, because they were too expensive, too large to turn easily in the field, and useful only in big field operations that were seasonal, not daily, events.[33]

In addition, the expense of operating these machines could be overwhelming for farmers. As Yerkes and Mowry point out, the costs of maintaining a tractor could far outweigh the actual purchase price, although few first-time buyers were aware of this. For example, the depreciation costs were considered high, "owing to the short life of tractors when in actual use on the farms." The farmer

still had to pay laborers when the tractor was broken down or while waiting for spare parts or for a skilled repairman to show up. Further, because the purchase price of tractors was high, the interest on the loan was also high. Tractors were usually bought on bank credit, therefore, a single poor year for crops could ruin a farmer whose notes were due. Bankers in the western states who were surveyed regarding their views of the new agricultural machinery felt that tractors were having an overall bad effect on farming in their areas. Far from supporting the view that tractors were a labor-saving or even deskilling innovation, Mowry and Yerkes bemoan the poor treatment tractors received at the hands of most farmers: "While it does not necessarily require an expert engineer to operate a gasoline engine in a fairly efficient manner, it does require a man with a comprehensive knowledge of the principles of the internal combustion engine, a thorough understanding of the particular machine being operated, and a good supply of common sense." In general, farmers felt that manufacturers had rushed their machines to the market far in advance of the tractors' readiness, and manufacturers worried that bad luck with one of these machines would sour farmers on other machines for a long time.[34]

Around 1913 or 1914 things began to change. Tractor manufacturers began to see the end of their main market for giant machines, namely the sod-busting farmers and ranchers of the far west. As this land came under cultivation, the heavy, expensive, and highly powered machines were not needed so much as smaller, lighter, implement-pulling machines. Manufacturers began to look around for new markets and concluded that smaller tractors that had both wide adaptability and capacity for belt work formed the most likely emerging market. Henry Ford, for instance, attending the Winnipeg Industrial Exhibition Association in 1910, discovered that most of the large traction machines whether steam or gasoline powered got mired in mud easily, and he resolved to develop a lighter and simpler tractor. As Wayne Broehl points out, the first gasoline tractors were still quite large and were too tricky for most farmers new to gasoline machines.[35] But the first big watershed for tractors came alongside World War I. As Allied food supplies dwindled, American farmers were urged to plant all they could, and as prices rose farmers were happy to comply. Many farmers expanded their farms during this period of high prices and ready markets, and many also bought tractors as a patriotic duty. Tractors seemed to offer several advantages. Because horses were also being used in the war, many farmers found it difficult to replace old or sick horses as a matter of course and thus had insufficient power to pull farm implements. Of course, hired men were also harder to find during the war. Some argued that farm women, who took on much of

the field work during the war, would have an easier time with tractors than with horse teams. Thus, many farms were trying to do as much or more than before the war with fewer animals and people doing the work, and tractors were demonstrably capable of helping farmers work faster. Farmers who expanded their farms for the war effort felt that tractors were more reliable than horses in timeliness of harvest as well. In addition, many implement manufacturers received wartime contracts for shell casings, prompting them to shift from batch production to mass production techniques. This not only drove the price of tractors down, but also made tractors simpler to repair and maintain. These reasons, combined with the decreased cost and complexity of tractors in general, pushed many farmers over the hump of resistance.[36]

For manufacturers, the tractor market was highly competitive. At Allis-Chalmers, tractor building grew out of the company's experience with heavy equipment manufacturing. They introduced their first tractor, the Oil Pull, in 1916, but farmers found it too heavy and slow. The company hired a new tractor-department manager named Harry Merritt in the hopes of breaking into the tractor market. Merritt, who was previously employed by the Holt company, developed an aggressive advertising campaign, spreading the word at tractor schools and in radio advertisements. He also created a club for successful tractor salesmen reminiscent of the team-building clubs sponsored by General Electric in the 1920s and 1930s. Allis-Chalmers salesmen who sold more than $100,000 in tractors attended an annual "Pow-wow," received special awards such as "The Slippery Truncheon," and adopted special titles such as "The Exalted Cyclops," and "The Honorary Distinguished Inquisitor." The company's most successful tractor, the 20–35, was introduced in 1927 and was a prominent part of the new international sales effort in Canada, Argentina, and Russia, which alone spent $3,000,000 on Allis-Chalmers machines in 1930. In spite of this elaborate effort, however, Allis-Chalmers had a hard time competing against more established companies such as Case, Deere, and International Harvester because they all had a larger line of agricultural implements and a more developed distribution network.[37]

Henry Ford's efforts to corner the tractor market were likewise thwarted. His goal was to provide farmers with a lightweight, inexpensive tractor, modeled on the highly successful Model T. The Fordson, first introduced at the Nebraska Plowing Demonstration in 1916, was sold to farmers in 1918. Although Ford promised early on to sell the tractor for $250, the Fordson cost $750, still inexpensive by tractor standards. In the early 1920s, the Fordson was by far the most popular small tractor in America. In 1922, 70 percent of the tractors sold to

American farmers were Fordsons, in 1923 they were 76 percent of the total, and in 1924, they were 71 percent. But then farmers began losing interest in the Fordson, which was simply too lightweight to do what farmers needed done, especially when it came to pulling three or four bottom-plows. They also had many design problems and were difficult to repair. By 1928, Ford stopped making Fordsons in the United States.[38]

One of Ford's biggest threats, however, was another tractor. The Farmall, introduced by International Harvester in 1924, was the first all-purpose, reliable, well-designed tractor on the market. Unlike previous tractors, which were not constructed for planting or cultivating, the Farmall was built with far more capabilities. Because it was higher off the ground, it could be driven through a partially grown field of corn or cotton without hurting the plants. Similarly, the rear wheels were wide enough apart that the machine could safely straddle crop rows for cultivation. The Farmall's durability and design quickly made it the most popular tractor in the 1920s.[39]

For the agricultural engineers, this sudden interest in tractors created a lot of problems, particularly with opportunistic manufacturers and gullible farmers. Arnold Yerkes found the tractors in 1917 nearly as unreliable as those he had studied ten years earlier. Tractors were still not able to totally replace horses, according to Yerkes, and were still too expensive not just to buy but to maintain. "A labor-saving machine," Yerkes pointed out, "which requires the expenditure of more time and energy to start it or keep it running than is required to do the job which it is intended to perform does not increase the efficiency of farm labor." As California engineer L. J. Fletcher put it, during the war "many tractors were hastily designed and tested and then put into production. They were sold because there was a demand for tractors and they looked like tractors." Other engineers concurred, complaining that there was "too much enthusiasm in the tractor business" and that "farmers are buying tractors without any reason at all." By war's end it was clear that some farmers had been taken advantage of by unreliable dealers. One observer of machinery trends reported that many tractor firms failed, leaving "further broods of orphan tractors in the farmers' hands," and predicted that this would not encourage farmers to take a risk on the next generation of tractors or on other machinery. This prediction turned out to be correct. By 1920 the lack of standardized models, the failure of tractor firms and the resulting evaporation of dealerships and repairmen, the economic depression in agriculture, and Henry Ford's dumping of one hundred thousand cheap Fordsons on the market strained what little credibility the tractor industry ever had.[40]

It was within this fractious context that debates among agricultural engineers developed over whether farmers should sell their horses and replace them with tractors. For some engineers there was no need for discussion, much less debate, so committed were they to farm mechanization. Arnold Yerkes was probably the most vocal and eloquent spokesman for the industrialization point of view, and he could see no reason at all to quibble when it came to getting rid of draft animals. In 1924, as chair of the ASAE's Committee on Power Farming, he expressed outrage that there still existed engineers who felt that, in some situations, draft animals might make more sense than tractors or other machines. The pro-horse lobby, led by horse enthusiast Wayne Dinsmore, reflected a somewhat different philosophy. More than anyone else, Dinsmore was able to mount an opposition to the wholesale shift from animal power to tractor power by focusing on the real complexity of farm operations, the dearth of reliable, comparative information, and the popularity of horses among many engineers. Indeed, so eloquent and intelligent was Dinsmore's appeal that it was Yerkes who seemed to be the flat-footed reactionary.[41]

Dinsmore's strategy was not simply to resist mechanization, but rather to caution against a headlong rush into the unknown. He liked to point out that virtually no research had been done comparing the motive power of horses and tractors except for a bit in Germany, so no one could really say that it was more efficient or cheaper or more effective to use a tractor. And it irritated Dinsmore that "the men that are displacing animal power with mechanical motive power I find to be almost invariably men that are using the little scrubby good-for-nothing horses." Dinsmore, who favored the massive Percherons, felt that it was hardly a fair test to compare tractors with poor horses. And Dinsmore had momentum on his side: in 1921 more than 95 percent of the power used in field work came from horses, not tractors.[42]

But his main arguments in favor of restraint rested on the idea that horses were more flexible than machines, and horses were already doing what tractors were claiming to do. The flexibility argument had several facets. First, in a tractor, all the horsepower was rigidly fixed in the engine. Farmers bought a ten horsepower or a thirty horsepower or whatever size machine, which may have been too much or too little power depending on the job that needed to be done. The problem was that some farm jobs required just a little power, while others required a lot. Horses, however, could be used singly or in groups as needed for particular jobs. Likewise, a poor-performing horse could be replaced more easily than a broken tractor. This was a viscerally compelling argument, because

farmers and engineers alike equated farm power with horse power and could easily envision increasing power by increasing team size. Indeed, this was how many farmers expanded during the war; not by buying a tractor but by using more horses. Although there was obviously a limit on how many horses one farmer could support, in many parts of the country a big team was cheaper to keep than machinery.[43] Second, Dinsmore argued that the horse was more reliable in the sense that if the farmer's tractor broke down during the crucial days of harvest or planting and he could not get it fixed quickly by the dealer, then he would be in serious trouble. If his horse broke down, the farmer could always get another horse to do the work or make do with a smaller team. This argument rested on the little-discussed fact that most farmers, as first-time tractor users, were unfamiliar with tractor repair and thus at the mercy of implement dealers who may or may not have been reliable.[44] This reliability also extended to weather problems, and horse fans were fond of pointing out that in a wet spring or fall tractors tended to get mired in the muddy fields. At the USDA's Farm Power Conference, Dinsmore reported on a farmer who said, "I tried a tractor, but I always ran into wet spots and I had to stop and get a team or two to pull it out and I lost more time hauling my mechanical power out of mud holes than I gained from its use, ten times over." While Dinsmore might be guilty of some hyperbole here, the general drift of his comments was reported by others as well.[45]

Other engineers offered their own reasons to stick with horses rather than switch to tractors. Farmers on moderate-sized farms of about 240 acres would have a hard time saving money with tractors unless the cost of keeping horses was unusually high or the farmers were especially good with motors. In general, a 240-acre farm simply could not support such a big purchase for such a limited use. Critics also noted that most farm implements used in field work were designed to be pulled behind horses rather than tractors, and, according to an International Harvester representative, many manufacturers were not anxious to redesign everything to fit tractors. This meant that farmers who shifted to tractors early in the process might find it difficult to locate implements adapted to tractor- rather than horse-pulling. Finally, a poorly maintained tractor that was rusty, had worn-out parts, or poor adjustment could "add thousands of dollars to the direct cost of production."[46] Studies done by agriculturalists in the states confirmed that farmers who adopted tractors did not always benefit from their investment. A study of 268 Illinois farmers found that when all the factors were considered, tractors gave these farmers no real advantage. They did not save time or money, despite the promotional promises to the contrary. In Montana, farm-

ers had "not developed the required mechanical ability to successfully operate their own tractor, and heavy out of pocket costs, depreciation, and crop failures are gradually tending [to] eliminate tractors."[47]

Tractors had advantages, of course, that horses did not. Yerkes suggested that tractor salesmen should tap into farmers' "innate desire to grow" by discussing how much bigger a piece of land a farmer could manage if he had a tractor. This was a common theme among both engineers and bankers, who frequently encouraged farmers to expand their acreages simply because tractors made it possible. Others argued that tractors could be operated twenty-four hours a day if need be, while a horse, obviously, could not. And in answer to those who complained that broken down tractors caused a loss of precious field time, others pointed out that tractors completed work so much faster than horses that even a delay due to weather or repairs would not matter so much in the planting or harvesting schedule. In this sense the tractor was viewed as an insurance policy against misfortune. In the late 1910s, however, it hardly mattered whether the engineers favored tractors or not; farmers were buying them in any case. The numbers were impressive. Between 1916 and 1919, tractor sales climbed dramatically, starting at 28,000 tractors sold in 1916; 50,000 in 1917; 96,000 in 1918; and 136,000 in 1919. Agriculturalists in the USDA began to realize that it was up to them to assist farmers and manufacturers alike in getting the facts regarding tractor use. With tractor manufacturers selling mediocre tractors quite easily, the market was ripe for unscrupulous and bogus promotions.[48]

For most engineers, as for most farmers, the middle road seemed the most attractive, at least through the 1920s. Both horses and tractors had advantages and disadvantages, and it seemed prudent to keep both on hand where possible. Tractors were great for belt work—connecting the tractor engine with belting to run grinders, sharpening stones, and pumps—while horses were fine for pulling implements such as cultivators, weeders, and manure spreaders, tools that were used as time permitted over the course of the season. As engineer John Hopkins pointed out as late as 1929, it was tricky for most farmers to calculate the most economical balance between the expense for the tractor, including gasoline, repairs, and insurance, versus the expense for hired help, including room and board, and to measure that against farm size, expected farm income from crops and livestock, and real day-to-day power needs. But by the early 1930s, many farmers found that such decisions were being made for them, because bankers began evaluating whether a farmer was a good risk or not according to the degree to which he was using power machinery such as tractors and combines. One banker who managed thirty-three midwestern farms reported

that he would always choose a new tenant who owned a tractor over one who did not, figuring that such a tenant would be more likely to get the crops in and out quickly in poor weather.[49]

With the combine, also called the harvester-thresher, there was much less debate regarding the advantages and disadvantages of adoption. This was because it was by definition a large, multipurpose machine (it both cut and threshed the grain), suitable only for small-grain growing. In turn, small grains such as wheat were often grown in larger fields than other grains such as corn because they commanded a lower price per bushel. Larger fields enabled farmers to use machines that were larger than ordinary tractors. Furthermore, combines were never expected to serve multiple uses on the farm itself. Although tractors were touted for their ability to do belt work in addition to field work, combines were limited to the field. Thus, the clientele for combines was both smaller in numbers and more focused in need than that for other machines.

The combine was first introduced in the Pacific northwest in the 1880s and began moving east and south by the mid-1910s; but it was not until the mid-1920s that it really took hold in the midwest. Most manufacturers and farmers thought that the combine was not suited to midwestern conditions. The grain had to be dry for combine harvesting, and a dry climate was never assured in the midwest. But in 1924, Massey-Harris demonstrated one of their combines in Stonington, Illinois, drawing a crowd of around two thousand people. This demonstration paved the way for the successful use of combines in the midwest, and in addition, it introduced soybean farming to the region. Two years later, more than sixty farms were using the combine. In that same year there were more than 8,200 combines used on wheat in Kansas. In Minnesota, adoption rates were also dramatic: in 1927 there were 11 combines in the state, most on large wheat farms in western Minnesota; by 1929 the number had climbed to 110. The combine was not without problems, however. It was expensive to purchase, costing between $1,100 to $3,000 in 1926 depending on size, and it was costly to repair. Some grain elevators refused to accept grain harvested with a combine because in the early years the grain tended to heat up and explode. And on some farms, because the combine was a composite machine, or one that "combined" the features of several separate machines, its functions overlapped with those of other machines and implements. So some farmers were reluctant to invest in a machine that could not be used fully on other farm operations and that would not allow him to get rid of other equipment or horses.[50]

But the advantages of owning a combine were apparently irresistible for many grain farmers. First, small grains such as wheat were especially susceptible to time

delays in harvest, and the combine seemed to improve farmers' chances of getting the grain in on time. It was so much bigger than either horse-drawn implements or tractors and could cover more ground than other methods in the same time that farmers were able to complete harvest more quickly. Second, wheat harvesting in particular traditionally required a large group of laborers, and most reports indicated that the combine was both more reliable and cheaper than hiring workers. According to one USDA study, the cost of harvesting and threshing an acre of wheat in 1928 was $3.30 to $4.22 without a combine, and about $1.50 with a combine. The USDA's E. H. Lehmann also pointed out that when the combine was used, farm women were spared the task of cooking for a big crew, a notoriously laborious job. Most striking, however, was the rate at which farmers enlarged their farms as a direct result of the combine. As one engineer described it, the combine finished the work so fast and so reliably that one farmer he knew doubled his farm size in one year, from 400 to 800 acres. M. L. Wilson reported a similar transformation as Montana farmers purchased combines in record numbers. In 1923, there were 10 combines sold in Montana, in 1924 the total was 51, in 1925 it was 144, and in 1926 it was 264. There is little doubt that the capability of the combine to complete more field work than ever before led many grain farmers to enlarge their farms. Farmers who specialized in small grains often avoided diversified farming and thus did not have to fit into the daily work such other tasks as milking the cows or tending other crops. With few other jobs competing for his time, he might well simply enlarge his grain acreage. Further, the cost of the machine, and the fact that most farmers had never faced such an expense before, except for land, pressured farmers to get as much lucrative work out of the combine as possible. And finally, the combine was good for one thing only; unlike a horse, it was not a general purpose tool. This also encouraged farmers to expand their commodity crops.[51]

The combine and the tractor represented different trends in agricultural modernization. In general, the tractor was a power source. It could pull implements just as a horse team did, and it could run small machinery in the shop as a generator did. Compared to a combine or steam thresher, a tractor was small in size and basic in design, and many of its inner workings were exposed to view in the early models. These early tractors were not without decorative flourishes, as collectors of old iron tractor seats can attest. In an effort to demonstrate a human touch and to show how easy their tractors were to operate, some companies used people with disabilities to advertise their machines. "Maimed Italian Soldiers Operate P&O Little Genius Tractor Plow," one firm boasted, showing

a photograph of three one-armed soldiers taking a break in their plowing of the Italian countryside. *Power Farming* ran a story about a farmer who, although he could neither speak nor hear, could effectively use a tractor.[52]

The combine, in contrast, was of a different order entirely. More than an alternative power source, the combine was huge, noisy, plainly industrial. It performed tasks that humans rather than horses had done previously, and it did them in a fraction of the time. Where the tractor was an impressive little machine, the combine was awe-inspiring. Where the tractor could share work with the horse, the combine appeared to be self-sufficient, a discouragement against diversification. A tractor could do many things adequately, but a combine could do one thing perfectly. For those involved in the roulette game of farming, the stakes ratcheted up when the combine came to town.

The agricultural engineers had a large share in the shift from traditional to industrial farming in the 1920s, despite their quiet demeanor. With their commitment to an engineering-based method of problem solving, the agricultural engineers tended to define problems in technical terms and tended to recognize only those problems that could be solved using engineering principles. If the land was too arid to support midwestern-style farming, then engineers would irrigate rather than move on; if farm laborers wanted higher wages, then manufacturers could provide nonhuman labor that, while it cost more, was also less argumentative. The idea that agricultural practice might *not* emulate factory practice or that agriculture might *not* get larger, more mechanized, more highly capitalized seems not to have occurred to the agricultural engineers. As Robert Stewart wrote of agricultural engineers: "Their basic approach was to increase per capita production through mechanization of large, efficient farms, thus reducing cost of production per unit produced, just as in any American industry. This philosophy committed them to the 'mass production' farm."[53]

The agricultural engineers created a professional system in which both academic and commercial interests concentrated on problems of mutual concern. By deciding to include manufacturers and businessmen in both its leadership and its routine activities, the ASAE indicated its willingness to blur the lines between the academy and the trade show and to acknowledge their common desires to modernize American agriculture through engineering. Of course, with this arrangement the agricultural engineers were unable to play a significant role in testing and regulation, and rarely did a member voice any concern about trends in the discipline. There were a few exceptions. In 1921, before most ma-

chinery was dependable, George Pond studied the effect of machinery on farmers' workdays. Scholars who have looked closely at the effect of domestic labor-saving technologies will see a parallel in Pond's findings, which indicated that tractors, automobiles, and even milking machines did not seem to shorten the farmers' workdays nor lighten their loads. By the end of the decade, when machinery was largely in place on most successful farms, the situation was slightly different. Although many farmers found that the gasoline engine, for example, had made their work less arduous and often less time-consuming, they also found that their operating costs were much higher because of it. This was not merely a problem of capital outlay for the tractor or the combine or the automobile but was also the cost of maintaining them. And what economists were hearing about was that it was an inflexible cost. That is, where farmers were used to a fluid economic circumstance, in which poor crops would result in the family eating less meat or having fewer trips to town, a good crop year would result in better and more plentiful food, home furnishings, and so forth. With so much money tied up in expensive machinery, however, that fluidity was severely compromised, as farmers paid bank notes on the equipment loans first, and other expenses such as family living costs or feed costs took second place. The implications were well described by L. H. Bean, "We may well raise the question whether the present generation of farmers is not paying the price of an agricultural revolution, the benefits of which may in time accrue to the next farm generation."[54]

The philosophy of production that so often accompanied farm mechanization tended to view nature itself as an obstacle. Describing the opening of new farmlands in Europe during World War I, one engineer wrote that this required "filling of drainage ditches, the removal of hedges and stone fences, and often the utilization of land that had not been cultivated for centuries; all to permit of using the more efficient power and machinery methods." In the American west, too, "a large acreage of fertile land still awaits the magic touch of the drainage engineer. Desert areas are still dormant awaiting the irrigation water which will cause them to bloom and produce." Plants themselves could present problems, and in this case it is the engineer, rather than the geneticist, who is predicting the biotechnological future. L. J. Fletcher, for one, stated: "It is entirely practical and possible to make mechanical changes in plants. If a plant presents difficulties in its present form to the use of mechanical power in cultivating or harvesting, it may be changed." For the agricultural engineers, these goals of mastery and control over nature were a logical outgrowth of their commitment to rural progress. They were also goals shared with other experts, such as

economists, agricultural leaders, urban bankers, and industrial people. All could agree that in general an increased application of scientific and engineering principles to agriculture and rural life would ensure efficiency, higher productivity, and a higher standard of living. And as experiments in large-scale farming were demonstrating, they were at least partly right.[55]

Chapter 4 Farms as Factories: The Emergence of Large-Scale Farming

Agriculture is the oldest of the industries and yet the slowest to receive the impulse of modern development.
—*H.W. Jeffers,* 1916

Visitors to the M. Johnson Poultry Ranch in Bowie, Texas, had probably never seen so many chickens in one place before. A writer for the *Reliable Poultry Journal* found it impressive even by poultry standards: "Imagine, if you can, a 350-acre farm, fairly 'painted white' with S. C. White Leghorns; also a roadway A MILE LONG leading all the way between poultry houses adjoining this roadway on either side, then consider just what it meant last spring to 'put out on the ground' of the home plant more than 75,000 baby chicks, then you will have a pretty fair idea of the extent of the M. Johnson Poultry Ranch." Similarly, visitors to the Campbell Farming Corporation in Hardin, Montana, probably had never seen so much wheat. When Montana writer Joseph K. Howard went there in 1949, he found that by standing in one spot on the 65,000-acre farm, he could see twenty-eight miles of wheat stretching all the way to the mountains, a view he ranked as "one of America's most spectacular vistas." A number of the large-scale farms

emerging in the 1920s offered themselves as spectacles to the curious, and these farms seemed amazing to many for their size or for the number of livestock all in one place or for the machinelike efficiency with which work was done. Writers were sometimes struck on an emotional level by the scale of operations, the cleverness of the mechanisms devised to substitute for human labor, and the apparent mastery over nature that many of these farms represented. To some they must have seemed a "futurama" display, a rural Epcot center, in which the farms of tomorrow were already in operation.[1]

During the 1920s, industrial farming concepts found their way onto real farms in America. The principles of efficiency, managerial oversight and planning, reliance on experts, mechanization, and large-scale operations moved from classrooms, lecture halls, and federal agencies to the rural countryside laid low by the farm crisis. There, on acreages large and small, engineers, economists, bankers, federal agents, and wealthy speculators created an unofficial experiment in what the former Nebraska governor called "factoryizing the farm." By 1930, according to a BAE survey, more than twenty-one thousand farms were considered large scale, defined as "a single farm or a group of farms under one closely controlled and supervised management, if the size of its total farm business was at least five to eight times as large as the typical farm business in the same locality producing the same kinds of products." Although the high plains wheat farms might seem the archetypical large-scale farm, in fact the highest number of such farms were in Texas, followed by California and then Alabama. The national total included 345 cotton farms, 200 general mixed farms, 124 beef cattle and sheep ranches, 117 fruit farms, 109 dairy farms, and 39 cash grain farms, 25 of which were devoted to wheat.[2]

Large-scale farms emerged in the American postwar consciousness in two ways. As discussed earlier, during the 1920s there was simply a great increase in the number of larger farms. Some were small farms that got bigger, some were consolidations, and some were new farms designed to take advantage of new mechanical and managerial capabilities. Although some of the large-scale farms came about as a result of the college- and industry-based agitation for factory farms, most farmers probably chose to enlarge their holdings for some other reason—a neighbor's farm became available, a farmer and his son decided to join forces, a new tractor could only be paid off by farming more land. But whether or not they recognized their relation to the broader trends in American agriculture, these farmers were caught up in a revolution that they were helping to create. During this time, large-scale farms were not only more common, but those that existed became even more visible as the concept itself began to be talked

about. This attention was not just in the farm press but in the popular press as well. There was no doubt that farms were getting larger and more industrialized during this period, and this generated both enthusiasm and concern.[3] It also precipitated a fair amount of misunderstanding, according to some, and it represented a major shift in the way most people thought about agriculture and rural life. Was it a good thing for farms to get bigger, and for farmers to be more like businesspeople, and for farm kids to study economics and management in preparation for a future in farming? What was it in rural communities that people wanted to protect against industrialism, and what were they happy to get rid of? Who would decide such questions, urbanites or rural farm families, and when? Such questions cut to the core of rural and urban anxieties alike and framed the debates that cropped up in decades to come.

The ideas behind industrial farming were neither coherently bundled for adoption by farmers nor easily seen on farms by a passing traveler. Nonetheless, farmers and others were incorporating the new practices at a good rate by the mid-1920s. Summarizing the events of 1926 in his annual report, the secretary of agriculture, not known for embracing radical or uncertain propositions, drew an unambiguous picture of this transformation:

> The United States has become great industrially largely through mass production, which facilitates elimination of waste and lowering of overhead costs. Large-scale organization in the business world has effected tremendous economies both in production and distribution, and has enabled manufacturers to supply consumers with what they want when they want it. It seems to me that in this matter agriculture must follow the example of industry. It must have a similar and larger scale development of its business organization, managed by competent executives. There are 6,500,000 farmers, each representing a unit of agricultural business. It is therefore not easy to organize agriculture for effective business operations. But the start that has been made in that direction indicates that it can be done.[4]

Gilbert Fite describes an almost surreptitious transformation around 1920, pointing out that "most Americans, including farmers themselves, did not fully grasp just what was happening and how the changes would affect farmers and their position in society." Although this change occurred gradually across the country, advocates for the shift agreed with the secretary: It was time for farmers to change their ways or move aside. Economist E. G. Nourse was not so sure that the steel mills or the automobile factory were exactly the right model for agriculture, yet "the essential features of economic organization which have brought efficiency into industrial pursuits must be incorporated into agricul-

ture or else it must remain the slow and backward brother in the family group of our economic life." By 1928, six great plains states had greatly increased their acres under production. In Texas, five million more acres were planted, in North Dakota, Montana, Nebraska, and Minnesota another one million acres in each state, in Colorado five-hundred thousand acres, and in Kansas, Oklahoma, and South Dakota three hundred and fifty thousand acres each. With the simultaneous decrease in the number of farmers, it was nearly impossible to operate this much new ground without using industrial methods.[5]

Like their colleagues the agricultural economists, the agricultural engineers had more than metaphor in mind when they referred to farms as factories. The idea of the farm as a factory was irresistible to many. Raymond Olney, one of the early leaders in the field, could wax eloquently on the subject: "No one will object to calling a farm a factory. It is a factory. The soil and seed are the raw materials, and from these are manufactured a variety of finished products, through the agencies of sun, air, moisture, power, and implements. The finished products of the farm factory are cereal, forest, vegetable, and fruit crops, and livestock and livestock products, are they not?" H. J. Jeffers visited a farm in which such principles were put into effect in the stables, generally one of the least factory-like places on a farm: "The cleaners, milkers and feeders work in regular shifts, five hours on and seven hours off. At 12:30, night and at noon, the floor cleaners appear for duty, and as soon as they have completed their work in one barn or about 1:00 the cow groomers begin work. These men are followed at 1:30 by the cow washers; at 2:00 by the milkers; 2:30 by the feeders, each crew working five hours in rotation order."[6] For the engineers, two things linked farms and factories. First, like factories, farms were productive enterprises in which materials were transformed into consumable goods. Like their factory counterparts, farmers used tools and machines to effect this transformation, they worked long hours, through periods of extreme heat and cold, they got dirty, and they endured the scorn of those in cleaner, less manual, occupations. Second, farm work, like craft work before it, seemed at last amenable to the application of power. In the nineteenth century, the work of spinners and weavers was transformed by the spinning jenny, the mule, and the Arkwright waterframe; similarly, armorers who had made "lock, stock and barrel" found themselves overseeing machines that did this in far less time. Many engineers felt that mechanization was an inevitable outcome of progress, merely a developmental stage on the road to modernity. They tended to see the internal combustion engine as the technological key that would unlock the door to industrialized agriculture.

Industrial farming offered engineers a convenient vehicle for promoting everything from generators to combines, all on the principle that if a machine could perform a task, it should. The problem before the 1920s was that most farmers did not seem to want much of the machinery that was available or found that heavy machinery such as combines and tractors was both too expensive and too big for their farms. Because agricultural engineers' professional credibility was based on their conviction that farming *would* be mechanized, they worked hard to create a context in which "power farming" would replace traditional farming. For example, if machinery was too expensive, farmers should consider cooperative ownership of land and equipment. If farms were too small to use such machinery efficiently, then farmers should buy more land to justify having the equipment. Or if farmers could not afford to buy more land, they should sell their land to a farming corporation that could afford such equipment and then work on the land as tenants. In these scenarios, it was made clear that the machinery, rather than the farm family, was at the center of the plan.[7]

That the factory was the reference point for engineers was apparent in their simple fascination with machinery and in the way they contrasted the work habits of "good" machines with "bad" laborers, in the manner of factory managers. Olney's characterization of this view is typical: "One farmer whom I have in mind purchased a small gasoline engine primarily for the purpose of pumping water for livestock. But soon he was not satisfied with using an expensive engine for only one kind of work. He decided that it wasn't earning him enough money in return for the amount that he had paid for it. He asked himself why his engine need stand idle a good share of the time any more than a hired man. Didn't it represent a considerable investment, the same as the hired man's wages? To be sure it did, and it was up to him to devise means of increasing its usefulness. The dollars and cents income from his investment would be measured by the hours per day or week that he could keep it busy."[8] One of the most striking aspects of this story is Olney's unwitting suggestion that a farmer didn't really need the machinery he found so desirable. A small stationary engine might prove ideal for pumping water, but the farmer was hard-pressed to think of other tasks it could ease: Feeding chickens? Laying tile? Cutting hay? Olney's response brings the factory system, in particular Frederick Taylor's system, into play. The secret, according to Olney, was to use belts and pulleys to harness the power of tractors and portable engines, to build a "power house" that would centralize all such activity, to position such equipment according to the "class" of work it would do and with an eye to avoiding "lost motion." Others would later suggest that entire farmsteads needed to be arranged differently, calling this the

"most important factor in its efficient and economical management, just as proper shop layout is essential in a factory."[9]

VARIETIES OF INDUSTRIAL LIFE

Many kinds of farms of the day could be considered industrial. During the late 1910s and 1920s there was a lot of press coverage given to "corporate" farms, although the meaning of the word was rarely explained. Although it might have meant farms that had been legally incorporated, many small farms were actually incorporated for reasons entirely apart from large-scale production or mechanization. Not all corporate farms were industrial farms, and not all industrial farms were incorporated. Western ranches were often incorporated, and those with range cattle or sheep had been incorporated as "the regular order of things in Montana for a generation and no one has thought anything about it."[10] Generally journalists used the term corporate farms to refer to farms that were large in acreage or product but that may or may not have been incorporated. Industrial farms could be large in size or large in product or highly mechanized or operated by managers and businessmen or without a farm family living on the farm itself. Most industrial farms had at least two of these features.

One common type of industrial farm was the chain farm, sometimes called a group farm. This was a set of farms that were supervised and tightly controlled by a single entity, such as a bank or farm management company, "a type of service well established in the industrial world." According to one writer, "Banks, loan companies, insurance companies, and real estate companies have probably done more work along the lines of so-called big scale farming than anyone else, and it is probable that they will be the ones to eventually hit upon a profitable and otherwise satisfactory system of management if such are forthcoming." The farms would usually be operated by tenants, and the tenants would follow the directions of managers or the owners, who would issue thorough and detailed instructions for the tenant to follow. The owner or manager would often select the seed to be sown and the machines to be used, would direct the plowing, seeding, disking, and harvest, and would select livestock for sale or slaughter. The tenant, for all practical purposes, was similar to a factory operative in that he followed management's directions and provided physical labor, but exercised little judgment or decision making. The Minch Brothers Farm in New Jersey was one example, comprising 1,800 acres on fifteen farms growing truck crops. Each farm was operated by men referred to as straw bosses, many of whom had previously owned the farms but now were hired out by the hour to the Minches.

The company owned all the tools, animals, plants, and buildings. This type of farm was also common within industries that had to produce their own raw materials. Canning companies were often organized this way, but so was a rubber company that grew 1,100 acres of cotton for its tire cloth and belt fabric operation.[11]

Many of the chain farms were supervised by a professional farm manager or a farm service agency. The most enterprising of these farm managers was Howard Doane. While a student of agriculture at the University of Missouri, Doane discovered that W. J. Spillman at the USDA was promoting "a new idea called farm management," and, following a correspondence with Spillman, he conducted what is considered the first farm management study in America. After Doane graduated, Spillman hired him at the USDA, where he worked for two years. In 1910, Doane became professor in the new department of farm management at the University of Missouri, where he stayed until striking out on his own in 1916. Doane worked for various banks and insurance companies for a few years, helping them figure out how much money to lend based on a farmer's production receipts. The more a farmer had earned in the past, the more he was likely to get in the future. In 1918, he began farm-management consulting with his brother (Howard concentrated on farm appraisals while his brother worked on mining claims), and after that business dissolved in 1923, he started Doane Agricultural Service. The proximate cause of this new company was Doane's move to St. Louis, where a large insurance company wanted him to take over all their farm field work and farm management. Doane's company did several kinds of things. First, it managed farms for owners who lived elsewhere, such as when someone inherited a farm that needed expert attention or a large farm that had become unprofitable or unwieldy. In such cases, Doane would appraise the farm and work out a plan of action (the company motto was "Do"), including choosing which crops to grow, how to arrange the fields, how much and what kinds of livestock to keep, making necessary repairs to outbuildings and fences, obtaining and servicing machinery, in other words everything real farmers would do if they had the time, money, and expertise. Second, Doane specialized in what came to be called "liquidation management"—that is, taking farms that a bank or insurance company had acquired through loan default or bankruptcy and improving them for ultimate resale. The work was similar to that performed for other clients, except that Doane's goal was to manage the farm on a temporary basis only. This aspect led some critics to charge that liquidation management companies skimped on everything from advice to seed quality to quality of tenant.[12]

Another example of the chain farm was the Central Investment Company in Bluffton, Indiana. Established in 1923 by the president of the Bluffton bank, CIC owned nineteen farms totaling 2,900 acres by 1927. Each farm was operated by a salaried farm laborer under the supervision of manager John Graham. The basic idea was to buy run-down farms, improve the soil, outbuildings, and so forth, and sell them as excellent farms. The company also introduced specialization, using one farm to farrow pigs, and another farm to fatten them, for example. Graham was an enthusiastic user of the latest farm machinery and boasted that his farm had tractors, a mechanical corn picker, twelve cream-separators, a large thresher, two hay balers, eighteen small engines, manure spreaders, and an assortment of other machines that could be moved from farm to farm as needed. Graham felt that his hired men were far happier using modern machines and commented on "the good feeling, the esprit de corps," that they seemed to have as a result. Graham believed in standardization, preferring to buy all his machinery from International Harvester because repairs and spare parts were more uniform and service was more reliable and consistent when the farm had only one make or model. The Midwest Canning Corporation of Rochelle, Illinois, was also reliant on tractors and in 1929 possessed a fleet of 124 of them. Midwest Canning, which grew peas for Del Monte, employed a manager and hired hands who worked nearly 18,000 acres in Illinois. By 1931, Aetna Life Insurance Company owned 600 farms in the midwest that were operated by tenants but managed by the company farm manager. An independent businessman, F. E. Fuller of Bloomington, Illinois, personally managed 40 farms that totaled about 10,000 acres by 1928. In nearby Champaign, J. E. Johnson developed a highly focused management system for overseeing 32 farms for the local bank. For each farm, Johnson, formerly a Farm Bureau official, created maps showing building locations, soil characteristics, and crop and rotation schemes, provided for operating budgets and accounting systems, and made an efficiency study of current and proposed farm operations. Some thought that the farm management systems in Illinois had demonstrated general principles of successful farming and recommended these methods to farmers in states with quite different conditions.[13]

Another form of industrial farming that was common in the produce regions of California was the large cooperative. Unlike the small farmer co-ops coming into existence that enabled farmers to buy farm supplies in bulk and sometimes market their crops and livestock collectively, the West Coast cooperatives were highly sophisticated produce businesses. The fruit growers were way ahead of other producers in sensing the importance of an industrial model for agricul-

ture. As early as 1895 one grower began promoting the standardization and grading of fruit to provide consumers with "identical commodities," made possible by "adopt[ing] the practices of other successful manufacturers." By 1928 this approach was well established, and growers could point to increasing specialization, "efficiency production," and "breadth of its marketing program." Indeed, with the added improvements in transportation, Americans were changing their food habits, buying fewer apples and turnips and more citrus fruits and asparagus. The California Fruit Growers' Exchange, for example, orchestrated the marketing of citrus coming from more than 8,000 growers. The farm-based cooperatives, such as the Berkeley Olive Association, resulted from the merger of small farms whose owners were eager to enjoy the advantages of large scale. As many have pointed out, by pooling their resources fruit and vegetable growers were able to hire marketing experts, build packing sheds, storage facilities, and pre-cooling sheds, and put in machines for grading and packing the produce. These co-ops centered on individuals pooling their resources and hiring a manager to oversee the whole operation. Established in 1914, the Berkeley Olive Association consisted of 27 individual farms spread over 502 acres, and the farms were managed by an association that included faculty members from the University of California and the University of Nevada as well as businessmen from both states. The idea here was that the farmers would raise the olives and the nonfarmers would raise the money for the farm, make decisions about production, and manage the packing plant and the marketing. This was considered a particularly promising form of industrial farming, where the product was singular, the acreage required was small, and the marketing was crucial.[14]

A variation on this theme was the farm without farmers. On the Poso Land and Products Company (also called the Hoover Farm, after its presidential owner), nearly 1,300 acres were managed by agricultural engineer Leslie W. Symmes. On this highly diversified farm, products included cotton, alfalfa, grapes, and orchard fruits. Insisting that this was neither a showplace nor an experiment station, Symmes described his farm as purely a business proposition, and he developed a set of accounting and bookkeeping procedures that were Tayloristic in their exactitude. Likewise, the California Packing Company devoted 4,000 acres to peaches, and each of its eighteen parcels of land included a bunkhouse, a cookhouse, and sheds for the workers. Each parcel was managed by a foreman, but farm headquarters were in San Francisco. Although this was a large farm by local standards, its main thrust as an industrial farm was neither scale nor mechanization, but management. Here the cold facts of the business of farming superseded the notion that farmers were yeomen wedded to the land,

yeomen whose way of life was as important to maintain as production goals were.[15]

For some farms, however, the mechanization of labor was the overwhelming reason to regroup along industrial lines. For example, with the introduction around 1927 of dryers and other machines used in haymaking, farmers could shift overnight from a labor-intensive operation to an almost completely mechanized one. Mechanized hay production was not an option for the struggling farmer; the initial capital investment was more than $21,000 and annual costs were estimated at another $22,000. The poultry industry also benefited from mechanical innovations that, again, encouraged producers to "scale up." On the M. Johnson Poultry Ranch in Bowie, Texas, for example, the "mass production of chicks" was made possible with the introduction of the Hall incubator. Relying exclusively on White Leghorn chickens, which seemed to "lend themselves" to "fit into a mass production environment," by 1926, Johnson's ranch included 75,000 chickens, 112,000 eggs in incubators, 1 million square feet of floor space, and 186 buildings. Called "the biggest poultry farm in the world," Johnson's operation would be emulated by poultrymen all over the country. The USDA reported in 1928 that specialization in the poultry industry was greatly accelerated by the introduction of such technologies as the mammoth incubator, the use of electric lighting to induce egg-laying out of season, the use of coal-stove brooders, as well as the systematic breeding of hens with high egg production.[16]

Between 1922 and 1926, acreage in cotton also increased, from 33 to 48 million acres. Cotton production also shifted geographically, as tractors, experimental pickers, and improved cotton gins appeared and as railroads extended lines into remote regions. Most of this new activity was in Texas and Oklahoma, where there was no boll weevil, where the land was level, and where the soil was easy to work. In northwest Texas and on the coastal plains near Corpus Christi, cotton farmers expanded their production dramatically. In the northwest, output increased from 5,000 bales in 1912 to 430,000 bales in 1926, and in south Texas for the same period it increased from 6,000 to 250,000. In Mississippi, one experiment station researcher urged planters to think of their fieldhands as factory workers and likewise to embrace machinery that would make field workers as productive and efficient as factory hands had become. Without question, machines had a huge effect on productivity, often doubling production within five or ten years' time. Further, as these examples illustrate, the most important farm machines were not always tractors and combines. Although the new driving machines were the most visually dramatic technologies, electrical machines were probably as critical in changing the face of agriculture. Grain and fruit dry-

ers, electric incubators, milking machines, and electrical lighting in farm buildings and yards enabled countless farmers to automate, speed up, or standardize farm tasks, which in turn required farmers to take on more obligations. Farm economist Frank App reported in 1928 that farm orchards were becoming a thing of the past because of specialization and mass production methods in the mid- and south Atlantic states. In those areas, spraying with chemicals and harvesting fruit with machines favored larger farms and bigger bank accounts.[17]

Some industrial farms copied not just the scale or business practices of industries but the entire industrial order represented in planned company towns such as Pullman, Illinois, the infamous home of both the Pullman Palace Car Company and one of the most notorious labor strikes in America. One of the most developed examples of the company town grew around the Coleman and Fulton Pasture Company (also called the Taft Ranch after its owner, President Taft's brother Charles P.), located on 100,000 acres on the Gulf Coast of Texas. The ranch, which was primarily a grain and livestock operation, raised 15,000 cattle, 5,000 sheep, 1,000 hogs, and 1,000 horses and mules, as well as the grain to feed them all. Four little towns were built on the land for the 4,500–5,000 workers needed to run the ranch. By one enthusiastic account, these farm workers enjoyed more modern conveniences than did most farm families in 1913. The houses were "modern and comfortable," with electricity, running water, and ice, and most had telephones either in the house or "within easy reach." The company built a hotel, hospital, several Protestant and one Catholic church, as well as company stores (which the workers were not required to patronize). The company also built processing sites, where beef was slaughtered and packed and where cotton was cleaned and spun.[18] Another example was Albert M. Todd, the "Peppermint King," who operated an 11,000-acre mint farm in Nottawa, Michigan. Todd provided housing and meals for his 200–300 workers, as well as a clubhouse, bathhouse, and library. As on the Taft Ranch, no liquor was allowed on the property. In an attempt to keep good workers year round, Todd also began raising shorthorn cattle in 1903, which gave the workers something to do in the winter, and he began a profit-sharing plan in which workers who stayed the year would receive a 10 percent bonus. And in California at the Mills Orchard Company, a diversified fruit, grain, and turkey farm of 8,300 acres, workers were given room, board, profit-sharing for leaders, and life insurance and medical care. What industrial farming enthusiasts failed to report, particularly in describing the large southern farms, was that many of these farms exacerbated the ethnic and class tensions prevalent in the region. In this respect, too,

they resembled industrial company towns; the laborers were subject to the same animosities on the farm that characterized their communities before.[19]

A high percentage of these industrial farms were located in the midwestern states, and these exhibited a different profile of industrial farming than in other parts of the country. In the midwest, one did not find the vast unbroken tracts of land common elsewhere, nor was there, for that matter, the isolation and aridity. Where the far west and southwest could offer large fields and rangeland for grazing, the corn belt could offer more intensive opportunities to focus on detailed and expert management of existing resources, resulting in higher yields, quicker weight gain in livestock, reduced freight charges, and other "efficiencies." The effect at first was a honing of agricultural practice more than a revolutionary transformation.[20]

One of the most innovative plans was hatched by retail king J. C. Penney in 1924. Penney wanted to do in agriculture what he had done in retail, namely, develop a massive production and marketing system that featured small, local units orchestrated by a central management that controlled every aspect of the business. Starting with 20,000 acres near Green Cove Springs, Florida, by 1927 the J. C. Penney–Gwinn Corporation Farms had acquired 125,000 acres that was divided up into 7,500 tiny farms of less than 20 acres each. The "farmers" of these small parcels were often not farmers at all, but customers of Penney's stores who were recommended by local store managers, who were charged with rounding up tenants. To qualify, one had to bring to Florida $750–$1,000, which was considered the minimum amount necessary to get through the first year. These farmers were out "on approval" as it were, and if, at the end of the first year, Penney found them sufficiently industrious and promising, then they could purchase their parcel with whatever earnings they made that year. As with the other company towns, Penney provided churches, stores, schools, and other urban conveniences, and built railroads, highways, a poultry farm, a cannery, and other production centers that would allow centralized integration of production and marketing. Leaving nothing to chance, he also provided expert advice to the farmers and their families through the J. C. Penney–Gwinn Institute of Applied Agriculture, which not only taught theoretical and applied agriculture but also home economics.[21]

These industrial farming company towns bore a striking resemblance to the industrial company towns and were designed to solve some of the same problems anticipated by the shift from artisanal work to industrialized production. Farmers were perceived as similar in many ways to immigrants and low-skilled

industrial workers: uneducated, rural, backward, and in need of civilizing. The company towns were thought to provide the accoutrements of the modern world—electricity, running water, schools—that agricultural and business leaders assumed rural people wanted, and the towns also offered a controlled, paternalistic environment considered crucial to the reeducation that some felt the new townspeople needed. Furthermore, company towns offered full-year employment by means of processing facilities, something even large-scale farms could rarely do. For farm workers resigned to seasonal unemployment and poverty, this was a decided bonus.

But the managerial approach also introduced an unsettling notion: that farming had become too complex for farmers. This simple but powerful idea operated at two levels. First, it corroborated what many urban critics had long suspected: that farmers as a group were not smart or hard-working. Second, it reinforced the idea that farm management experts needed to redesign the basic principles of the farm enterprise. The perception that farmers were fundamentally incompetent had a long and painful history; the distance between the heroic yeoman and the dumb hayseed was never very great. Henry Ford, who portrayed himself as a friend to farmers, nonetheless believed that farming was at best a part-time venture that occupied farmers only about thirty days a year; the remainder of the time farmers were just fooling around. One particularly vituperative and often quoted attack on farmers labeled them "quarter-section half-wits," arguing that "at least five million farmers—men, women, and children—must be forced out of their futile occupation; and the faster the better for all concerned."[22]

Farmers as a class had long been subjected to this sort of ridicule, but the primary thrust of this new attack centered not on farmers' intelligence but on their efficiency. As the mantra of industrial farming advocates, efficiency referred to a hazy set of characteristics that were more easily identified by their absence. Although the term sometimes suggested performing more work in less time or for less money, as in factory parlance, this was not the most prominent or consistent definition. Rather, commentators linked efficiency with managing rather than performing tasks and with increasing profit. One agricultural engineer called on farmers to "avail themselves of supervision by those who are competent and trained for the work." And many observers would agree with a radio commentator who pointed to the many "inefficient tenants" and "those farmers who have some ability at farming but not quite enough ability to make a success out of farming." As economist E. G. Nourse argued, "It would seem a self-evident proposition that in no field of human endeavor could it be expected that

leaving managerial decisions to two-thirds of all the workers could result in anything but inefficiency almost medieval in character." Curiously, few critics gave concrete examples of farmers' inefficient behavior, but the tone of their remarks is clear. Farmers did not follow clock time, did not hurry through their work, did not move or speak quickly, did not perform tasks in a clear, serial fashion, did not finish one thing before starting another. In others words, farmers' behavior was intrinsically preindustrial.[23]

Yet if it seemed clear that farmers were inefficient, less apparent was how to address the problem. Although agricultural economists were inclined to agree that farmers needed help, they did not possess any data with which to either identify the problem unambiguously or to make recommendations. In the early 1920s economists had only begun to design and implement cost-accounting methods intended to discern what farmers spent their money on and how much they made. Without this information, it was difficult to pinpoint where improvements could be made. Nonetheless, it was clear to the economists that, as E. H. Taylor put it, "There is a place in farming for the expert, just as in industry." "The thing to do," Taylor reported a banker as saying, "as any other business that gets in a jam would do, was to call in an expert."[24]

In this context, potential investors recognized the virtues of using the factory as a model for efficient farming. Nonfarmers—particularly businesspeople with little knowledge of farming but lots of money to invest—could be persuaded to invest in agriculture if the risk seemed small and the profits adequate. And they might be more willing to make an investment if the farmer was also a manager who used methods familiar to manufacturers. Industrial farming offered many advantages to such investors. It brought together the capital that farming so sorely needed; it limited the liability of any individual investor; it provided management opportunities for capable people who had no capital of their own; and it neatly separated the sentiment of farming from the business of production.[25]

The industrial farms that most urbanites envisioned were the large mechanized grain farms of the plains. Thomas D. Campbell's Montana Farming Corporation was the most famous of these and will be discussed in detail in Chapter 5. Although Campbell had more land and panache than many others, he was by no means the only one to seize the opportunities offered by combining wheat, unbroken land, and machinery. In both Montana and Kansas farming entrepreneurs were busy either starting operations or converting their family farms into industrial farms. Much of this activity was generated by machinery; in 1915 there were just under 2,500 tractors in the hard winter wheat belt, but by 1926 there were nearly 34,000. The actual capacity of combines also increased; in 1917

combines were nine feet wide, by 1927 they were made up to forty-eight feet wide and required much bigger tractors to pull them. One advantage of the combine was that it reduced the man-hours of labor required at harvest from 120 24-hour days to 30 24-hour days. This mechanical capability, by all accounts, was the single most important reason for the increase in farm size; one writer claimed that the introduction of the combine-harvester in 1917 "forced" the consolidation of small farms. Farmers would buy equipment, need to make more money to pay for it, buy more land to grow more wheat, require more equipment, and so on. In Kimball County, Nebraska, three brothers operated a wheat farm of more than 8,000 acres, an enterprise made possible with eight combines and ten tractors. Outside Houston, Texas, W. B. Dunlap oversaw rice production on 30,000 acres, all of it supported by an elaborate system of drainage canals, pumping stations, and rice mills. In California, rice growing was similarly an industrial operation. In the Sacramento Valley in 1917, many growers had farms of hundreds and even thousands of acres, relying on large tractors for the planting, threshing, and hauling of rice.[26]

Industrial farming in Kansas increased at a rapid clip in the late 1920s, with farmers breaking an estimated 10,000,000 acres of virgin prairie on the southwest edge of the winter wheat belt. In that state alone, combine use increased from about 8,000 farms in 1926 to 20,000 just two years later. The combine not only increased the speed of the harvest; it also eliminated the need for a grain binder, and for shocking the wheat, stacking it, and threshing it, never mind feeding harvest crews, all of which promised significant financial savings. Many farmers began to pool their resources in an effort to take advantage of the large-scale machinery that had become available. In Kansas City, the Bird family established the Wheat Farming Corporation, which hired workers for two or three months a year for eight-hour days and had them punch time-clocks on the tractors. Additionally, "when it is necessary to work in three shifts, large lights illuminate the prairies at night." Said the director of the Southwestern Wheat Improvement Association after describing the Bird company, "I believe corporation farming is going to increase very fast, especially since large farming units are necessary to go with our large tractors and large farming equipment. Our Southwestern wheat farmers must produce wheat more cheaply in order to compete with other areas where land is cheap and where wheat growing can be made a success." But these changes were not limited to wheat production. The Garden City Sugar and Land Company, for instance, started out as a sugar company in the 1890s, and by 1920 it had grown to 40,000 acres, relying on a complex irrigation system and the heavy use of tractors.[27]

For many observers this heralded the dawn of a bright new age for agriculture, but for others it seemed to spell disaster. According to a Kansas sociologist, "In one township where the combine has been adopted by practically all farmers, the average size of farms doubled and the number of farms decreased one-half in less than five years." As the rural population declined, rural schools struggled to fill their classrooms. The Kansas School Code Commission found that in 1927–28, 6 schools had no students, 15 had 1, 34 had 2, 68 had 3, 132 had 4, and 114 had 5 students. Rural towns began to vanish as merchants lost customers and farm families moved off the land. Another problem that the new wheat machinery introduced was related to the timing of the harvest. Threshing crews traditionally worked their way around an area, finishing up one farmer's harvest before beginning another, a practice that staggered the arrival of the grain at the elevators and storage facilities. With mechanical harvesting equipment, most farmers brought their crops to the elevator at the same time, not only lowering the price each received but generating a crisis in storing and transporting the grain. The situation in Kansas was serious enough that incorporated farms were made illegal in 1931, a maneuver that other midwestern states considered or copied.[28]

M. L. Wilson had become convinced by early 1931 that "agriculture has to move in the direction of industry which means that more use must be made of machinery, scientific management and large farms." He was mindful, however, that this was not "a popular doctrine," and the reasons were not hard to see. In Montana alone industrial farms were linked to various problems, including: crop specialization, which many considered an offensive mode of farming; hard times for "those who have not made this transition"; marketing difficulties resulting from wheat arriving at the elevator all at once; new problems in training laborers and supervising them in the big, isolated fields; the need to figure out how to service machines out in the fields; the need for advanced credit and careful planning of crops; and the "dissolution of neighborhood and community relationships with development of roads, cars, and this new farming style." The social upheaval occurring alongside industrial farming had begun already with the introduction of automobiles, trucks, paved roads, and rural schools but was exacerbated by the dramatic changes in wheat growing of the mid-1920s. Still, industrial farming, at least in Montana, represented to Wilson a logical and natural next step in agricultural development.[29]

Wilson's openness to industrial farming was shaped in part by the peculiar conditions faced by Montana farmers. As Wilson explained it, farmers in Montana had followed the behavior of midwestern farmers in terms of farm size and

farm practice, despite the fact that the conditions of farming were quite different. Midwestern farmers, for example, could consider the 160-acre homestead tract an adequate farm size, but western farmers on arid land could not hope to survive on less than about 800 acres. Western farmers also could not as easily diversify their production as midwestern farmers could, and they were much more isolated from terminal markets. For Wilson, Montana farmers could find salvation from greatly enlarging their farms, focusing on wheat, and using power equipment, an essential response to the increased farm size.[30]

Wilson developed an extension project for Montana farmers called Low Cost Wheat Production, in which he aggressively promoted farm expansion and mechanization. Enlisting the aid of colleagues in Montana State University's departments of agronomy, agricultural economics, and agricultural engineering, Wilson's project aimed to "increase the efficiency of the capitalistic family wheat farmer." He preferred the term capitalistic to corporate or industrial, because it emphasized his idea to expand existing farms rather than create a new brand of farmer. In 1929, Wilson received the enthusiastic cooperation of implement manufacturers, who donated farm machinery, and the Great Northern Railroad, which provided transportation for carrying machines and agricultural experts from town to town. Dubbed the "Low-Cost Wheat Train," this part of the project featured experts from the college who explained the merits of the machinery on board, ways to finance the purchase of such machinery, and how farm expansion and machinery could together lead to more profitable farming. Wilson thought that on a mechanized and specialized wheat farm of 2,500 acres, the farm family could do all the work itself with machines, something that would have been impossible with horses.[31]

WEIGHING THE COSTS

For critics of industrial farming, the march of agricultural progress, as achieved through farm management, larger scale, and mechanization, was neither inevitable nor desirable. The objections they raised clarified some potential outcomes of industrial farming and emphasized the assumptions that were being made about what these outcomes would look like. Their arguments also reveal the identity crisis many agriculturalists felt in this transitional period. Caught between the golden years of agricultural prosperity before World War I and the deepening economic depression before the New Deal, they recognized that although traditional farming was gone forever, nothing clear had taken its place.

For both the agriculturalists and the critics, the similarities between industry and agriculture were explored from every angle, but the differences were more often ignored.

The differences between industrial and agricultural laborers were particularly troublesome, in part because the large scale of industrial farms introduced a subject dear to industrial manager's hearts: the supervision of workers. When the first generation of engineers had invented managers as the authoritarian buffer between workers and owners, they had set up a system in which workers were perceived as untrustworthy, ignorant, and lazy—a set of beliefs straight from the Taylorist movement. This mindset also emerged in discussions of workers on industrial farms, where laborers and tenants who had previously been seen as future farmers were now seen as requiring surveillance. A study from the U.S. Chamber of Commerce in 1929 likened farm and factory laborers in this way: "Hired laborers on a corporation farm naturally do not have as great an interest in the success of the enterprise as does the proprietor of a small farm. While the small farmer cheerfully will work late at night to get his hay crop into the mow ahead of a rain, or spend sixteen hours hard running in the field during irrigation time, hired laborers will do these things only if paid overtime wages, usually on a 'time-and-a-half' basis. The wide dispersion of farm laborers on some types of farms accentuates the problems which arise from lack of interest on the part of the laborers, by making supervision difficult."[32]

Others argued that the differences in the nature of agricultural and industrial work were more relevant. Unpredictable weather, for instance, made it harder to plan work for farm laborers, a problem that industry did not have to consider. On a farm, it was difficult to achieve "the minute division of labor" and standardization of tasks so essential to industrial planning, and some felt that the work itself was "so exacting" that only hard-to-find, skilled farm labor would fit the bill. And at least one engineer thought the whole question of farm labor was moot because there were not enough farm managers to supervise the workers anyway.[33]

The idea of industrial farming also exacerbated the free-floating discontent of some rural spokesmen, who linked the impending decay of "rural civilization" with the evil intent of the "big fish," generally urban bankers who seemed to want to turn farmers into "peasants." These concerns were often voiced, especially after World War I, but the undefined character of industrial farms only encouraged those who felt the urban threat most keenly. A typical example of this sentiment was voiced in a radio debate about industrial farming sponsored

by Purdue University, in which J. M. Keefe predicted that "corporate farming will reduce the private farmer to mere serfdom and you will soon be swallowed up in a huge complex system." Another writer quoted "a well-known capitalist" as refusing "to be a party to the consequent destruction of the standards of rural life" and of fearing, not that industrial farming would fail, but that it would succeed. H. A. Wallace wondered "what our efficiency is finally going to buy us in terms of human satisfaction." His friend, Irish poet, editor, and rural cooperative organizer George Russell, concurred: "Some agricultural scientists," he said, "are like the elephant who saw the baby chicks and said: 'look at the poor, motherless things, with nobody to look after them,' and then, out of the kindness of her heart, lay down on them." All such comments, whether originating on the farm or in the city, reiterated a belief in the idea that farmers represented those characteristics and values that were essential to the moral health of the nation and that farm families must be preserved whether or not they met the industrial standards of efficiency. Responding to concerns about the creation of a peasantry, M. L. Wilson replied, "I think much of the talk about the peasant class . . . is sentimental bunk. Besides, the kind of farming which requires the operation of machinery is of such a nature as to require a very intelligent operator."[34]

Unlike those who worried about the problems that industrial farming might encounter, others pointed to the real economic problems industrial farms were already facing. Especially for those who viewed industrial farming as an investment opportunity, the Depression leveled a serious blow that, if not fatal, was at least worrisome. Malcolm Cowley was one of the few critics able to counter the upbeat rhetoric of enthusiasts with the harsh realities of corporate capitalism in farming: "At present the corporation farms are faced by difficulties on which they never counted. They can grow wheat for forty cents a bushel or even less, but having harvested and threshed it in one operation, by the most modern methods, they must sell it in an old-fashioned competitive market for twenty-five. They are units of organization in the midst of a disorganized society." The problem, critics agreed, was that industrial farms that used lots of machinery and labor and that were highly capitalized were simply not flexible enough to adjust to market downturns. Whereas family farmers were able to fall back on a subsistence level of income and, especially if they had no debts, ride out a bad market, industrial farms had to meet a payroll and bank loans regardless. In the most thorough comparison, one economist listed the differences between farmers and manufacturers and argued that manufacturers, unlike farmers, were able to adjust their production to changing conditions:

> The manufacturer . . . does practically no manual work for himself, but hires it done by others. The farmer . . . does a large part of the manual work himself. . . . The manufacturer buys his raw materials from others. The farmer buys raw materials only to a small extent. . . . He cannot discharge his working force. He, himself, is the working force. He cannot . . . discontinue purchases of raw materials, because he is essentially a producer rather than a fabricator. Another element of risk is introduced by the long period of the process. A shoe manufacturer can put his product on the market within a few weeks from the time the order is set in motion in his shop. But between plowing and harvesting, long months must intervene with no opportunity for varying the output. Manufacturers can ease their products into the market gradually, and at their own discretion. Farmers dump their annual output on the market, all together, all at once, and at a fixed date.[35]

But for every pessimist there was an optimist. Rural editor Wheeler McMillan thought that ultimately, industrial farms would be "a distinct improvement" for farmers and agriculture in general. So did Loren Schuler, editor of the *Country Gentleman.* A professor of agricultural engineering at Iowa State University, J. B. Davidson, believed that large-scale farming would eventually improve all manner of rural discontent, including "do[ing] away with the slums in agriculture, if you please." To those who would oppose industrial farming on the grounds that it would destroy the prosperity and independence of American farmers, many critics could only shake their heads. Why, asked Davidson, "make such a fetish of the small family farm as an ideal. In agriculture," he said, "there is the lowest standard of living of any group and the lowest wage scale. In many sections a mule's work is worth more than a man's. Why continue a social system that produces such results?" One farmer laughed at the prospect of losing his much-vaunted independence, calling it a cruel myth for farmers who owed the bank so much money that they could only do what the banker said. "What chance has the average small farmer, ignorant, poor, and unprogressive, even to survive, much less prosper, in the face of this rising flood of technical improvements and mass production?" asked two writers. "His race is run. For him, the battle is already lost." Others agreed: "We wonder if he [the small farmer] would not gladly exchange his independence (and his poverty) for comfortable living quarters and a steady job as an employee of Tom Campbell?" Clearly, the appeal of the farming life was lost on these critics, who saw the farmer's bank account as the only relevant measure of worth.[36]

Although most felt that, in the end, industrial farming was "a money proposition," that is, it would succeed or fail depending on whether it was more prof-

itable than family farming, it was hard to figure out how industrial farming could thrive under Depression circumstances. But as Henry Wallace astutely observed, the demise of a particular industrial farm did not spell the end of the idea, and once the Depression subsided he fully expected it to make a comeback.[37]

In 1929, the U.S. Chamber of Commerce issued a report on industrial farming that aimed to define what an industrial farm was, determine how many were in operation, and evaluate their success relative to family farms. The chamber did not mince words in declaring that in terms of profit, industrial farms were no more successful than family farms. This was good news for critics of industrial farming, who felt vindicated in their defense of small family farms. As advocates could point out, however, the report did not say that industrial farms were less profitable either; rather, the report emphasized that investments in land, machinery, and large scale were not a magic road to prosperity. One writer interpreted the study's results as proof that all farms, large or small, needed to base their operations in "sound, scientific management" if they wanted to turn a profit and added that, especially in the wheat states, bankers were stressing this to their farmers. Thus, both sides in the debate used the report to support their own arguments.[38]

After 1930 the press began to lose interest in industrial farming, partly because the novelty had worn off but mostly because the Depression took center stage. Farmers who in the 1920s were nearly alone in their economic and social despair were now joined by industrial workers and urbanites. Indeed, the Depression was perhaps less of a shock to family farmers, who were getting used to privations, and instead it ushered in many New Deal programs that, for the first time, offered farmers federal assistance in the form of loans and electricity.

But while the press found industrial farms less compelling, at the same time most observers realized that agriculture was undergoing a profound transformation. Farmers who thought that the postwar depression was anomalous were realizing that the prewar prosperity and stability were the more unusual events. Clarence Poe, a highly respected farm editor, urged farmers to face realistically the economic and social changes underway. Although Poe was not pleased with the prospect of industrial farms, he suggested that there were only two alternatives to family farming: state socialism, as demonstrated by the Soviet collectivized farms, and the mass cooperation of small, family farmers, the option Poe favored. As long as someone was going to redefine agricultural production, Poe figured, it may as well be the farmers themselves rather than absentee owners and corporations who shaped the new agriculture.[39]

Several agricultural economists argued, however, that although agriculture was surely experiencing an important transition, it was one of gradual adaptation to industrial methods rather than one of abrupt change. According to John D. Black, there was simply no compelling reason for family farms to become large farms except in a few commodity areas such as wheat and maybe livestock. Farms could get larger and more capitalized without fundamentally changing in structure or organization. E. G. Nourse agreed, pointing out that one of the central reasons why the Industrial Revolution occurred as it did was that new power sources, such as steam, were not practical to operate on a small scale. Using this logic, the introduction of the steam engine directly led to the up-scale of production sites. Individual production, which could no longer compete with industrial production, therefore was centralized to take advantage of the new power sites. Nourse failed to see, however, that the opposite was actually the case in agriculture. Technological developments such as the internal combustion engine and portable electric power plants were designed to be highly individualized and small scale; even the smallest farm could modernize its farming operations.[40]

Economists and brain-trusters Mordecai Ezekial and Sherman Johnson advanced a slightly different plan. Combining the features of the various schemes, they proposed the creation of a national farming corporation that would oversee all forms of agricultural production across the country. Taking advantage of regional specialization, they argued that a centrally managed, vertically integrated organization could move raw farming materials through individual farms, establish production goals and quotas, distribute machinery, labor, and capital, and move farm products from one region to another. Bearing a striking resemblance to the industrial world, this plan was a sort of gigantic conveyor belt; Texas cattle would move to Iowa for feeding and to Ohio for slaughter and packing; Nebraska corn would move to New York dairymen for cattle feed, and so on. Furthermore, because farmers would be working for the corporation, they would find a much lower individual risk and a much higher standard of living, perhaps even living in town rather than in the country. The proposal was awesome in its complexity, but it resonated with those who felt that the only way out was to rationalize production on a massive scale. This idea was popular with many observers coming from a more commercial background, including Robert S. Brookings, who wrote an essay on the subject and distributed it to the U.S. Congress as an alternative to the McNary-Haugen Bill. This bill, which was defeated following a long and rancorous debate, would have established a parity price for farm products such as wheat, thus guaranteeing farmers a base price.[41]

It wasn't simply the momentum of the industrial world that made the agricultural revolution seem inevitable. Agricultural developments abroad were beginning to have an impact on American farmers as well; if production was cheaper someplace else, then the world market prices would drop and American farmers would have to compete with these lower prices. One of the most powerful threats was the Soviet Union, whose collectivized farms represented the worst nightmare American farmers could imagine. The Soviets had some of the same agricultural advantages that Montana farmers had: massive tracts of land, soil that had never been tilled, and a climate advantageous to wheat growing. They also had a gigantic labor pool and cash to invest in American farm implements, which they bought in record numbers. It was no accident that when the Soviets were designing their large-scale wheat operations, they hired Thomas D. Campbell to advise them, and they in turn sent many Soviets to Montana to study Campbell's methods.[42]

The big problem, said Walter Pitkin, was economic rather than political. Because the Soviets could produce much more wheat than the Americans, they would set the world price for wheat, and the Americans could find themselves priced out of the competition, a situation that Pitkin felt was fair since American farmers were, he thought, lazy and old-fashioned. Another critic agreed, claiming: "Collectivization is posed by history and economics. Politically, the small farmer or peasant is a drag on progress. Technically, he is as antiquated as the small machinists who once put automobiles together by hand in little wooden sheds. The Russians have been the first to see this clearly, and to adapt themselves to historical necessity." These dire pronouncements failed to attract a big following, but nonetheless they did contribute to the general tone of the debate on industrial farming by setting an outer limit on what the new agriculture would look like. At the other extreme from collectivization, of course, stood Nourse's small but mechanized family farms. As the debate wound down, these two views shaped the parameters of what agriculture could, or should, be, and although industrial farming began to fade from view, the innovations introduced with it did not.[43]

Chapter 5 The Campbell Farming Corporation

Modern farming is 90 percent engineering and 10 percent agriculture.
—*Tom Campbell,* 1919

Many industrial farming enthusiasts did not themselves come from farms. Their interest was borne of a modest understanding of farming, a passing familiarity with the daily rigors of farm life. For some the attractiveness of the industrial ideal lay in its abstraction, in its potential to serve as a template for other productive activities. It was certainly easier to imagine creating new industrial farms than to imagine turning existing, messy, and chaotic farms into industrial units. It was this hypothetical ideal that operated most forcefully, and for some, the power of the industrial ideal was primarily rhetorical. Many discussed the industrial farm not as a real goal that could be planned and created but as an approach to farming that used a different set of guidelines than farmers were accustomed to using. For these observers, the industrial farm was a conceptual model that would assist farmers in modernizing their practices.

For Tom Campbell, however, the industrial ideal was an entirely re-

alizable goal. Raised on a farm and educated as an engineer, Campbell deeply believed that farming should and could be made more rational and productive through engineering methods. "The farm is a factory. It is operated on exactly the same principles of mass production, cost accounting, specialized machinery, and skilled mechanical labor as any great industrial organization in this country." Campbell spoke from his own experience in the wheat-growing areas of North Dakota and Montana, lands which were classified as semiarid and which received less than fifteen inches of rain per year. Campbell and M. L. Wilson had come to a similar conclusion regarding farming in this part of the world and that was to make farms much bigger, to use machinery, and to follow principles of farm economics and management in order to keep things moving in a rational and predictable manner. Campbell did not think all farms in America needed to be large, however; he thought that they should all be *industrial,* in the sense of practicing these factory-based principles, but scale should be geared to rainfall. "The minimum economic unit in Iowa, where the rainfall is 29 inches or more, is 640 acres. That means you can take almost any four quarter-section farms through this section, make one 640 acre farm, eliminate almost three sets of buildings and almost three groups of equipment, and you can afford to pay your manager $2,500 to $3,000 a year and your overhead will not exceed three, four, or five dollars an acre. And you start out with success written in the first line, because you have got efficient management; you have got a man with brains and ability to do the job, particularly if he is an engineer." Farming, for Campbell, was an honorable and important profession, but it was not for the sentimental.[1]

Several things set Campbell apart from other industrial farming advocates. First, he was successful over the long term, keeping the Campbell Farming Corporation going until his death in the mid-1960s. Although other industrial farms also managed to stay in business, few had as high a profile as Campbell, so it is hard to track who stayed around and who did not. Second, his charismatic style and love of publicity ensured that he was well known to American farmers and industrial farming enthusiasts, and this enabled him to serve as a role model for other farmers wanting to modernize their operations. It also ensured that bankers in the states who followed these things had a yardstick by which to evaluate all types of farmer clients. Campbell gave bankers, insurance companies, and other lenders a way of measuring farming more generally. Third, by raising money in New York and Minneapolis for his farming venture, Campbell demonstrated that he was not alone in thinking that it was time for agriculture to industrialize. The financial backing of J. P. Morgan, Louis Hill, and other indus-

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Thomas D. Campbell standing next to the Stutz Bearcat he drove around his farm. Courtesy of Phoebe Knapp Warren.

trialists lent credibility to this claim in a way that all the agricultural engineers and economists could not; if the big bankers were willing to take a chance on an engineer-turned-farmer, then smaller bankers and policy makers might take a chance as well.[2]

THE BUSINESS OF FARMING

Campbell was born in 1882 and grew up in rural North Dakota during the days of bonanza farming. His father raised several thousand acres of wheat, and according to Campbell, his family owned the first steam thresher in the Red River Valley. He operated the steam engine when he was sixteen years old and enjoyed the mechanical side of farming even then, earning a reputation as a farm mechanic who could fix anything. His father put him in charge of operations on his farm, including the threshing. He finished high school in Grand Forks in

1898, attended Upper Canada College for one year, and then transferred to the University of North Dakota, from which he received the school's first B.A. in Mechanical Engineering in 1903. While a student at the University of North Dakota, Campbell lived on the farm in a shack with one of the winter foremen who took care of the horses off-season. In addition to learning mechanics on the farm, he also learned how to handle himself as boss of a threshing crew, which typically consisted of "lumberjacks from Minnesota, hobos, bums, card sharks, [and] prize fighters from the twin cities and Duluth who would come to help harvest the crops." After spending one year at Cornell doing postgraduate work, Campbell returned to North Dakota to help his ailing father.[3]

After college, Campbell held several jobs that combined his interests in engineering and management. First, he was hired by the Northern Dakota Railroad Company, which operated a company called the Pembina Cement Company. His job was to build a 25–30 mile railroad for regional commercial transportation, both sending cement out to the small towns and farms and receiving farm produce on the return run. Campbell was made president of the company, but he could not save it from failure. This loss apparently did not reflect badly on Campbell, because he next was made general superintendent of the Grand Forks Street Railway; but in 1906 this venture also went bust. These losses were mollified, however, by his marriage to Bess Bull the same year; Bess was the daughter of the Cream of Wheat founder George Bull.

Within a few years, both Bess and Campbell's mother developed tuberculosis, and the family decided to move to California, where both the air and business prospects seemed preferable to those in North Dakota. By 1910, Campbell had acquired a position with the Torrance Marshall Company, a land development concern that laid out the town of Torrance. It was through J. S. Torrance, who sat on the board of J. P. Morgan's bank, that Campbell met Morgan, who was to figure so prominently a few years later in the creation of the Campbell Farming Corporation. Campbell also managed a 100,000-acre ranch in California that grew wheat, alfalfa, and beans, and a 7,000-acre cotton ranch in Arizona.[4]

Once the United States became involved in World War I, Campbell began to develop an idea for serving the country by growing massive amounts of wheat on Native American reservation land in Montana. His theory was that because wheat was in short supply and because the Native Americans did not appear to be doing much with their land, it was a perfect opportunity to turn idle land toward a patriotic endeavor. It was difficult for a private person to gain access to the reservation land, and Campbell knew that he would need federal approval

and assistance. He wrote to several different federal officials with his idea, including Herbert Hoover at the Food Administration and the Interior Department, but he received a cool response. In exasperation, he sent a telegram directly to President Woodrow Wilson in late October 1917, asking if, since a war was raging, the government would lease 20,000 acres of reservation land to him so that he could produce wheat for the allies. "We understand that the Government subsidizes ship factories, munitions factories, and so forth," Campbell wrote, reasoning that food production should rank as highly as arms development. His efforts were rewarded; within one day Frank Thackery, a supervisor from the Indian Department in the Interior Department, was on his way to California to learn more of Campbell's plan.[5]

Government representatives supported Campbell's idea and moved quickly to ensure its development. Campbell had envisioned farming 20,000 acres, but after visiting the reservations, Thackery suggested that perhaps, with machines and capital, he could just as well farm 200,000 acres. Campbell called on business associates, who wrote testimonials to the Interior Department's Franklin Lane extolling Campbell's virtues. In addition to Louis W. Hill, president of the Great Northern Railway, four bank presidents, a dean and a professor from the University of North Dakota, several attorneys, ranchers, and insurance men wrote letters. Within six months the Commissioner of Indian Affairs had approved Campbell's leases on the Crow, Blackfeet, and Fort Peck reservations in Montana and on the Shoshone (Wind River) reservation in Wyoming. "[I]t is believed," he wrote to Secretary Lane, "that large areas of rich farming land will be brought under cultivation, resulting in the addition of from one to three million bushels of wheat to the food supply of the nation, at a time when it is sorely needed. At the same time, [it] . . . will result in great benefit to the Indians by bringing in a substantial revenue from lands now unproductive besides enhancing the value of the lands by cultivation and other improvements." Congressmen were also impressed, authorizing the money to clear the weeds out of old irrigation ditches so that they could be used on a small part of the farm.[6]

The deal was certainly excellent from a business point of view. Because the land was federally owned, Campbell did not have to pay taxes or interest, and this at a time when those costs were driving many small farmers out of business. This was attractive to investors as well, because it made their returns that much more likely. It is a little harder to weigh the advantages to the Native Americans, because the lease system was extremely complicated. Campbell had leases both with the tribes and with individual Indians who held allotments, which were handed down through families. Sometimes a lease would be for one-sixty-fourth

of an acre, because it had been divided up through inheritance. Ordinarily, when tribes leased out their land for grazing, they were paid as little as six cents per acre for upland areas, and as much as twenty cents per acre for bottom or streambed lands. Leases with wheat growers paid about fifty cents an acre. According to Campbell, Thackery insisted that Campbell pay his rentals in a share of the crop rather than in a cash lease, with the tribes receiving one-tenth of the crop for the first five years and one-fifth for the second five years. But Campbell was happy to switch to the cash system if the Native Americans preferred it, by which Campbell would pay fifty cents per acre for the first two years, seventy-five cents an acre for the third year, and one dollar per acre in the fifth year. Whether or not the tribes wanted the land fenced and supplied with outbuildings, all such improvements to the land would belong to them when the leases ended. Campbell also occasionally bought land outright from individuals; in 1924 he purchased 160 acres from Sidney Blackhair for $475 and 160 acres from Grace White for $600. Journalists commented on Campbell's friendly relations with the tribes, in particular the Crow, but some observers were skeptical. M. L. Wilson, who in 1919 was in graduate school at the University of Wisconsin in Madison, reported to Campbell that many people in Madison thought Campbell was just "skimming the Indian." Nine years later, however, Wilson felt that the tribe was getting much better returns from the land with Campbell farming on it than they would have otherwise.[7]

Once the scale of the farm increased, the need for money increased as well. For this Campbell was able to depend on his connections. J. S. Torrance's business relationships with J. P. Morgan and Louis W. Hill (president of the Great Northern Railway and well known by the large-scale farmers in North Dakota and Montana) helped Campbell secure an interview with Morgan that resulted in a promise of $2 million from Morgan and other New York bankers. According to Campbell, Morgan was taken with the idea for more than strictly economic reasons. "Young man," he said to Campbell, "your project is the most romantic, the most patriotic, the most interesting and, I believe, one of the most profitable ideas that has ever been presented to me." Campbell also received backing from Charles Sabin, president of Guaranty Trust, and both Sabin and Morgan agreed to sit on the board of directors of the Montana Farming Corporation. By the time Campbell left New York in late May, he had received subscriptions in the amount of $750,000 and expected $250,000 from investors in California, such as Torrance, and in Minnesota, such as Hill. The only caveat was that Morgan did not want to be publicly identified with the project; he told Campbell that if it got out, "people will accuse him [Morgan] of 'grabbing every-

thing.'" Following several bad crop years, the eastern investors decided to pull out of the farm, and Campbell bought their shares back from them at a good price. The Montana Farming Corporation thus became the Campbell Farming Corporation in 1922.[8]

The land that Campbell leased lay mostly along the Big Horn River and Little Big Horn River in southeastern Montana, except for a unit in the northern part of the state on the Sioux reservation at Fort Peck. The Fort Peck unit, which was the first one Campbell operated, was three hundred miles away from the other units, and after a year Campbell decided to concentrate strictly on the Big Horn River units. There were ultimately seven units, also called camps. Unit 1, which was more than 11,000 acres, was located just below the junction of the two rivers, on what was known as the Fort Custer Flats. As Frederick Stevens reported to the board, "The only evidence at present of its historic character are thousands, perhaps millions of broken bottles near the former site of the Fort, so numerous and so scattered as to make it necessary to avoid a considerable area in the plowing operations." Camp 2, located on 5,000 acres, was twelve miles south of Camp 1 on the same plateau rising above the Little Big Horn. Camp 3 was just south of Camp 1 on the Big Horn and was divided between the Big Horn Unit and the Fort Smith Flats Unit. It was the only irrigated section and Campbell leased it out to two separate groups of tenants who grew spring wheat on it. Starting in 1921, Campbell added Camp 4, on the western plateau above the Big Horn.

Campbell's farm was thus not simply one big rectangular piece of land. Even in a state as flat and as recently settled as Montana, the terrain was broken up with gullies and streams, and much land was already owned by tribes and by ranchers who grazed cattle on it. Campbell could not personally manage so much land; the Fort Peck unit demonstrated how difficult it was to supervise such vast distances. So the entire farm was divided into contiguous units, and each unit was managed as a semi-separate farm. Camp 4 was the nerve center of the entire farm; it was where most of the crew lived, where the main kitchen was located, and where the main organizational activity occurred during the season.[9]

In late June 1918, Campbell began turning the sod on his first fields at Fort Peck and Unit 1 on the Custer Flats. Because of the machinery he was using, Campbell was able to plow more than 3,000 acres in just the first week, an astonishing rate of progress for any farmer. By the end of his fall seeding operations, he had developed 7,000 acres overall. The following fall, he planted 45,000 acres, and the following, he planted 55,000. Each year Campbell expanded his operations until he reached a peak of 100,000 acres. His process did

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Camp One, Campbell Farming Corporation, 1926. This site is known as the Custer Flats. Courtesy of Phoebe Knapp Warren.

not change much in the first few years, and it was dictated by two things: the arid climate of Montana, where annual rainfall was normally only twelve inches, and a passionate commitment to using the most up-to-date machinery then available. There were basically two big tasks: first plowing and planting, and later harvesting. Each process required large numbers of workers and machines. It began by using a gasoline tractor to pull four-, six-, or ten- bottom moldboard plows, which cut four to six inches into the sod and turned it into furrows. This was followed by a packer, a heavy, cast-iron cylinder or roller that tamped the earth down to conserve moisture. The tractor then came around again, this time pulling steel discs sixteen inches in diameter, twenty discs lined up every seven inches. This further broke up the clods of soil and ended by creating what was called a dust mulch on the field's surface. In the fall Campbell planted winter wheat, and in the spring he planted spring wheat and flax. After two years, a field would be left unplanted, or fallow, and the following season the weeds that had grown there were plowed under to provide soil nutrients. Thus, in any given year, Campbell had two-thirds of his acreage in crops and one-third in fallow.[10]

The harvesting operation was more dramatic and generally drew tourists who wanted to see the novel sight of miles and miles of wheat being cut with twenty or thirty giant machines. Campbell experimented a bit with different machines and mechanical processes, but by the mid-1920s he had settled on a satisfactory

combination. Campbell wanted to find a way to avoid depending on the big threshing crews that had dominated the wheat harvest and that "have always been a great source of annoyance to farmers." His new method featured depositing the cut wheat in "windrows" on the ground, and these were then picked and threshed rather than put into traditional shocks. First the ripened grain was cut by a four-unit string of reapers, each with a ten-foot span. The reapers were refashioned so that the bundling device that was usually attached was replaced with an extension carrier, which deposited the grain in the windrow. One worker stood on a running board that ran along the four machines, and he would move among them as needed and could signal the tractor driver with a pull-bell. Once the grain had dried in the windrow a combine picked the grain up, threshed it, and deposited it in wagons moving alongside or in a storage bin on the machine itself. The windrow method of harvesting, which was a new development, offered several advantages over the old methods. In addition to using far fewer laborers, it also eliminated the costs of twine (used to tie shocks) and gasoline. But although Campbell did use less twine, he used many more machines than did traditional wheat farmers. By 1929, he owned 52 tractors, 100 seed drills, 21 combines, 80 binders, and 11 threshing machines. Campbell attached mile counters to the driving machines so he could record the number of miles each worker drove, both to gauge his workers' abilities and to figure out bonuses at the end of the season.[11]

During the first few years, the units were built into livable, if not luxurious, camps. At first, workers lived in big military-type tents, but buildings were constructed by about 1920. At Fort Peck, for example, there were two separate units, each with several single-story bunkhouses, a two-room house for the manager,

[To view this image, refer to the print version of this title.]

Promotional photograph of Campbell's wheat harvesting machinery. Courtesy of Phoebe Knapp Warren.

a kitchen with ice-house and dining hall, a blacksmith shop, machinery sheds, but no bath house. Fort Peck also had a huge, 40-acre garden for growing food for the camps—potatoes, turnips, beets, carrots, beans, cabbage, pumpkins, and more were grown on site. Campbell himself did not have a house on the ranch, preferring to bunk with the men at the units or at a "fourth-class hotel" in Hardin, a practice his treasurer frowned upon. By the mid-1920s each unit also included an office, "shower baths," and daily delivery of mail and supplies. Eventually the units were wired for electricity, and men paid $1.25 per day for room and board. M. L. Wilson thought that camp conditions were far above average. The food was considered quite good, and meals had been planned by a dietitian. The bunk houses, too, were more than adequate. Ramon Kent, who worked for Campbell as a "plow-monkey" in 1923 when he was fifteen years old, recalled that the shower was a luxury because it was "a rare thing for farm labor in the 1920s." Wilson felt that the living conditions were a big reason why laborers returned year after year, especially during the Depression years.[12]

In addition to the facilities on the units, the main headquarters in Hardin provided a central office, gasoline pumps, grain bins, access to railcars, and a shop. The shop was well equipped to handle repairs to the machinery and was operated by skilled machinists. It included welding equipment, a brass foundry, wood shop, and machine shop, and it was used primarily for overhauling machines. Skilled workers could also machine "replacement parts from rough castings, by making up interchangeable tractor bearings, by providing bushings for valve seats that may be replaced in the field, and by developing methods of using scrap parts such as tractor axles, which are upset and turned down into valves." It was difficult, however, to find men who could work to Campbell's specifications, which were, in effect, engineering rules: "We have lots of shop men who think they are accurate," Campbell explained to his fellow engineers, "but if you give them the ordinary stunt which is required in all engineering colleges, to take a piece of cast iron and make it one by three or four, perfectly square in every way and perfectly straight on all edges and sides, until they do it they have no conception of how hard it is."[13]

On one level Campbell's ranch was simply a gigantic farm, similar to other farms but for its scale. But on another level, the similarity is deceptive, because the scale itself seemed to dictate a more industrial response to production, and one which few farms could even imagine. It will be useful here to examine how the industrial approach was reflected in three dimensions of the Campbell Farming Corporation development. The first factor we'll consider is mechanization

of the fieldwork, and with that Campbell's relationships with industrialists and manufacturers. The second is labor, not only unskilled labor but also skilled and managerial. Where did the workers come from, what experience did they have for this sort of work, and what did they do? The third dimension we'll look at is management, which in this case refers to supervising the laborers to use the machines.

THE HUMAN SIDE OF MECHANIZATION

It was difficult for implement manufacturers to ignore Campbell. He purchased so much equipment that even the largest companies had to take notice, many even offering special considerations to Campbell, such as discounts. He was also a trained engineer, which meant that he was a tough customer because he understood the strength of materials used, the way in which parts were designed and how well they functioned, and the overall reliability of machines such as tractors that worked sixteen hours a day without stopping and often were operated by inexperienced workers. Campbell spent a lot of time communicating with manufacturers about their equipment; he was helping them work the bugs out of their new equipment, and they appreciated the feedback, even if it was negative.

Even though some of these companies, like Holt and John Deere, had been around for decades, they had more experience with large machines than with small, farm-sized ones. Holt had been making machines for the large California ranches and was accustomed to the industrial scale and approach of farmers there. Campbell's approach was not so novel to Holt, and in 1949, Campbell was still driving Holts he had purchased in 1929, so well were they made and adapted to his needs. In contrast, Deere, like other midwestern manufacturers, had little experience of this sort and had just started making farm-sized tractors. But few manufacturers were prepared for Campbell's special requirements. The biggest problem for soil breaking machines was the soil itself. The sod was tough to cut and turn, and this put stress on most plows. The soil below the sod, however, was also unlike most American farm soil in that it was a mucky, gumbo-type soil, heavy and dense. The combination was a challenge for manufacturers, whose markets had not before included such a farm, and some had difficulty believing Campbell when he explained it to them. Campbell wrote to one manufacturer looking for "ten outfits complete including about twelve 14″ breaker bottoms together with disc packer and drill, all in one outfit. This should plow

about forty acres per day of twenty-four hours and I would want your absolute assurance that your engine would have power to pull such an outfit in sod such as we find in Montana."[14]

For many companies the challenge was a worthy one, because a positive review from Campbell could mean both sales and favorable publicity. Campbell anticipated this angle right from the start, boasting to his associates that "the machinery companies are getting right down to brass tacks as they realize that this will be one of the biggest advertisements they have ever had and I expect to buy machinery pretty cheap." There is little evidence to show that he did get bargains on machines, but manufacturers were extremely interested in Campbell's work; as one put it, "There are enough red corpuscles in my anatomy to want to be accessory to . . . your success in this venture." The promise of sales was the most immediate inducement, but the promise of wide publicity was especially attractive to small companies. In return for "borrowing" a machine, Campbell would report back to the manufacturer on the implement's performance in the field. The Hall-Perry Machinery Company in Butte, Montana, loaned Campbell a Cletrac for a season to see how he liked it and to advertise its virtues; Haynes Steelite, which made ploughshares, was allowed to use Campbell's photograph in their advertisements, a significant advantage in a competitive market.[15]

Some manufacturers who were unfamiliar with Campbell's operation had trouble understanding the scale of operations, so unusual was it in agriculture. Campbell bought some things in such large quantities that he expected to receive distributor's discounts on the cost. His attempt to buy cylinder head gaskets was met with disbelief because he did not fit any of the usual categories of those who need lots of gaskets, such as manufacturers and car and truck dealers. Campbell's effort to purchase barbed wire led to similar problems. He placed an order for several traincar loads of barbed wire with that commercial favorite of rural people, Montgomery Ward, but found that they could not fill such a large order. He then turned to American Steel and Wire, a large, specialized concern, which was happy to sell such a large amount. But this company also had a tip for Campbell: in the future, they said, Campbell should buy even large quantities from local dealers, who resented Campbell for bypassing them when he spread money around.[16]

When Campbell bought driving machines from manufacturers, he expected the company to send someone to Montana to help assemble them if necessary and to help teach drivers how to operate them properly. When Campbell bought some disc plows from John Deere in the summer of 1918, the company sent two

men from Illinois to help "until plows are adjusted and running satisfactorily." Holt Manufacturing in California sent one man to Hardin in June, to help train operators, and another in August, to make routine adjustments. Sometimes Campbell insisted that a company send a representative before he would complete an order for machinery, particularly if he was requesting a special feature or redesign of the standard model. He was a demanding customer and cut deals wherever he could. The following note to one of his unit managers was typical: "Mr. Grupe, from whom we purchased the engine and combine, has agreed to come down and put the machine we bought from him in good condition without cost to us for his time, but we are to furnish him helpers free."[17]

But sometimes a company was not saved by sending a representative to Hardin, and Campbell's impatience with what he considered poor workmanship or disingenuousness could be fierce. He had wanted to buy a lot of machinery from J. I. Case "owing to Mr. Morgan's connection" with the company. So he was chagrined when, after buying twenty of the popular Wallis Cub tractors from Case, he found that the cylinder blocks broke and the crank shafts were crooked, probably due to the hard use he gave them. Although Case sent someone to repair them, Campbell had to furnish helpers and room and board, and the representative was unable to put them in working order. This earned Case a steaming letter from Campbell: "We understand from several different sources that you have had considerable trouble in other parts of the country with cylinder blocks, crank shafts and clutch plates (we have also broken about twenty of the latter), and that in most instances you have made replacements gratis. We know from a reliable source that during war times you had to turn down a large percentage of shipments of tractor repairs, and that cylinder blocks were used that did not prove satisfactory, because they did not contain the proper proportions of cast iron to withstand the strain of the combustion chamber of the cylinder." This excerpt highlights the importance of Campbell's role in the transitions taking place in agriculture: few manufacturers were accustomed to dealing with a farmer who was also a mechanical engineer. Campbell was expert in machine design and repair, and enjoyed a reputation for knowing farm machines. So it was not unusual for Campbell to complain about the features or performance of the machines he bought and to demand both repairs and personal attention from the manufacturer. He was also lavish with his praise for machines that worked well, and as manufacturers got used to his demands and as the market for machines increased the manufacturers' experience, this happened more frequently. After using the International Harvester 15–30s for the first time in 1930, he wrote a letter to the company praising such a "wonderful machine."

He had purchased ten machines and operated them twenty-four hours a day for six weeks without a single breakdown, a record few machines could match.[18]

The process of mechanizing farming during this time was nothing short of slow and painful. One intriguing view of this process comes from a rather long interchange between Campbell and the Stinson Tractor Company that began in the summer of 1918 and lasted until the following spring. Both Campbell and his father had a long personal relationship with Leslie Stinson, who started the company, and this perhaps explains Campbell's higher expectation for the machines he bought from them. But Campbell ran into trouble, and when he did, he was not dealing with the founders but with the Stinson factory. It began on the fourth of July, when Campbell wrote to complain that the tractors he had recently purchased were poorly assembled, poorly inspected, and would not run more than a day or two. Stinson had sent someone for two days who got the tractors working fine at first, but once he left things deteriorated rapidly. Campbell's next complaint, five weeks later, bears quoting:

> We would like to know at what price your company would be willing to take the ten Stinson Tractors back. The engines are very unsatisfactory, and are only in the experimental stage. It will take several years before you find all their weak points and correct them. We are building a protection around the fan to save the drivers from injury as we have had two fan blades come with sufficient force to cut a mans head off should it happen to be in the way. It is impossible to keep them cool. They use much more gas than they should, and they seem to be made of very poor material with the exception of the engine. Nearly all of the pipes which are used to connect the front wheel with the frame seem to be made from old discarded flues, and they either break or bend. Every place you go in our field you can see a Stinson engine out of commission.[19]

In response, Stinson blamed the tractors' poor performance on the laborers Campbell had used as drivers, calling them "inexperienced, disinterested, city schooled boy[s], who ha[d] never had the proper training in field operations of farm tractors." Noting that he was not surprised to hear Stinson's answer to the complaint, Campbell went on, with evident sarcasm:

> I presume the inexperienced operators were the cause of the fan blades flying to pieces. I presume they were also the cause for the very old and deteriorating flues breaking. Also the cause of a crack in the large cast iron frame which Mr. Spooner [a Stinson representative laid up at the farm with a broken foot] says undoubtedly was a flaw in the making. Undoubtedly the same operators make the engines hard to steer in loose ground. They undoubtedly because of their inexperience make the roller bearing in the end of the crank shaft wear out. Their same inexperience perhaps makes it neces-

> sary to remove the pump to pack it, as well as their city bringing up undoubtedly had considerable to do with placing the radiator back of the engine where it gets all the hot air, instead of in front. No tractor manufacturer expects his machines to get in the hands of experts.

Much to Campbell's chagrin, Stinson refused to send anyone else out to Hardin to help with the tractors, citing a lack of available men.[20]

There the situation sat until early October, when another problem occurred. "Mr. Spooner, sometime before his accident, while acting as your expert, put an auxiliary water tank on one of the Stinson tractors to help keep it cool and this auxiliary tank exploded because of the excessive heat generated by the motor a few days ago and severely scalded one of our foremen. The man is now in the hospital and will undoubtedly be there for at least one month. We have repeatedly told you that Mr. Spooner was not competent to adjust, improve, or rebuild your engines, and we expect to hold you accountable for this accident." Campbell continued to complain, arguing that Stinson's tractors were built solely for the lower elevations of Minnesota ("your people utterly ignore our situation out here") and refused to pay a parts bill of $398 on the grounds that the company had never bothered to send a senior representative out to Montana to see what a disaster the Stinson tractors were. Regarding the debt, Stinson wrote: "Mr. C. H. Stinson does not intend to make a trip to Crow Agency at this time. We do not intend to enter into any letter-writing contest regarding this account." The following spring Campbell ended the exchange with a short note: "We have abandoned all hope of using them this spring, and are putting them in the yard as they go out of commission from day to day, and will do our plowing with two Government artillery tractors." It is noteworthy that Holt also lectured Campbell about letting a "cheap man who does not know his business" drive the new machinery.[21]

This exchange is noteworthy for several reasons. First, it tends to support the idea that the first tractors were poor specimens. Farmers started buying tractors in the late 1910s, but to suggest that farmers began acting like modern producers around then is misleading if the tractors in question were difficult, if not impossible, to use. Although some tractors surely worked well, it is clear that the work to be done differed wildly from one state and climate to another. This is something Campbell repeatedly complained about. Manufacturers, according to Campbell, just did not understand what conditions were like in Montana, nor did they understand how hard-working a machine had to be on his farm. Indeed, the bulk of the farmers in America were not in Montana, and the market there was simply not as developed or as large as that in midwestern, eastern,

and southern states. But this meant that ordinary farmers had to spend a lot of time maintaining and perhaps repairing their equipment; company representatives certainly did not visit every farmer who had a complaint or spend several days helping a farmer get a machine in good working order. Although Campbell had a big advantage because his scale and pocketbook enabled him to insist on extra attention from manufacturers, it must have been even more difficult for ordinary farmers.

The previous exchange is also important because manufacturers did not see their tractors and combines as "labor-saving" in the sense that we are accustomed to thinking about it, either in industry or elsewhere. The general view was that when machines were introduced into workplaces, it was because they would do something humans had been doing but machines could do much faster or more accurately or more safely. Machines were seen primarily as skill replacers rather than skill enhancers. For farmers, tractors and combines were attractive because they made field work go faster, and therefore farmers could do more field work. The main attribute was speed. Tractors were replacing horses; then, both horses and tractors pulled implements that plowed the ground, or planted seed, or reaped grain. One did not need to be highly skilled to drive a horse and implements through the field; a little observation and experience were usually all the training one received before starting the work. Tractors were quite different, for two reasons. First, it was not obvious how to drive a tractor, particularly if one had never driven a car or truck before. How to start the engine, how and when to use the brakes, and how to judge speed and distance were things that one was shown by an expert or practitioner. Second, the machinery was so expensive that most farmers would not put their least skillful worker on it, reserving it for their most reliable people. For Campbell, this meant hiring skilled tractor drivers whenever possible rather than unskilled high-school boys. It may have been purely self-serving for implement manufacturers to blame the drivers whenever the equipment failed to work properly, but it may have been equally naive for managers like Campbell to assume that the machines could and should withstand inexperienced and thoughtless operation.

WORKING ON THE CAMPBELL FARM

An operation the size of Campbell's relied on the labor of many types of workers. Just like at a manufacturing plant, there were people who were foremen and supervisors, there were unskilled laborers, various kinds of skilled labor, as well as cooks, stenographers, and so forth. After eight years, Campbell had about

twenty permanent workers whom he employed year-round. He employed about fifty men during the summer between planting and harvest, and the biggest group, around 250, for the harvest itself. The question of full employment was a constant source of difficulty for agriculturalists. Most farms were seasonal in the sense that the main work was carried out from the time getting into the fields in the spring and getting crops to market in the fall. In between there was cultivating, disking, sometimes re-seeding, and fence repair, as well as maintaining work animals such as horses and tending any livestock that a farm might have. But during the off season, from harvest to spring, there was little steady work on farms beyond low-level maintenance, usually just enough work for the farmer himself. On larger farms it could be difficult to find enough for extra workers or hired men to do off-season, and they typically would move elsewhere—into town or further south or west where climate allowed more time in the field—until hired back in the spring. The problem with this was that if a farmer found an especially good worker, he wanted to try and find more permanent employment for him on the farm; farmers complained a lot about transient workers and the problems they brought. One of the promises of industrial farming was that farms would be so large that there would be plenty of maintenance work for valuable employees through the off-season.[22]

For the industrial farms, the problem of keeping good workers was compounded by the fact that so many workers were managerial rather than unskilled. It was hard to find good managers in factories and hard to find good farm hands on farms, but finding good managers with both industrial and agricultural experience was a challenge. And Campbell worried a good deal about it. In the spring of 1918 he began trying to locate men who could be the unit managers, overseeing 5,000 acres each and supervising lots of workers. "If any of your associates should hear of healthy executives who would like to go west for ten years or even less, please let me know, as the science of farming will be supplied by ourselves and Government experts, and these managers can be successful if they are experienced executives."[23] Campbell was not intending to turn farmers into managers, but rather executives into rural leaders. In his mind the key thing for a good manager was business sense and organizational ability. They could pick up the agricultural part from others on the ranch. But only a modern education and management experience could really train someone to do what Campbell needed. It was not surprising that Campbell first offered managerial positions to men he had worked with before. One of his first choices was A. H. Avery at Iowa State University, to whom he offered $3,000 per year in salary plus bonus for managing 15,000–20,000 acres and for selecting two or

three hundred college boys to work on the harvest. Avery did work with Campbell until his family farm in Iowa needed his help in late 1919. Campbell also offered managerial positions to former associates from Grand Forks, and at least one, Tom Hart, joined Campbell as a unit manager.[24]

Campbell also had an acute need for tractor and combine operators, a job classification that was just emerging among farm laborers. A tractor operator had to know first, simply how to operate a tractor. Second, he had to know what to do if it did not function properly. For the first generation of mechanized farmers, this was not intuitive, but came from training or at least close observation of someone who knew the ropes. Referring to owners of large wheat farms in eastern Oregon, one writer suggested that "unless the tractor owner is mechanically inclined or is able to hire a thoroughly competent tractor man, he is almost certain to find his tractor an unprofitable investment." Campbell concurred, identifying the compounded problems of the introduction of large and complex machines and the inability to use them of the most obvious occupational group. "Machines have been sold to farmers who have no mechanical knowledge whatsoever, which required adjustments within a thousandth of an inch. There are very few people who can think in thousandths of an inch unless they are technically trained." One way to find good workers was to announce job openings at the tractor and automobile schools that were cropping up all over, which manager R. W. Lohman did. In January of 1919, the Montana Tractor, Truck, and Automobile School opened in Billings, offering a four-week course of study that included "gas and oil engines and electrical ignitions." Holt also tried to help recruit tractor operators for Campbell's first harvest.

Pay scales were calibrated based on the difficulty of operating particular machines. For example, a Caterpillar operator in 1920 was paid $125 plus room and board per month, plus ten cents per mile driven; Case and Altman-Taylor "engineers" made $100 plus benefits, and Fordson and truck operators made $80 plus benefits. Wages for basic tractor operators were $75 plus benefits per month, although "men of many years' actual shop and field experience on the biggest machine who are thoroughly qualified to act as engine foreman" could make as much as $120 plus benefits per month. Wages for harvest workers were similarly detailed: Wallis Cub operators made $140 plus benefits per month, binder and other machinery operators made forty cents per hour plus, shockers made fifty cents per hour plus, Ford truck drivers and general laborers made $100 per month plus benefits.[25] The pay scale was the subject of some dispute between Campbell and his managers. Lohman did not think that $75 per month was an attractive wage for a tractor operator, and he had trouble finding qualified men

at that rate. One correspondent said flat out that a "first class Caterpillar operator" would ask for $150 per month from Campbell and would receive it elsewhere. Campbell disagreed, pointing out that they would receive a bonus of fifty cents per mile for every mile over sixteen driven per day; this "should result in from five to seven dollars per day for a good man." According to the USDA, ordinary farm laborers in Montana in 1921 and 1922 were paid on average $42 per month plus room and board, but a reasonable wage for skilled workers was determined as always by whatever the market would bear.[26]

Still, there were lots of people who were interested in working for Campbell and who seemed particularly drawn to the industrial approach to agriculture. Many had no experience whatsoever with farm work but brought considerable experience in factories. John Fox was one such person. In 1919 he asked Campbell for a job; his qualifications were that he had been the foreman of the machine tool shop at Standard Aircraft Corporation in Elizabeth, New Jersey, for more than two years and before that had been in charge of the machine shop at International Motor Company. Campbell immediately offered him the job of machine shop foreman for $175 per month plus benefits. Another man, a forty-five-year-old master mechanic who had worked for Stone and Webster, International Harvester, Westinghouse, and Southwark Foundry in Philadelphia inquired about a similar position, but Lohman could not match his reported $250 *per week* rate of pay.[27]

Even unskilled workers were drawn from a nontraditional farm labor pool. During the first year, nearly all the workers were city boys from Minneapolis: "We try to get boys from good families who have been brought up well. We tell them before they start that the work is hard and the hours are long and that lily-livers and nurslings are not wanted. What we want is red-blooded boys that [*sic*] are willing to work, who have brains and are honest. We prefer those who have an aptitude for mechanics." Few of these boys had any farm experience, however; Campbell was more interested in taking his chances with inexperienced kids than with "any gang of hard-boileds or I.W.W's in the world. We try to keep that sort out of our organization." He did not like to hire married men, largely because he could not house families out on the units, and therefore a worker's family would have to rent a house in Hardin. As he said to one job-seeker, "Our camps are run army style," and one can't help but feel that Campbell himself enjoyed the intensity and fraternity of life on the units. Campbell did like to hire former farmers: "They make excellent tractor operators, for they have paid some bills themselves and they know what it is. They earn $6.00 a day or more, their wives are contented and happy, and they have not the anxieties and cares they

had before." But after about ten years, reportedly, Campbell relied mostly on skilled or semiskilled workers, rarely hiring unskilled men. A devoted teetotaler himself, Campbell forbade drinking on the units and became infuriated when he learned about his employees going into Hardin on payday to drink bootleg liquor with the locals.[28]

A fairly random sample of letters Campbell received from men seeking employment gives a good sense of what sort of laborers were interested in industrial agriculture and also a sense of the historical transition it signaled. A good number of the applicants in the early spring of 1928 were high school and college students looking for summer employment. Many of them were studying agricultural engineering and had experience driving farm machinery. Several students of William Boss at the University of Minnesota applied for positions driving tractors and combines, and one wanted to work in the shop after working the harvest at Campbell's the year before. Other students from Washington, Wisconsin, Missouri, Kansas, and even Montana also wanted jobs with machinery. One young engineering student from Ohio bragged that he "drove a $20 Ford forty-two hundred miles through the Western states, [and] I made all the repairs on the car myself," which almost surely got him a job with Campbell. Another student of farm marketing at Carleton College simply wanted some practical experience in bookkeeping: "I am not particularly qualified to do any particular work. I can operate a typewriter but I am not very good at keeping books. Outside work, I am not very much better prepared but I am willing to accept most any position." In general, Campbell was keen to hire college students for the harvesting and threshing work from mid-July to mid-September, although he offered the following caveat, which applied to young men of all sorts, in writing to a friend in New York: "We find it very necessary to explain to the young men what they are up against so that there will not be any misunderstanding and I ask that you please tell Miller that the days are very hot. We work long hours, the fields are dusty, and it is rather disagreeable unless the fellow is of the right type. We find that the young men who are athletically inclined, want to make the team, or get in good condition, welcome the work they get on our job. Others go home after the first or second day. There is a certain thrill about a summer on a western ranch where everything goes at high pressure that appeals to most young men and we like to have them with us."[29]

Some of the applicants were young to middle-aged men who had gone to one of the tractor schools, and each one who did identified his specialty. One listed familiarity with Allis Chalmers and Rumely tractors but confessed he knew nothing about combines. Another followed the harvest north every year and had

lots of experience with International Harvester machines. Another knew Aultman Taylors and large Holts. A fairly typical applicant, speaking for himself and a friend, wrote from California that "we wouldn't go way up to Hardin unless we could be assured that we could get a 30 [horse power] or 60 [horse power] A&T [Aultman Taylor] or 75 [horse power] or 120 [horse power] Holt to drive for myself. . . . If we went to Hardin and did not get a tractor and a paying job we would be about a thousand miles off of our route to Maryland." One man had just graduated from the Sweeney Auto and Tractor School in Kansas City, one of the most prominent of the trade schools, and was looking for a job as a mechanic. Another was enrolled at the Hanson Auto and Tractor School in Fargo, North Dakota, and hoped to snag a job as a tractor driver.[30]

Some applicants were people who wanted to make a new start in the west, almost regardless of the work. Veterans, for example, had often picked up experience driving or repairing tractors in the army, particularly the Caterpillar-type track-laying machines, and were thus excellent candidates for Campbell's ranch. One war veteran, though probably not unique, returned from the war to find that his farm had been sold and sought a way back into agriculture. Some veterans, such as this one, found that their "nerves are shot," and saw Campbell's ranch as a tonic. Another type of applicant had little if any experience in either agriculture or machinery, but was simply drawn, as J. P. Morgan had been, to the romance of Campbell's project. To one such New Yorker who had a job as a manager in a stevedore company, Campbell wrote, "We would not recommend your considering coming to Montana inasmuch as our work is entirely different from anything that you have had and it would be impossible for you to qualify as a tractor operator or any of the skilled workmen such as taking care of a string of plows or binders which are not listed on our regular application blank." Campbell suggested that he join the harvest in the fall if he was really keen to go west. One fifty-two-year-old bachelor who worked as chief engineer of United Gas Improvement Company in Philadelphia wanted to join Campbell because he was sick of the city (Campbell hired him); a student wrote from Yugoslavia saying he wanted to immigrate permanently to work on Campbell's ranch; a recent graduate in chemical engineering from Stanford wanted to quit his job at General Electric in Chicago to "learn the agricultural industry from the ground up."[31]

Finally, there were the former farmers who applied to Campbell for work. By the late 1920s, as a result of repeated drought and the dramatic success of new, large farm machines, it seemed evident that the days of the family farm in Montana were numbered. Many went bankrupt in the early 1920s, as the price of

wheat plummeted and as taxes increased. Some applicants in this situation offered their whole families to work for Campbell. Henry Seeman from Willard, Montana, had been a farmer for twenty-six years and had a wife and four small boys. Although not claiming any expertise with machinery, he called himself "an all around man" and claimed that his wife could "handle a good size bunch" as a cook. A middle-aged couple from Iowa with two children had lost their farm and wanted to "go west and start over." Yet another wanted a job as a tractor driver, having acquired his experience from his own 800-acre farm, since lost. These applications reveal a widening cultural divide between generations. Most of the former farmers were over the age of thirty-five and had a wife and children, and few had any experience with the new machinery, which probably contributed to their downfall as farmers. As agricultural economists such as M. L. Wilson argued, it was just not possible to be a successful wheat farmer in the arid west unless one farmed at least 800 acres. And no farm family could physically manage such a large farm without the new machinery. Any farmer who either resisted the transition or who failed to receive a bank loan to buy the machinery was, by this explanation, doomed. In Campbell's mind, that was really just business. He was not without empathy for these farmers but thought that it was futile to argue with common sense and reality.[32]

During the corporation's first few years, Campbell also had tenant farmers on the two irrigated units. These units were located on the eastern side of the Big Horn River and were discontinued within two or three years for reasons unknown. One unit was managed by a Japanese immigrant, Sam Okomoto, whose wife was the unit cook. Some of the laborers on the unit were also Japanese. Campbell was quite impressed with Okomoto. He had immigrated to the United States around 1907 and had farmed on the Crow reservation for six or seven years before Campbell met him. According to Campbell, Okomoto had acquired "a fine reputation for efficiency and honesty," and Campbell paid him $200 per month plus a one-third share of the net profits on his unit of 2000 acres. Okomoto was one of Campbell's favorite workers, and Campbell wanted to expand his acreage. But by 1921, Campbell decided to stop farming that piece of land, and Okomoto headed back to Japan. Campbell and the tenants of the Fort Smith Wheat Company on the Fort Smith flats did not have such a cordial relationship. The unit was leased from Joseph Klodt in Wyoming but managed by two men named Anderson and Westerfelt, who became notorious in the CFC offices for their outrageous spending habits and irresponsible behavior. Campbell continually nagged them about their extravagant use of supplies, their bloated payroll, their tendency to charge personal trips to the company, and

their poor work habits, but little seemed to penetrate, and Campbell ultimately discontinued their lease. Nonetheless, M. L. Wilson thought that Campbell had a "wonderful personality," and could instill "esprit de corps in a bunch of men better than any man I every saw." Wilson described a scene from the early 1920s when he "drove out with him in his Stutz racing car to his unit No. 4 where there were twelve 30–60 Altman Taylors pulling eight bottoms. When we reached the field where the tractors were in operation, he stopped the car, ran and jumped on the first engine, shook hands with the engineer, slapped him on the back and told him what a good fellow he was, jumped down on the plows and performed the same operation with the plowman, and so on with each outfit. With the ordinary man this would have taken considerable time, but Mr. Campbell's athletic ability stood him in good stead for the whole procedure was over in less than ten minutes."[33]

Following the day-to-day activities of the Campbell Farming Corporation through written records reveals something of the farm's character and rhythm in its first few years. In particular, it shows how Campbell organized his workforce and management. Campbell's managers were extremely important to the overall success of the farm, and Campbell chose them carefully. He was an exacting boss, and the managers sometimes had a difficult time maneuvering between the workers' needs and Campbell's crystal clear vision of how his industrial farm should operate. Much of the first year was spent hiring workers, buying machinery, putting up fencing, and plowing and planting. By the fall of 1918, Campbell had plowed and planted 7,000 acres to winter wheat and flax. By July of the following year the CFC was in full swing. Another 28,000 acres were plowed, and in the fall a total of 45,000 acres were planted. During the summer Campbell kept a close watch on his employees, his fields, and his machinery, and he rode all three hard. When he found a problem somewhere he minced no words: "I noticed yesterday that the main axle bearing was cut in a Case engine at [unit] No. 1 because of the lack of oil. This is absolutely inexcusable, and I am going to insist that you discharge anyone who is so incompetent, inefficient and disinterested that he will not even oil his engine. . . . I have never seen such a mess in my life as our milk cans, which are used for filling gasoline tanks. They look as if they had been run over or thrown from a ten-story building, or else handled by a lot of smashers rather than men of intelligence." And, in a similar tone, "Do not give cars to the men to come to town on Saturday nights. . . . There is more damage done on these night trips in our cars than perhaps any other way." He lambasted manager Albert Avery for the condition of Unit 1 as it looked on Campbell's visit: "There are more broken tongues, broken reaches,

broken Hausmann hitches, broken parts of engines, trucks, and other equipment than there should be after three years of operation. There are more empty oil barrels in the yard than the Continental Oil Company has in Hardin." Campbell had no tolerance for what he saw as carelessness and indifference, and, as one put it, "he is a crank on waste." As a result he micromanaged everything that went on at the units, complaining and criticizing both the laborers and the managers. "For over a year I have been urging that you be more careful of your machinery, trucks and other equipment and in spite of constant requests that you demand from your men more care and caution in operation of the machinery there has been no improvement whatsoever." He said that he would begin holding managers responsible for their men's actions, but he ended on a softer note: "I know this has been a hard year to do work and it is hard to maintain enthusiasm in the face of such poor crops, but anyone can be a good fellow in good times, but it is adversity which tries a man and shows his character."[34]

Campbell was strict with his laborers as well and had high expectations of them borne from both his engineer's devotion to efficiency and his desire to cut extraneous fat from the operation. His workforce in the fall of 1919 was the largest ever, and Campbell wanted them in the field at 7:00 A.M. sharp and finished up at 7:00 P.M., with an hour off for lunch. This schedule did not sit well with at least one unit manager, who pointed out to Campbell that "when we put the eleven hour day into effect [last June], we had to get practically an entirely new crew." Other organizations in the area, such as a sugar refinery and another ranch, followed a ten-hour day even at harvest time, which "has long been accepted [as] the length of the farm day in this part of the country." Campbell was adamant, however, and his way won. The following year, in fact, he kept the men in the field from twelve to fourteen hours per day during harvest, with pay set at fifty cents per hour plus board for ordinary laborers.[35]

One reason for this draconian work schedule may have been the damage done to most Montana farmers by the drought in 1919. Campbell's crops were destroyed, as were those of other farmers, so that in the spring of 1920 he was basically starting over again. Financially the company was in tough shape; Campbell expressed to his auditor, "If anybody gets any money from us this year which they are not entitled to it will be because we have been chloroformed." Yet Campbell was nothing if not resilient, and he went about the spring planting as before, settling into a farm routine. As he left for a trip to California, he gave Tom Hart a laundry list of chores around the farm: grade some of the roads, return well-drilling equipment to the Crow reservation, install lubricator on the Caterpillars, pack fields and clean weeds out of them, fix commissary roof and

paint, collect poles from Crow reservation for fence posts, and hire a fence rider to keep horses and cattle out of the fields. It was an off-season list of jobs that would have looked familiar to any farmer and that filled the days between planting and harvest. By July the crops began to look promising. Stevens was so confident he predicted that "the proceeds of this year's crops will allow us to retire all our Bills Payable [*sic*] and pay a fair dividend on our stock and will leave enough cash to finance, unaided, at least two years' operations." Indeed, the real problem facing Campbell was storing the anticipated crop of 500,000 bushels of wheat and getting it to market in a timely manner. Montana farmers frequently had difficulty getting enough railroad cars to send their grain to St. Paul when the price was most attractive. Campbell purchased 150 collapsible metal grain bins in case the car shortage left him holding more grain than he wanted. This was a safeguard that most small farmers could not manage.[36]

As a manager, Campbell brought a businesslike approach to the farm that could be both welcome and aggravating. Interviews with Campbell portrayed a crisp and efficient organization operated by trained managers: "An operation manager is in charge in the field. There is a farm manager in charge of each of the seven farms who is responsible to the operation manager for the economical operation of his unit. His daily report . . . brings out all the important facts regarding his day's work. Each farm [unit] has its own quota of men, machinery, spare parts, and repair trucks for emergency repairs, and is camped and provisioned as a unit. The field operations of plowing, seeding, etc. are under the supervision of separate foremen who report to the farm manager." But back on the units, Campbell continued to nag the managers about poor work habits. "Do not let the men pile up on the front end and running boards. . . . Please ask the fellows to keep the hoods over the engines. . . . Do not let any one of the threshing machines remain idle anywhere one day. . . . Move at night, if necessary." And similarly, "Please report promptly any losses of wheat which you observe on the road either from fast driving or accidents . . . so we can make the proper charge" against the driver of the truck or car. The difference between the public face and the private one is jarring, with Campbell's micromanagement strategies sometimes at odds with modern management ideals.[37]

Financially the farm struggled for many years. After the drought ruined the crops in 1919, the postwar market collapse ruined the farm's income in 1920, and that was followed by a grasshopper invasion on the Fort Peck unit in which 15,000 acres were consumed by the insects. The optimistic outlook of early 1920 was scaled back by the late fall. Although the farm would take in about $1 million, it would all go back into the farm and its massive debts rather than to share-

holders or investors. Expenses were astronomical by farming standards. By the end of 1919, Campbell had spent $830,000 on machinery and equipment, more than $141,000 on roads, fences, land, and buildings, more than $110,000 in advances to tenants, and $156,000 on an ill-advised livestock investment, and that was not a complete tally. In 1928, Campbell's costs were still high. Monthly bills for gasoline and oil for the machines and vehicles were between $4,200 and $10,000; labor was between $6,700 and $19,000; meals for workers averaged about $2,500. But Campbell claimed that his costs were half what they would be on an average wheat farm (when calculated on a cost-per-acre basis), saying that he reduced costs by raising wages, a strategy to "speed up our old men and attract some better men." He also claimed that the maintenance costs for the machinery had been halved over a three-year period, which made sense considering the time invested in learning about the machines. The drought continued off and on until 1926 but then returned again in 1929. In 1931, Campbell planted 32,000 acres of wheat but did not harvest a single bushel because of the drought, and in 1934 the farm had a hard time paying its bills, so poor were the crops.[38]

In spite of these problems, Campbell's operation attracted international attention, particularly from the Soviet Union. Although it is not entirely clear how this connection was made, it seems likely that the barrage of publicity that Campbell both created and received in 1927 and 1928 led to the original contact. One writer claimed that the Soviet government offered Campbell a million acres of land if he would agree to operate a Soviet farm in part as a demonstration for the Soviets but that Campbell preferred to consult with the Soviets from Montana. The Soviets paid quite handsomely for the privilege, and Campbell's family attorney claimed that Campbell's motives were inspired by the hard financial times that followed the repeated droughts. In the summer of 1929 two different groups of Soviet agriculturalists visited Campbell's farm to study his methods, his use of machinery, and his management style. The following summer Campbell combined a family vacation in the Crimea with a month-long consulting visit to the "Gigant" state farm which, he claimed, was modeled closely on his own farm in Montana. It was, of course, much bigger than even the Campbell Farming Corporation. The supporting town had a population of 17,000 people, and he described the town as one with "electric light plant, parks, schools, administration buildings, modern systems of sewage disposal, well paved streets and public baths, . . . landscape gardening and recreation ground." The five farm units were each 100,000-acres large, that is, each one was the size of the whole Montana Farming Corporation. One of Campbell's projects on the trip was designing thousands of miles of roads that could accommodate trucks

moving grain from the fields to the centralized storage bins. Campbell also worked as an intermediary between the Soviets and the American manufacturers, drumming up business for Americans and finding reputable manufacturers for the Soviets. He also promoted the Haynes Steelite Company, which made ploughshares, to the Soviets and invited a company representative to the farm while the Soviet delegation was visiting there in the summer of 1929. In 1930, Campbell officially established the Campbell Engineering Corporation, based in New York City, through which he represented American manufacturers to the Soviets. Thinking ahead about how the Soviets would move the grain, Campbell sent a note to the Ford Motor Company indicating the need for 40,000 to 50,000 trucks. He also contacted the General Tire and Rubber Company, Foote Brothers Gear and Machine Company, and French and Hecht to see if they might be interested in selling things to the Soviets. In the 1940s, Campbell also consulted for the British government in England and for the French in Tunisia, where he helped establish cooperative demonstration farms. French and Tunisian officials also stayed on Campbell's farm several times to study his methods and ideas.[39]

Campbell's farm was certainly big—and important—but was it industrial? Tom Campbell thought it was, and so did many other contemporary observers. They thought so in part because of the scale of the farm and its ability to inspire amazement or, to a small neighboring farmer, perhaps dread. Among historians, however, there is a tendency to believe that the Campbell farm was not as significant as other industrial phenomena, pointing to such obvious examples as U.S. Steel, Ford Motor Company, or even Heinz Brothers. I propose that it was industrial for four reasons. First, the farm was utterly dependent on machinery, just as any other big industry. The routine and reliable operation of the machines, the progressive movement of material from one machine operation to another, and the need for specialized knowledge to supervise the machines all point to an industrial operation. Second, the farm was also completely dependent on expertise, in this case both economic and engineering expertise. Campbell's engineering-based leadership was the most important dimension of this, but considerable, too, was his reliance on the former engineers and shop men in his crew. Third, because wheat was a low-price commodity, it was essential for Campbell to practice economy in every aspect of farm life and to impose exacting management strategies to ensure that men and machines were in the right place at the right time. This attention to management was a hallmark of modern industrial logic, and Campbell adhered to it as much as possible on the re-

mote farm units. Fourth, Campbell was dependent on outside capital, which clearly separated his farm from most ordinary farms. The idea that agriculture was an investment opportunity was so foreign to the majority of American businessmen that it was unusual for a farm to attract funds, particularly from sources such as New York bankers. That Campbell successfully did so was a signal to others that farming was changing: it was becoming industrial.

Although Campbell was not the only farmer who operated on such a large and mechanized scale, he was one of the few to appear in the pages of both engineering journals and banking magazines. As a professionally trained engineer, Campbell attracted a lot of attention and could speak with authority to nonfarmers about the revolution that was occurring. He was also an articulate spokesman for farmers, particularly with the press and "east coast capitalists," as bankers and government men were often called. He represented a hybrid of two traditions, engineering and farming, and he showed that the two had much in common. His long-term success is compelling evidence for the soundness of his views.

Chapter 6 Collectivization and Industrialization: Learning From the Soviets

Planning in such detail is necessary under Russian conditions, and could be profitably used on many American farms.
—*Guy Bush,* 1931

By the late 1920s, the pace of change in American farming was escalating rapidly, not only in wheat farming but in all sectors of agricultural production, in part because the difficulties of the postwar years were still fresh in people's minds. The new farm machinery was more reliable and available than it was ten years before, farmers were more likely to practice businesslike methods of farming and record keeping, and the virtues of large-scale farming were, if not established, at least promising. Foreign visitors in record numbers came to the USDA and to Montana after reading about the new methods and philosophies of production, and in 1928 the Soviet Union began formally studying American wheat farming in earnest.

From 1927 to 1932, between 1,000 and 2,000 American technical experts went to the Soviet Union as advisers to the Soviet government. Many were sent there to assemble and service machinery, set up facto-

ries, or instruct Soviet workers in engineering. Such companies as General Electric, Ford, and Caterpillar sent mechanics, engineers, and executives for a few months or even a few years. Other Americans were hired directly by the Soviet government through its New York–based agent, the Amtorg Company. Many of these Americans were largely indifferent to the political and social revolution that was taking place around them, focusing instead on the generous salaries they were being paid and on getting their business done so they could return home.[1]

Among these thousands of American technical experts was a small group of American agriculturalists who, like their industrial counterparts, were expected to bring the Soviets up-to-date on American scientific and technological approaches to production. M. L. Wilson, for example, spent about six months advising the Soviets on their plan to grow 400,000 acres of wheat. E. J. Stirniman, an agricultural engineer from the University of California, and L. J. Fletcher, an agricultural engineer with Caterpillar, spent about two years teaching the Soviets how to assemble and operate farm machinery. John Q. McDonald, another Caterpillar engineer, traveled around the Soviet state farms assessing the equipment needs of different crops. Guy Bush, a writer for *Wallaces' Farmer,* spent a year helping to establish a hog-breeding unit. Another group, which included agricultural engineer J. B. Davidson, traveled to the Siberian area of Biro-Bidjan to advise a New York–based Jewish relief organization regarding the land's agricultural suitability as a Jewish autonomous state.[2]

In spite of the brief amount of time these agriculturalists spent in the Soviet Union and despite their collective lack of influence in world affairs, their experiences had a powerful effect on American agriculture in the 1930s. This was not because these men were politically sympathetic to the Soviets or because they were enamored of the Soviet way of life or even, as Lewis Feuer so persuasively argued about New Dealers, because agriculturalists were inspired by the notion of central, social planning. Rather, it was because the Soviet plan to grow wheat on an industrial scale and in an industrial fashion was similar to American ideas about the direction American agriculture should take.

As one of the leading advocates of large-scale farming in America, Wilson found several similarities between American and Russian agriculture. The Soviets, like Wilson, were primarily interested in wheat, a grain that had growing qualities that made it more easily industrializable than other crops, for example, corn. As a result, much of the large-scale farming enthusiasm in America was among wheat experts. Not coincidentally, the physical conditions of wheat farming in Montana were similar to those in the Northern Caucasus of Russia;

both had a semiarid or arid climate and a vast area of flat land nearly devoid of such obstacles as creeks, trees, roads, and buildings. In American industrial farming, large, flat tracts of land were essential to the successful use of farm machinery. Tractors and combines needed the space to turn around and move continuously, and only a large tract could financially support an investment in this expensive equipment.

For the Americans, an invitation to visit the Soviet farms and help establish industrial farming on them was an irresistible opportunity to expand the experiment in large-scale wheat farming. The Soviet Union offered a much larger canvas on which to plot out industrial farms, and no farmers would be hurt if the experiment did not succeed (as at Fairway). The Americans working in the Soviet Union would have the chance to focus completely on planning a truly large-scale farm, and their efforts would supply data for the American experiment. How many hours could a Holt combine operate? How many people were required to plow how many acres, and how long would it take? All the questions that had arisen with the American work could now be addressed on a much larger scale, demonstrating for better or worse the limits of industrial farming practices.

AN AMERICAN FIVE-YEAR PLAN

Although Russian interest in American farm machinery predated the Revolution of 1917, the Soviet restructuring of society and productive enterprise included the reconfiguration of peasant agriculture as well, and in 1919 peasants began to be moved onto collective farms. Before the revolution, peasants followed traditional agricultural patterns in which families lived in small villages and farmed many small strips of land scattered nearby. In this system, large seasonal tasks such as planting and harvesting were performed communally, without regard to who owned each strip. As is well documented elsewhere, most peasants resisted collectivization because of the government's coercive and brutal methods and because the government simply took harvested grain. In both cases the peasants and their traditional communes were eliminated from the production decisions. Kulaks, or rich farmers, were also brutalized; historians estimate that during collectivization, millions were driven into exile or killed.[3]

The famine of 1921 and 1922 sparked American interest in Soviet agriculture for the first time, which led to several relief delegations to the Soviet Union. Harold Ware, who would later become the single most important figure in bringing American agricultural methods to Russia, and Dr. Joseph Rosen, who headed

the American Relief Administration, Jewish Joint Distribution Service (also called Agro-Joint), both led groups to Russia. Ware's group included six North Dakota farmers, at least some of whom had been members of the radical Non-Partisan League, and they brought with them twenty-two tractors and several tons of medicine and food. A brilliant social entrepreneur, Ware was one of the few Americans who was as interested in the Soviet's political experiment as in their agricultural experiment; he was an astute observer and a remarkably effective promoter of agricultural modernization. He was also a prominent member of the American Communist Party and a son of Ella Reeve ("Mother") Bloor. Born and raised in Pennsylvania, Ware attended the two-year agricultural course at Penn State University before seeking first-hand experience in farming. After running his own farm for three years, Ware worked as a draftsman in a shipyard during World War I and then worked as a harvest hand for half a year.

When news of the Bolshevik Revolution reached him in New York, Ware felt that he could best serve the cause by introducing American agricultural experts and machinery to the Soviet Union, and with the aid of the American Communist Party he organized agricultural assistance. Once in the Soviet Union, he saw first-hand the horror of mass starvation and he witnessed for himself the Soviet farmers' apparent ignorance of Western agricultural techniques. Ware's sentiments were captured in a 1929 diary entry: "I have an offer to help on Russian matters with one of the big (American) companies. It means enough money to live decently. As it is I can just get by and keep the kids in decent schools. But it also means that I shall always feel that I left a job undone, one that dumb luck makes me better than anyone else able to help: the agricultural revolution from individual to industrial. I can and will help its rapid transition. Now in Russia we can save them millions of dollars and millions of hours of human slavery." On visiting the countryside Ware was surprised to discover that peasant farmers did not plough the soil deeply enough to provide aeration and that they let newly turned soil dry out in the field before fall planting. Many peasants threshed wheat by dragging a huge flat stone over the sheaves. Such practices, as farmers in the arid western United States knew, were guaranteed to exacerbate an already delicate soil system, allowing what little moisture there was to evaporate.[4]

Operating as a one-man development project, Ware persuaded the relief committee to give him $75,000 to buy tractors, and he convinced the Soviet government to give him a farm west of the Urals in Perm. With his crew of North Dakota farmers, Ware traveled around demonstrating how the tractors worked, and he taught forty peasants how to operate the machines. According to Bruce

Bliven of the *New Republic,* Ware essentially tricked the peasants into combining their tiny fields into larger fields by promising such "collectives" a tractor of their own. As Lem Harris described it, Otto Anstrom, one of the North Dakota farmers, was one day demonstrating a tractor to a large group of peasants, one of whom had asked Anstrom to plow his field. Anstrom responded that the farmer's field was too small for a tractor, but if he and his neighbors put their farms together, then he would plow it. By 1925, the Soviet government gave Ware another farm, this time in the northern Caucasus, which Ware named the Russian Reconstruction Farms. On this unit, Ware introduced peasants to tractor farming, and in exchange, the Soviet government agreed to pay for all agricultural improvements until the end of a specified time. Ware continued spreading the word on tractors and, with Lenin's support, was made assistant director of Sovhoz no. 2, where most of the Americans worked.[5]

In this postfamine period the Soviets also became eager to acquire American farm machines, which was no doubt at least partly due to Ware. For instance, in 1922 the Soviet government imported more than $200,000 worth of American farm implements, and it spent another $1 million in the first two months of 1923. In a systematic effort to both investigate foreign equipment and lure foreign manufacturers to the Soviet Union, the Soviet government sponsored an international agricultural exhibition outside Moscow in August of 1923. With the promise of highly favorable shipping rates and potential tax benefits, this exhibition attracted many American implement manufacturers, including Deere and Company, Advance-Rumely Threshing Company, Beall Tool Company, New Moline Plow Company, and Oliver Chilled Plow Works. According to one source, by 1925 the Soviets were buying tractors in record numbers; in that year alone more than 5,000 tractors were imported and used in spring and fall plowing. And by 1927 the Soviets had purchased a total of 27,000 tractors and other machinery from the United States, mostly from International Harvester and Ford. Clearly, the Soviets were becoming persuaded that American machines, if not American expertise, could be a worthwhile investment.[6]

For the Soviet government, industrializing agriculture offered a means of industrializing the republic more generally. Lacking both the money and the technical expertise to shift the economy rapidly into a manufacturing mode or provide such modern services as domestic electrification, sanitation, or telephone exchanges, leaders decided that the best way to raise the money necessary to invest in Western industrial machinery was to grow and sell wheat. Russians had long participated in the international wheat market, but their productive capacity was hampered by the growing population and by antiquated agricultural

techniques. Hundreds of thousands of acres of good wheat-growing land had never been plowed. Furthermore, the famine of 1921 made the Soviets highly sensitive to the importance of stabilizing and ensuring wheat production. Reingold Niebuhr explained it succinctly: "The farmer must be collectivized to destroy his individualism, chief opposition to soviet politics. He must also be collectivized to increase his production. His production must be increased so that more grain can be exported. More grain must be exported so that more machines can be bought. More machinery must be bought so that industrial plants may start operation. The industrial plants will increase the industrial population and at the same time provide machinery for collective farms in which the psychology of the industrial worker will be reproduced in the country. So the logic runs in a circle."[7]

In June of 1928 the Soviet government set up the Grain Trust, or Zernotrust. Under the direction of M.Y. Kalmanovich, the Grain Trust had a dual purpose: to produce massive quantities of wheat and to train thousands of Russian peasants to operate agricultural machinery. In a country as large, populous, tradition-bound, and emotionally torn as the Soviet Union, these were herculean goals. The project involved establishing farms of hundreds of thousands of acres on land that had never seen a plow; building housing for the peasants and advisers who would live there; procuring farm machinery from America and Germany; and educating thousands of Soviet citizens in the details of Western agriculture.[8] The Grain Trust wheat farms were different from existing farms and, as in America, the new agriculture represented a sharp divergence from traditional practice. But whereas in America some traditional farmers were able to modernize by degrees, in Russia agriculture appeared to be starting all over again, with little continuity with the past. First, all the buildings and roads had to be built from scratch so that modern conveniences could be included from the start. When State Farm no. 2, called Verblud, was built in 1929, it included electricity, running water, sewers and plumbing, and central heating in many of the dormitories and work buildings. Most of the existing peasant villages had none of these modern technologies. Second, those agriculturalists who came to Verblud were often not peasants at all but agricultural students and engineers wanting to learn Western agricultural techniques. Thus, the general population on the state farms was younger, better educated, and more enthusiastically in favor of the agricultural revolution than the peasants or the kulaks.[9]

With the Grain Trust in operation, the pace of procuring farm implements increased substantially. Although reliable figures are hard to secure, unofficial reports were stunning. In January 1929, Wilson reported that the Soviets bought

350 Cletracs; in June, Amtorg reportedly ordered 6,750 tractors from John Deere and International Harvester; in August they ordered 1,700 heavy duty truck engines from Hercules Motor Corporation, and in December another 1,000; Cletrac sold another 708 tractors in August. By August of 1930, the Soviets ordered $5 million worth of Caterpillar 60s. The Department of Commerce estimated that between January and March of 1930, tractor sales to Russia added up to about $20 million overall. In July of that year, Russians ordered another $40 million in tractors and combines. The Soviet market was in some ways more important to American manufacturers than the American market, at least when it spiked in this way.[10]

The Grain Trust began investigating American wheat production closely in January 1928 when they sent a delegation to Montana to observe Wilson and Campbell in action. Another Soviet group visited Campbell in July, inviting him to Russia to help them organize their farming operations. Campbell declined because field work was in full swing, but he took them up on their offer in January and again eighteen months later. Wilson was first contacted by the Soviets in September of 1928, when J. G. Ohsol of the Amtorg Company wrote asking him some basic questions about large-scale wheat growing. Telling Wilson that the Soviets were in the process of organizing "some rather large grain farms," Ohsol quizzed Wilson: Are such large farms profitable? Should the crop be diversified or is monoculture better? Should artificial fertilizer be used? Should the crop be rotated and, if so, with what? What kind of farm machinery should be used, and what would be the cost per acre to use it? How many laborers would be required?[11]

The following month Wilson was visited by Harold Ware. After telling Wilson about his own efforts to modernize Soviet farming, Ware explained the Soviet government's plans to establish an experimental wheat farm of 100,000 acres, a school for tractor operators, and a working wheat farm of nearly 400,000 acres. Writing to a friend several days later, Wilson called the Soviet plan "the largest experiment in mechanical farming in the world." After discussing the plan in detail, Wilson agreed to meet with Ware and several others in Chicago in early December in order to create a master plan detailing what the Soviets needed to do to achieve their production goals.[12]

In a Chicago hotel in the first two weeks of December, Wilson, Ware, and Guy Riggin, who managed the Lone Warrior farm in Brockton, struggled to figure out precisely how one would turn an unplowed 500,000 acres of Russian soil—land that was unpopulated, without roads, buildings, or power—into a bustling and productive set of farms producing spring and winter wheat, farmed

by highly skilled Soviet citizens with the most modern Western farm equipment. It was a difficult task, not least because two of the three had never set eyes on the Soviet Union. Nonetheless, their combined skills were formidable. Ware had spent a number of years farming in the Soviet Union and was familiar with the government bureaucracy, basic climatic and soil conditions, and the Soviet temperament. What Ware lacked was a knowledge of how to manage a large-scale enterprise and a sense of what specialized farm machinery was available and appropriate to Soviet conditions.[13]

In their report for the Grain Trust, Wilson, Ware and Riggin argued that the Soviets should adopt virtually the same wheat growing system that both Wilson and Campbell advocated. They made few concessions to the fact that many aspects of the system (for example, "timeliness of operations") would be more difficult to accomplish in the Soviet Union. Rather, they presented their plan as though it were a strictly technical and nearly formulaic problem that could be solved without considering social, psychological, political, or cultural issues. It was this opportunity for seemingly objective problem-solving that Wilson found so appealing in the Soviet situation.[14]

The heart of Wilson and Ware's report was a description of Wilson's pet project for wheat growers, the summer fallow system, which was a rotational system on which land was divided up into winter wheat fields, spring wheat fields, and summer fallow fields. Wilson recommended this approach as a replacement for the continual cropping of wheat, which tended to reduce soil moisture, and he thought it was particularly effective in such areas of light rainfall as Montana. The key features of the system were to increase the wheat acreage, to reduce the amount of planting and plowing done each year on the farm through rotation, and to use machinery for all these operations.[15] As Wilson pointed out, planting wheat according to the summer fallow method was not practical on small farms, because it required farmers to keep a large chunk of land out of production while it was "in fallow." For example, a 300-acre farm might have 100 acres in spring wheat, 100 in winter wheat, and 100 in summer fallow; thus, the farmer would be producing on only 200 acres at a time. Although the system did generate larger yields overall, a wheat farm of that size could not support a Montana family in 1929. The summer fallow idea, then, was not an isolated "input" a farmer could simply adopt or not adopt; it had repercussions for other aspects of the farmer's operation.[16]

The most important implications of the summer fallow method were in the ways farm size was affected and farm machinery was used. Because wheat prices were lower than prices for most other grains, a farmer needed to grow a lot more

wheat than, for instance, corn. And since in the United States wheat was grown in the arid west rather than in the humid midwest or south, midwestern farms of 160 acres were an inappropriate model for western farmers. Farmers could improve their wheat yield per acre by rotating wheat with fallow, but the farms needed to be much bigger; 700 or 800 acres would be the minimum in Montana. But because no farmer could adequately farm that much land by himself, particularly since wheat planting, harvesting, and threshing were highly sensitive to timing, a farmer needed to invest in the new harvesting machinery. Finally, in order to pay for this expensive new machinery, farmers needed to produce as much wheat as possible, starting the cycle all over again.[17]

For Wilson, this method of wheat production was an exercise in careful, systematic management. That is, the central problems of the endeavor were as much in organizing and ordering things as they were in understanding agricultural science. Along with others in the new field of farm management, Wilson was interested in redefining agricultural issues so that a problem in wheat yields was not simply a problem of poor seed or too much rain but also of proper management of machinery, labor, credit, and time. For example, since the wheat crop was split between spring and winter crops, machinery and labor use were spread out over the year rather than concentrated in one short burst of activity. Similarly, spreading the crop out over the year reduced the risk from a single weather or insect disaster. As Wilson pointed out, if the farmer was going to spend a lot of money on machinery, it was absolutely necessary to have as dependable and predictable a crop as possible.[18]

The tricky thing about "factory wheat farming," as Wilson called it, was that since each element was highly dependent on all the other elements, a problem in any one area could foul up the entire system. As Wilson wrote, "The advantages of factory wheat farming lie entirely in its ability to use large power units. If small power units are used, the number of operating laborers is accordingly increased and the advantages of low cost factory wheat farming over small scale farming begin to disappear." It was this interdependence among factors that made meticulous management so critical and that made the Russian context so risky.[19]

Two examples of management methods from Wilson, Ware, and Riggin's report will illustrate the high degree of planning they thought essential to their system. The first example was the establishment of a "standard seasonal program" for the four land units of 2,500 acres each, in which they listed what would be done in each field, when, and with what equipment from late March to early October. For instance, from June 1 to June 8 field no. 2 would be cultivated with

the Duckfoot cultivator. It would take eight days and 147 tractor hours to accomplish this with two tractors. On June 9 the rotary rod weeder and Duckfoot would cultivate field no. 4, ending June 17 and spending 147 tractor hours. From August 10 to August 20, field no. 4 would be cultivated with the disc-plow; it would take 292 tractor hours, so with three machines it should take just under 10 days to complete. Obviously, the breakdown of even one machine could wreak havoc on such a precise system.[20]

In the second example, Wilson, Ware, and Riggin lay out the operations of a mobile group of nine workers who travel from one field to another in a completely equipped portable field station. Whereas in the traditional American farm, a farmer traveled from his farm to the fields each day, with the land unit idea, such large parcels of land were involved that it was more practical for the farm workers to camp in the fields until the jobs were done. The land unit consisted of a bunk wagon, restaurant wagon, shop wagon (with electric generator), and club tent ("for books, games, meetings, and radio"), as well as field machinery that was kept in a convenient, central location. The staff for each land unit would include a manager, field foreman, mechanic, cook, two greasers, and three tractor drivers. Wilson had a clear vision of how these men would operate as "a fighting unit," as he put it, able to work in a timely manner with little wasted motion. Wilson believed that "the principle of labor management is a high degree of specialization and division of labor," and he gave an example of this in action: "At noon the thermos lunch boxes insure hot lunches for the men. While they are eating the greasers should come to the field and be oiling the drills or combines with extra oil carried in tractor cabs for the purpose. The tractors are so constructed and equipped that they do not require service except at 12-hour periods. Thus they get a complete service each night at the Unit Camp." This plan bore a striking resemblance to Campbell's camp units, which, although more permanent than the wheeled units, epitomized the same farm management principles of centralized authority and diffused labor groups.[21]

AMERICANIZING STATE FARMS

If the Americans traveling to the Soviet Union between 1929 and 1931 had any illusions about the extent to which they could harness Soviet energies and modernize Soviet agricultural practice, they surely would have had their eyes opened upon arriving in the Soviet countryside. The sheer scale of what was called the Soviet "experiment" in agriculture was overwhelming. By 1928, for instance, the Soviets had established fifty-three state grain farms on seven million acres of

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Verblud under construction. E. J. Stirniman Collection, Department of Special Collections, University of California, Davis.

land; only four years later there were more than two hundred farms on forty-one million acres. Scattered widely around the Soviet empire, each state farm, or sovhoz, was a vast and isolated expanse that was given seed, peasants, machinery, and directions from the Grain Trust in Moscow but, due to poor transportation networks, was only loosely connected to the rest of the farms in the system. The Soviets also established hundreds of Machine Tractor Stations in the northern Caucasus and Ukraine. These were centralized locations that held tractors and other big farm implements that the villages and collectives could take turns using.[22]

Most of the American experts were located at Verblud (which means "camel"), located about 1,000 miles south of Moscow and 40 miles southeast of Rostov-on-Don. They were housed in a small village named Egorlikskaya. When Lement Harris arrived in Verblud in June of 1929, he found a number of other Americans recruited by Ware already at work. Harry Minster, from Connecticut, served as an interpreter; George McDowell, who had become a Soviet citizen and married a Russian woman, was in charge of all construction and repairs; Bob Robertson, a Kansas farmer employed by Caterpillar Tractor to assemble and operate Caterpillar combines; M. W. Thatcher, chief sales representative of Caterpillar, and L. C. Fletcher, who also worked for Caterpillar and whom Wil-

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Machinery parts as they arrived in Verblud. The crates in which they were sent were recycled, soon becoming portable showers for field crews. E. J. Stirniman Collection, Department of Special Collections, University of California, Davis.

son wanted along on the trip. Shortly after Harris arrived he inquired about Ware's whereabouts and was told: "He is in Moscow. We hear he is bringing down a real live professor from Montana. That's all we need!" McDowell also greeted Harris with a little song, perhaps inspired by the Jimmy Rodgers hit song "He's in the Jailhouse Now":

> You're on the sovhoz now,
> You're on the sovhoz now,
> You'll never get rich, you son of a bitch,
> You're on the sovhoz now.[23]

When Wilson got to Verblud in 1929, it had a total of 375,000 acres, of which 150,000 were already planted to wheat. The "farm" enclosed many small villages, where small peasant strips of land were now owned by the state, and several larger villages where peasants were still allowed to work their own small plots. The farm headquarters at Verblud constituted a sort of boomtown in which nearly all the buildings were new and many were equipped with modern conveniences such as plumbing and electricity. Some of the buildings were made out of the ship-

ping crates in which tractors arrived from the United States. Most of the residences were large, multifamily or dormitory-style buildings, which Stirniman described as "high, huge, straight, box-like, hideous . . . as graceless, as soulless as the culture and creed of the modern communist." Nonetheless, these dwellings to the Americans were a huge improvement over the peasants' little mud houses, which were dark with dirt floors. Other new buildings included an administrative office, postal and telephone offices, a cooperative store, a restaurant, a worker's building, a clubhouse, and a large building for the Experiment Station and Library. This particular building also housed the Institute, which was a two-year school in farm machinery attended by about 1,000 students. Finally, separated from the housing and offices was "machinery park," where the machine shops, garages, and warehouses were located. Likening its appearance to "a display at a State Fair," Stirniman reported that with a "huge woodworking shop, machine repair shop, warehouse for repair parts and an electric shop," it was one of the biggest and best equipped machine shops anywhere.[24]

The main business on the farm, of course, was growing wheat and assembling and maintaining farm machinery. These twin goals sound simple enough, un-

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The mechanized wheat farm was named "Verblud," the Russian word for "camel." Camels were the traditional agricultural machines in the Northern Caucasus. J. B. Davidson Collection, Iowa State University Library/University Archives.

til it is recalled that both the wheat and the machines were scattered over 200,000 acres, that most of the peasants and students had never used machinery before, that lines of authority were, to the Americans, both rigid and perplexing, and that in wheat farming, the proper timing of planting and harvesting is key to success. Although the Americans were intellectually aware of these issues, the realities seemed to stun them viscerally. For agricultural experts, both corporate and academic, and for visiting journalists, the enormity and difficulty of the task at hand were daunting when they were standing in that vast, flat landscape. But in recruiting Wilson, Hal Ware was acknowledging that the key to growing so much wheat was organizational. And the report that he, Riggin, and Ware prepared in Chicago was focused on this issue. But the difference between the idealized plans of portable farming units as described in the report and the unpredictability of actually operating such units was striking.

All the sovhozes were operated on the unit plan, in which the sovhoz was divided up into separate units (Verblud had eight units), each with its own offices, warehouse, machine shop, a club tent, dining area, and in 1931 most planned to build bunkhouses for the workers. According to Stirniman, the field workers generally stayed at the unit throughout the harvest season, returning to headquarters only when the harvest concluded. Although Wilson and Ware's plan had suggested creating portable field stations that would travel with the field crews, it appears that the Soviets instead created more field units, which were not portable at all. Some portable stations were used for the most remote sections, but the general pattern was that the workers went to the fields for an eight-hour shift, meals were brought out to the field halfway through the shift, and then everyone returned to the unit. The workers, rather than the facilities, were portable. In other ways, too, the Soviets modified the American plan. At harvest, according to Harris, camps were set up among the fields, consisting of a large tent that held thirty sleeping cots, a bunkhouse on wheels for the women tractor drivers and cooks, a wheeled repair shop, and a wheeled kitchen. Ware also rigged up a solar shower using, again, the plentiful crates in which tractors had been shipped. Where the plan had suggested working sixteen-hour days with crews of nine workers, the Soviets worked around the clock with field crews of twenty-four. The goal of reducing the number of people required to raise wheat did not seem to have as much currency in the Soviet Union as it did in the United States.[25]

Assembling and operating the farm machines created the most trouble, although it is difficult to sort out the different causes of machine problems. One problem related to the training, or lack of it, that peasants and students received.

[To view this image, refer to the print version of this title.]

The staff of the field kitchen, Verblud. J. B. Davidson Collection, Iowa State University Library/University Archives.

During the first few years at Verblud, many peasants were given little training because leaders wanted to get the crops in and out as quickly as possible. Thus, people who had never seen a tractor before were assigned to a field crew and expected to operate the equipment. Each day the workers would get up at 4 A.M. and spend an hour greasing and oiling the tractors and combines before beginning their shift. But because the tractor drivers were not trained to make repairs, Ware assigned one mechanic to each group of four Caterpillar machines. The mechanic was put on a horse with a saddlebag full of tools and oil, and if a driver had a problem, he or she would hoist a white flag as a signal to the mechanic. The mechanic would gallop over and make the necessary repairs. But there were misunderstandings. Discussing the short life span of machinery at Verblud, Stirniman recalled his horror at discovering one tractor crew taking a break and draining all the hot water from the tractor's radiator so that they could make tea. Jean Walker, a tractor engineer, complained bitterly that the Soviet field workers refused to do any maintenance work on their tractors and that they were satisfied if their tractors could run on two or three cylinders. Combines

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A Soviet student making repairs on an International Harvester tractor. J. B. Davidson Collection, Iowa State University Library/University Archives.

that would have worked for ten or twelve years in America were "ruined" after two in the Soviet Union, according to Walker. With embarrassment and irony, Walker related that while he and his combine crew helped the peasants finish their traditional harvest in 1930, by 1931 the peasants were helping Walker, so broken down was his machinery. In late 1929, before the Soviets set up their own factory, Wilson had blamed the Germans for manufacturing shoddy equipment, saying that they would duplicate American machinery using inferior materials. He went on: "There are so many little practical kinks about building machinery that the manufacturer has gained thru experience that the German manufacturers have entirely overlooked. For this reason a great lot of the German equipment that was shipped into Russia last spring is not much more than junk now and even though the German manufacturers gave them five years credit, the Russians have found that it was expensive machinery after all."[26]

Assembling the machines as they arrived from the United States was similarly frustrating. Most of the implement manufacturers sent assembly crews to oversee this operation on the farms; Stirniman's main job was directing the assembly and repair operations. But the system was limited. For illiterate peasants, and for non–English-speaking students, instructions written in English were of little use. A. J. Bruman, an American who was working in Biro-Bidjan, wrote to Wilson, "This is our first venture into combine work and, if you know how McCormick Deerings are shipped for export, you will realize what a time I had assembling them with an inexperienced crew no member of which has ever seen a combine." If parts were missing from the shipment, then those machines were as good as junk since there was no way to get spare parts except from the American factory itself, which meant agonizing delays. Mordecai Ezekiel, who was a young USDA agriculturalist in 1930 when he visited Verblud, reported several disastrous interactions between Soviet workers and the farm machinery. The Soviets, he argued, "especially the ignorant, uneducated workman, has a sublime faith in his own knowledge and ability which is ludicrous." Ezekiel described how such workmen hated to be told by Americans how to do things and would

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Night crew moving camp, Verblud. J. B. Davidson Collection, Iowa State University Library/University Archives.

[To view this image, refer to the print version of this title.]

Soviet women with a harvester, Verblud. J. B. Davidson Collection, Iowa State University Library/University Archives.

insist on figuring out their own way to assemble machinery. One vivid example involved a combine that would thresh soybeans: "One of the American specialists suggested how to set the teeth in the cylinder and adjust the speeds to do the job properly. Later he found the machine set as had seemed right to the workers, running full blast and churning the beans into an excellent imitation of soybean-oil butter. Again the workers announced proudly that they had discovered something. No one before had ever had the idea of threshing beans with a combine—they were the first on earth to try it! The engineer's statements that it had been done for twenty years in America, and could be done with the same combine far better than they were doing it, fell on deaf ears. The Russians thought they had discovered something new under the sun—and both the joy and the arrogance of discovery was theirs."[27] Ezekiel interpreted this behavior as a result of Socialist philosophy: "Every Russian worker," he argued, "has been told that he is as good as every other man. . . . He feels that he is his own boss; he alone is responsible for what he does; and no one has the right to tell him what to do." Whatever the validity of this explanation, other Americans reported similar experiences in which their advice was rejected by Soviet workers.[28]

In Wilson's view, this Soviet resentment of the Americans was the most difficult problem the Americans had to face in bringing industrial methods to So-

viet agriculture. Wilson attributed this attitude to a "very strong nationalistic feeling" among the Soviets, an explanation that could have applied to workers in any country, communist or not. For Wilson, though, the most serious problems this caused had to do not with poor machine building or shoddy workmanship, but with authority. If Soviet workers were resentful, and Soviet leaders were unwilling to give Americans authority on the project, then, Wilson felt, the Americans were doomed to fail. Indeed, one of the outcomes of the tensions was that the Soviets decided not to bring many Americans over as advisers after 1931.[29]

Although both the Soviets and the Americans agreed that education would play an important role in this machine revolution, both the philosophy and organization of education were profoundly different in the two countries. Thus, there seemed to be no Soviet counterpart to the American agricultural engineer, agricultural economist, or mechanic. The most prominent agriculturalists were the "agronomes," college- or institute-trained agriculturalists who often had been the directors of the pre-Revolutionary estates; Wilson described them as "a cross between an agronomist and a farm management man." But unlike farm managers in America, the agronomes' approach to agriculture was highly abstract and theoretical, with little practical, field experience. In scientific matters, such as botany or soil chemistry, the agronomes were considered "on a par with Americans." But in technical or mechanical matters, according to Wilson, they were utterly inexperienced. By 1930, however, efforts to train students became more common. The Lenin Agricultural Academy had a special program in large-scale farming, the Lomonsov Technical Institute in Moscow had a group of faculty devoted to studying the subject, as did the Leningrad University and the Timiriazev Agricultural Institute.[30]

The training institute at Verblud offers a good example of the peculiarities of the Soviet approach to agricultural modernization. As described by Stirniman, it was a cross between college and the military. Most of the students had "the equivalent of sixth grade schooling" and little experience in agricultural matters. Those with mechanical ability had come from factories, although this was a small group. As Stirniman put it, "Jobs as students were much coveted." This was because the students were paid a stipend that exceeded the rate that laborers or office workers were paid, were furnished with room, board, clothing, and books, and were guaranteed jobs on other state farms on completing their agricultural study. They lived in dormitories, had playing fields for sports, and, unlike peasants, had little to lose and much to gain by embracing industrial agriculture.[31]

The Soviets' goals for industrializing agriculture also extended to the factory production of farm machines, and by 1930 a tractor factory had been established in Stalingrad. Here again Americans were brought to the Soviet Union to help set things up; in August of 1930, 300 American engineers, foremen, and skilled workers arrived in Stalingrad to oversee production. Another factory was opened at Kharkov in 1931 and one in Cheliabinsk in 1933. Over the next few years, production figures were impressive. In 1934, both Stalingrad and Kharkov were producing more than 40,000 tractors, and at the end of its second year, Cheliabinsk was making more than 10,000.[32]

But problems plagued the tractor factories. American engineers who consulted in the tractor factory in Stalingrad were surprised by the "lack of coordination" and absence of a "routing system" that might keep production orderly. According to engineer John Bekker, the Stalingrad factory was beset by both gross mismanagement and duplicity. He recounted that the Soviets finished building the factory ahead of schedule, that its director promised to produce 37,500 tractors between May and October 1930, and that the very first tractor rolled off the line to become the centerpiece of the May Day parade. But soon thereafter the factory declined, as materials failed to arrive, workers sat idle, or tractors were built with defective or insufficient parts. By October the workers were cynical and demoralized and the tractors were all but ruined. At the Communar combine factory in Zaparozhe, Ukraine, according to Harris, Soviet workers purchased a few Caterpillar combines, took them apart, and made blueprints of each part. While the factory got motors from the Stalingrad factory, and ball bearings from Moscow, the Communar made its own gears, shafts, and sheet steel and assembled it all into combines. Although the workers did assemble machines that looked like combines, to echo one American's comment on early American tractors, the Soviet combines were not as high quality as the Caterpillars. Harris reported that the blueprints were not done precisely enough, leading to measuring and milling errors and many essential parts were left off machines.[33]

Some worried that Soviet schools were not training workers properly in industrial methods, with the result that workers entering industrial employment were unable "to operate these new automatic machines." The Soviets also lacked proper materials, such as case-hardened steel. Reportedly, some of the Soviets working in American implement factories with the goal of learning proper techniques were pessimistic that the Soviets could quickly adopt Western ways; one Soviet worried that what they had hoped to accomplish in five years would actually take an entire generation.[34]

One of the big problems centered on what the Americans perceived to be deficiencies in Russian organization and management of both workers and materials. That the Americans and the Russians followed different standards when it came to these things should have come as no surprise. Indeed, in one of the earliest notices regarding the Soviets' desire for agricultural assistance, the Soviets pointed out that in "introduc[ing] up-to-date American practice and methods," they needed not only agricultural knowledge but also "business and managerial ability." Nonetheless, the Americans were taken aback with the apparent extent of this need. Warning an American implement dealer to always send things directly to the Soviet farm instead of to Moscow, Wilson characterized Russian office systems as "just about 5,000 years behind the times." After Wilson returned to the United States he sent books back to the Soviet farms, not on the subject of agriculture, but on scientific management and accounting.[35]

What was becoming clear to many of the Americans was that industrialization did not take place simply because people owned machines; an industrial psychology was also crucial. Even in the agricultural sector, the difference between farming in the traditional manner, with human labor and animals, and farming in the modern way, with Caterpillar tractors and time cards, was a nearly unfathomable stretch. Journalist Marion Tyler described the difference as seen on Ware's Russian farms in 1927: "Machinery is not entirely new to Russian peasants. At seeding time and harvest old-fashioned machines appear in the fields. A local cooperative group has a huge, wooden infinitely complex structure of pipes and wheels and belts that looks as if it might be used to make music in a circus. With it, fifty-seven workers can thresh a thousand poods of grain in a day. The Americans have a neat little machine which eight people can run, threshing two thousand poods a day. They have another with which three operators can cut and thresh a thousand poods, and skip the binding process altogether. This almost qualifies as a miracle."[36]

When Wilson was seeking colleagues' advice about whether or not he should go to Russia, L. G. Michael at the USDA was enthusiastic, having spent several years there himself. But he also offered a caution against any overly optimistic expectations Wilson might have: "I do not believe that you could accomplish anything of lasting value in Russia in two years. Affairs move too slowly in that country. They have an expression 'cee chaz' which means 'this very hour.' They always do things 'cee chaz.' That is to say 'sometime.' It is like the Spanish 'tomorrow.' Delays are harassing and the inertia of the people heartbreaking."[37]

Wilson's final report to the Grain Trust, submitted in September 1929, tried to balance the theoretical and idealistic quality of the first report with the harsh

and perplexing realities of life on the state farms. He reemphasized the interrelatedness of machinery and management, pointing out that "in American industry . . . organization and administration are as important as machines or technical systems, and . . . large-scale production is the result of an economic complex in which the organization, business administration, machines, technique, and labor, all function in a harmonious way." More to the point, he continued, "no matter how well mechanical equipment is selected and agronomic scientific theory applied, unless there is comparable organization and administration wheat will not be produced at low cost."[38] After observing the situation on the state farms all summer, however, Wilson was worried that "the managerial side is not developing as rapidly as the mechanical, and there is a tendency to carry over into the Sovhoz administration a peasant or pre-revolutionary estate management idea rather than starting with an assumption that a definite managerial psychology and administrative technique must develop to control the new type of mass production." This was, of course, strikingly similar to the situation on American farms ten years earlier. There, too, the agricultural experts were disappointed that farmers were not better situated for modernization, that they did not quickly learn mechanical principles, and that they did not appreciate the importance of proper bookkeeping and proper care of machinery.[39]

By the end of his stay, Wilson was ambivalent about the Soviet wheat situation. On the one hand, his ideas about the best way to industrialize wheat production—ideas hatched on the plains of Montana—were proving difficult to accomplish in the Soviet Union. Although he could continue to insist that his recommendations were a rigorously interdependent package, there was little he could do if the Soviets decided to disaggregate the package and choose only the machinery component. On the other hand, as Wilson was to tell his American colleagues, even with this imperfect transfer of American methods, the Soviets would be a real competitor in the world wheat market. After struggling to get Montana farmers to increase their scale from 160 to 800 acres, it seemed inconceivable that the Russians, who opened more than 500,000 new acres to wheat and who bought hundreds of thousands of dollars worth of machinery, could fail to be a huge contender.

Indeed, the threat of cheap Soviet wheat on the world market was worrisome, and it indicated that industrialized agriculture had come of age. Predicting that the Soviets would soon be exporting 200 to 300 million bushels of wheat per year, Wilson suggested that Montana wheat farmers consider how that would affect their own wheat operations, saying "there never was a time when our Montana wheat farmers especially should be so concerned with efficiency and low-

ering costs than they are at the present time." And for Wilson, that meant doubling or tripling the size of wheat farms and investing in the new farm machinery. Wilson was not alone in this assessment. As early as 1925, journalist Bruce Bliven put the equation in somewhat starker terms after visiting Ware's Russian farm: "The ignorant peasant in his village is not the only person who needs to have pounded into him the principle of large-scale, efficient and intelligent operations. Here in our own United States, most of our farms are still too small to make profitable the sort of machine operation which is most economical."[40]

The Russians did constitute a real presence on the world wheat market, but the more profound phenomenon in 1932–34 was the famine that killed an estimated five million people. As described by Dana Dalrymple, the brutality of the famine was magnified by the fact that it resulted not from environmental causes such as drought or crop failure, but rather from state policy. In the process of collectivizing the peasants, according to Dalrymple, the peasants were forced to give up their independent sources of support (for instance, garden plots and livestock). The collective farms themselves were devoted to wheat production rather than to the somewhat more diverse food production that occurred before. When the wheat was harvested in 1931, the government confiscated it all, leaving virtually nothing for the peasants. This act was repeated in 1932 and 1933. Because the Soviet government by that time prevented foreigners from traveling to the grain regions, however, most Americans were largely unaware of the famine at the time.[41]

After his return from the Soviet Union in October 1929, Wilson decided not to write up a formal article on his trip, but he did write to friends and colleagues about his experiences abroad. In general he was extremely upbeat about the Russian people and the living conditions, and he was clearly thrilled by the entire experience. The hotel in Moscow, for example, was the best hotel he had ever stayed in; the Ukrainian women who threshed the wheat, with their colorful dresses and kerchiefs, strong arms, and beautiful singing voices were a moving sight; the young Soviet students were quick to learn mechanical principles and were sure to become fine agricultural engineers. He was good-humored and philosophical about the Soviet way of doing things, was interested in absolutely everything, and developed a genuine warmth and admiration for the Soviet people. As he was quick to point out, although he was not a socialist, he admired the Soviets for tackling such a serious problem in such a sustained and, from Wilson's point of view, intelligent manner, and he seemed pleased with their success.

Wilson, however, did return with a much more realistic understanding of what the Soviets were able and willing to do in regard to wheat production. As Stirniman was preparing to leave for his stint in the Soviet Union, Wilson confided that the plans he and Ware had prepared for the Soviets were not likely to be carried out. By the time Stirniman and Jean Walker returned to the United States in early 1932, the experiment seemed to be over. "The Grain Trust as a whole, is no more," wrote Walker, referring to the fact that the highly centralized trust had been split up and disaggregated. In terms of suggesting how to organize and operate the wheat farm, Wilson felt that the Americans had ultimately failed; "I am afraid that we missed it very badly," he confessed to Stirniman.[42]

Wilson's reading of the Soviet situation and his understanding of what the Soviet experience might teach American agriculturalists are interesting in light of later developments in American agriculture. For example, Wilson and others definitely came away with a distaste for socialism and a renewed loyalty to both democracy and capitalism. Reporting to a colleague that he had been invited to return to the Soviet Union for a visit at a fee that was more than four times his salary, Wilson admitted that he would rather help American farmers than "our Bolshevik competitors." Stirniman, who spoke out against his Soviet experiences when the Soviets failed to pay him his full salary in 1931, was reportedly heckled by Soviet sympathizers and shortly thereafter quit discussing the subject entirely. For some agriculturalists, like Wilson, the Soviet trip was an isolated professional excursion rather than the beginning of a new and sustained interest in international agricultural affairs; for others, like Stirniman and John McDonald, it led to careers in international implement sales.[43]

Wilson was aware of the potential similarities between the British Industrial Revolution and the emerging industrialization of agriculture, but he was virtually unable to relate it to American farms. Wilson was neither the first nor the only American agriculturalist to note the similarities between these two historical events, but he was one of the few to actually observe it in the Soviet Union. Wilson did consider the negative effect of mechanization on agricultural employment in general. Yet these remarks remained mere observations and musings; he did not push the ideas further to consider how the peasants compared to American farmers. How did mechanization affect American farmers? Will they be absorbed into the ranks of factory laborers?

Another issue that had resonance both in the Soviet Union and in America was the cost of mechanizing agriculture. For an American farmer, one of the biggest issues in thinking about whether to buy tractors and combines was the

ability to pay for them. In 1929, for example, a combine cost between $1,100 and $2,200, depending on its size. The high cost of this machinery, and the farmer's uncertainty about whether the increased production would pay for and justify his new equipment, were serious stumbling blocks to the mechanization of agriculture. In the Soviet Union, in contrast, individual farmers were not even the main unit of production; equipment was purchased by the government for the use of the collective farms. So when Americans reported that the Russians purchased $15 million worth of American agricultural machinery in 1929, they were reporting not that Russian farmers had been persuaded of the advantages of industrial farming, but that the Soviet government had. This difference between whether it was the farmer or the state absorbing the cost of industrializing agriculture was an issue virtually ignored by the agriculturalists who promoted large-scale farming in the United States.[44]

Indeed, the profound differences between Soviet and American farms and farmers were often either played down or even misrepresented by American writers. Writing for American farmers, for example, L. J. Fletcher claimed that "the grain trust is organized much like an American corporation. There is a board of directors responsible to the chief governing committee of the nation. The main office of the trust is in Moscow."[45] An even more outrageous explanation of the collective was offered in 1935 by Niels Hansen: "The worker is a shareholder in the collective, which is nothing more or less than a business corporation organized for profit."[46]

What is interesting about the American views of the Soviet farms was the extent to which they saw these farms as reflections of their own interests and concerns and to which they used these farms to confirm their new theories about agricultural production. That is, the Americans viewed the giant Soviet farms as huge experiment stations on which the Americans could test their most radical ideas for increasing agricultural production and, in particular, wheat production. Much of what they wished to learn more about simply could not be tried in America, partly because it would cost too much, partly because no suitably large farmsite was available, and partly because many farmers and farm laborers would be alarmed at the implications of this kind of experimentation. By spending a few months in the Soviet Union, some felt, one could try the ideas out to see if they were viable on some level and could then bring back to America the improved version of agricultural change.

This Soviet program functioned for the Americans much as other development programs have since, that is, as an opportunity to both offer assistance to those in need and to try new agricultural ideas that may not be easy to do in

America. In this sense the Soviet Union served as a sort of guinea pig for the American agriculturalists. It was, in fact, an example of what Mark Hobart calls "counter-development," in which the host country ends up providing as much as it is given by the outsider. Hobart is referring primarily to raw materials and resources, but one could just as easily consider knowledge a raw material. This was somewhat paradoxical, in that the Soviets invited the Americans because they were thought to have real expertise in the subjects of large-scale agricultural production and agri-industrial management. But in fact, American expertise in the field was largely theoretical in 1929. The largest farm in America at this time was Tom Campbell's farm in Montana, but at 100,000 acres it was a garden compared to the Soviet's 400,000 acres. And, of course, Campbell's farm was exceptional. Similarly, the Soviets wanted the Americans to teach them all about mechanizing farm operations, but at this time most American farms were just beginning to invest in mechanical equipment. And the Soviets desperately wanted advice about how to organize hundreds of thousands of peasants into working and living units, trained to farm collectively and efficiently, but in this the Americans were woefully out of their league. Nonetheless, they attempted to help the Soviets in much the same way the industrial engineers had—that is, by promoting whenever possible the application of Frederick Taylor's principles of scientific management.[47]

As one examines the Americans' expectations and attitudes toward their Soviet venture, one is struck by how much faith they had in the power and persuasion of rational, demonstrable scientific fact. Their recommendations regarding how the Soviets should set up a planting, plowing, and harvest schedule, for example, were sensible, well-organized, and doomed to fail in the Soviet Union, ignoring as they did such crucial facts of Soviet life as a hostile or recalcitrant workforce, or the lack of what Wilson called the "timeliness" of getting supplies. Even in the United States these plans would have been optimistic, actually, because they were based on an unrealistic idealization of nature and human behavior. And insofar as the plans represented what the Americans would do if they also had millions of acres of flat land, lots of laborers, and a government commitment to spare no expense in meeting production goals, the plans were designed for a theoretical place. Neither Russia nor America, this abstract agricultural place obeyed the laws of physics and chemistry, recognized no political or ideological stance, admitted no legislators, lobbyists, or interested people of any kind, and in fact existed simply to enable scientists to test out their ideas.

This is not to suggest that the American agricultural experts acted in bad faith.

Rather, it is to point out that their effort was driven not by the certainty of scientific tradition, but by the uncertainty of scientific hypothesis. With the venture based on a handful of existing large-scale farms and on a small pile of scientific studies of dubious relevance, the Americans were hopeful, and at times supremely confident, that their ideas would work in the Soviet Union as well as in the United States. They seemed to think that if agriculture is based in true scientific evidence, it should work the same way anywhere in the world. Clearly, they were wrong.

Conclusion Changing the Landscape

Should the idea of corporation farming prevail we would lose what we now have. We would get instead an industrialized agriculture with farmers no longer independent individuals, but hired wage earners.
—*Arthur Capper,* 1933

The end of the 1920s signaled the end of the first stage of agricultural industrialization in the United States. By the time the Great Depression was recognized as a major and sustained crisis, the material and ideological components of industrialization had taken root in several parts of the country and in various commodity sectors. Where the industrial ideal had been introduced, it survived the Depression and flourished when that crisis subsided. Although the ideal itself and the practices it represented probably did not save farmers who were already failing, the new agriculture did not hurt those who jumped aboard in the hope of maintaining their farms during tough times.

The Depression shifted attention away from the ongoing discussion about whether farms should stay small or get larger, whether they should maintain a diversity of products or focus on a single crop or animal, and whether they should resist or embrace mechanical solutions

to farm problems. For many farm families, the New Deal programs that grew out of the Depression offered welcome relief from several years of droughts, low prices, high interest rates, and despair. Many urban dwellers were shocked by the sudden drop in economic stability, but those in the countryside had endured worse and were finally able to see a way out. These programs offered not a return to untroubled times, but an acceleration toward the modern, businesslike farm that experts had been promoting. The Rural Electrification Administration was a clear example of this effort to modernize and industrialize the farm and farm home. In terms of the larger industrial agenda, rural electrification was more than a belated improvement in farm families' standards of living and more than an opportunity to enjoy such modern conveniences as electric lighting in the home, barn, and farmyard, appliances like refrigerators and radios, and the feeling of participating in the same modern life that city people experienced. Electrification also led to higher expectations; now a family needed to have even more cash to have a "normal" standard of living, which included the ability to incorporate electrical machines into farm production. Now the barn not only could be electrified, it should be electrified, and the cows not only could be milked by machine, they should be milked by machine. Modernity and mechanization, once so foreign to rural families, were delivered by the New Deal programs, and the opportunities, it turned out, were also responsibilities.

The pace of industrialization was uneven across the country, determined by geography, affluence, climate, and crop. The first places to adopt large farm machines were those for which machines were originally developed: places that were flat and hot, where fields were large and unbroken, and where the favored crops required little fussy attention. Farmers who lived where mechanization was possible tended to adopt such machines in order of affluence and education; the most educated and affluent typically bought the first machines, while the less financially able waited until the machines were more reliable, less expensive, and more essential for farmers to stay in a particular commodity game. Similarly, the first farmers to begin keeping farm accounts were those who lived in states with a history of successful farming, states that supported the agricultural college and extension service most generously and consistently. But because teaching farm accounting to farmers was labor intensive, it was slower to catch on in states with fewer extension workers who had larger territory to cover. The western and southern states were slow adopters in this regard, but again the midwestern states were among the first.[1]

Many farmers could not or would not adopt new machinery in the 1920s. Because of the farm depression, most of them could not afford to spend money on

anything that was non-essential and certainly not on something that cost hundreds or thousands of dollars. Many had no savings, no collateral, no one to ask for a loan, and simply no way to purchase a large item. Those who had horses, implements, and family members able to work in the fields may have felt that driving machinery such as tractors was a luxury. These farmers tended to manage quite well without one. Some farmers were sentimental about their traditional way of doing things and, like those who depended on the powerful Percheron horses, were reluctant to trade in a companionable horse for a loud and unreliable machine. At the same time, there were various reasons why a farmer might decide to give machines a try. He might have the money saved from a land sale or an inheritance, or he might have sufficient faith in and curiosity for machinery. He might have the opportunity to expand his acreage due to moving neighbors or public land auctions but at the same time he might realize that only with mechanical help could he reasonably care for such a large tract. He might be trying to keep a son on the farm, or lure one back after the war or college; many writers commented on the appeal tractors held for the younger generation. The farmer may even have been the last one in his area to hold out against buying a machine and could now no longer compete with his neighbors unless he, too, worked with one. Those with machines—once the quality of the machines had been stabilized by the end of the 1920s—got their crops to market sooner and received a higher price; they got their crops in and out of the field faster and avoided additional weather problems; and they were favored by bankers, who saw farm mechanization as a smart step into the future.[2]

As it did everywhere else, technological change in the countryside happened family by family, farmer by farmer, banker by banker. People became convinced that they needed to modernize or industrialize for their own reasons and in their own time. But personal choice was more available to the affluent, early adopters than to the others. The affluent farmers could wait until they were convinced that mechanized farming was right for them because there was no one pushing them to change. As the first ones to take an interest, they were free to push the manufacturers a little, to nudge the bankers a little, and to talk to the extension agents. Because these farmers played a critical role in demonstrating the virtues of mechanized farming, once they did jump on the bandwagon, they had more authority in general. Later adopters, however, had many fewer choices and at some point had to mechanize or get out of farming.

Both mechanization and quantification in agriculture lent themselves to a "transfer mentality." The success of mechanized farming in one place with one

kind of crop could be easily translated into a belief in the general superiority of mechanization. If combines were effective in Garden City, Kansas, then they would also be effective in Ohio; if the unit system of farming worked in Russia, it might also work in Saskatchewan or Montana. If farm machines worked well with wheat, they should also work with corn or cotton. If chickens could be bred to tolerate a mechanized and indoor barnyard, then why not pigs and cows? If a farmer could learn to write up a rational balance sheet of inputs and outputs, then every sort of farming could be made comparable to every other, and farmers could be businessmen producing units of goods at set prices, not so unlike a factory owner making shoes or widgets. This kind of thinking was characteristic of agriculturalists in the 1920s and, in particular, reminiscent of how they conceived of the best way to rationalize the productive process. There was so much variability in American agriculture, so many different crops, types of farmers, types of land and climate, that agricultural experts were anxious to find not only a language, but also a practice that could make farming more manageable. Those in one particular spot—extension agents in Nebraska or rural bankers in Texas—did not really care about the overall complexity, could not really see how chaotic it was, and were focused on the local or, at best, the regional. It was the agriculturalists who traveled across the country and abroad, who worked in federal service at some point and thus saw the difficulty of meeting so many disparate needs, who began to feel in the 1920s that a larger vision was needed. What followed was that agricultural experts began to focus not on the idiosyncrasies and differences among farmers, but on the similarities, trying to find common problems that would be amenable to uniform technical solutions. And it was this rationalizing activity and the agricultural experts' belief in it as an analytical tool that made American agriculture transferable to other countries in what came to be known as the Green Revolution.[3]

Technical assistance programs abroad such as those seen in the Green Revolution have aimed to provide expert advice and scientific solutions to entrenched agricultural problems, and they have usually had dual goals of increasing the food supply and training local people to maintain technical systems. Such programs have been both praised and castigated because they have had mixed results. Some programs have indeed helped increase food supplies but at the same time resulted in the reduction of traditional foods and cultural practices because those introduced by Western experts were favored. The experts themselves have generally been trained in science, technology, and economics, but not as frequently in anthropology or history, and this background has sometimes led experts to view problems as strictly technical and straightforward rather than cul-

tural and complicated. It has been a matter of identifying "solvable" problems, rather than problems that need solutions.[4]

For example, the Rockefeller Foundation began a program in Mexico in 1943 that focused on improving Mexico's ability to supply its domestic food needs. This humanitarian goal led to a program including agricultural training and education as well as research and extension activities for farmers growing corn and wheat or raising cattle. The program had its greatest success where Mexican participants were most similar to Americans—that is, in cattle ranching and wheat growing, as well as in education. It was less successful in areas and situations that did not have an American parallel, such as with efforts to persuade Mexican peasants growing corn to change their practices. The definition of what constituted the biggest problems in Mexican agriculture in general was made by the Mexican government, the Rockefeller Foundation, and the American agricultural experts who advised them. The difficulties facing Mexican peasant farmers, however, were not considered solvable, because they centered on issues such as education and land reform, which the Americans felt were too politically sensitive. In the end, the program counted its successes in training agricultural experts, in decreasing the amount of food imported into Mexico, and in improving cattle breeds, precisely those areas in which America and Mexico were similar.[5]

In this sense the industrialization of agriculture can be seen as the process of making agricultural techniques and principles universal. From a technical, industrial point of view, Montana and the Caucasus are essentially interchangeable because the crops are the same, the geography is similar, and they are both amenable to the same equipment and schedule. Those dimensions that are different—the history, the people, the political and economic situation—are irrelevant to the problem of producing wheat. Farmers in Mexico were thought of in the same context as farmers in Iowa as experts tried to figure out how to persuade Mexicans to grow hybrid corn rather than their own open-pollinates. As Mark Hobart points out, those things about rural life that are heterogeneous to the participants tend to be grouped together by the experts.

The industrialization of agriculture was thus a complicated transition from the traditional to modern, involving individual farm families, the state, new agricultural experts, manufacturers, bankers, and journalists, all playing a role in either pushing or resisting the trends toward "factoryizing" the farm. The process itself was framed by the emergence of three new elements in agricultural production and, consequently, in technical assistance programs. The first was the agricultural experts, who in this story were agricultural engineers and econ-

omists, but who might just as well be entomologists or hydrographers. Their role was linking their emerging professional identity to the rationalization of agricultural production, which created a group of people able to carry the rationalization project through time and space. The second element was the creation of new material vehicles of change, in this story tractors, combines, and account books. These tools both enabled farmers to expand their productive activity and enabled experts to measure their own effectiveness as carriers of industrial change. The third, less tangible element was the creation of new metaphors that captured the direction the experts wanted modernization to take. Here the primary metaphor was the farm as a factory, and the secondary metaphor was the farmer as a businessman. Both of these were powerful metaphors in the sense that they sparked the imagination of business and urban leaders who could actually make such transformations happen.

Looking around rural America, it would seem that the industrial revolution has not yet penetrated every corner of production. There are plenty of small farms still operating, not only in commodity production but increasingly in specialty, niche-oriented markets. It is not hard to find a bucolic countryside, dotted with grazing livestock and grain silos. But in many places these vistas are deceiving, and on closer examination the farmhouses and barns are empty. In some sectors, such as poultry and pork, industrialization has moved with a vengeance, filling farmyards with confinement systems that automatically control food, water, climate, and animal movement. These are perhaps the Lowell Mills of the agricultural revolution, the logical outcome of several generations of rationalizing, systematizing, and standardizing.[6]

The industrial revolution in American agriculture surely led to many benefits, as the USDA often points out: a more plentiful food supply, tremendous food variety, a less physically taxing workload for farmers, a higher standard of living in the countryside. This revolution, however, has also led to some serious problems: continuing food distribution problems, both domestically and internationally, an increasing problem ensuring and regulating food safety, a chronic decrease in the number of farm families, a flow of people and capital from rural to urban areas, and an incomprehensible set of deals between federal officials and farmers that make little sense and potentially do as much harm as good. Development experts ignore at their peril the complex history of industrial agriculture, for the patterns of change set in the American case are now replaying all over the world. The benefits of industrial agriculture are invariably countered by the costs, whether those are measured in financial, environmental, or human terms. There were myriad, complicated human intentions that

guided the first stage of this revolution and that shaped the agricultural landscape for decades after. This industrial revolution was far from a simple unfolding of inevitable outcomes; it was characterized by twists and turns, lost opportunities and wonderful surprises. It might behoove us to think of agricultural transformation as a set of possibilities, rather than inevitabilities, for change.

Appendix

PROGRAM FOR THE 1910 MEETING OF THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS
with biographical information when available on presenters

President's Address

Philip S. Rose, associate editor, *American Thresherman,* and editor, *Gas Review*

Agricultural Engineering Classification

J. Brownlee Davidson, professor of agricultural engineering, Iowa State College

Discussion

L. W. Ellis, Rumely Company, La Porte, Indiana
J. A. King, Hart Plow Company, Charles City, Iowa
Win. Hepburn
P. Rose, *American Thresherman*
J. B. Davidson, Iowa State College

Agricultural Engineering and the Demand for Agricultural Engineers

S. Fortier, irrigation agent, USDA

Discussion

P. S. Rose, *American Thresherman*
L. W. Ellis, Rumely Company
J. A. King, Hart Plow
Win. S. Aldrich, director, Clarkson College of Technology

Draft Apparatus for the Lecture Room

C. K. Shedd, became professor of agricultural engineering, Iowa State College, 1916

Hollow Clay Blocks for Building Purposes

M. L. King, was at Iowa State College in 1911; in 1916 was secretary of the Permanent Buildings Society

The Reconstructive Work of the Agricultural Engineer

Newell Sanders

Tractive Efficiency

L.W. Ellis, Rumely Company

Discussion

W. A. Cavanaugh, International Harvester
W. F. MacGregor, J. I. Case
J. B. Davidson, Iowa State College
L. W. Ellis, Rumely Company

The Neglect of the Power Problem

E. P. Edwards

Discussion

J. A. King, Hart Plow Company
O. H. Caldwell
P. Rose, *American Thresherman*

The Agricultural Engineer and the South

Daniels Scoates, professor of agricultural engineering, Mississippi A & M University

The Iowa Recording and Integrating Dynamometer

J. B. Davidson, Iowa State College

Discussion

W. A. Cavanaugh, International Harvester

Principles of Ventilation Applied to Farm Buildings

F. H. King

Fencing the Farm

H. E. Horton, in 1917 was with American Steel and Wire Company

PROGRAM FOR THE 1926 MEETING OF THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS
with biographical information when available on presenters

Presidential Address

F. A. Wirt

Research in Agricultural Engineering, 1925

R. W. Trullinger, senior agricultural engineer, USDA, Office of Experiment Stations

Rural Electrification from an Economic and Engineering Standpoint

L. S. Wing

Tractor Lug Studies on Sandy Soils

John W. Randolph, in 1921 was assistant professor of agricultural engineering, Auburn University

Some Factors to Be Considered in Extending the Use of the Combine Harvester

M. A. McCall

National Agricultural Engineering Research

R. W. Trullinger

A Study of Factors Involved in Ensilage Cutter Design

F. W. Duffee, professor of farm mechanics, University of Wisconsin

A Study of the Dynamics of the Disk Harrow

E. G. McKibben, instructor of agricultural engineering, University of California

A Method of Research as Applied to a Project on the Air Requirements of Poultry

Henry Giese

Some Results of Tests of the Operation of Combines in Illinois

I. P. Blauser, in 1921 was a student in agricultural engineering, Ohio State University

Machinery in Corn Borer Control

C. O. Reed, professor of agricultural engineering, Ohio State University

Grain Storage, Drying, and Shrinkage Problems

E. W. Lehmann, professor of agricultural engineering, University of Illinois

Four Important Factors in the Manufacture of Concrete Pipe for Alkali Soils

Dalton G. Miller, senior drainage engineer, USDA

Studies in the Electric Brooding of Chicks

George W. Kable, agricultural engineer, Oregon State University

Automatic Control of Natural Draft Ventilation of Stables

J. L. Strahan, in 1919 was at the Department of Rural Engineering, Cornell University

Irrigation in Relation to Soil Moisture and Plant Growth

F. J. Veihmeyer, assistant professor and irrigation engineer, University of California

Recent Investigations in the Farm Storage of Apples, Potatoes, and Similar Crops

W. G. Kaiser, assistant manager, Cement Products Bureau

Grain Handling Methods in Relation to Combine Harvesting

E. J. Stirniman, assistant professor, Agricultural Engineering, University of California

Tile Spacing and Depth as Function of Soil and Crop Type

H. B. Roe, associate professor, Agricultural Engineering, University of Minnesota

Relation of Power to Agricultural Production and Profits

C. D. Kinsman, senior agricultural engineer, Bureau of Public Roads, USDA

Abbreviations

BAE-NA	Records of the Bureau of Agricultural Economics, United States Department of Agriculture, Record Group 83, National Archives
CFCH	Campbell Farming Corporation Headquarters, Hardin, Montana
FES-NA	Records of the Federal Extension Service, Record Group 33, National Archives
FHH	F. Hal Higgins Collection, Shields Library, University of California, Davis
HAW	Henry A. Wallace Papers (microfilm)
HCT	Henry C. Taylor Papers, Historical Society of Wisconsin
JBD	J. B. Davidson Papers, Iowa State University, Ames, Iowa
JDB	John D. Black Papers, Historical Society of Wisconsin
LSRM	Laura Spelman Rockefeller Memorial, Record Group 25, Rockefeller Foundation
MCE	College of Engineering Records, Bently Historical Library, University of Michigan

MLW	M. L. Wilson Papers, Montana State University Special Collections
RE	Richard Ely Papers, Historical Society of Wisconsin
RF	Rockefeller Family Papers, Record Group 3, Rockefeller Foundation
TC	Thomas Campbell Papers, Montana Historical Society, Helena

Notes

INTRODUCTION

1. Kathryn Marie Dudley, *Debt and Dispossession: Farm Loss in America's Heartland* (Chicago: University of Chicago Press, 2000); see also Peggy F. Barlett, *American Dreams, Rural Realities: Family Farms in Crisis* (Chapel Hill: University of North Carolina Press, 1993).
2. See, for example, Alan Olmstead and Paul Rhode, "An Overview of California Agricultural Mechanization, 1870–1930," *Agricultural History* 62 (1988): 86–112.
3. David Goodman, Bernardo Sorj, and John Wilkinson, eds., *From Farming to Biotechnology: A Theory of Agro-Industrial Development* (Oxford: Basil Blackwell, 1987).
4. Mary Neth, *Preserving the Family Farm: Women, Community, and the Foundations of Agribusiness in the Midwest, 1900–1940* (Baltimore: Johns Hopkins University Press, 1995); Hal S. Barron, *Mixed Harvest: The Second Great Transformation in the Rural North, 1870–1930* (Chapel Hill: University of North Carolina Press, 1997); Jane Adams, *The Transformation of Rural Life: Southern Illinois, 1890–1990* (Chapel Hill: University of North Carolina Press, 1994); Ronald R. Kline, *Consumers in the Country: Technology and Social Change in Rural America* (Baltimore: Johns Hopkins University Press, 2000). See also Nancy Grey Osterud, *Bonds of Community: The Lives of Farm Women in Nineteenth-Century New York* (Ithaca: Cornell University Press, 1991).

5. The notion of technological systems was introduced by Thomas P. Hughes in *Networks of Power: Electrification in Western Society, 1880–1930* (Baltimore: Johns Hopkins University Press, 1983). Benton MacKaye, "The New Exploration: Charting the Industrial Wilderness," *Survey Graphic,* May 1, 1925, pp. 153–157, 192, 194.
6. Henry A. Wallace, "Odds and Ends," *Wallaces' Farmer* 55 (October 18, 1930), p. 1661.
7. See Ellis W. Hawley, *The Great War and the Search for a Modern Order: A History of the American People and Their Institutions, 1917–1933* (New York: St. Martin's Press, 1979), p. 88; P. G. Holden to Mortimer C. Cooley, August 7, 1915 (MCE, box 7, folder "June 1913").
8. On the triumph and paradox of scientific and technological change in agriculture during this period, see United States Department of Agriculture, *Technology on the Farm* (Washington, D.C.: Government Printing Office, 1940). Although women were centrally involved in many farm operations, I generally refer to farmers as "he" because that is the language of my sources.
9. On Hoover see Hawley, *The Great War,* p. 55. See also Robert Wiebe's *The Search for Order, 1877–1920* (New York: Hill and Wang, 1967) for the classic account of the rise of bureaucratic, professional social mores in America.
10. Kate Brown, "Gridded Lives: Why Kazakhstan and Montana Are Nearly the Same Place," *American Historical Review* 106 (February 2001): 17–48 on p. 22. The idea that agricultural developments in one part of the country would affect practices elsewhere was remarked on by many; see, e.g., "Factory Farming," *Pennsylvania Farmer,* December 22, 1928, p. 3.

CHAPTER 1: THE INDUSTRIAL IDEAL IN AMERICAN AGRICULTURE

Epigraph: E. G. Nourse, "Economic Issues of Large-Scale Farming," *Agricultural Engineering* 10 (January 1929): 13–17 on p. 17.

1. Secretary of Agriculture, *Annual Report of the Secretary* (Washington, D.C.: Government Printing Office, 1924).
2. An excellent discussion of regional variations is Gilbert Fite, *American Farmers: The New Minority* (Bloomington: Indiana University Press, 1981), pp. 20–22.
3. Fite, *American Farmers,* pp. 22–24.
4. Commission on Interracial Cooperation, "The South's Landless Farmers" (Atlanta: Commission on Interracial Cooperation, 1937), n.p., quoted in Gilbert Fite, *Cotton Fields No More: Southern Agriculture, 1865–1980* (Lexington: University of Kentucky Press, 1984), p. 150.
5. Fite, *Cotton Fields,* pp. 150–51.
6. Fite, *Cotton Fields,* pp. 150–89; Pete Daniel, *Breaking the Land: The Transformation of Cotton, Tobacco, and Rice Cultures Since 1880* (Urbana: University of Illinois Press, 1985), especially pp. 245–51.
7. Daniel, *Breaking the Land,* pp. 215–36, on p. 222.
8. Fite, *American Farmers,* p. 25. See also Jane Adams's fascinating ethnohistory of seven southern Illinois farms in *The Transformation of Rural Life: Southern Illinois, 1890–1990* (Chapel Hill: University of North Carolina Press, 1994). Mary Neth's account of farm

communities during this period emphasizes the tension between mechanization and agrarian values of reciprocity and exchange; see Mary Neth, *Preserving the Family Farm: Women, Community, and the Foundations of Agribusiness in the Midwest, 1900–1940* (Baltimore: Johns Hopkins University Press, 1995). A great deal could be written on farmers' changing self-perception; David Vaught suggests that in California, growers preferred to be considered horticulturalists rather than farmers, and thus of a higher social class; see David Vaught, *Cultivating California: Growers, Specialty Crops, and Labor, 1875–1920* (Baltimore: Johns Hopkins University Press, 1999), pp. 9–10.

9. Fite, *American Farmers,* pp. 26–27; William C. Robbins, *Colony and Empire: The Capitalist Transformation of the American West* (Lawrence: University Press of Kansas, 1994), p. 74. On the bonanza farms see Hiram M. Drache, *The Day of the Bonanza: A History of Bonanza Farming in the Red River Valley of the North* (Fargo: North Dakota Institute for Regional Studies, 1964); see also Alva Benton, "Large Land Holdings in North Dakota," *Journal of Land and Utility Economics* 1 (October 1925): 405–13. On the role of the railroads see Roy V. Scott, *Railroad Development Programs in the Twentieth Century* (Ames: Iowa State University Press, 1985).
10. Steven Stoll, *The Fruits of Natural Advantage: Making the Industrial Countryside in California* (Berkeley: University of California Press, 1998), pp. 25–29. The classic fictional account of the role of the railroad in nineteenth-century California agriculture is Frank Norris's *The Octopus: A Story of California* (1901; repr. New York: Penguin, 1986); Donald J. Pisani, *From the Family Farm to Agribusiness: The Irrigation Crusade in California and the West, 1850–1931* (Berkeley: University of California Press, 1984), pp. 6–10.
11. Although Vaught is reluctant to call his growers "industrial," their enthusiasm for new technologies and science, reliance on experts, and elaborate organizational techniques related to marketing seem to me important markers of a new approach. See Vaught, *Cultivating California,* pp. 7–10.
12. Theodore Saloutos and John D. Hicks, *Agricultural Discontent in the Middle West, 1900–1939* (Madison: University of Wisconsin Press, 1951), p. 90; on land prices see Willard W. Cochrane, *The Development of American Agriculture: A Historical Analysis*, 2d ed. (Minneapolis: University of Minnesota Press, 1993), p. 100.
13. The best book on the 1920s farm crisis is James Shideler, *Farm Crisis* (Berkeley: University of California Press, 1957). In his "The Year in Agriculture," *Yearbook of Agriculture for 1922* (Washington: Government Printing Office, 1923), pp. 2–10, Secretary of Agriculture Henry C. Wallace reported poignantly on the difficulties facing American farmers. See also George Warren, "Which Does Agriculture Need—Readjustment or Legislation?" *Journal of Farm Economics* 10 (January 1928): 1–15, in which he rehashes the arguments among economists regarding the causes of the farm crisis. For a good overview of the situation in Montana see Michael P. Malone, Richard B. Roeder, and William L. Lang, *Montana: A History of Two Centuries* (Seattle: University of Washington Press, 1976), especially chapters 10 and 12.
14. Saloutos and Hicks, *Agricultural Discontent,* p. 100.
15. Malone, Roeder, and Lang, *Montana,* p. 283.
16. Henry C. Wallace, "A National Agricultural Program: A Farm Management Problem," *Journal of Farm Economics* 6 (January 1924): 1–7 on p. 2.

17. See, for example, Catherine McNicol Stock, *Rural Radicals: Righteous Rage in the American Grain* (Ithaca: Cornell University Press, 1996).
18. Economist E. G. Nourse located the beginnings of urban interest in farming even earlier: "Migration to the city, decline of our agricultural surplus, and the rising cost of living have caused merchants, bankers, educators, politicians and even the private consumer to feel a sudden access of interest in questions touching the economic organization of our agriculture. They have not been concerned primarily about the prosperity of the individual farmer nor pledged to maintain the existing order, but they have been decidedly solicitous about the efficient working of the system as a whole, to the end that there may be cheap and abundant materials for trade and manufactures and a lower cost of living." Edwin G. Nourse, "What is Agricultural Economics?" *Journal of Political Economy* 24 (April 1916): 377, quoted in H. C. M. Case and D. B. Williams, *Fifty Years of Farm Management* (Urbana: University of Illinois Press, 1957), p. 141.
19. The Harvard professor was Thomas N. Carver, from discussion at the Conference on Farm Life Studies, Office of Farm Management, United States Department of Agriculture (USDA), May 1–3, 1919 (National Archives, Record Group 83, box 3, series 124), pp. 74–75; Charles H. Everett, editor, *Wisconsin Agriculturalist,* to John D. Black, December 1, 1925 (John D. Black Papers, box 1, folder 1925, Historical Society of Wisconsin); see John Gjerde, *Minds of the West: Ethnocultural Evolution in the Rural Middle West, 1830–1917* (Chapel Hill: University of North Carolina Press, 1997), for an excellent discussion of the ethnic enclaves in the upper midwest; Benjamin C. Marsh to John D. Black, November 28, 1925 (Black papers, box 1, folder 1925).
20. D. H. Otis, "The Farm Manager Well Trained," *Record of the Proceedings of the American Farm Management Association,* hereafter *Proc. AFMA* (November 1914): 10; W. J. Spillman, "Farm Organization Investigations and Their Relation to the Farm Survey," *Proc. AFMA* (November 1914): 12–14 on p. 12; George F. Warren, "Farm Efficiency Factors and Cautions in Their Use," *Proc. AFMA* (November 1914): 44–50; Andrew Boss, "What the Future Holds in Farm Management," *Proc. AFMA* (August 1915): 5–9 on p. 6; F. W. Peck, "Farm Records as a Basis of Increasing Farm Profits and Improving Methods of Management," *Proc. AFMA* (November 1913): 53–62.
21. Michel Foucault, *Discipline and Punish: The Birth of the Prison,* trans. Alan Sheridan (New York: Pantheon, 1977).
22. For the shift from artisanal to industrial production in nineteenth-century America, see Merritt Roe Smith, *Harpers Ferry Armory and the New Technology: The Challenge of Change* (Ithaca: Cornell University Press, 1977); Steven J. Ross, *Workers on the Edge* (New York: Columbia University Press, 1985); Judith McGaw, *Most Wonderful Machine: Mechanization and Social Change in Berkshire Paper Making, 1801–1885* (Princeton: Princeton University Press, 1987); and Daniel Nelson, *Managers and Workers: Origins of the New Factory System in the United States, 1880–1920* (Madison: University of Wisconsin Press, 1975). For the factory, see Lindy Biggs, *The Rational Factory* (Baltimore: Johns Hopkins University Press, 1998).
23. For the Lowell system, see Lawrence F. Gross, *The Course of Industrial Decline* (Baltimore: Johns Hopkins University Press, 1993); Thomas Dublin, *Women at Work* (New York: Columbia University Press, 1979); Gary Kulik, "A Factory System of Wood: Cultural and

Technological Change in the Building of the First Cotton Mills," in Brooke Hindle, ed., *Material Culture of the Wooden Age* (Tarrytown, N.Y.: Sleepy Hollow, 1981), pp. 300–335.

24. David Hounshell, *From the American System to Mass Production* (Baltimore: Johns Hopkins University Press, 1984). For Blanchard, see Carolyn Cooper, *Shaping Invention: Thomas Blanchard's Machinery and Patent Management in Nineteenth-Century America* (New York: Columbia University Press, 1991).
25. See George L. Henderson, *California and the Fictions of Capital* (New York: Oxford University Press, 1999), especially pp. 3–27.
26. Lewis Mumford, *Technics and Civilization* (New York: Harcourt, Brace, 1934); Bruno Latour, "Where are the Missing Masses? The Sociology of a Few Mundane Artifacts," in Wiebe Bijker and John Law, eds., *Shaping Technology/Building Society* (Cambridge: MIT Press, 1992), pp. 225–58; David Noble, *Forces of Production* (New York: Oxford University Press, 1984).
27. In early-nineteenth-century industrialization, standardized parts were not necessarily interchangeable because they were often still made by artisans. Only when parts were machine made did they become interchangeable.
28. Alfred Chandler, *The Visible Hand: The Managerial Revolution in American Business* (Cambridge: Harvard University Press, 1977). The notion of efficiency is extremely problematic, and frequently refers to power relations as much as speed or economy of work.
29. Frederick Winslow Taylor, *Principles of Scientific Management* (New York: Harper, 1911). The best account of scientific management in industry is Hugh Aitken, *Scientific Management in Action: Taylorism at the Watertown Arsenal* (repr. Princeton: Princeton University Press, 1985); Robert Kanigal, *The One Best Way: Frederick Winslow Taylor and the Enigma of Efficiency* (New York: Viking, 1997).
30. For Ford see Hounshell, *From the American System to Mass Production;* Stephen Meyer III, *The Five Dollar Day: Labor Management in the Ford Motor Company, 1908–1921* (Albany: SUNY Press, 1981).
31. The literature on modernism is too large to cite here; but I have found useful David Harvey, *The Condition of Postmodernity: An Inquiry into the Origins of Cultural Change* (Oxford: Blackwell, 1989); Ansen Rabinbach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity* (New York: Basic Books, 1990); Terry Smith, *Making the Modern: Industry, Art, and Design in America* (Chicago: University of Chicago Press, 1993).
32. David Danbom, *The Resisted Revolution*: *Urban America and the Industrialization of Agriculture, 1900–1930* (Ames: Iowa State University Press, 1979).
33. The now-classic study of the contours and consequences of industrial farming in the lower plains is Donald Worster, *Dust Bowl* (New York: Oxford University Press, 1979). On irrigation, see, for example, Mark Fiege, *Irrigated Eden: The Making of an Agricultural Landscape in the American West* (Seattle: University of Washington Press, 1999). For dry-land farming on the upper plains, see Mary Wilma Hargreaves's masterful books, *Dry Farming in the Northern Great Plains, 1900–1925* (Cambridge: Harvard University Press, 1957), and *Dry Farming in the Northern Great Plains: Years of Readjustment, 1920–1990* (Lawrence: University Press of Kansas, 1993). Comments from Herbert Quick (Farm Loan Board, Treasury Department) at the 1919 Conference on Farm Life Studies (Record Group 83, box 3, series 124, National Archives), p. 9.

34. J. L. Dumas (banker and farmer from Dayton, Washington) at the 1919 Conference on Farm Life Studies (Record Group 83, box 3, series 124, National Archives), pp. 18–19; T. C. Atkesen (National Grange), ibid., pp. 26–27; Roger Babson, "Effects of Business upon Agriculture," *Journal of Farm Economics* 6 (January 1924): 41–60 on p. 53; George Stewart, "Can the Farms of the United States Pay for Themselves?" *Journal of Farm Economics* 2 (October 1920): 177–92; Henry C. Wallace, "Annual Report of the Secretary," *Yearbook of Agriculture for 1923* (Washington: Government Printing Office, 1924), p. 10.
35. See H. R. Tolley, "The Relation of Efficiency in Production to Returns from Farming," paper delivered to the Land Grant Association, November 16, 1926 (Record Group 83, box 2, series 124). The vantage point issue is in Henry C. Taylor, "Research in Agricultural Economics," *Journal of Farm Economics* 10 (January 1928): 33–41, and M. L. Wilson, "The Source Material of Economic Research and Points of View in Its Organization," *Journal of Farm Economics* 8 (January 1926): 1–15.
36. H. C. Wallace, "Annual Report of the Secretary," *Yearbook of Agriculture for 1921* (Washington: Government Printing Office, 1922), p. 16; Henry C. Taylor, "The New Farm Economics," *Journal of Farm Economics* 11 (July 1929): 362–63; Walton H. Hamilton, "Agricultural Research in a Changing Order," *Journal of Farm Economics* 8 (January 1926): 56–65, on p. 61; E. G. Nourse, "The Outlook for Agriculture," *Journal of Farm Economics* 9 (January 1927): 21–52; E. G. Nourse, "Some Economic Factors in an American Agricultural Policy," *Journal of Farm Economics* 7 (January 1925): 1–21.
37. E. G. Nourse, "The Outlook for Agriculture," pp. 29 and 51; John D. Black, "Agriculture Now?" *Journal of Farm Economics* 9 (April 1927): 137–62; Benjamin C. Marsh to John D. Black, November 28, 1925 (John D. Black papers, box 1, folder 1925).

CHAPTER 2: BY THE NUMBERS

Epigraph: George Warren, "Agricultural Surveys," *United States Department of Agriculture Bulletin 344* (1914): 422–24.

1. Here I am relying upon James C. Scott's discussion of the relations between the state and agricultural production; see Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven: Yale University Press, 1998); William Cronon, *Nature's Metropolis: Chicago and the Great West* (New York: Norton, 1991); and on the food security question, see John Perkins, *Geopolitics and the Green Revolution: Wheat, Genes, and the Cold War* (New York: Oxford, 1997).
2. Henry C. Taylor and Anne Dewees Taylor, *The Story of Agricultural Economics in the United States, 1840–1932* (Ames: Iowa State College Press, 1952); see also Alfred Charles True, *Alfred True on Agricultural Experimentation and Research* (New York: Arno Press, 1980) for detailed information on when courses of study were offered at the agricultural colleges. Louis Ferleger and William Lazonick describe this shift in terms of a "managerial revolution" that was promoted by the federal government; see their "The Managerial Revolution and the Developmental State: The Case of U.S. Agriculture," *Business and Economic History* 22 (winter 1993): 67–98; see also Ferleger and Lazonick, "Higher Education for an Innovative Economy: Land-Grant Colleges and the Managerial Revolution in America," *Business and Economic History* 23 (fall 1994): 116–27.

3. This refers to the creation of what Jim Scott calls "an agriculture of legibility and simplicity" (*Seeing Like a State,* pp. 262–306).
4. "In 1848 it was reported that the cost of raising wheat was $9.40 an acre, and resulted in a profit of $4.10. The cost of producing an acre of corn was $32.00, and the profit was $11.50." Such figures were typical of the somewhat random reports farmers offered; see J. T. Horner, "The United States Governmental Activities in the Field of Agricultural Economics Prior to 1913," *Journal of Farm Economics* 10 (October 1928): 429–60 on p. 438.
5. The organization of American agriculture is discussed in A.Hunter Dupree, *Science in the Federal Government* (Cambridge: Harvard University Press, 1957), chapter 8; Charles Rosenberg, *No Other Gods: On Science and American Social Thought* (Baltimore: Johns Hopkins University Press, 1976); Alan I. Marcus, *Agricultural Science and the Quest for Legitimacy* (Ames: Iowa State University Press, 1985); Deborah Fitzgerald, *The Business of Breeding: Hybrid Corn in Illinois* (Ithaca: Cornell University Press, 1990), chapter 1; Margaret Rossiter, "The Organization of the Agricultural Sciences," in Alexandra Oleson and John Voss, eds., *The Organization of Knowledge in Modern America, 1860–1920* (Baltimore: Johns Hopkins University Press, 1979), pp. 211–48. On farmers' ambivalent feelings regarding urban-based traditions and values, see David Danbom, *The Resisted Revolution: Urban America and the Industrialization of Agriculture, 1900–1930* (Ames: Iowa State University Press, 1979), and Hal Barron, *Mixed Harvest: The Second Great Transformation in the Rural North, 1870–1930* (Chapel Hill: University of North Carolina Press, 1997).
6. Isaac Phillips Roberts, *The Farmer's Business Handbook* (New York: McMillan, 1903); see also H. L. Steiner, *How to Keep Farm Accounts* (Toledo, Ohio: Steiner, 1908); John A. Bexell, *Farm Accounting and Business Methods* (Springfield, Mass.: The Home Correspondence School, 1911).
7. Winifred Rothenberg, *From Market Places to a Market Economy: The Transformation of Rural Massachusetts, 1750–1850* (Chicago: University of Chicago Press, 1992). Taylor and Taylor, *The Story of Agricultural Economics,* pp. 326–53.
8. Willard W. Cochrane, "Agricultural Economics at the University of Minnesota, 1886–1979" (Minnesota Agricultural Experiment Station, Department of Agricultural and Applied Economics, misc. publication no. 21, 1983), p. 5; see also Taylor and Taylor, *The Story of Agricultural Economics*, pp. 394–403. For examples of this approach, see Andrew Boss, "Detailed Cost Studies," *Journal of Farm Economics* 8 (January 1926): 126–36; and Andrew Boss, "Forty Years of Cost Accounting Records," *Journal of Farm Economics* 27 (February 1945): 3–6.
9. On Bailey, see Taylor and Taylor, *The Story of Agricultural Economics,* pp. 347–50, quoted on p. 50; on Cornell generally see ibid., pp. 356–66; George Warren, "Agricultural Surveys," *United States Department of Agriculture Bulletin* 344 (1914): 422–24. For a critique of these methods see C. L. Holmes, "Reorganization from the Point of View of the Individual Farm," *Journal of Farm Economics* 8 (January 1926): 102–17.
10. Thomas Haskell, *The Authority of Experts: Studies in History and Theory* (Bloomington: Indiana University Press, 1984); M. C. Burritt, "Farm Management Demonstrations—Past, Present, and Future," *Journal of Farm Economics* 1 (September 1919): 63; H. C. M. Case to H. C. Taylor, in reference to Utah farmers, October 27, 1919, and H. C. M. Case to H. C. Taylor, February 17, 1921 (both in BAE-NA, box 2, series 124); P. K. Whelpton,

"Demonstration Work on Cost of Production Records in Nebraska," *Journal of Farm Economics* 1 (September 1919): 48; Secretary of Agriculture E. T. Meredith sounded an optimistic note when he wrote in 1920: "Cost studies also inform the general public regarding the cost of producing farm products and should tend to bring about a more general realization on the part of the consumer of the necessity of paying prices which will adequately reward the farmer and secure the necessary supplies in the market"; see "Report of the Secretary," *Yearbook of Agriculture for 1920* (Washington: Government Printing Office, 1921), p. 29.

11. For Wisconsin, see D. H. Otis, "Field Course in Farm Management," *Proc. AFMA* (November 1913): 28–36; D. H. Otis, "The Farm Manager Well Trained," *Proc. AFMA* (November 1914): 9. For the cooperative engineering courses, see David F. Noble, *America by Design: Science, Technology, and the Rise of Corporate Capitalism* (New York: Knopf, 1977), chapter 8; and W. Bernard Carlson, "Academic Entrepreneurship and Engineering Education: Dugald C. Jackson and the MIT-GE Cooperative Engineering Course, 1907–1932," *Technology and Culture* 29 (July 1988): 536–67; for Missouri, see D. H. Doane, "Classroom Work in Farm Management," *Proc. AFMA* (November 1913): 42–43; Andrew Boss to President G. E. Vincent, October 10, 1912, quoted in Cochrane, "Agricultural Economics at the University of Minnesota," p. 10; for California, see Loy Sammet, "Agricultural Economics in the University of California at Berkeley," pp. 1–2, and E. C. Voorhies, "Beginnings of Agricultural Economics at the University of California," February 8, 1939, both in Giannini Foundation of Agricultural Economics Library, University of California at Berkeley.
12. The Office of Farm Management was located in the Bureau of Plant Industry; the Bureau of Agricultural Economics was not opened until 1922. Sigmund von Frauendorfer, "Development Methods and Results of Agricultural Economic Research in the United States," *Journal of Farm Economics* 10 (July 1928): 286–311. See also J. T. Horner, "The United States Governmental Activities in the Field of Agricultural Economics Prior to 1913," *Journal of Farm Economics* 10 (October 1928): 429–60.
13. Von Frauendorfer, "Development Methods," pp. 294–95. The history of agricultural economics, as opposed to farm management, is not well covered; but see Richard Lowitt, *Journal of a Tamed Bureaucrat: Nils A. Olsen and the BAE, 1925–1935* (Ames: Iowa State University Press, 1980); Henry Charles Taylor, *A Farm Economist in Washington, 1919–1925* (Evanston, Illinois, 1926; repr. Madison: Department of Agricultural Economics, University of Wisconsin at Madison, 1992); many thanks to Jess Gilbert for giving me a copy of this book.
14. H. C. Taylor, "Development of the American Farm Economics Association," *Journal of Farm Economics* 4 (April 1922): 94; "Report of the Committee on Teaching," *Proc. AFMA* (November 1913): 6–9; von Frauendorfer, "Development Methods," pp. 294–95.
15. George Warren, "President's Annual Address," *Proc. AFMA* (November 1913): 21; D. H. Otis, "The Farm Manager Well Trained," *Proc. AFMA* (November 1914): 5–12 on p. 7; H. W. Jeffers, "Our Immediate Responsibility," *Proc. AFMA* (December 1917): 5–8 on p. 7. Lawrence Busch and William B. Lacy, *Science, Agriculture, and the Politics of Research* (Boulder: Westview Press, 1983).
16. Jeffers, "Our Immediate Responsibility," pp. 5–8 on p. 8; G. I. Christie, citing Secretary

Meredith, "Office of Farm Management—Conference on Farm Organization and Farm Equipment," Office of Farm Management, USDA, April 17–19, 1919, p. 2; Christie's comments on p. 55 (BAE-NA, box 3, series 124); the other two conferences were "Office of Farm Management—Conference on Farm Life Studies," Office of Farm Management, USDA, May 1–3, 1919 (ibid.); "Office of Farm Management—Conference on Land Economics," Office of Farm Management, USDA [spring 1919] (ibid.); von Frauendorfer, "Development Methods," pp. 299–300.

17. For tensions, see Taylor and Taylor, *The Story of Agricultural Economics,* pp. 84–98; von Frauendorfer, "Development Methods," pp. 294–95; Henry C. Taylor, "Research in Agricultural Economics," *Journal of Farm Economics* 10 (January 1928): 33–41. Remarks about USDA and state college agricultural employees are based on my unpublished research on the educational and career paths of agriculturalists in the late 1910s and 1920s. The primary source of information is a publication called, variously, "List of Technical Workers in the Department of Agriculture" or "List of Workers in Subjects Pertaining to Agriculture and Home Economics in the USDA and in the State Agricultural Colleges and Experiment Stations" (USDA, misc. publications, published under various titles from 1914 on); George Warren to Richard Ely, September 25, 1918 (RE, box 61, folder 6); L. H. Bailey to H. C. Taylor, March 1, 1903 (HCT, box 6, folder 5); Henry A. Wallace to Henry C. Taylor, January 4, 1924 (HCT, box 25, folder 6). When Taylor told Wallace of his concern that he, Taylor, appeared to "knock economists," Wallace replied, "A certain amount of knocking will do them good. . . . Who could knock economists more effectively than the one who knows them from the inside? Of course none of us want to knock economists except insofar as they prostitute themselves by going over to the enemy too easily" (Wallace to Taylor, December 1, 1927, HCT, box 25, folder 6). Cochrane, "Agricultural Economics at the University of Minnesota," pp. 12–15; John D. Black to Benjamin F. Hubert [c. March 10, 1929] (JDB, box 2, folder 1929-March); M. L. Wilson, "The Source Material of Economic Research and Points of View in its Organization," *Journal of Farm Economics* 8 (January 1926): 1–15.

18. Early models included E. C. Parker and T. P. Cooper, "The Cost of Producing Minnesota Farm Products, 1902–1907," *USDA Bulletin* 117 (April 1910); H. C. Taylor, "The Prices of Farm Products," *USDA Bulletin* 209 (May 1911); E. L. Currie, "The Cost of Growing Wheat on Irrigated Areas in the Gallatin Valley," *USDA Bulletin* 111 (October 1916); F. W. Peck, "Methods of Conducting Cost of Production and Farm Organization Studies," *USDA Bulletin* 994 (November 15, 1921); Rex E. Willard, "Annual Report of Farm Management Extension, North Dakota, 1925" (FES, T-879, reel 10); H. C. Taylor, "Research in Agricultural Economics," *Journal of Farm Economics* 10 (January 1928): 33–41; after farm management, the next most popular research subject was the marketing of farm products, followed by farm credit and then land economics. H. C. M. Case, "Trip to Wisconsin, Minnesota, Iowa, Indiana, and Michigan," [1920] (BAE-NA, entry 124, box 2); and "Annual Report of Farm Management Extension, Iowa, 1920" (FES, T-860, reel 7).

19. Colorado, California, Wyoming, Nevada, Idaho, and Washington either had not yet started the work or were just beginning to distribute account books, often without much instructional support. Work was strong in Illinois, Ohio, Minnesota, Nebraska, and the Dakotas, although Missouri was having trouble. Maine was the only New England state

with a program in place, although New Hampshire, Massachusetts, Vermont, and Connecticut were trying to hire someone to start the programs in their states. See H. C. M. Case to H. C. Taylor, trip reports for August 23, October 20, and October 27, 1919 (BAE-NA, box 2, series 124).

20. F. Josiah Chase, "Report of Farm Management Demonstration," Montana State College of Agriculture, Co-operative Agricultural Extension Circular no. 8, December 1, 1915; Chase, "Results of Demonstrations in Missoula County," 1916 (MLW, box 22 of 46, file T-18).
21. M. L. Wilson, "Annual Report, Farm Management Demonstration Work, 1922," and M. L. Wilson, "Annual Report of Farm Management Demonstration Work, 1923" (both in MLW, box 23, file T-24).
22. F. Josiah Chase to Ernest W. Anderson, April 28, 1916 (MLW, box 22 of 46, file T-18).
23. "Report of the Secretary," *Yearbook of Agriculture, 1925* (Washington, D.C.: Government Printing Office, 1926), p. 21.
24. Henry Ford, in collaboration with Samuel Crowther, *My Life and Work* (Garden City, N.J.: Doubleday, 1922). On Ford's village industries see Howard Segal, "Little Plants in the Country: Henry Ford's Village Industries and the Beginning of Decentralized Technology in Modern America," in Jack Salzman, ed., *Prospects: The Annual of American Cultural Studies* 13 (New York: Cambridge University Press, 1988), pp. 181–223.
25. M. L. Mosher and H. C. M. Case, "Second Annual Report for the Cooperation in the Farm Bureau–Farm Management Service for the Year 1926," University of Illinois department of farm management and the farm bureaus of Livingston, McLean, Tazewell, and Woodford Counties, April 22, 1927 (MLW, box 3 of 46, folder D-22).
26. "Report of the Farm Management Extension Committee," submitted to and unanimously adopted by county agricultural agents of Montana at their annual winter conference, Bozeman, Mont., January 20, 1917 (MLW, box 22 of 46, folder T-19); see also Chase to F. S. Cooley, February 26, 1917 (*ibid.*, folder T-18).
27. "Report of the Secretary," *Yearbook of Agriculture, 1924* (Washington, D.C.: Government Printing Office, 1925), p. 53.
28. "Report of the Secretary," 1924, p. 53.
29. F. Josiah Chase, "Annual Report of Farm Management Demonstrations in Montana for 1916" (MLW, box 22 of 46, file T-18); F. Josiah Chase, "Narrative Report," December 1916 (MLW, box 22 of 46, folder T-19); H. C. M. Case to H. C. Taylor, February 27, 1920, and Case to Taylor, June 10, 1921 (BAE-NA, box 2, series 124). Farm management extension annual reports for Iowa, 1925 (FES, T-860, reel 27), and North Dakota, 1925 (FES, T-879, reel 10). For the various federal acts see Alfred Charles True, *Agricultural Experimentation and Research,* pp. 356–73 and passim; Mary Neth, *Preserving the Family Farm: Women, Community, and the Foundations of Agribusiness in the Midwest, 1900–1940* (Baltimore: Johns Hopkins University Press, 1995).
30. P. K. Whelpton, "Demonstration Work on Cost of Production Records in Nebraska," *Journal of Farm Economics* 1 (September 1919): 47–48; Case to Taylor, October 11, 1920, and Case to Taylor, February 17, 1921 (BAE-NA, box 2, series 124).
31. M. L. Mosher, "Farm Management and the County Agent's Program," Complete Report of the Farm Management Section of the Conference of Extension Workers of the Corn

Belt States, May 16–18, 1923, pp. 26–27; H. C. M. Case, trip report (Wisconsin, Minnesota, Iowa, Indiana, Michigan) [1920]; and Case to H. C. Taylor, February 17, 1921 (BAE-NA, entry 124, box 2). The best book on county fairs is Leslie Prosterman, *Ordinary Life, Festival Days: Aesthetics in the Midwestern County Fair* (Washington: Smithsonian Institution Press, 1995), which includes a lengthy discussion of the practice and psychology of contest evaluations.

32. G. I. Christie to H. C. Taylor, March 9, 1920 (BAE-NA, entry 124, box 2); H. C. Taylor to Donald Murphy, January 7, 1927 (HCT, box 25, file 6). On scorecards, see Deborah Fitzgerald, "Farmers Deskilled: Hybrid Corn and Farmers' Work," *Technology and Culture* 34 (April 1993): 324–43; "Farm Management Extension Annual Report, North Dakota, 1925" (FES, T-879, reel 10).
33. M. L. Wilson to Arthur Woods, April 20, 1923 (MLW, box 36 of 46, folder AJ-2).
34. H. C. Taylor, "The Fairway Farms Project," n.d. (MLW, box 37 of 46, folder AK-2).
35. Taylor, "Fairway Farms" (ibid.); Harold Fabian to Arthur Woods, February 26, 1930 (MLW, folder AI-4); M. L. Wilson, "Report of Secretary and Managing Director to the Board of Directors, Fairway Farms Corporation, for the Years 1925–1926," January 25, 1927, pp. 12–13 (MLW, box 36 of 46, folder AH-16); Mary Hargreaves, *Dry Farming in the Northern Great Plains,* 1900–1925 (Cambridge: Harvard University Press, 1957), pp. 478–83; "Report of the Secretary," *Yearbook of Agriculture for 1929* (Washington, D.C.: Government Printing Office, 1930), p. 17.
36. Hargreaves, *Dry Farming,* pp. 48–50.
37. M. L. Wilson, "Annual Report, Farm Management Demonstration Work, 1922" (MLW, box 23, file T-24).
38. M. L. Wilson, "Reminiscences of Milburn Lincoln Wilson" (New York: Columbia Oral History Research Office, 1975); see also William Rowley, *M. L. Wilson and the Campaign for the Domestic Allotment* (Lincoln: University of Nebraska Press, 1970); Harry C. McDean, "M. L. Wilson and the Origins of Federal Farm Policy in the Great Plains, 1909–1914," *Montana: The Magazine of History* 34 (autumn 1984): 50–59.
39. Harold Fabian to Arthur Woods, February 26, 1930; M. L. Wilson, "Report of Secretary . . . for the Years 1925–26" (MLW, folder AH-16), p. 13.
40. M. L. Wilson, "Reminiscences," pp. 542–45. The Fairway project was also seen by some as "a practical experiment in dealing with the problems of the agricultural 'ladder.'" See L. C. Gray, "The Status of American Research Work in Agricultural Land Economics," *Journal of Farm Economics* 10 (April 1928): 137–50 on p. 147.
41. H. C. Taylor, "Reminiscences of Henry C. Taylor" (Columbia Oral History Project, 1952), pp. 149–53. Rudolf Bertheau to Beardsley Ruml, October 29, 1923 (LSRM, series 3, box 56, folder 605); Ruml to A[rthur] W[oods], December 21, 1923 (*ibid.,* box 60, folder 648); John D. Rockefeller to Raymond Fosdick, April 25, 1924 (RF, 2c, box 46, folder 393). Regarding the overseeing committees, see M. L. Wilson to Beardsley Ruml, March 27, 1924 (MLW, box 36 of 46, folder AI-2); Wilson to H. C. Taylor, February 23, 1924 (MLW, box 37 of 46, folder AK-2). See [Wilson], "Outline of Plan of Organization and Operation of the Fairway Farms Corporation of Montana" (MLW, box 36 of 46, file AJ-3). Chester Davis bumped around quite a bit before joining the Agricultural Adjustment Administration in 1933. After serving in Montana, he spent a year as director of grain marketing for the Illi-

nois Agricultural Association, several years as an agricultural consultant, and four years as executive vice president of Cornstalk Processes; see "The Reminiscences of Chester C. Davis" (Columbia Oral History Project, 1952–53). Ely often complained to Wilson that he was not kept apprised of Fairway matters, and Wilson seems to have thought that Taylor would keep Ely informed; see Richard Ely to Wilson, February 7, 1928 (MLW, box 36 of 46, folder AJ-2), and Wilson to Taylor, February 24, 1928 (MLW, box 37 of 46, folder AK-4). Wilson tried to keep publicity on the Fairway to a minimum because the press seemed to misrepresent the Fairway idea and focus instead on Rockefeller; see Wilson to Ely, June 1, 1925 (RE, box 92, folder 3).

42. M. L. Wilson to Richard Ely, March 27, 1924 (RE, box 87, folder 1); M. L. Wilson, "Progress Report of the Fairway Farms Corporation of Montana," January 10, 1925, p. 2 (MLW, box 36 of 46, folder AH-15); M. L. Wilson to J. L. Humphrey, September 5, 1924 (MLW, box 37 of 46, folder AJ-4); for detailed reports of different farms see Wilson to Richard Ely, October 21, 1924 (RE, box 89, folder 7). Ely, Taylor, and others went to Montana to take a driving tour with Wilson of possible farms for Fairway.
43. M. L. Wilson to J. L. Humphrey, September 3, 1924, and Wilson to Humphrey, November 15, 1924 (both in MLW, box 37 of 46, folder AJ-4).
44. Descriptions of tenants are from the 1927 and 1937 annual reports regarding each farm. See subsequent notes for details.
45. See files "Rosebud Farm" [1927] and "Rosebud Farm" [1937] (MLW, box 41 of 46, folders AS-82 and 83).
46. "Rosebud Farm" [1937], p. 10.
47. "Cloverleaf Farm" [1927] and "Cloverleaf Farm" [1937] (MLW, box 39 of 46, folder AS-1); "Cloverleaf Farm" [1937], pp. 1–2;
48. "Cloverleaf Farm" [1937], p. 8.
49. "Cloverleaf Farm" [1937], p. 7.
50. J. L. Humphrey to Wilson, September 12, 1925 (MLW, box 37 of 46, folder AJ-5); Wilson's optimism can be seen in "Financial Statement of Estimated Income, Fairway Farms Corporation Operations, 1925" (RE, box 95, folder 7); Rockefeller Foundation disbursements are listed in M. L. Wilson, "Report on Fairway Farms Corporation of Montana," November 18, 1929 (RF, 2c, box 46, folder 393); M. L. Wilson to H. C. Taylor, October 5, 1926 (MLW, box 37 of 46, folder AK-2), M. L. Wilson to Chester Davis, December 23, 1926 (MLW, box 36 of 46, folder AJ-1); H. C. Taylor to Chester Davis, January 18, 1927, and Davis to Taylor, January 20, 1927 (both in HCT, box 9, folder 7); Wilson's grief about selling the Brockton farm, and his relief after the Rockefeller bailout, were evident in his words to Davis: "I do not believe that you and [Nils] Olsen ever came nearer to getting five thousand dollars handed out on a silver platter than you did on this Lone Warrior deal." Wilson to Davis, February 26, 1927, and Davis to Wilson, January 28, 1927 (both in MLW, box 36 of 46, folder AJ-1).
51. Even some of Wilson's tenants were distracted by the Rockefeller money, and Humphrey, the treasurer, worried that they were careless with money because they could "turn on the faucet to the Rockefeller money." J. L. Humphrey to M. L. Wilson, January 13, 1926 (MLW, box 37 of 46, folder AJ-6); M. L. Wilson, "Progress Report of the Fairway Farms Corporation of Montana," January 10, 1925, pp. 1–2 (MLW, box 36 of 46, folder AH-15);

J. L. Humphrey to James Hobbins, November 30, 1926 (MLW, box 37 of 46, folder AJ-6); Richard Ely to M. L. Wilson, June 17, 1924 (RE, box 88, folder 3).

52. M. L. Wilson to Chester Davis, December 23, 1926 (MLW, box 36 of 46, folder AJ-1); M. L. Wilson to H. C. Taylor, January 28, 1927 (MLW, box 37 of 46, folder AK-3); Harold Fabian to Arthur Woods, February 26, 1930 (MLW, box 36 of 46, folder AI-4).
53. M. L. Wilson to H. C. Taylor, January 28, 1927 (MLW, box 37 of 46, folder AK-3); M. L. Wilson to H. C. Taylor, February 24, 1928 (MLW, box 37 of 46, folder AK-4); E. A. Starch to Allis Chalmers Tractor Company, March 2, 1932 (MLW, box 37 of 46, folder AM-5).
54. M. L. Wilson to H. C. Taylor, February 1, 1927 (MLW, box 37 of 46, folder AK-3).
55. M. L. Wilson, "Memoranda Regarding Report of Mr. Harold P. Fabian on the Fairway Farms Project of Montana Submitted to Colonel Arthur W. Woods on February 26, 1930," April 4, 1930, pp. 3–4 (MLW, box 36 of 46, folder AI-4); Harold Fabian to Arthur Woods, February 26, 1930 (ibid.).
56. Raymond Fosdick to Beardsley Ruml, October 31, 1929 (RF, 2c, box 46, folder 393); J. L. Humphrey to M. L. Wilson, May 5, 1930 (MLW, box 37 of 46, folder AJ-8); M. L. Wilson to Arthur Packard, September 21, 1932 (MLW, box 36 of 46, folder AI-3); Harold Fabian to Arthur Packard, December 5, 1932 (RF, 2c, box 46, folder 393); H. Fabian to A. Packard, March 2, 1933 (MLW, box 36 of 46, folder AI-3); H. C. Taylor, "Notes on Montana Trip, June 3–10, 1937" (MLW, box 36 of 46, folder AH-14); A. Packard to H. Fabian, June 29, 1942 (RF, 2c, box 46, folder 393).
57. M. L. Wilson to Richard Ely, December 1, 1924 (RE, box 90, folder 1); Wilson's early high spirits were everywhere apparent, as in his report on a fund-raising trip to St. Paul: "With reference to my stop in St. Paul, I took my letter of introduction to Mr. Pearson, thinking that I was quite a guy. He scarcely took time to read it and wrote 'Mr. Finnegan' on the corner and sent me downstairs." M. L. Wilson to J. L. Humphrey, November 29, 1924 (MLW, box 37 of 46, folder AJ-4); M. L. Wilson, "Reminiscences," pp. 534–35; Harold Fabian to Arthur Woods, February 26, 1930 (MLW, box 36 of 46, folder AI-4); Arthur Packard to M. L. Wilson, March 24, 1930, and Arthur Packard to Mr. Debevoise, December 9, 1932 (both in RF, 2c, box 46, folder 393).
58. Mary Hargreaves, *Dry Farming in the Northern Great Plains: Years of Readjustment, 1920–1990* (Lawrence: University Press of Kansas, 1993), p. 59.

CHAPTER 3: AGRICULTURAL ENGINEERS AND INDUSTRIALIZATION

Epigraph 1: Arnold Yerkes, "Relation of Large Machine Units to Production," *Transactions of the American Society of Agricultural Engineers* (hereafter *Trans. ASAE*) 12 (1918): 136–50 on p. 142.

Epigraph 2: Philip S. Rose, in a discussion of F. H. Demaree, "Larger Farm Implements and the Cost of Crop Production," *Trans. ASAE* 5 (1911): 26–42 on p. 38.

1. For an overview of the subject of farm mechanization see my "Beyond Tractors: The History of Technology in American Agriculture," *Technology and Culture* 32 (January 1991): 114–26.
2. For a curious comparison of rural and urban mechanization problems, see H. W. Peck, "The Influence of Agricultural Machinery and the Automobile on Farming Operations,"

Quarterly Journal of Economics 41 (1927): 534–44. Other engineers have been studied by Edwin T. Layton, Jr., *The Revolt of the Engineers: Social Responsibility and the American Engineering Profession* (Baltimore: Johns Hopkins University Press, 1986); Monte Calvert, *The Mechanical Engineer in America, 1830–1910: Professional Cultures in Conflict* (Baltimore: Johns Hopkins University Press, 1967); David Noble, *America by Design: Science, Technology, and the Rise of Corporate Capitalism* (New York: Knopf, 1977); Bruce Seely, "Research, Engineering, and Science in American Engineering Colleges: 1900–1960," *Technology and Culture* 34 (April 1993): 344–86. For the Country Life Commission, see David Danbom, *The Resisted Revolution: Urban America and the Industrialization of Agriculture, 1900–1930* (Ames: Iowa State University Press). For a good discussion of the backgrounds of more recent agricultural professionals, see Lawrence Busch and William Lacy, *Science, Agriculture, and the Politics of Research* (Boulder: Westview Press, 1983).

3. In his *Consumers in the Country: Technology and Social Change in Rural America* (Baltimore: Johns Hopkins University Press, 2000), Ron Kline argues that farm families were not "just" consumers, but rather were actively engaged in rejecting and transforming the technologies presented by urban promoters.
4. W. W. McLaughlin, "Agricultural Engineering and Farm Efficiency," *Yearbook of Agriculture* (Washington, D.C.: Government Printing Office, 1926), pp. 130–35 on p. 130.
5. The main source of information for the ASAE is Robert Stewart, *Seven Decades That Changed America: A History of the American Society of Agricultural Engineers* (St. Joseph, Missouri: ASAE, 1979). Biographical information for Davidson taken from *American Men of Science,* 9th ed. (1955); Obituary for Charles A. Ocock, *Agricultural Engineering* 41 (July 1960): 466.
6. Charter members received their degrees from University of Nebraska, Iowa State College, University of Minnesota, North Dakota College, University of Wisconsin, University of Illinois, and Michigan State College; the one exception to all generalizations was Howard Riley, who received a degree at Cornell in 1901. Biographical information obtained from *American Men of Science,* 9th ed. (1955).
7. A very small collection of Davidson's papers is at Iowa State University Archives. For Boss, see *American Men of Science,* 10th ed. (1960).
8. Harry Bainer's son Roy became a prominent agricultural engineer at the University of California. Information on Harry Bainer from Roy Bainer, *The Engineering of Abundance,* an oral history conducted by A. I. Dickman (Oral History Center, University of California at Davis, 1975), pp. 4–8; on Ocock, see *Agricultural Engineering* 41 (July 1960): 466.
9. Information on these engineers was obtained from *American Men of Science* primarily. Some people who did not show up there were located in the ASAE's journal, which listed "Applications for Membership" each month, identifying the applicant's place of employment but not his educational background. Since I know that some degreed engineers (e.g., E. J. Stirniman) did not enter their biographical information in *American Men of Science,* I figure that some of these agricultural engineers may in fact have had degrees regardless of the nature of their employment.
10. An excellent example of this collective biographical technique is Arnold Thackray and Jack Morrell, *Gentlemen of Science: Early Years of the British Association for the Advancement of Science* (New York: Oxford, 1981).

11. See Robert Stewart, *Seven Decades,* pp. 1–4; Philip S. Rose, discussion of E. P. Edwards, "Neglect of the Power Problem," *Trans. ASAE* 4 (1910): 97; J. B. Davidson, "President's Annual Address," *Trans. ASAE* 1 (1908): 10; Stewart, *Seven Decades,* p. 28; L. W. Chase, "President's Annual Address," *Trans. ASAE* 7 (1913): 22.
12. For professionalization, see, e.g., Thomas L. Haskell, ed., *The Authority of Experts: Studies in History and Theory* (Bloomington: Indiana University Press, 1984); Dorothy Ross, "Professionalization and the Transformation of American Social Thought," *Journal of Economic History* 38 (1978): 494–99; Alexandra Oleson and John Voss, eds., *The Organization of Knowledge in Modern America, 1860–1920* (Baltimore: Johns Hopkins University Press, 1979); Philip S. Rose, "President's Annual Address," *Trans. ASAE* 4 (1910): 13; Stewart, *Seven Decades,* pp. 10–13; F. A. Wirt (Maryland State College), Farm Power Conference, Office of Farm Management, USDA, October 1919 (BAE, entry 124, box 3), p. 47; H. B. Walker *et al.,* "Placing of Agricultural Engineering Students," *Trans. ASAE* 17 (1923): 260–68; C. R. Sessions, "Agricultural Engineering in the West," *Trans. ASAE* 5 (1911): 82–95; L. W. Chase, "Instruction in Farm Machinery," *Trans. ASAE* 1 (1907): 51–52; J. B. Davidson, "President's Annual Address," *Trans. ASAE* 2 (1908): 6, 13.
13. H. C. Ramsower, "Instruction in Agricultural Engineering as Viewed by an Agricultural Engineer," *Trans. ASAE* 3 (1909): 131–36 on p. 136; J. G. Wynn, "President's Annual Address," *ibid.*, pp. 5–11 on p. 11; H. M. Bainer, "Need of Research Work in Agricultural Engineering," *Trans. ASAE* 1 (1907): 15–25 on pp. 16–17; E. B. McCormick, "How Engineering May Help Farm Life," *USDA Yearbook of Agriculture* (1915), pp. 101–12 on p. 104; Philip S. Rose quoted in Stewart, *Seven Decades,* p. 28. The struggle among early agriculturalists to get and maintain authority is discussed in my *The Business of Breeding: Hybrid Corn in Illinois* (Ithaca: Cornell University Press, 1990).
14. O. W. Sjogren, E. E. Brackett, C. W. Smith, and F. R. Nahavec, "The Nebraska Tractor Tests," *USDA Bulletin 177* (January 1921). Robert C. Williams, *Fordson, Farmall, and Poppin' Johnny* (Urbana: University of Illinois Press, 1987), pp. 67–70.
15. "Three Boys, A Combine, and An Expert," *Farm Implement News* 51 (April 17, 1930): 28–29 on p. 29. For an excellent consideration of the nature of mechanical knowledge, see Douglas Harper, *Working Knowledge: Skill and Community in a Small Shop* (Cambridge: Cambridge University Press, 1987).
16. "Courses of Instruction in Power Farming," *Power Farming* (November 1918): 34–35; "Instruction in Tractor Operation," *Power Farming* (February 1918): 42–43.
17. H. C. Ramsower, comments at Farm Power Conference, p. 63.
18. See Samuel Fortier, "Agricultural Engineering and the Demand for Agricultural Engineers," *Trans. ASAE* 4 (1910): 24–41 on p. 26; Stewart, *Seven Decades,* pp. 49–51; H. C. Ramsower, "Methods of Instruction in Agricultural Engineering," *Trans. ASAE* 3 (1909): 131–36 on p. 134; H. M. Bainer, "Need of Research Work in Agricultural Engineering," *Trans. ASAE* 1 (1907): 15; J. B. Davidson, discussion of Bainer, *ibid.*, p. 25.
19. Howard W. Riley, "The Courses in Agricultural Engineering That Should Be Offered," *Trans. ASAE* 1 (1907): 5–14; J. B. Davidson, discussion of Riley, *ibid.,* p. 12; A. H. Gilbert, "Report of the Committee on Education," *Trans. ASAE* 10 (1916): 102.
20. Frederick W. Taylor, *Principles of Scientific Management* (New York, 1911).
21. Alfred Chandler elaborates on the notion of throughput in *The Visible Hand: The Man-*

agerial Revolution in American Business (Cambridge: Harvard University Press, 1977). A brilliant description of how wheat was transformed into a nearly liquid commodity is William Cronon's *Nature's Metropolis: Chicago and the Great West* (New York: W. W. Norton, 1991). In *Forces of Production: A Social History of Industrial Automation* (New York: Oxford University Press, 1984), David Noble discusses how numerically controlled machine tools seemed to offer factory managers a perfect answer to the labor problem. The classic satire about the totally automatic factory is Kurt Vonnegut, *Player Piano* (New York: Holt, Rinehart and Winston, 1952). For a recent real example of this, see Frederic M. Biddle, "Future Imperfect," *Boston Globe,* May 2, 1989, pp. 41, 50.

22. See Danbom, *The Resisted Revolution;* on the Progressives, see Robert H. Wiebe, *The Search for Order, 1877–1920* (New York: Hill and Wang, 1967).
23. E. B. McCormick, "President's Annual Address," *Trans. ASAE* 11 (1917): 9; see also his "How Engineering May Help Farm Life," *USDA Yearbook of Agriculture* (1915), p. 105.
24. McCormick, "How Engineering May Help Farm Life," p. 105; E. B. McCormick, "The Work of the Division of Rural Engineering, USDA," *Trans. ASAE* 11 (1917): 92–103 on pp. 93–94; L. W. Chase, "Farm Building Location as a Factor Affecting Farm Labor Efficiency," *Trans. ASAE* 6 (1912): 96–116. The farm household was likewise targeted for improved efficiency. For example, in *Power Farming,* Mrs. Avis Vestal's regular column "Farm Home Mechanics" constantly exhorted farm women to modernize; see, e.g., her "What Makes an Efficient Country House?" *Power Farming* 17 (August 1918): 34. See Katherine Jellison, *Entitled to Power: Farm Women and Technology, 1913–1963* (Chapel Hill: University of North Carolina Press, 1993).
25. A. B. Dineen, "Standardization of Farm Machinery," *Trans. ASAE* 12 (1918): 151–59 on p. 156; Theo Brown, "Standardization in the Implement Industry," *Trans. ASAE* 17 (1923): 115–19.
26. L. W. Ellis, "Tractive Efficiency," *Trans. ASAE* 4 (1910): 72–85 on p. 73; W. A. Cavanaugh, discussion of Ellis, *ibid.*, p. 79; W. N. Nye, discussion of J. B. Davidson, "Laboratory Efficiency," *Trans. ASAE* 7 (1913): 220–35 on p. 227; C. O. Reed, discussion of J. B. Davidson, "Laboratory Efficiency," *ibid.*, p. 232.
27. W. F. MacGregor, discussion of Ellis, "Tractive Efficiency," *ibid.*, p. 82.
28. The drive to mechanize farm work, particularly the work done by migrant laborers, has been written about extensively, beginning with Carey McWilliams's important study, *Factories in the Field* (Boston: Little, Brown, 1939). Other good examples of this genre are Cletus Daniel, *Bitter Harvest: A History of California Farmworkers, 1870–1940* (Ithaca: Cornell University Press, 1981), and Mark Kramer, *Three Farms* (Boston: Little, Brown, 1977). M. R. D. Owings, "New Methods and New Machines for the Farm," *Scientific American* (February 18, 1911): 170–72 on p. 170; W. H. Handschin, Farm Power Conference, October 1919, p. 26; Junius Cook, "Regulation of Farm Equipment Manufacture and Distribution," *Trans. ASAE* 12 (1918): 160–66 on pp. 161–62; F. M. White, "President's Annual Address," *Trans. ASAE* 10 (1916): 6; L. J. Fletcher, "Mechanization of Agriculture," *Farm Implement News* 49 (September 13, 1928), p. 23; George A. Pond and Louis B. Bassett, "Cost of Combine Harvesting in Minnesota," *University of Minnesota Agricultural Experiment Station Bulletin* 266 (May 1930), pp. 24–25; O. C. Stine, "Agriculture

in United States Specializing More and Using More Machinery," *USDA Yearbook of Agriculture* (1930), pp. 115–17.

29. See W. F. Handschin, J. B. Andrews, and E. Rauchenstein, "The Horse and the Tractor," *University of Illinois Agricultural Experiment Station Bulletin* 231 (February 1921): 171–223 on p. 222; Mr. Johnson, Conference on Farm Organization and Farm Equipment, Office of Farm Management, USDA, April 17–19, 1919 (BAE, series 3, box 124), p. 92. Discussing the new corn-picking machines in 1926, one writer barely mentioned the machine's abilities, instead emphasizing its main advantage as being its potential to "do away with high-priced, inefficient, and undependable hired help." L. A. Reynoldson, "Mechanical Corn Picker in the Corn Raising States," *USDA Yearbook of Agriculture* (1926), pp. 521–22 on p. 522. For some crops, of course, there was no question but that both farmers and engineers were anxious to get rid of field workers. For a discussion of the rural "elimination" of black labor in cotton, see "Cotton Harvesting Machines," *Farm Implement News* 48 (August 4, 1927): 16. For a discussion of immigrant black labor in sugar cane, see "Falkiner Cane Harvester," *Farm Implement News* 51 (December 18, 1930): 18–19 on 19. "It may create a crisis in human economics in a number of West Indian isles where now cane harvest is the principle cash-producing occupation of the year. This is not true in Florida, for there is little labor there of a nature adaptable to hand harvesting of cane, and what there is available is none too reliable and energetic." For a more recent report on sugarcane harvesting, see Alec Wilkinson, *Big Sugar: Seasons in the Cane Fields of Florida* (New York: Knopf, 1989); for California, see Stephen Stoll, *The Fruits of Natural Advantage: Making the Industrial Countryside in California* (Berkeley: University of California Press, 1998).
30. Arnold Yerkes, discussion of E. R. Wiggins, "Economics of the Farm Tractor," *Trans. ASAE* 9 (1915): 79–103 on p. 95.
31. For Allis-Chalmers, see Stephen Meyer, *Stalin over Wisconsin: The Making and Unmaking of Militant Unionism, 1900–1959* (New Brunswick: Rutgers University Press, 1992), pp. 16–22; Charles H. Wendel, *The Allis-Chalmers Story* (Sarasota: Crestline, 1988), pp. 6–16; Walter F. Peterson, *An Industrial Heritage: Allis-Chalmers Corporation* (Milwaukee: Milwaukee County Historical Society, 1976). For Case, see Wendel, *The Allis-Chalmers Story,* p. 6–16; Wayne Broehl, Jr., *John Deere's Company* (New York: Doubleday, 1984), pp. 350–51. On International Harvester, see Barbara Marsh, *A Corporate Tragedy: The Agony of the International Harvester Company* (New York: Doubleday, 1985).
32. W. F. McGregor, "The Combined Harvester-Thresher," *Trans. ASAE* 19 (1925): 40–47; C. Parker Holt, "Early Developments of the Holt Manufacturing Company," ms., June 26, 1935 (FHH, D-56, box 28, file 15), pp. 14–15. Ann Foley Scheuring, "A Learned Profession: A History of Agriculture at the University of California" (Working Paper no. 61, July 1990, Agricultural History Center, University of California at Davis. I am grateful to Mort Rothstein for bringing this to my attention); Alan L. Olmstead and Paul Rhode, "An Overview of California Agricultural Mechanization, 1870–1930," *Agricultural History* 62 (1988): 86–112; Robert E. Ankli and Alan Olmstead, "The Adoption of the Gasoline Tractor in California," *Agricultural History* 55 (1981): 213–30. One arena in which California had few followers was rural electrification; California farms were electrified much earlier than other farms because power companies put electricity in to drive irrigation

pumps; see S. H. McCrory, "Rural Electrification Grows," *USDA Yearbook of Agriculture* (1932), p. 450. For typical reports on the way in which conditions in California and the northwest created a large-scale mentality, see R. B. Gray, "Tractor's Adaptation to Varied Farm Operations Rapid in Recent Years," *USDA Yearbook of Agriculture* (1932), pp. 437–41; William Hurst, "Some Types of Harvesting Reach High State of Development," *ibid.*, pp. 445–46. H. H. Mowry and A. P. Yerkes, "Is the Farm Tractor a Factor in Reducing the Cost of Production on Farms of 150 Acres or More?" *Proc. AFMA* (November 1913), pp. 119–20. On sales in Russia, Portugal, France, and Mexico, see "Agricultural Implements and Machinery," *Scientific American* 118 (January 26, 1918): 90.

33. See, e.g., the comments of J. H. Sheppard from North Dakota Agricultural College in reference to the premature sale of tractors there around 1910, Farm Power Conference, October 1919, pp. 70–72; Mowry and Yerkes, "Is the Farm Tractor a Factor?" pp. 121–22; on handmade tractors, see Meyer, *Stalin over Wisconsin,* pp. 16–22; on the riskiness and expense of investing in the new shop equipment necessary to manufacture tractors, see Arnold P. Yerkes, "Relation of Large Machine Units to Production," *Trans. ASAE* 12 (1919): 136–50.
34. Mowry and Yerkes, "Is the Farm Tractor a Factor?" pp. 117–24. For a nuanced and persuasive account of farmers' reasoning regarding tractor purchases, see Sally Clarke, *Regulation and the Revolution in United States Farm Productivity* (Cambridge: Cambridge University Press, 1994).
35. Reynold M. Wik, "Henry Ford's Tractors and American Agriculture," *Agricultural History* 38 (April 1964): 79–86; Reynold M. Wik, *Henry Ford and Grass-Roots America* (Ann Arbor: University of Michigan Press, 1972), pp. 85–86; C. M. Eason, "Tendency of Farm Tractor Design," *Trans. ASAE* 9 (1915): 59–78 on pp. 59, 61; "National Tractor Demonstration," *Wallaces' Farmer* (August 17, 1917): 6; Broehl, *John Deere's Company,* p. 397.
36. Cooke, Conference on Farm Organization and Farm Equipment, p. 91; David B. Danbom, *Born in the Country: A History of Rural America* (Baltimore: Johns Hopkins University Press, 1995), pp. 194–96; Meyer, *Stalin over Wisconsin,* p. 20.
37. Peterson, *An Industrial Heritage,* pp. 250–54. For the General Electric camps, see David Nye, *Image Worlds: Corporate Identity at General Electric, 1890–1930* (Cambridge: MIT Press, 1985), pp. 93–111.
38. Broehl, *John Deere's Company,* pp. 478–79; Wik, *Henry Ford and Grass-Roots America,* pp. 89–95.
39. Broehl, *John Deere's Company,* pp. 478–79; Wik, *Henry Ford and Grass-Roots America,* pp. 85–86.
40. Arnold Yerkes, "Relation of the Tractor to Farm Efficiency," *Proc. AFMA* (December 1917): 156–65, quotation on p. 164; L. J. Fletcher, "Factors Influencing Tractor Development," *Trans. ASAE* 15 (1921): 142–49 on p. 144; Daniels Scoates, Conference on Farm Organization and Farm Equipment, p. 87; Woods, Conference on Farm Organization and Farm Equipment, p. 86; I. W. Dickerson, "Farm Machinery Developments," *Wallaces' Farmer* 45 (February 6, 1920): 420–21 on p. 420; F. Hal Higgins, "Fifty Years of Orchard Tractors," ms., n.d. (FHH, D-56, box 174, file 762).
41. Arnold Yerkes, "Report of the Committee on Power Farming," *Trans. ASAE* 18 (1924): 132–37. According to Robert Stewart, this dispute reached such a crescendo by 1924 that

then-president Raymond Olney called the principals as well as fifteen others to his hotel room at the annual meeting to settle the issue; see Stewart, *Seven Decades,* pp. 44–45.

42. Wayne Dinsmore, "Efficiency of Horse Labor," *Trans. ASAE* 13 (1919): 78–86 on p. 82; Wayne Dinsmore, "The Efficient Use of Animal Power," *Trans. ASAE* 15 (1921): 213–26 on p. 213. In a memo, L. A. Reynoldson suggested that the USDA should conduct an economic study comparing horses and tractors, since "no scientific research work has been carried out to determine the most effective types of farm power." L. A. Reynoldson, memo to Mr. Hobson, June 6, 1919 (BAE, series 124, box 4).
43. Wayne Dinsmore, Farm Power Conference, October 1919, p. 21; Christie, Farm Power Conference, October 1919, p. 5.
44. It was not only American farmers who were in this position; as discussed in Chapter 6, American tractors in the Soviet Union broke down often, and engineers blamed Russian peasants just as they blamed American farmers for the problem. Horses or oxen often had to rescue field work in both settings, to the amusement of everyone but the engineers.
45. Dinsmore, Farm Power Conference, October 1919, p. 21.
46. Handschin, Andrews, and Rauchenstein, "Horse and Tractor," p. 223; Dinsmore, "Efficiency of Horse Labor," p. 82; G. A. Ranney, Farm Power Conference, October 1919, p. 30; E. T. Robbins, "Big Teams on Illinois Farms," *University of Illinois College of Agriculture Circular* 355 (April 1930); E. M. Poirot, "Farm Equipment and Efficiency," *Farm Implement News* 49 (February 16, 1928): 17.
47. H. R. Tolley and L. A. Reynoldson, "The Cost and Utilization of Power on Farms Where Tractors Are Owned," *USDA Bulletin* 997 (December 21, 1921); M. L. Wilson, "Annual Report of Farm Management Demonstration Work, 1923" (MLW, box 23, file T-24).
48. Arnold Yerkes, "Tractor Use Makes Bigger Farms," *Farm Implement News* 41 (February 5, 1920): 106–107; George Iverson, "Possibilities of the All Purpose Tractor," *Trans. ASAE* 16 (1922): 89; George Wilbur, Farm Power Conference, October 1919, p. 84; Christie, Farm Power Conference, October 1919, p. 7; Trowbridge, Conference on Farm Organization and Farm Equipment, pp. 88–89. Tractor figures in H. R. Tolley, "The Farm Power Problem," *Journal of Farm Economics* 3 (April 1921): 91–99 on pp. 91–92; H. C. Taylor to secretary of agriculture, April 3, 1920 (BAE, entry 124, box 7). M. L. Wilson, "Report of the Secretary and Managing Director to the Board of Directors, Fairway Farms Corporation, for the Years 1925–1926" (MLW, box 36 of 46, folder AH-16).
49. C. M. Eason, "Tendency of Farm Tractor Design," p. 60; "Working a Tractor Efficiently," *Wallaces' Farmer* 42 (September 14, 1917): 1, 6; C. W. Hunt, Farm Power Conference, October 1919, p. 78; L. J. Fletcher, "Factors Influencing Tractor Development," *Trans. ASAE* 15 (1921): 142–49 on p. 143; C. D. Kinsman, "Summary of the National Farm Power Survey," *Trans. ASAE* 18 (1924): 101–13 on p. 112; John A. Hopkins, "Horses, Tractors, and Farm Equipment," *Iowa State University Agricultural Experiment Station Bulletin* 264 (June 1929). J. E. Johnson, "He Prefers Tenants Who Have Tractors," *Farm Implement News* 53 (February 4, 1932): 28–29.
50. E. H. Lehmann, "Combines in Illinois," *University of Illinois Agricultural Experiment Station Circular* 316 (May 1927): 3–5; F. A. Lyman, "Farm Equipment Developments of the Past Year," *Farm Implement News* 49 (January 5, 1928): 16–17 on p. 16; George A. Pond and Louis B. Bassett, "Cost of Combine Harvesting in Minnesota," *University of Min-*

nesota Agricultural Experiment Station Bulletin 266 (May 1930), p. 30; Lehmann, "Combines in Illinois," pp. 15–16. R. S. Kifer and L. A. Reynoldson, "Wheat Harvesting by Combine Advantageous under Right Conditions," *Yearbook of Agriculture* (1927): 692–95.

51. See Sanford Rikoon, *Threshing in the Midwest, 1820–1940: A Study of Traditional Culture and Technological Change* (Bloomington: Indiana University Press, 1988); Mary Neth, *Preserving the Family Farm: Women, Community, and the Foundations of Agribusiness in the Midwest, 1900–1940* (Baltimore: Johns Hopkins University Press, 1995); Lehmann, "Combines in Illinois," pp. 15–16; F. A. Jackson, "Influence of Combine on Grain Growing," *Farm Implement News* 46 (February 12, 1925): 20–21 on p. 20; USDA, "Advantages and Disadvantages of Combines," *Farm Implement News* 49 (March 29, 1928): 14–15; F. A. Jackson, "Combine Creating Box Car Shortage," *Farm Implement News* 49 (26 July 1928): 10. Montana farmers were strongly encouraged to mechanize and expand and did so fairly readily; see M. L. Wilson, "Research Studies in the Economics of Large Scale Farming in Montana," *Agricultural Engineering* 10 (January 1929): 3–12.
52. Advertisement for Parlin and Orendorff Co., Canton, Ill., in *Power Farming*, November 1918, p. 37; Mrs. Mary Rose, "Deaf Mute Succeeds with Tractor," *Power Farming,* August 1918, p. 16.
53. Stewart, *Seven Decades,* p. 93.
54. George Pond, "The Length of the Farmer's Working Day," *Journal of Farm Economics* 3 (July 1921): 146; L. H. Bean, comment on Wilford I. King's "The Gasoline Engine and the Farmer's Income," *Journal of Farm Economics* 11 (January 1929): 64–78 on pp. 76–78. For historical treatments of this subject, see Ruth Schwartz Cowan, *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave* (New York: Basic, 1983), and Susan Strasser, *Never Done: A History of American Housework* (New York: Pantheon, 1982).
55. R. B. Gray, "American Machinery Is Influencing Agriculture Greatly in Other Lands," *Yearbook of Agriculture* (1932), p. 453; E. A. White, "President's Annual Address," *Proc. ASAE* 15 (1921): 7–10 on p. 8; L. J. Fletcher, "Factors Influencing Tractor Development," *Trans. ASAE* 15 (1921): 142–49 on p. 149; L. J. Fletcher, "Mechanization of Agriculture," *Farm Implement News* 49 (September 13, 1928): 22–23.

CHAPTER 4: FARMS AS FACTORIES

Epigraph: H.W. Jeffers, "How the Investigator in Farm Management Problems Can Help the Farmer," *Proceedings of the American Farm Management Association,* November 1916, pp. 5–9 on pp. 5–6.

1. "This Country's Largest Poultry Plant Is in Texas," *Reliable Poultry Journal* 33 (February 1927): 868, 870; see also Frank L. Platt, "The Biggest Poultry Farm in the World," *American Poultry Journal* 58 (January 1927): 11, 88–89, 92–96. Joseph K. Howard, "Tom Campbell: Farmer of Two Continents," *Harper's* (March 1949): 55–63. A contemporary comparison might be the confinement "egg factory"—the gravity slides in which eggs are delivered to the crates, the automatic feed and watering units, and the chickens jammed together in cages piled twenty cages high; the automatic lighting and temperature con-

trols, which are used to mimic an accelerated day and night rhythm, are also quite spectacular to see. For technological spectacle, see David Nye, *American Technological Sublime* (Cambridge: MIT Press, 1994).

2. D. Curtis Mumford, "Large-Scale Farming in the United States" (Washington, D.C.: USDA, Bureau of Agricultural Economics, April 1938), p. 2; Sam R. McKelvie, "Can the Farm Be Factory-ized?" *Nation's Business* 15 (April 1927): 106, 108–10.
3. H. R. Tolley reported that "since 1925 developments have been under way which have resulted in a remarkable increase in the size of farms in certain areas" (H. R. Tolley and C. L. Holmes, "Large-Scale Farming in the United States," Bureau of Agricultural Economics, presented at the Annual Extension Conference, Lexington, Kentucky, October 1929; found in MLW, box 3 of 46, folder D-28).
4. "Report of the Secretary," *Yearbook of Agriculture, 1926* (Washington, D.C.: Government Printing Office, 1927), p. 7.
5. Gilbert Fite, *American Farmers: The New Minority* (Bloomington: Indiana University Press, 1981), p. 69; E. G. Nourse, "The Revolution in Farming," *Yale Review* 8 (October 1918): 90–105 on p. 93; "Report of the Secretary," *Yearbook of Agriculture, 1928* (Washington, D.C.: Government Printing Office, 1929), p. 10.
6. Raymond Olney, "The Farm Power House: A Factory Idea," *Power Farming* (November 1917): 7–8, 40–41, on p. 7; H. W. Jeffers, "The Practical Application of Farm Management Principles," *Proc. AFMA* (August 1915): 51–60 on p. 57.
7. Edgar L. Smith, "Corporate Farming," *Proc. AFMA* (1917): 47–57, on p. 52; A. E. Grantham, "Advantages of Big over Little Farms," *Practical Farmer* 115 (February 1, 1919): 40. The development of farm implements was only one of the areas of specialization in agricultural engineering; other important subfields included irrigation and drainage, rural electrification, farm structures, and land reclamation.
8. Olney, "The Farm Power House," p. 7.
9. H. H. Slawson, "Industrializing Agriculture in the Corn Belt," *Bureau Farmer* 4 (March 1929): 11–12, 32–35, on p. 12.
10. Mumford found that only a small percentage of large-scale farms were incorporated (Mumford, "Large-Scale Farming," p. 17); M. L. Wilson to George Severance, December 31, 1928 (MLW, box 3 of 46, folder D-27).
11. For definitions, see Mumford, "Large-Scale Farming," pp. 2–7; Robert Stewart, "Helping the Farmer Merge," *Bankers Magazine* 119 (October 1929): 517–23 on p. 523; Lewis P. East, "Tendencies Point to Larger Farming Units," *Indiana Farmer's Guide* 85 (June 29, 1929): 268. John R. McMahon, "The Best Farmer in New Jersey," *Country Gentleman* 83 (September 14, 1918): 10–11, 32; Charles E. Gapen, "New Farms from Old," *Country Gentleman* 78 (May 10, 1913): 740–41; A. B. Macdonald, "Sugar on the Kansas Plains," *Country Gentleman* 85 (January 24, 1920): 10–11, 56; Nourse, "The Revolution in Farming," p. 95.
12. Doane Agricultural Service, Inc., "Pioneering for Twenty-Five Years in Farm Management and Rural Appraising and Other Agricultural Services," in *Little Journeys to Farmland* ("published every now and then by Doane Agricultural Service, Inc."), October 1, 1944; D. Curtis Mumford, "Large-Scale Farming in the United States," p. 6.
13. "Are We Coming to Corporation Farming?" *Power Farming* (February 1927): 5, 9; E. H. Taylor, "How Many Farms Can One Man Run?" *Country Gentleman* 93 (October 1928):

3–4, 120, 123; C. H. Davey, "An Outstanding Example of 'Corporation Farming,'" *Farm Implement News* 50 (May 2, 1929): 80–81. Wayne Gard, "Agriculture's Industrial Revolution," *Current History* 34 (September 1931): 853–57; Robert Stewart, "Mass Production on the Farm," *New Republic* 59 (June 17, 1927): 230–32; Jay Whitson, "The Farm Manager Gets His Chance," *Wallaces' Farmer* 54 (August 9, 1929): 1089, 1104–5; Robert Stewart, "When a Bank Turns Farmer," *Journal of the American Bankers Association* (February 1929): 726–27, 816; H. H. Slawson, "Industrializing Agriculture in the Corn Belt," *Bureau Farmer* 4 (March 1929): 11–12, 32–35; Herman Steen, "Supervised Tenant Farming in Illinois," *Montana Farmer* 17 (October 15, 1929): 3, 17.

14. E. G. Nourse, "The Revolution in Farming," pp. 98–99, 100–102; Robert Stewart, "Big Business Methods for the Farm," *Journal of the American Bankers Association* 18 (June 1926): 842, 845–46; Robert Stewart, "The Size of the Farm Business," *Commonweal* 9 (January 23, 1929): 336–37. A similar arrangement was used at Liberty Groves Operating Corporation; see "Cooperative Cultural Work Shows Decided Advantages," *California Citrograph* 13 (June 1928): 294. Quotations of B. F. Walton, in Steven Stoll, *The Fruits of Natural Advantage: Making the Industrial Countryside in California* (Berkeley: University of California Press, 1998), p. 64. On changing food habits, see "Report of the Secretary," *Yearbook of Agriculture for 1928,* pp. 24–26.
15. Clotilde Grumsky, "Where Hoover Meets the Farm Problem from Within," *Magazine of Business* 55 (April 1929): 415, 474–75; John E. Pickett, "The New President's Kern County Farm," *Pacific Rural Press* 117 (February 23, 1929): 238, 247; Carol K. Neilson, "Industrialized Agriculture: A Peach Ranch," *Commerce and Finance* 17 (March 28, 1928): 691–92.
16. Robert Stewart, "Mass Production Methods Make Farming Pay," *Forbes* 20 (November 15, 1927): 18–20, 44, on p. 18. Frank L. Platt, "Biggest Poultry Farm in the World," *American Poultry Journal* 58 (January 1927): 88–92, 94–97; "Report of the Secretary," 1928, p. 24; William Boyd and Michael Watts, "Agro-Industrial Just-in-Time: The Chicken Industry and Postwar American Capitalism," in David Goodman and Michael Watts, eds., *Globalising Food: Agrarian Questions and Global Restructuring* (London: Routledge, 1997), pp. 192–225; Glen Bugos, "Intellectual Property Protection in the American Chicken-Breeding Industry," *Business History Review* 66 (spring 1992): 127–68. Not all large poultry operations were industrial, however; a Petaluma, California, egg farm with 30,000 hens evinced no other unusual characteristics. See James Dryden, "The Biggest Hen Farm," *Country Gentleman* 85 (January 10, 1920): 6–7, 90.
17. L. P. Gabbard, "Effect of Large-Scale Production on Cotton Growing in Texas," *Journal of Farm Economics* 10 (April 1928): 211–24. This paper was read at the 1927 American Farm Economics Association meeting, and the discussion of it was led by J. D. Pope of the Alabama Agricultural Experiment Station. Pope, plainly alarmed at the competition this was giving to farmers in Alabama, tried to downplay the stability and long-term consequences of Texas cotton farming. Gilbert Fite, *Cotton Fields No More: Southern Agriculture, 1865–1980* (Lexington: University of Kentucky Press, 1984), pp. 51–52. See Ronald Kline, *Consumers in the Country: Technology and Social Change in Rural America* (Baltimore: Johns Hopkins University Press, 2000). Frank App, "Mass Production and Quality," *United States Banker* 1 (September 1928): 12–13, 33–35.
18. See Stanley Buder, *Pullman: An Experiment in Industrial Order and Community Planning,*

1880–1930 (New York: Oxford, 1967). Theodore Price, "A 100,000–Acre Business," *World's Work* 25 (January 1913): 271–75; Barton Currie, "100,000 Acres of Business Farming," *Country Gentleman* 80 (June 12, 1915): 1010–11. For the Taft Ranch, see A. Ray Stephens, *The Taft Ranch: A Texas Principality* (Austin: University of Texas Press, 1964). An excellent historical analysis is Neil Foley, *The White Scourge: Mexicans, Blacks, and Poor Whites in Texas Cotton Culture* (Berkeley: University of California Press, 1997).

19. Walter Andrews, "Largest Mint Farm in the World," *World Today* 5 (July 1903): 917–20; James Mills, Jr., "Owner's Opinion of Large Scale Farms," *Agricultural Engineering* 12 (September 1931): 348–50.
20. See Jay Whitson, "The Farm Manager Gets His Chance," *Wallaces' Farmer* 54 (August 9, 1929): 1089, 1104–5.
21. Thomas Tapper, "Successful Chain Store System Is Applied to a Farming Project," *Manufacturers Record* 89 (March 18, 1926): 75–76; John C. Snowbrook, "How One Man, J. C. Penney, Is Solving the Farm Problems of Hundreds," *Manufacturers Record* 91 (February 10, 1927): 61–62; Richard W. Edmunds, "Unique Farm Development of 120,000 Acres in Florida," *Manufacturers Record* 91 (May 26, 1927): 75–76. James C. Penney, "Why I Am Breeding Fine Stock," *Field Illustrated* 36 (March 1926): 11–13. The J. C. Penney Archive also has a collection of promotional materials on the farm; I thank Joan Gosnell for her assistance with this.
22. Henry Ford, *Today and Tomorrow* (Garden City, N.J.: Doubleday, 1926), pp. 211–12. Walter Pitkin, "The Great Dirt Conspiracy," *Forum* 86 (August 1931): 118–23, on p. 120. Pitkin did not limit his venom to farmers, but directed it as well towards industrialists: "Several of our billionaires and near-billionaires devoutly worship the Old American Farm Home; witness Henry Ford's mania for collecting the junk of that sorry institution. . . . Some of them, too, are like our famous Henry in that much of their fortune is invested in making things for small farmers. Wipe out the latter, and where would Henry sell his cunning little tractors?" (p. 123).
23. E. G. Nourse, "Economic Issues of Large-Scale Farming," *Agricultural Engineering* 10 (January 1929): 13–17. F. E. Fuller, "Large-Scale Farming Problems Discussed," *Agricultural Engineering* 10 (January 1929): 31–33, on p. 32. This was a general discussion following a session on large-scale farming at the annual meeting. The "author" indications in this and following references to this discussion refer to named discussants rather than formal authors. John D. Black, *Agricultural Reform in the United States* (New York: McGraw Hill, 1929), pp. 272–73; Paul Macy, G. P. Lamb, F. J. McGreal, J. M. Keefe, "Corporation Farming: Affirmative and Negative of Radio Debate," *Purdue Agriculturalist* 25 (December 1930): 54–56, 66–68.
24. Taylor, "How Many Farms Can One Man Run?" p. 120.
25. Charles D. O'Neal, "Solving the Farm Problem," *Manufacturers Record* 90 (August 26, 1926): 67–69.
26. W. E. Grimes, "Effects of Improved Machinery and Production Methods on the Organization of Farms in the Hard Winter Wheat Belt," *Journal of Farm Economics* 10 (April 1928): 225–31; C. L. Holmes, "Prospective Displacement of the Independent Family Farm by Larger Farms or Estate Management," *Journal of Farm Management* 11 (April 1929): 227–47 on pp. 230–31; "Report of the Secretary," *Yearbook of Agriculture, 1927* (Wash-

ington, D.C.: Government Printing Office, 1928), p. 29; "A Big Scale Farm in the Panhandle," *Nebraska Farmer* 70 (February 18, 1928): 309; Barton W. Currie, "Rice—From Prairie to Market," *Country Gentleman* 80 (August 14, 1915): 1294–95; Carl Crowe, "A New Eight-Million Dollar Crop," *Country Gentleman* 82 (October 13, 1917): 10–11, 35.

27. W. E. Grimes, "Effects of Improved Machinery," pp. 227–28; "Incorporated Farms," *Literary Digest* 95 (October 1, 1927): 68–69; Wayne Gard, "Agriculture's Industrial Revolution," *Current History* 34 (September 1931): 853–57 on p. 855; H. M. Bainer to M. L. Wilson, January 9, 1930 (MLW, box 3 of 46, folder D-27). On sugar, see A. B. Macdonald, "Sugar on the Kansas Plains," *Country Gentleman* 85 (January 24, 1920): 10–11, 56.
28. Grimes, "Effects of Improved Machinery," pp. 775, 779; W. E. Grimes, "Social and Economic Effects of Large Scale Farming in the Wheat Belt," *Journal of Farm Economics* 13 (January 1931): 21–26; W. E. Grimes, "Effect of Combined Harvester-Thresher on Farming in a Wheat Growing Region," *Scientific Agriculture* 9 (August 1929): 773–82. See Wayne Gard, "Agriculture's Industrial Revolution," p. 853; "Corporate Farming Increases—Kansas, Nervous, Starts Inquiry," *Business Week* (June 18, 1930), p. 22; "Corporate Farming Fights for Its Life in Kansas," *Business Week* (May 27, 1931), pp. 20, 22. Laws in Iowa and Illinois are discussed in Herman Steen, "Corporations Farm Many American Acres," *New York Times Magazine* 20 (May 26, 1929), p. 11. On the Iowa law, see Henry A. Wallace to Arthur Collins, February 3, 1931 (HAW, reel 5). Collins was president of Collins Farms, the only corporate farm operation in Iowa, which was bankrupted by 1932. On the Minnesota law, see Emil L. Regnier to H. A. Wallace, February 2, 1931 (HAW, reel 5).
29. M. L. Wilson, "Research Studies in the Economics of Large Scale Farming in Montana," *Agricultural Engineer* 10 (January 1929): 3–12, on p. 10; M. L. Wilson to Harold Fabian, January 26, 1931 (MLW, box 36 of 46, folder AI-4); M. L. Wilson, "Annual Report of Farm Management Demonstrations, 1929" (MLW, box 24 of 46, folder T-66), pp. 3–4.
30. Malcolm Cutting, "Big Doings in Montana," *Country Gentleman* 94 (May 1929): 22–23, 130–131.
31. Wilson, "Research Studies," pp. 1–5, 12; Malcolm Cutting, "Farm Relief by Factory Methods: Fairway Farms Corporation, Montana," *Nation's Business* 18 (February 1930), p. 194; M. L. Wilson, "Reminiscences of M. L. Wilson" (Columbia Oral History Research Office, 1975), p. 565.
32. United States Chamber of Commerce, Agricultural Service Department, "Large-Scale Farming" (Washington, D.C., July 29, 1929), p. 18.
33. Andrew Boss quoted in "Another View on Corporate Farming," *Farmer* (March 17, 1928): 488; Holmes, "Prospective Displacement," pp. 239–40; John D. Black, *Agricultural Reform,* p. 373; Bernard Black, letter to *Rural New Yorker* (December 29, 1917), pp. 1461–62; Mordecai Ezekial and Sherman Johnson, "Corporate Farming—The Way Out?" *New Republic* 63 (June 4, 1930): 66–68; Don P. Shannon, "No Hired Help Problems on His Farm," *Farmer* (March 17, 1928): 1; U.S. Chamber of Commerce, "Large-Scale Farming," pp. 1–2; E. A. Stokdyk, "Corporate Farms or Peasantry?" *Northwestern Miller* 153 (March 21, 1928): 1092; Stewart, "Big Business Methods for the Farm," pp. 842, 845–46; J. Brownlee Davidson, "Large-Scale Farming Problems Discussed," *Agricultural Engine*er 10 (January 1929): 31–32.

34. The tensions between rural and urban dwellers have been covered extensively. See Richard Hofstadter, *The Age of Reform* (New York: Random House, 1955); David Danbom, *The Resisted Revolution* (Ames: Iowa State University Press, 1979). For contemporary accounts, see "Corporation Farming," *Farmers Elevator Guide* 25 (November 1930): 14–15; J. M. Keefe, "Corporate Farming—Affirmative and Negative of Radio Debate," p. 66; Herman Steen, "Corporations Farm Many American Acres," p. 11; "Corporate Farming," *Grain World* 101 (January 30, 1929): 8; M. L. Wilson to T. H. Summers, March 5, 1929 (MLW, box 3 of 46, folder D-27); Donald R. Murphy, "Down with the Corporation Farm," *Wallaces' Farmer* 55 (October 25, 1930): 1695.
35. Roger Babson, "Effect of Business upon Agriculture," *Journal of Farm Economics* 6 (1924): 41–60 on p. 46.
36. Wheeler McMillan, "Shall We Make Factories of Our Farms?" *Farm and Fireside* 52 (March 1928): 7, 45–46 on p. 7; "The Old Order Changeth," *Country Gentleman* 90 (April 11, 1925): 16; "Large-Scale Farming Problems Discussed," *Agricultural Engineering* 10 (January 1929): 31–34; Frank Ridgeway, "Must the Farm Be Industrialized?" *Bureau Farmer* 4 (February 1929): 7–8; Edward S. Mead and Bernhard Ostrolenk, "The Farm Problem: Mass Production Threatening Efficient Small Farmers," *Annalist* 32 (September 14, 1928): 391, 413, on p. 413; a similar view is expressed by C. W. Pugsley, president of South Dakota State College and former USDA employee, in his address to the South Dakota Bankers Association; see his "Agriculture of Tomorrow," *Commercial West* 55 (June 8, 1929): 17, 74; John F. Fennelly, "The Fallacy of Diversification," *Commerce and Finance* 14 (December 16, 1925): 429–30, on p. 430.
37. Malcolm Cowley, "Is the Small Farmer Dying?" *New Republic* 68 (October 7, 1931): 212; Martel McNeely, "A Midwest Agricultural Revolution," *Country Gentleman* 101 (July 1931): 12, 25; "Corporation Farming," *Farmer* (January 28, 1928): 1; Samuel Crowther, "The New Agriculture," *Country Gentleman* 93 (January 1928): 11–12, 129, 131; "No Need to Fight," *Pennsylvania Farmer* 100 (May 4, 1929): 6; Arthur Capper, "Will Big Scale Farming Last?" *Rotarian* 43 (October 1933): 17–19, 59–61.
38. U.S. Chamber of Commerce, "Large-Scale Farming"; "A Farming Analysis," *Commercial West* 56 (September 14, 1929): 6–7.
39. Clarence Poe, "Can the Little Farmer Survive or Are We Headed for Corporation Farming with Hireling Cultivators?" *Rural America* 10 (February 1932): 4–6.
40. John D. Black, *Agricultural Reform,* pp. 371–78; E. G. Nourse, "Economic Issues of Large-Scale Farming," *Agricultural Engineering* 10 (January 1929): 13–17; Donald R. Murphy, "Down with the Corporation Farm," *Wallaces' Farmer* (October 25, 1930): 1695, 1710.
41. Mordecai Ezekial and Sherman Johnson, "Corporate Farming—The Way Out?" *New Republic* 63 (June 4, 1930): 66–68. Ezekial was probably influenced here by his travels in the Soviet Union, where he toured collectivized farms. See Mordecai Ezekial, "In the Grain Belt of New Russia," *Wallaces' Farmer* 56 (July 11, 1931): 825, 840, and "Showing the Russian How It's Done," *Wallaces' Farmer* 56 (July 18, 1931): 848, 857. Robert S. Brookings, "Agricultural Corporations: The Conversion of Agriculture into a Prosperous Industry," and Brookings, "Socializing the Soulless Corporation: A Sequel to Agricultural Corporations" (Washington, D.C.: Judd and Detweiler, 1928); "Suggest Operation of Farms by Big Corporations," *Who Is Who in the Grain Trade* 17 (September 17, 1928): 23–27; Charles

O'Neal, "Solving the Farm Problem," *Manufacturers Record* 90 (August 26, 1926): 67–69; T. W. D. Duke, "Integration of the Business of Agriculture," *Commerce and Finance* 16 (January 9, 1927): 2308. The idea for a national farm corporation had been proposed a decade earlier to little response; see Edgar L. Smith, "Corporate Farming," *Proc. AFMA* (1917): 47–57.

42. The relationship between Soviet collectivization and American large-scale farming has not been much addressed by historians. For contemporary accounts, see McNeely, "Midwest Agricultural Revolution," p. 12; "Corporation or Cooperation?" *Bureau Farmer* 7 (September 1931): 13.
43. Pitkin, "The Great Dirt Conspiracy," p. 119; Michael Gold and Malcolm Cowley, "Is the Small Farmer Dying?" *New Republic* 68 (October 7, 1931): 211–213, on p. 211.

CHAPTER 5: THE CAMPBELL FARMING CORPORATION

Epigraph: Thomas D. Campbell, "The Industrial Opportunity in Agriculture," *Magazine of Business* 54 (December 1928): 656–57, 728, 730, 732.

1. Malcolm Cutting, "A Manufacturer of Wheat," *Country Gentleman* 91 (August 1926): 18–19, 44, on p. 18; Thomas Campbell, "Manufacturing Wheat on a 95,000 Acre Farm Factory," *Agricultural Engineering* 8 (October 1927): 265–68 on p. 265; Thomas Campbell, "Ten Years Experience in Manufacturing Wheat on 100,000 Acres," *Agricultural Engineering* 10 (January 1929): 18–20 on p. 19. Other major articles describing Campbell's operation include Thomas Campbell, "What the Farmer Really Needs," *Magazine of Business* 53 (June 1928): 724–28, 752; Malcolm Cutting, "Largest Wheat Farm Like a Great Factory," *New York Times* 20 (September 12, 1926): 5. One of the only secondary reports on Campbell is Doug Edwards, "'The Greatest Hazard of All Is the 'Human Element'": Manning the Machines of the World's Greatest Wheat Farm" (manuscript in author's possession, 1999). Craig Miner describes another industrial wheat farmer in Kansas during the same period in his *Harvesting the High Plains: John Kriss and the Business of Wheat Farming, 1920–1950* (Lawrence: University of Kansas Press, 1998).
2. Some of Campbell's Montana neighbors were not so impressed with his farming ability; see "Corporation Farming," *Farm Implement News* 52 (December 10, 1931): 13, repr. from *Montana Farmer;* and "Corporation Farming," *Farmstead, Stock and Home* (February 15, 1928): 3.
3. Biographical information for Campbell comes from Thomas D. Campbell, "Autobiography," unfinished manuscript, n.d. (CFCH), and "A Giant of World Agriculture," *Journal of the Clan Campbell Society* 19 (Summer 1992): 16–18. I am grateful to Phoebe Knapp Warren for sharing these materials. See also Calvin H. Crouch to Cato Sells, January 31, 1918 (TDC, box 3, file 3). Asked about the reasons for getting involved in industrial farming, an elderly Tom Campbell recalled that "it was the bonanza farming which was so familiar to me when a boy that caused me to have the urge to do something about the mechanization of farming. I resented the hardships and long hours of toil suffered by my mother and other pioneering women" (Campbell to Leonard Sackett, April 11, 1956, North Dakota Institute for Regional Studies).

4. "A Giant of World Agriculture"; Philip S. Rose, "The Biggest Wheat Farm in the World," *Country Gentleman* 83 (October 26, 1918): 6–7, 36.
5. Rose, "Biggest Wheat Farm," p. 6; Campbell considered starting another industrial wheat farm in the San Joaquin Valley but apparently nothing came of the plan. See Harold M. Finley, "Montana's Wheat King Massing Power Farming Artillery for Restoration of California's Old-Time Grain Empire," *Los Angeles Times,* Farm and Tractor Section (March 11, 1923): 12–13, 15, 20.
6. Franklin Lane to Tom Campbell, April 6, 1918, and Cato Sells to Franklin Lane, April 6, 1918 (TDC, box 13, file 1).
7. See Thomas Campbell to Joseph Cotter, May 9, 1918, and attached article, "Plan Big Wheat Yield on Idle Indian Lands," *New York Times* (May 9, 1918): 15 (TDC, box 13, file 1); Rose, "Biggest Wheat Farm," p. 7; Thomas Campbell to Cato Sells (Commissioner of Indian Affairs), February 14, 1919 (TDC, box 13, file 3); Ola Maddox to Thomas M. Robinson (Deputy tax collector), June 25, 1928 (TDC, box 16, file 7). According to one source, Campbell planned to return the land to the Native Americans as a highly valuable and productive farm eventually; see "A Giant of World Agriculture," p. 17. M. L. Wilson to H. A. Wallace, June 30, 1928 (MLW, box 3 of 46, folder D-29). A brief conversation with Barney Old Coyote, who as a teenager had attended the ceremony in which Campbell was adopted by the Crow tribe, indicated that the Crow were grateful for the income that Campbell's leases provided, particularly during the Depression, and he felt that Campbell had been a good friend to the tribe (conversation at Campbell Farming Corporation Reunion, July 25, 1999). Campbell's lease of reservation land was hardly unique. See, e.g., Charles El Hoke, "Nothing to $300,000," *Country Gentleman* 79 (January 31, 1914): 28–29, for a description of the Vancelous Farm in Ponca, Oklahoma. Much of this land was leased from the Ponca Indians.
8. "Nothing pleases me more than the cordial treatment which I get from Mr. Morgan," Thomas Campbell wrote to Stevens (Campbell to F. W. Stevens, March 10, 1920; Campbell to L. W. Hill, May 2, 1918 (TDC, box 13, file 1); Frederick Stevens, "One Million Bushels of Wheat: A Belated War Story" (privately printed pamphlet, 10 pp., CFCH), pp. 8–9. Campbell to L. W. Hill, May 23, 1918 (TDC, box 13, file 3); Campbell to A. E. Edwards, president of National Bank of Pasadena, April 29, 1918, and Campbell to Franklin Lane, April 30, 1918 (both in TDC, box 13, file 1). Other members of the board were Charles D. Norton, Francis H. Sisson, Frederick W. Stevens, Maxwell M. Upton, James A. Stillman, and J. S. Torrance. The only indication of Campbell's nervousness came when Torrance seemed ready to pull out of the plan. Campbell wrote: "Wire received. Don't withdraw now. It looks as if my own friends had lost confidence. It would not have made any difference in the beginning as I did not suggest your participation until it came from you but it will now. I have met all of your objections and can take care of later payments. If the twenty five is too much make it less." Torrance later defaulted on his subscription and left the board. See Campbell to J. S. Torrance, June 5, 1918; and T. Rousseau to Campbell, April 30, 1919, which includes minutes of the meeting held February 11, 1919 (TDC, box 13, file 1). The particulars of this transition are somewhat cloudy; according to M. L. Wilson, Morgan's personal admiration for Campbell led Morgan to

sell his leases and equipment back to Campbell for somewhere between $50,000 and $100,000, leaving the investors with a loss of about $1,000,000 (Wilson to H. A. Wallace, June 30, 1928, MLW, box 3 of 46, folder D-29).

9. Jane Slattery, "Tom Campbell—Montana Wheat Farmer" (term paper, winter 1964, CFCH). Campbell cancelled the Fort Peck lease in spring of 1921, worrying that the Native Americans would object; see Campbell to board of directors, March 1, 1921 (TDC, box 13, file 2); F. W. Stevens to board of directors, September 1918 (TDC, box 13, file 36); F. W. Stevens to board of directors, July 1920 (TDC, box 13, file 3).
10. F. W. Stevens trip report to board of directors, September 1918, p. 3 (TDC, box 13, file 3). Frederick W. Stevens, "Wall Street Finances Hardin Enterprise" [part of lead story "Hardin, Magic City of the Big Horn Valley"], *Billings Gazette* (December 31, 1918): 1–2. Stevens was treasurer of the Montana Farming Corporation; see also "Great Farming Corporation Is Ready to Start," *Billings Gazette* (March 6, 1919): 4. A vivid description of the day-to-day operations on a bonanza farm is William Allen White, "The Business of a Wheat Farm," *Scribner's* 22 (November 1897): 531–48. Although it covers an earlier period, this report captures something of the intensity of this type of large-scale farming.
11. The best description of harvesting is Thomas Isern, *Bull Threshers and Bindlestiffs: Harvesting and Threshing on the North American Plains* (Lawrence: University Press of Kansas, 1990), which almost viscerally captures the harvesting experience. Also excellent is R. Sanford Rikoon, *Threshing in the Midwest, 1820–1940: A Study of Traditional Culture and Technological Change* (Bloomington: Indiana University Press, 1988). Thomas Campbell to Edward Barber, July 28, 1926 (TDC, box 1, file 46). An excellent description of the harvest is "Operating a 95,000 Acre Wheat Farm," *Mechanical Engineering* 50 (October 1928): 748–52; Thomas Campbell, "Manufacturing Wheat on a 95,000 Acre Farm Factory," *Agricultural Engineering* 8 (October 1927): 265–68; Robert Stewart, "Mass Production on the Farm," *New Republic* 59 (July 17, 1927): 230–32.
12. F. W. Stevens to board of directors, July 26, 1920 (TDC, box 13, file 3). J. S. Johnston to board of directors, September 28, 1920 (*ibid.*); Hulda Miller Fields, "From Buffalo Trails to Tractor Tracts across the Western Horizon" (unpublished ms., spring 1927, 30 pp., CFCH). The bath houses and solar water heater were Stevens's idea; he believed that "the evening shower baths are worth a lot in efficiency and good will" (Stevens to board of directors, July 26, 1920, TDC, box 13, file 3); Joseph Kinsey Howard, "Tom Campbell: Farmer of Two Continents," *Harper's* 198 (March 1949): 55–63; M. L. Wilson to H. A. Wallace, June 30, 1928 (MLW, box 3 of 46, folder D-29). Ramon Kent was quoted in a pamphlet prepared for the Campbell Farming Corporation Reunion held at the Big Horn County Museum in Hardin on July 24–25, 1999.
13. Campbell, "Operating a 95,000 Acre Wheat Farm," pp. 751–52; Campbell, "Manufacturing Wheat," p. 267.
14. Thomas Campbell to A. E. Morrison (general manager, Imperial Tractor Co., Minneapolis), May 2, 1918 (TDC, box 13, file 3).
15. Thomas Campbell to Theodore Rousseau, June 5, 1918 (TDC, box 13, file 3); M. L. Foster (manager, A. H. Averill Machinery Co., Portland, Ore.) to Campbell, May 22, 1919 (TDC, box 10, file 6); O. B. Maddox to Foote Brothers Gear and Machine Co., January

30, 1930 (TDC, box 11, file 31); Campbell to Hall-Perry, April 4, 1929 and Hall-Perry to Campbell, April 7, 1929 (TDC, box 11, file 32); E. E. LeVan to Campbell, February 19, 1931, and Campbell to LeVan, March 10, 1931 (TDC, box 11, file 32).

16. McCord Manufacturing Co. (Detroit) to Montana Farming Corporation, April 22, 1919 (TDC, box 1, file 26); Montgomery Ward to Montana Farming Corporation, September 17, 1918, Fred Gale to Thomas Campbell and Tom Hart, July 31, 1919 (TDC, box 11, file 8). Campbell to Theodore Rousseau, June 6, 1918 (TDC, box 13, file 3); Montgomery Ward to Montana Farming Corporation, September 17, 1918, Fred Gale to American Steel and Wire, February 8, 1919, and W. R. Abbott (manager, American Steel and Wire) to Montana Farming Corporation, May 17, 1919 (all in TDC, box 11, file 8).
17. Thomas Campbell to Tom Hart, June 9, 1920 (TDC, box 8, file 9).
18. Thomas Campbell to Theodore Rousseau, June 5, 1918 (TDC, box 13, file 1); Deere and Weber Company telegram to Campbell, July 11, 1918; A. E. McAdams (John Deere) to Campbell, July 20, 1918, Campbell to McAdams, July 20, 1918, Campbell to McAdams, July 28, 1918 (all in TDC, box 10, file 17); for Holt, see R. W. Lohman to Holt Manufacturing, June 24, 1919, and Ben C. Holt to Campbell, August 4, 1919 (both in TDC, box 1, file 21). Campbell wanted the Paris Manufacturing Co. in Stockton to send an engineer to Hardin to go over the blueprints for a harvester that he, Campbell, had redesigned; see Lohman to Paris Manufacturing Co., May 26, 1919 (TDC, box 1, file 29); Campbell to Tom Hart, June 9, 1920 (TDC, box 8, file 9). Campbell to A. E. McKinstry (vice president, International Harvester), June 17, 1930 (TDC, box 11, file 33).
19. Thomas Campbell to Stinson Tractor Co., August 18, 1918 (all Stinson correspondence is in TDC, box 11, file 4); for the prior relationship, see Campbell to Stinson, September 29, 1918.
20. W. B. Gleason to Thomas Campbell, August 24, 1918; Campbell to Stinson, August 1918. Before getting Gleason's letter Campbell had sent a telegram to the company asking for another representative because Spooner was unable to work: "Engines less satisfactory every day. . . . Should be in a garden" (Campbell to Stinson, August 27, 1918); W. B. Gleason to Montana Farming Corporation, September 3, 1918).
21. Thomas Campbell to Stinson, October 3, 1918, Campbell to Stinson, October 16, 1918, Stinson to Campbell, October 21, 1918, Campbell to Stinson, October 24, 1918, Stinson to Campbell, April 9, 1919, and Campbell to Stinson, April 12, 1919. Holt Manufacturing Company to Campbell, August 1, 1919 (TDC, box 11, file 4).
22. Malcolm Cutting, "A Manufacturer of Wheat," p. 19. An excellent assessment of Campbell's labor situation is Edwards, "The Greatest Hazard."
23. Thomas Campbell to Mr. Ewing and Theodore Rousseau, 23 May 1918 (TDC, box 13, file 3).
24. Thomas Campbell to A. H. Avery, April 29, 1918 (TDC, box 13, file 1); Campbell to Avery, November 18, 1919 (TDC, box 8, file 2); Campbell to John Lemay, May 2, 1918, Campbell to (?) Brekke, May 22, 1918 (both in TDC, box 13, file 1).
25. R. S. Washburn, "Tractor Farming in Dry Regions Has Advantages," *Yearbook of Agriculture, 1926* (Washington: GPO, 1927), pp. 734–36 on p. 735. Campbell, "Manufacturing Wheat on a 95,000 Acre Farm Factory," p. 267; Frank D. Hennessy to R. W. Lohman,

February 5, 1919; Frank L. Peterson to Montana Farming Corporation, August 9, 1919 (TDC, box 10, file 25); Campbell to Gordon, Hart, and Keyes (unit managers), March 2, 1920 (TDC, box 13, file 13), and form letter, Montana Farming Corporation, March 29, 1919 (TDC, box 1, file 19); Campbell to Preston Clapper, August 4, 1920 (TDC, box 1, file 12); "Montana Tractor, Truck and Automobile School to Open in Billings on Jan. 6," *Billings Gazette* (December 23, 1918): 8; "Billings Woman Graduates from Tractor School," *Billings Gazette* (February 4, 1919): 5.

26. R. W. Lohman to Thomas Campbell, March 22, 1919; Campbell to Lohman, March 24, 1919 (both in TDC, box 1, file 9); F. B . Connelly Co. to Lohman, August 6, 1919 (TDC, box 1, file 9); H. C. Wallace, "Report of the Secretary," *Yearbook of Agriculture, 1922* (Washington: GPO, 1923).
27. John Fox to Campbell, 22 Apr. 1919; Lohman to Fox, 5 May 1919; L.F. Annis to Campbell Farming Corporation, 16 June 1919; Annis to Lohman, 7 July 1919 (all in TDC, box 1, file 19); Theodore Rousseau telegram to Campbell, 3 June 1920 (TDC, box 8, file 16).
28. Rose, "Biggest Wheat Farm," p. 36; J. R. T to Matt Michaels, March 14, 1928 (TDC, box 2, file 33); Campbell, "Manufacturing Wheat on a 95,000 Acre Farm Factory," p. 266; Campbell, "Operating a 95,000 Acre Wheat Farm," p. 751; Campbell to D. L. Egnus (elected official, Hardin), October 13, 1927 (TDC, box 1, file 50).
29. Where not noted, all correspondence is to Thomas Campbell. Fred Ward (St. Paul), May 24, 1928; R. Sumner Sowers (St. Paul), March 3, 1928; Laurence Whiting (Minneapolis), April 3, 1928; A. D. Wilson, Jr., May 24, 1928; W. U. Counryman (Everett, Wash.), May 3, 1928; Hugh Emerson (Ashland, Wisc.), May 29, 1928; Claude Kincaid (Columbia, Mo.), May 1, 1928; Alonzo Lambertson (Fairview, Kans.), May 30, 1928; Thelow R. Leach (Bozeman), February 29, 1928; Harold Pinches, May 1 and 28, 1928; the student who drove through the west was Harold Clift (Columbus, Ohio), May 7, 1928; the bookkeeper was Quentin Jones (Northfield, Minn.), April 22, 1928; Campbell to W. J. Miskella, April 27, 1928; Campbell to Walter Case (president, Case, Pomeroy and Co., New York), April 29, 1927) (all in TDC, box 2, files 33 and 34).
30. George Wishnot to Campbell Farming Corporation, March 20, 1928; Amos Miller (Winslow, Ark.), May 14, 1928; H. W. Lindsay (New Rockford, N.D.), March 12, 1928; N. G. Vignault (California), May 28, 1928; Joseph Houck (Lewiston, Mont.), January 13, 1928; Herman Kosbau (Fargo), January 8, 1928 (all in TDC, box 2, files 33 and 34).
31. Joseph Newberger (Baltimore) to Campbell Farming Corporation, May 28, 1928; M. S. Cornell (Troy, Mont.) [spring 1928]; John Lane (Oak Lawn, Ill.) May 28, 1928; W. J. S. Phillips (New York), February 29, 1928; Thomas Campbell to W. J. S. Phillips, March 3, 1928; Ashmun Brown to Campbell, June 29, 1927; Campbell to Ashmun Brown, July 11, 1927; Campbell to Ashmun Brown, July 26, 1927; Peter Milinoyevic to Campbell, January 26, 1928; C. W. Lewis (LaGrange, Ill.) June 27, 1928 (all in TDC, box 2, files 33 and 34).
32. Henry Seeman (Willard, Mont.), February 20, 1928; Mrs. W. H. Decker (Chariton, Iowa), June 4, 1928; George Vincent (Lewiston, Mont.), March 20, 1928 (all in TDC, box 2, files 33 and 34).
33. F. W. Stevens to board of directors, July 26, 1920 (TDC, box 13, file 3), Campbell Farm-

ing Corporation paysheet for April 15 to May 1, 1919 (TDC, box 2, file 33); Thomas Campbell, "To Whom It May Concern" (Steamship Company), September 22, 1921 (TDC, box 13, file 37); Campbell to Rousseau, July 19, 1919 (TDC, box 8, file 16). On Fort Smith, see Campbell to Joseph Klodt, May 3, 1919, Campbell to Klodt, October 15, 1919, Campbell to Klodt, December 3, 1919 (all in TDC, box 1, file 2). Interestingly, the only mention of nonwhite workers at the CFC was on these units. The Fort Smith gang also angered Campbell when they rejected a black cook Campbell had sent there: "It is perfectly absurd the men had any objection to the colored cook, as they are usually the best in the world and we had one in our family for several years. I think this objection is the result of propaganda by the present cook" (Campbell to Preston Clapper, August 9, 1920 (TDC, box 1, file 12). M. L. Wilson to H. A. Wallace, June 30, 1928 (MLW, box 3 of 46, folder D-29).

34. Thomas Campbell to Tom Hart, July 31, 1919 (TDC, box 11, file 8); Campbell to all unit managers, August 13, 1919 (TDC, box 13, file 13); Campbell to Al Avery, August 14, 1919 (TCC, box 8, file 2); Campbell to unit managers, August 13, 1919.
35. Thomas Campbell to Theodore Rousseau, June 6, 1918, and Campbell to Rousseau, July 8, 1919 (both in TDC, box 13, file 1); Campbell to J. P. Morgan, July 11, 1919 (TDC, box 8, file 15); Frederick Stevens to Campbell, August 22, 1919 (TDC, box 13, file 3); Malcolm Cutting, "A Manufacturer of Wheat," p. 44; Campbell to Fred Gordon, September 7, 1920 (TDC, box 8, file 8).
36. Thomas Campbell to Joseph Keyes, March 10, 1920 (TDC, box 8, file 11); Campbell to Tom Hart, June 9, 1920 (TDC, box 8, file 9); F. W. Stevens to board of directors, July 19, 1920 (TDC, box 13, file 3).
37. Campbell, "Operating a 95,000 Acre Wheat Farm," p. 752; Thomas Campbell to Tom Hart, August 6, 1920 (TDC, box 8, file 9); Campbell to Fred Gordon, September 7, 1920; and Campbell to Fred Gordon, November 24, 1920 (both in TDC, box 13, file 13).
38. Cutting, "A Manufacturer of Wheat," p. 44; J. S. Johnston (assistant treasurer, Montana Farming Corporation) to board of directors, September 28, 1920, and Thomas Campbell to board of directors, March 9, 1920; cost sheet (both in TDC, box 13, file 3); Cutting, "A Manufacturer of Wheat," quoting Campbell, p. 18; Howard, "Tom Campbell," p. 62; Dan Maddox to Kelly-How-Thomson Co., August 28, 1931 (TDC, box 11, file 34); Kelly-How-Thomson Co. to Campbell, November 8, 1934; O. B. Maddox to Kelly-How-Thomson Co., November 20, 1934 (both in TDC, box 12, file 7).
39. Edward Angley, "Thomas Campbell—Master Farmer," *Forum* 86 (July 1931): 18–22, on p. 20; G. S. Gordeef to Thomas Campbell, March 20, 1928; Campbell to Gordeef, April 11, 1928 (both in TDC, box 2, file 23); Dan W. Maddox to Kelly-How-Thomson Co., May 15, 1931 (TDC, box 11, file 34); Campbell to Timothy Beresney, August 5, 1929, and Timothy Beresney to Campbell, August 24, 1929 (both in TDC, box 2, file 17); Campbell to W. C. Davis, August 10, 1929 (TDC, box 11, file 31); Campbell to Vaclav Partl, June 20, 1930 (TDC, box 2, file 25); Thomas Campbell, "The Gigant—or Giant Farm," ms., July 8, 1932 (CFCH); Campbell to the Ford Motor Company, September 13, 1930 (TDC, box 2, file 25); F. P. Gormely to Campbell, July 1, 1929, and Campbell to Gormley, July 6, 1929; Campbell to S. S. Poor (General Tire and Rubber), June 18, 1930 (all in TDC, box 11, file 32); Campbell to W. F. Heesch, June 18, 1930, Campbell to W. C. Davis, August 27, 1930

(both in TDC, box 11, file 31). On Tunisia, see Slattery, "Tom Campbell," pp. 7–8, and Howard, "Tom Campbell," pp. 56–58. See Thomas D. Campbell, *Russia: Market or Menace* (London: Longmans, Green, 1932).

CHAPTER 6: LEARNING FROM THE SOVIETS

Epigraph: Guy Bush, "Nine Out of Ten Pigs Died: Iowa Farmer Tells of Raising Hogs in Russia," *Wallaces' Farmer* 56 (November 14, 1931), pp. 7, 30.

1. This estimate is offered by Peter Kuznick in his *Beyond the Laboratory: Scientists as Political Activists* (Chicago: University of Chicago Press, 1987), p. 113. M. L. Wilson said that he had seen about fifty Americans in the Soviet Union when he was there, many of whom were mechanics sent by the various implement manufacturers; M. L. Wilson to Julius Meisenbach, November 18, 1929 (MLW, box 10 of 46, file F-19). Lewis Feuer provides a vivid description of many American visitors in his "American Travelers to the Soviet Union, 1917–1932: The Formation of a Component of New Deal Ideology," *American Quarterly* 14 (summer 1962): 119–49. For more general views of American businessmen in Russia during this period, see, for example, Charles M. Muchnic, "A Business Man's View of Russia," *Harpers* 159 (September 1929): 437–53; Walter Rukeyser, "I Work For Russia, 1–6" (series in 6 installments), *Nation* 132 (May 13, 1931): 523–24; May 20, 1931, pp. 551–52; June 3, 1931, pp. 606–8; June 10, 1931, pp. 626–28; June 17, 1931, pp. 652–53. Oswald Garrison Villard, "Russia from a Car Window, 1–6" (series in 6 installments) "I. The Observer's Problem," *Nation* 129 (November 6, 1929): 515–17; "II. The Industrial Vision," November 13, 1929, pp. 542–46; "III. The Spirit of the Government," November 20, 1929, pp. 576–79; "IV. The Unfolding of a Great Drama," November 27, 1929, pp. 619–21; "V. The Soviets and the Human Being," December 4, 1929, pp. 654–57; "VI. The Soviets and the Future," December 11, 1929, pp. 712–14.
2. Biographical information for Wilson and Davidson from *American Men of Science*, 7th ed., 1944. For Fletcher, see ibid., 6th ed., 1938. For Wilson, see also "Reminiscences of M. L. Wilson" (Columbia Oral History Research Office, 1975). Information on Stirniman supplied by Jane and Ann Stirniman. The trip to Biro-Bidjan is described in Franklin S. Harris et al., "Report of the American ICOR Commission for the Study of Biro-Bidjan and Its Colonization" [1929] (JBD); Franklin S. Harris (chair), Benjamin Brown, J. B. Davidson, Charles Kuntz, Kiefer B. Sauls, L. Talmy, "Summary of Report on the Biro-Bidjan Colonization Project" [1929] (MLW, box 10 of 46, file F-19); "Report of M. L. Wilson, Tractor Farming Specialist, Montana Agricultural College, United States of America on the Biro-Bidjan Settlement Project in the Amur District of Siberia" [1929] (MLW, box 10 of 46, file F-22); Robert Weinberg, *Stalin's Forgotten Zion: Birobidzhan and the Making of a Soviet Jewish Homeland* (Berkeley: University of California Press, 1998); I am grateful to Paul Josephson for bringing this book to my attention. Guy Bush's stories offer one of the few looks at the livestock situation; see Bush, "Nine Out of Ten Pigs Died," pp. 1179, 1202; Guy Bush, "Where Hired Men Issue Orders," *Wallaces' Farmer* 56 (November 28, 1931), pp. 1218, 1231; Guy Bush, "What Is Russia's Major Vice?" *Wallaces' Farmer* 56 (December 26, 1931), pp. 1271, 1276. McDonald went on to become Caterpillar's overseas president, retiring from the company in 1961. See his "Russian Notes" (FHH,

D-56, box 340, file "Russia—John Q. McDonald Reports"); F. Hal Higgins to E. J. Stirniman, July 8, 1961 (FHH, cat. 3947).

3. My understanding of Soviet agriculture during this period is based on reading Lazar Volin, *A Century of Russian Agriculture* (Cambridge: Harvard University Press, 1970); Zhores Medvedev, *Soviet Agriculture* (New York: W. W. Norton, 1987); Roy D. Laird, *Collective Farming in Russia—A Political Study of the Soviet Kolkhozy* (Lawrence: University of Kansas Press, 1958); Alexander Nove, *Glasnost in Action* (Boston: Unwin Hyman, 1989); Robert V. Allen, *Russia Looks at America: The View to 1917* (Washington, D.C.: Library of Congress, 1988); Joseph Finder, *Red Carpet* (New York: Holt, Rinehart and Winston, 1983); Holland Hunter and Janusz M. Szyrmer, *Faulty Foundations: Soviet Economic Policies, 1928–1940* (Princeton: Princeton University Press, 1992); Maurice Hindus, *Red Bread* (New York: Jonathan Cape and Harrison Smith, 1931); Louis Fischer, *Men and Machines in Russia* (New York: Harrison Smith, 1932); and Anna Louise Strong, *I Change Worlds* (New York: Holt and Company, 1935). H. C. Taylor shared his worries about the peasants with Wilson before Wilson left for the Soviet Union: "I am wondering if this new system of farming which they are trying to introduce is not a scheme on the part of the city end of Russia to cut under the peasantry by finding a way of producing their food supply independent of the peasants. Your imagination is as good as mine with regard to what this all may mean in the way of a desperate struggle" (Taylor to Wilson, January 23, 1929, MLW, box 37 of 46, file AK-4); see also V. M. Golovnin to Wilson, November 1, 1929 (MLW, box 10 of 46, file F-19), for a similar prediction.
4. The best source of information on Ware that I have located is Lement Harris, "Harold M. Ware (1890–1935), Agricultural Pioneer, U.S.A. and U.S.S.R." (occasional paper no. 30, 1978, American Institute for Marxist Studies). See also Bruce Bliven, "Mr. Ware and the Peasants," *New Republic* 43 (July 22, 1925): 232–35; Clarissa Ware, "In Russia with Western Pioneers," *Survey* (November 1, 1922), pp. 162–65, 174. For early tractor imports see Dana Dalrymple, "The American Tractor Comes to Soviet Agriculture: The Transfer of a Technology," *Technology and Culture* 5 (1964): 197–214. For the American relief expeditions to the Soviet Union in the early 1920s, see Merle Curti, *American Philanthropy Abroad* (New Brunswick, N.J.: Rutgers University Press, 1963). Joseph Rosen's role in Soviet agriculture is described in Dana Dalrymple, "Joseph A. Rosen and Early Russian Studies of American Agriculture," *Agricultural History* 39 (July 1964): 157–60; "Dr. Rosen Goes to Russia," *New York Times* (October 16, 1922): 15. The Ware quotation is from Lement Harris, *My Tale of Two Worlds* (New York: International Publishers, 1986), pp. 74, 68.
5. Lement Harris writes that Ware spent most of 1925 in the United States raising money for the Russian Reconstruction Farms, obtaining financial and/or moral support from Horace Truesdell of the USDA, writer Stuart Chase, Frank P. Walsh of the War Railway Board, and George Lawrence Parker of the Boston Unitarian Church, to name a few. The farms were then operated for about three years. Other Americans involved with this farm were Harry Minster, who was from Stamford, Connecticut, was fluent in Russian, and managed several flour mills; George McDowell, a skilled mechanic and carpenter who received the Order of Lenin; Joe Broecker, a J. I. Case demonstration agent who accompanied the Case tractors to the Soviet Union and stayed for about six months at no salary;

and Otto Anstrom, a North Dakota farmer whose exploits are colorfully recounted by Lement Harris, who was also in the Soviet Union with Ware for a time; Harris, "Harold M. Ware," pp. 36–40; Bruce Bliven, "Mr. Ware and the Peasants," p. 234; Marian Tyler, "The American God in Russia," *Nation* 124 (January 12, 1927): 37–38. Wilson comments on Ware's farms in letters to C. D. Kinsman, November 7, 1929 and to E. J. Stirniman, November 6, 1929 (both in MLW, box 10 of 46, folder F-19). Harris, *My Tale of Two Worlds,* p. 73. There is very little written on Russian Reconstruction Farms; the best is Anne Borders Lynch, *Two Years in Russia: 1925–1927* (Raleigh, N.C.: Pentland, 1999), which includes a reprint of Karl Borders, *Village Life under the Soviets* (New York: Vanguard, 1927).

6. See, e.g., *Thresherman's Review* (September 1910): 49; "Plan Russian Exhibition," *Farm Implement News* 44 (January 4, 1923): 16; "Tractors for Russia," *Farm Implement News* 44 (January 25, 1923): 16; "Russia Announces Big Agricultural Show," *Farm Implement News* 44 (March 22, 1923): 12; "U.S. Firms at Moscow Fair," *Farm Implement News* 44 (August 2, 1923): 12. In the spring of 1923 the German company Krupps announced plans to establish experiment stations around the Soviet Union to demonstrate and sell steam-driven plows, threshers, and harvesters. See "Krupps' Plan to Get Russian Farm Machine Trade," *Farm Implement News* 44 (April 12, 1923): 11. The 1925 figures were found in "Russia Buys Farm Machinery as Fast as Cash Can Be Found," *Farm Equipment Dealer* (October 1925): 12; "Russia Buys More Tractors," *Farm Implement News* 48 (February 3, 1927): 18.
7. Reingold Niebuhr, "Russia's Tractor Revolution," *Christian Century* (September 17, 1930): 1111–12.
8. Substantive and reliable information on the Grain Trust has been difficult to locate; this discussion is based primarily on Wilson's letters and journalistic references. The secondary literature in Soviet agricultural history says very little on this. For a typical American portrayal, see C. Parker Holt, "Russia's Five-Year Grain Production Program," *Farm Implement News* 50 (1 August 1929): 26–27.
9. Mordecai Ezekial, "In the Grain Belt of the New Russia," *Wallaces' Farmer* 56 (July 11, 1931): 825, 840, on p. 840.
10. Dalrymple, "American Tractor," pp. 211–13; M. L. Wilson to C. S. Noble, January 3, 1929 (MLW, box 10 of 46, file F-18); "Russia Buys More Tractors," *Farm Implement News* 50 (June 20, 1929): 19; "Soviet Tractor Purchases," *Farm Implement News* 50 (July 11, 1929): 14; "Soviets Buy Truck Engines," *Farm Implement News* 50 (August 15, 1929): 21; "Cletrac Sales in Russia," *Farm Implement News* 50 (August 22, 1929): 11; "Russia Orders More Hercules Engines," *Farm Implement News* 50 (December 12, 1929): 31; "Caterpillar Gets Russian Order," *Farm Implement News* 51 (August 14, 1930): 11; "Russian Progress," *Farm Implement News* 51 (August 7, 1930): 25; William Stoneman, "Farming under the Bolsheviks," *Successful Farming* (May 1934): 22; "Tractors in Russia," *Farm Implement News* 54 (March 16, 1933): 8; "Soviet Sales Boost Exports," *Farm Implement News* 51 (May 15, 1930): 19; "Russia Places Big Orders," *Farm Implement News* 51 (August 14, 1930): 12.
11. For example, when the Russian Bureau of Agricultural Information in New York asked M. A. McCall at the USDA to arrange an itinerary for visiting "agronomes," the request ended up on Wilson's desk (M. A. McCall to Clyde McKee, May 18, 1928, MLW, box 10 of 46, file F-17). Thomas D. Campbell, *Russia: Market or Menace?* (London: Longman's,

Green and Company, 1932), pp. 1–3. See also M. Shapovalov to Wilson, June 27, 1928, and Wilson to Shapovalov, July 31, 1928; Ilytchev cable to Wilson, March 29, 1929, and Wilson cable to Ilytchev, March 30, 1929, regarding an itinerary for seven Soviet agriculturalists who planned to spend five months in the United States studying industrial agriculture for the Grain Trust; J. M. Dowell to Wilson, April 6, 1929 (all in MLW, box 10 of 46, file F-17). J. G. Ohsol to Wilson, September 18, 1928 (MLW, box 10 of 46, file F-18). Ohsol also attended and participated in the annual meeting of the American Society of Agricultural Engineers in 1928; see *Agricultural Engineering* 10 (January 1929): 31–38. In his *Russia: Market or Menace?* Campbell describes several trips he made to the Soviet collective farms as an adviser.

12. I have found no evidence that M. L. Wilson knew or cared about Ware's political persuasions. Wilson to C. S. Noble, January 3, 1929 (MLW, box 10 of 46, file F-18).
13. M. L. Wilson to L. S. Margolin, March 22, 1929 (MLW, box 10 of 46, file F-18).
14. H. M. Ware, M. L. Wilson, and Guy Riggin, "Tentative Plan for Organizing Demonstration Factory Wheat Farm for Grain Trust at Verblude [*sic*] North Caucusus [*sic*], U.S.S.R." [February 1929] (MLW, box 10 of 46, file T-22).
15. Ware, Wilson, and Riggin, "Tentative Plan," pp. 2–3; for a fuller discussion of the summer fallow method, see M. L. Wilson, "Research Studies in the Economics of Large Scale Farming in Montana," *Agricultural Engineering* 10 (January 1929): 3–12, and Malcolm Cutting, "Big Doings in Montana," *Country Gentleman* 94 (May 1929): 22–23, 130–31.
16. Ware, Wilson, and Riggin, "Tentative Plan," passim.
17. Wilson, "Research Studies." Some difficulties, such as too much rain, were beyond even Wilson's control. But in 1931, when fields were too wet for tractors to pull planters, Stirniman persuaded the Soviets to provide him with a bombing plane so that he could sow the wheat from the air, a trick that had worked in California. See Henry Wales, "Russia to Sow Wheat from a Bombing Plane," *Chicago Daily Tribune,* May 22, 1931.
18. Ware and Wilson, "Outline Report on Plan for Organizing and Operating Demonstration Factory Wheat Farm, School of Practice in Large-Scale Wheat Farm Operation and Management and Experimental and Research Unit Dealing with Economics, Engineering, and Labor Organization Problems in Factory Farming" (MLW, box 10 of 46, file F-22), pp. 2–3.
19. Ware, Wilson, and Riggin, "Tentative Plan," p. 5.
20. Ibid., pp. 9–10.
21. Ibid., pp. 13–14.
22. This discussion is based largely on E. J. Stirniman, "An Agricultural Engineer Looks at Mechanized Farming in Russia," a three-part speech he gave to the World Grain Conference meeting in Regina, Ontario, in 1933; I am grateful to Ann Stirniman for making it available to me. Part 2 gives a detailed description of the Verblud farm, the organization of experts and peasants, the physical layout, and how the experimental and educational work was organized. Also useful was an unpublished manuscript entitled "Russian Ukraine During 5 Year Plan of 1930 and 1931 as Seen by Edward J. Stirniman, Ph.D., Agricultural Engineering, Iowa State, and Madge Ryan Stirniman, B.A., Home Economics, Iowa State" (n.d.; thanks to Jane Stirniman for providing a copy of this document). According to L. J. Fletcher, although there were virtually no roads except between impor-

tant cities, this amounted to "a tremendous opportunity for the building of graded dirt roads in the USSR": "Observations on Russian Agriculture," *Farm Implement News* 51 (March 13, 1930): 26–27, on p. 27. For machine tractor stations, see J. W. Pincus, "Agricultural Machinery in the Soviet Union," *Farm Implement News* 51 (June 5, 1930): 36; "Central Power Farming in Russia," *Farm Implement News* 50 (December 5, 1929): 27.

23. Camels were widely used in the northern Caucasus for pulling wagons, much as early Americans used oxen. Although camels were rarely used in the fields directly, it is ironic to name a mechanized farm after the beast of burden these machines were meant to replace. One is tempted to surmise that the Soviets, in addition to having a sense of humor, were less sanguine than the Americans about the potential success of their mechanization efforts. Wilson proved to be "no impractical egghead," however, and apparently earned the respect of both the Russians and the Americans; comparing the German machinery representatives to the Americans, Russians told Harris that the Americans were "regular guys." Harris, *My Tale of Two Worlds* (New York: International Publishers, 1986), pp. 58–59, 65. Thanks to an anonymous reviewer for pointing out the Jimmy Rodgers connection.
24. Whether trying to tally the number of tractors at Verblud or the number of acres, it has been extremely difficult to find figures that agree. For example, Wilson says that Verblud had a total of 375,000 acres, while Stirniman says 287,000. For the description of Verblud, see Stirniman, "An Agricultural Engineer" part 2, pp. 2–3. On the use of crates for housing, see L. J. Fletcher, "Observations on Russian Agriculture," *Farm Implement News* 51 (March 13, 1930): 26–27. See also Harris, *My Tale of Two Worlds,* pp. 43–45.
25. Stirniman, " An Agricultural Engineer," part 2, pp. 8–11; M. L. Wilson to Elmer Starch, May 15, 1929 (MLW, box 10 of 46, file F-18); Harris, *My Two Worlds,* pp. 65–66.
26. E. J. Stirniman to F. Hal Higgins, September 17, 1961 (FHH, cat. 3947, E. J. Stirniman file). Jean Walker to M. L. Wilson, December 10, 1931 (MLW, box 10 of 46, file F-21); Jean Walker, "Machines Crippled in Soviet Harvest," *New York Times,* November 4, 1931, p. 24; Wilson to L. C. von Patten, December 5, 1929 (MLW, box 10 of 46, file F-19). See also Dalrymple, "The American Tractor," pp. 202–8; Harris, *My Two Worlds,* p. 68.
27. A. J. Bruman to M. L. Wilson, June 22, 1930 (MLW, box 10 of 46, file F-20). Wilson told the manufacturers of Cheny Weeders that, in future, the company should include pictorial instructions for assembling the weeders since the Russians were not able to read written English (Wilson to L. C. van Patten, December 24, 1929, MLW, box 10 of 46, file F-19). Mordecai Ezekial, "Showing the Russians How It's Done," *Wallaces' Farmer* (July 18, 1931): 848, 857.
28. Ezekial, "Showing the Russians," p. 857. See also Walter Duranty, "Experts See Failure in Big Soviet Plant," *New York Times,* November 22, 1930, p. 9.
29. M. L. Wilson to C. D. Kinsman, November 7, 1929; Wilson to E. J. Stirniman, November 6, 1929 (both in MLW, box 10 of 46, file F-19).
30. M. L. Wilson to E. J. Stirniman, November 18, 1929 (MLW, box 10 of 46, file F-19); Wilson to W. R. Woods, October 26, 1929 (ibid., file F-18); Wilson to C. D. Kinsman, November 7, 1929 (ibid., file F-19). Wilson's assessment of the agronomes seemed to deteriorate over the next few years; commiserating with Stirniman in 1932, Wilson remarked

on their "cussedness and contrariness," a view Stirniman shared (Wilson to Stirniman, February 23, 1932, *ibid.,* file F-21). Mordecai Ezekial, "Showing the Russians," p. 848. Pincus, "Agricultural Machinery in the Soviet Union," p. 36.

31. Stirniman, "An Agricultural Engineer," part 2, pp. 11–13.
32. See "Russian Progress"; J. W. Pincus, "Tractor Production in U.S.S.R.," *Farm Implement News* 56 (August 1, 1935): 23. According to Lement Harris, the Soviets made Caterpillar tractors "unencumbered by patent restrictions. Any objections that the Caterpillar company may have had were soothed by a five million dollar order for 60 horsepower tractors which the Soviet government placed." It is not clear to what years this refers; see Harris, "Harold Ware," pp. 47–48. Dana Dalrymple, "The Stalingrad Tractor Plant in Early Soviet Planning," *Soviet Studies* 18 (October 1966): 164–68; Dalrymple, "The American Tractor," pp. 197–202.
33. Harris, *My Tale of Two Worlds,* pp. 90–91. The lack of coordination was noted by Warren Noble of Noble Engine Company of Cleveland, as reported to Walter Duranty, "Big Factories Test Soviet System," *New York Times,* March 24, 1930, p. 13. John Bekker's assessment is in Duranty, "Finds Soviet Plant Badly Mismanaged," *New York Times,* October 9, 1930, p. 5.
34. [Jesse] "Tapp" to M. L. Wilson, March 6, 1930 (MLW, box 10 of 46, file F-20); Otto Anstrom to Wilson, January 6, 1931 (*ibid.,* file F-21); "Tapp" to Wilson, *ibid.*
35. M. A. McCall to Clyde McKee, May 18, 1928 (MLW, box 10 of 46, file F-17); M. L. Wilson to L. C. van Patten, December 24, 1929 (*ibid.,* file F-19). After returning home from Russia, Wilson sent L. C. Margolin American books on scientific management, large-scale production, and accounting; see Wilson to Margolin, November 13, 1930 (*ibid.,* file F-17).
36. Tyler, "The American God in Russia," p. 37.
37. L. F. Michael to M. L. Wilson, January 14, 1929 (MLW, box 10 of 46, file F-18).
38. Wilson, "Suggested Plan for the Organization and System of Operation of Demonstration Wheat Sovhoz at Verblude, North Caucasus, USSR," August 1929 (MLW, box 10 of 46, folder F-22), p. 3.
39. Wilson, ibid., p. 4.
40. M. L. Wilson to C. S. Noble, November 6, 1929; Wilson to J. V. Bennett, November 8, 1929, and Wilson to E. C. Leedy, November 15, 1929 (all in MLW, box 10 of 46, file F-19); Bliven, "Mr. Ware and the Peasants," p. 234; Walter Pitkin, "The Great Dirt Conspiracy," *Forum* 86 (August 1931): 118–23, on p. 119. Wilson's friend Noble was written up in "Beating Russia in Game of Cheap Wheat Production Is Object of Experiments in Cost Reductions on Big Noble Farms," *Lethbridge (Alberta) Herald*, April 30, 1931.
41. Dana Dalrymple, "The Soviet Famine of 1932–1934," *Soviet Studies* 15 (January 1964): 250–84. While a lot of this wheat was used by the government for export, a fair amount was also held back in reserve for the military or routed to industrial workers. Dalrymple argues that this was also the ultimate weapon in persuading the peasants to collectivize or in punishing those who refused. In this sense the famine was deliberate.
42. M. L. Wilson to E. J. Stirniman, November 6, 1929 (MLW, box 10 of 46, file F-19); Jean Walker to Wilson, January 10, 1932 (*ibid.*, file F-21); Wilson to Stirniman, February 2, 1932 (*ibid.*).

43. M. L. Wilson to E. C. Leedy, November 15, 1929 (MLW, box 10 of 46, file F-19); personal communication with John Stirniman, August 1993. Wilson ultimately did travel abroad regularly when working with the Ford Foundation.
44. See, for example, M. L. Wilson to V. N. van Golovnin, November 6, 1929 (MLW, box 10 of 46, file F-19). On costs, see E. H. Lehmann, "Combines in Illinois," *University of Illinois Agricultural Experiment Station Circular* 316 (May 1927): 3–16; George A. Pond and Louis B. Bassett, "Cost of Combine Harvesting in Minnesota," *University of Minnesota Agricultural Experiment Station Bulletin* 266 (May 1930): 5–31.
45. "Big Farming in Russia," *Wallaces' Farmer* 55 (February 1, 1930): 198.
46. "Soviet Farm Set-Up," *Country Gentleman* (April 1935): 14–15, 86, on p. 86.
47. Mark Hobart, "Introduction: The Growth of Ignorance?" in Mark Hobart, ed., *An Anthropological Critique of Development* (London: Routledge, 1993), pp 1–30.

CONCLUSION: CHANGING THE LANDSCAPE

Epigraph: Arthur Capper, "Will Big-Scale Farming Last?" *Rotarian* 43 (October 1933): 17–19, 59–61, on p. 61.

1. Bryce Ryan, "A Study in Technological Diffusion," *Rural Sociology* 13 (1948): 273–85.
2. On "making do," see Mary Neth, *Preserving the Family Farm: Women, Community, and the Foundations of Agribusiness in the Midwest, 1900–1940* (Baltimore: Johns Hopkins University Press, 1995).
3. Mark Hobart, "Introduction: The Growth of Ignorance?" in Mark Hobart, ed., *An Anthropological Critique of Development* (London: Routledge, 1993), pp. 1–30, provides a provocative analysis of the unintended consequences of this top-down approach.
4. See, e.g., Alessandro Bonanno, Lawrence Busch, William H. Friedland, Lourdes Gouveia, and Enzo Ningione, eds., *From Columbus to ConAgra: The Globalization of Agriculture and Food* (Lawrence: University Press of Kansas, 1994), and Michael Watts, "Development III: The Global Agrofood System and Late Twentieth Century Development (Or Kautsky *Redux*)," *Progress in Human Geography* 20 (1996): 230–45.
5. See Deborah Fitzgerald, "Exporting American Agriculture: The Rockefeller Foundation in Mexico, 1943–1953," *Social Studies of Science* 16 (1986): 457–83; Bruce Jennings, *Foundations of International Agricultural Research: Science and Politics in Mexican Agriculture* (Boulder: Westview Press, 1988).
6. See, for example, Brian Page, "Restructuring Pork Production, Remaking Rural Iowa," in David Goodman and Michael J. Watts, eds., *Globalizing Food: Agrarian Questions and Global Restructuring* (London: Routledge, 1997), pp. 133–157. On the way in which the vertical integration of hog-raising and pork production have transformed rural areas, see Deborah Fink, *Cutting into the Meatpacking Line: Workers and Change in the Rural Midwest* (Chapel Hill: University of North Carolina Press, 1998), and Donald D. Strull, Michael J. Broadway, and David Griffith, eds., *Any Way You Cut It: Meat-Processing and Small-Town America* (Lawrence: University Press of Kansas, 1998). On poultry, see William Boyd and Michael Watts, "Agro-Industrial Just-in-Time: The Chicken Industry and Postwar American Capitalism," in Goodman and Watts, eds., *Globalizing Food,* pp. 192–225.

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