# Specialization and American Agricultural Innovation in The Early Industrial Era: John Hare Powel and Livestock Breeding

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English gentry engaged in specialized agricultural innovation figure prominently in accounts of early industrial Britain [4; 14; 22]. By contrast, scholarship on early American industrialization generally ignores contemporaneous agricultural specialists and innovators. Yet American economic historians have shown that by 1840 specialization had resulted in substantial increases in agricultural productivity and that in one important agricultural sector, dairying, almost all productivity increases between 1850 and 1910 are attributable to the diffusion of improved techniques adopted by some eastern farmers before 1850. [1; 18, pp.140-45] Their findings suggest that early nineteenth century agricultural innovation is an important untold story. I argue that, as in British accounts, elite agricultural reformers were prominent characters in this tale. Their unusual skills and resources enabled them to transfer and domesticate the techniques of Britain's agricultural revolution, techniques that, in the case of dairy farming, achieved widespread dissemination only in the late nineteenth century.

My argument is based primarily on the papers of John Hare Powel, a Philadelphian who, in the 1820s and 1830s, successfully operated a highly specialized agricultural enterprise. Powel established a dairy cattle breeding farm designed to acquire from England, produce locally, and disseminate throughout the United States animals that could yield increased amounts of milk and that transmitted these capacities to their offspring. In achieving these goals he also adopted and diffused British innovations in animal husbandry. Although Powel was probably the outstanding example of successful agricultural specialization in antebellum America, he was not unique. My research in the Powel Papers, a virtually complete collection of his outgoing correspondence and a partial file of his incoming correspondence, has identified a number of other breeders, most of them in New England and the Middle Atlantic states, who shared Powel's goals and employed many of his methods.

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Judging from Powel's correspondence with these men, the private papers of innovative specialists can provide an important complement to generalized accounts of agricultural improvement derived from census records and published agricultural literature. Private papers help explain successful innovation and suggest that innovative breeders played an important role in the subsequent diffusion of improved dairy practices. As was the case for new industrial technology, the transfer and development of new agricultural practices was a complex and prolonged process, making innovation much harder to explain than diffusion [6]. At least in the case of dairy agriculture, reformers' correspondence reveals that successful innovation depended on highly sophisticated business skills and that a short-lived combination of social circumstances and social values encouraged talented men to devote themselves to agricultural innovation in the 1820s and 1830s. Thereafter, economic factors provided incentives for additional farmers to adopt new methods [1; 2; 3], but since the diffusion of new farm practices depended on local demonstration [6; 29, p. 283], the activities of Powel and his peers indicate that numerous innovative breeders helped diffuse improved dairy practices and that breed improvement was part of the technological system they disseminated.

Understanding long-term trends in American agriculture requires that we examine their early nineteenth-century roots. As we know, American agriculture has developed through its increasing dominance by businessmen at the expense of farmers and the family farm. While we must be careful not to read the story of twentieth-century agriculture back into nineteenth-century agricultural history, most American agricultural history has gone to the opposite extreme. Agricultural historians have too often limited their concern to agricultural innovations that were widely adopted by contemporary farmers, a focus that necessarily restricts our definition of successful innovation in an era when the vast majority of Americans farmed.

Most notably, this emphasis has discouraged serious study of elite agricultural reformers. Briefly stated, Powel and his peers, the men who organized scores of antebellum societies for improving American agricultural practice [19; 20, pp. 83-87], have been dismissed because they were unrepresentative of American farmers, and they developed methods that the average contemporary farmer could not or would not adopt. For example, Albert Demaree, whose treatment of agricultural reformers is more sympathetic and perceptive than most, offers this capsule description of elite agricultural innovators:

> Strange as it may seem, the initiative and direction of these organizations came from professional and business men, whose main interests were not agricultural. Naturally the chief benefits accrued to these gentlemen farmers. In reaching the "dirt farmer" and meeting his problems, these societies and their publications were failures [10, pp. 8-9].

Although such statements accurately reflect early nineteenth-centrury "dirt farmers'" opinions and practices, they are a strange basis for dismissing reformers as unworthy of serious historical consideration. By

applying the same criteria to early nineteenth-century manufacturing, we would ignore many promoters and developers of new textile machinery because their innovations were not suited to domestic spinsters and craft weavers and dismiss Francis Cabot Lowell and Moses Brown from consideration because they were merchants rather than traditional textile manufacturers. Viewed in this light, the basic distinction between Powel and Lowell is not that Powel's technology was less viable in the long run, but that it took much longer for Powel's innovations to replace conventional methods.

Of course, textiles, especially the northern New England or Lowell system textile mills that have attracted most scholarly attention, represent an extreme case of the rapid diffusion of a new technology [26; 32]. In iron-working, tanning, grain milling, saw milling, and brick making, numerous traditional enterprises coexisted with a few innovative establishments for prolonged periods. We know comparatively little about technological change in these industries, but our limited evidence suggests that, as in dairying, technical innovation was retarded by the small size of many local or regional markets. This was true because such industries produced goods that could not profitably be shipped long distances, they processed local raw materials, or their extensive use of land confined them to rural or semi-rural locations, circumstances that also characterized dairy farming. In such enterprises, favorably located, creative entrepreneurs such as Oliver Evans and Zaddock Pratt developed innovative techniques that were unsuited to most small, contempoprary firms, but, gradually, more and more entrepreneurs adopted their methods as improved transportation created additional large markets [7, pp. 46-48; 11]. Similarly, by the 1820s John Hare Powel's Philadelphia location favored dairying and dairy breeding [18, pp. 140-45; 30, pp. 150-52] and his correspondence shows that he and his fellow breeders introduced from England and developed in America all of the techniques that, according to economic historian Fred Bateman, late nineteenth-century dairymen adopted to increase dairy productivity. Thus, like Evans and Pratt, Powel merits study even though few contemporary farmers employed his methods.

Powel and his fellow elite reformers have also been dismissed because they were independently wealthy or brought to their agricultural endeavors money earned in other businesses or professions. Again, the charge is true, but analogy to industrial ventures suggests that this was an asset rather than a liability. Dairy breeders such as Powel supplied the capital goods (improved dairy cattle) that made later dairy farming profitable [4, p. 69]. As was the case for the early nineteenth century machine tool industry, this entailed developing an extremely complex and novel technology, one that required a much larger long-term investment than average farmers could muster and more risk than most would assume. For example, at the time Powel began importing cattle, English cattle breeding was only seventy-five years old, and improved dairy Shorthorns, the first English dairy breed, had originated only forty years earlier [25, pp. 161-69]. Consequently, as Powel's correspondence with English breeders makes clear, he not only spent large amounts of money purchasing and transporting animals (about $10,000 in his first three years), but also had to write off some of these animals as bad investments. Moreover, English breeding and husbandry practices were still the subject of hot dispute both in England and in America so that Powel footed the bill for testing the

reliability of various breeders and their advice. He also expended time and money experimenting with many improved American cattle and publicizing the results of his breeding activities. In sum, just as machine tool development had to be underwritten by federal arms contracts, the development of dairy breeding required the capital of early neneteenth-century gentlemen.

As important as the money he invested was Powel's investment of his formal and informal education. After preparing at home with his well-educated English father, Powel attended the College of Philadelphia for three years, then acquired professional training by entering the counting-house of his maternal relatives, Willing and Francis. An apt student, he travelled for the firm to Calcutta, traded on his own account, and made $20,000. His later success as a breeder depended on his mastery of each of the various mercantile skills: negotiating, selecting reliable ship captains, writing clear letters of instruction, and keeping accounts of ventures.

Most impressive is Powel's creative development of cost accounting methods. This enabled him to break even while selling many imported animals at or below cost, giving away some of the animals he raised, charging nominal fees for stud service, housing and selling animals for his principal English breeder, and donating his premiums from livestock shows to the societies that sponsored them. Whereas few nineteenth-century farms kept accounts even of their variable costs and industrial accounting generally ignored fixed costs throughout the nineteenth century [5, pp. 97, 103; 9, pp. 22, 226-40; 33, pp. 8-12, 16-17], Powel typically derived livestock prices by carefully calculating breeding costs. He included depreciation of his breeding stock; insurance charges in the form of estimated risk of loss or injury in transit or on his farm; annual interest charges on the capital invested in his livestock; and the apportionment of overheads such as farm maintenance, expenses of keeping bulls, and unusual expenditures for labor, seed, and fertilizer required to cultivate the root crops, hay, clover, and grain that he introduced to supply his animals with adequate year-round nutrition. In addition to making Powel's own enterprise possible, his accounting methods abetted innovation by others because his calculations fixed the cost of improved livestock at realistic rather than speculative levels [25, pp. 177-81]. Moreover, Powel shared his accounting insights with prospective purchasers. His letters instruct other breeders in how to calculate potential returns on investments in his cattle, including adjustments for the lower market value of crosses between pedigreed animals and the superior domestic cows that bore most of the progeny of Powel's imported bulls.

Powel's creative use of his mercantile skills is equally apparent in his correspondence with ships' captains. Because improved dairy Shorthorns were perishable capital goods, provision for their transfer to America involved much more complex negotiations than were required to transfer textile machinery. Powel learned early of the damage caused when animals in transit were not milked regularly and completely; fed properly prepared food in appropriate quantity; provided with quarters on deck that allowed limited movement but minimized the amount they would be thrown against one another; kept clean; and loaded and unloaded with care. He selected captains willing to supervise these activities and to construct

special quarters, and he provided these men with complete instructions for routine care as well as basic veterinary supplies accompanied by detailed descriptions of symptoms and remedies.

Many of Powel's fellow breeders shared his educational advantages.[2] They also had extraordinary informal educations. In Powel's case, formal mercantile training was followed by a pleasure trip to France and England, where he served as secretary to the American legation in London and polished the skills of dealing with English gentlemen, later reflected in linguistic patterns that distinguish his English from his American agricultural correspondence. On his return to America, his informal education continued as an officer in the volunteers and in the regular army during the War of 1812. He travelled widely and acquired familiarity with the climate and topography of various regions, knowledge he employed regularly in his American agricultural correspondence.

In addition to displaying the exceptional skills that made early agricultural innovation possible, the Powel Papers suggest why members of his generation of the American elite devoted their talents to agricultural reform. Part of the answer lies in the Whig political affiliation of Powel and many of his fellow breeders, including America's leading Whig statesman, Henry Clay. Like Clay, Powel's largest commitment was to American economic development through the simultaneous promotion of agriculture, transportation, and industry. Most of his nonspecialist correspondence is devoted to such issues an internal improvements, frontier land policy, linen manufacture, the tarriff, and the development of Pennsylvania coal lands. He especially encouraged the creation of a regional transportation network in and around Philadelphia, an activity that required elite promoters and fostered increasing specialization by altering real estate values. Powel's larger political and economic concerns enabled him to appreciate the potential contribution of agricultural specialists and to endow his role as agricultural reformer with political and social significance.

In creating a new and significant social role, Powel and his peers resemble the nineteenth-century agricultural scientists portrayed by Charles Rosenberg and Margaret Rossiter and the popular lecturers depicted by Donald Scott [27, pp. 135-52; 28; 31]. Like these men, Powel's generation of agricultural reformers was inspired not only by their vision of America's future, but also by the dearth of acceptable professional roles for men of their status and experience. Powel made these motives explicit in an unusual youthful letter. The letter lacks the self-restraint that characterizes the rest of his correspondence because, as he confessed in an apology to his family penned the next day, "I had ... taken port wine enough to make me talkative and stupid, [and] as I had no Companion to chatter with I made you the unhappy victim of my stupidity" [24, undated

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[2] In addition to fragmentary information available in the various sources cited in the references, here and elsewhere I have relied upon the Dictionary of American Biography for information on the careers of Powel and a number of his correspondents.

(1811-1812)]. Powel is contemplating what to make of his future. "The point," he says, "will be to occupy myself profitably and gratify my aunt," a wealthy, childless widow who had adopted him. Elizabeth Powel's late husband had been a founder and officer of the Philadelphia Agricultural Society so that family tradition sanctioned agricultural reform. At this juncture, however, the youthful Powel is most aware of his dissatisfaction with the careers that had attracted men of his uncle's generation:

> The Law as a profession won't do. I should die first, there are besides twenty-six long years over my head and twenty thousand reasons in my noodle against it. Commerce I can't bear. It is the devil, the life of a Merchant Bull and devil I would rather be hanged than think of it. Why not be a Farmer, a practical farmer, my dear John, some of you perhaps will say? I should answer, any ass that eats oats and has an open Barn can make much better manure than any Chymist that reads Books and has a Compost Heap, and I am sure that a Chum who can sow and reap knows much more of his business than any gentleman that may attempt to direct him. I'll be no Farmer [24, undated].

Judging from their career paths, many of Powel's fellow reformers shared his discontent. To Powel's listing of the law and mercantile activity we can add the military, which lost interest for Powel and others after the War of 1812, and politics, which proved so tedious to Powel in the 1820s that he resigned his Pennsylvania legislative seat before his term expired. Powel's network also included men who had found that the medical and religious professions lacked the prestige and opportunities for zealous advocacy that had engaged the energies of an earlier generation.

A final possible role that Powel clearly did not relish was that of gentleman farmer. As his letter makes clear, he considered the activities of such men futile because they were excessively dependent on books and patronizing in their attitudes toward common farmers. Powel continued to disparage this sort of agricultural reform. In 1824, writing to a man whose nephew contemplated a career in agricultural improvement, Powel characterized the major contribution of Philadelphia's earlier agricultural reformers, The Memoirs of the Philadelphia Agricultural Society, as

> edited by farmers whose of theories are so subtle that in practice they have seldom been applied. They are the work principally of Dr. Mese [James Mease, a prolific writer and long-time society officer] who writes without thought and has the genius to farm without land [23, undated (6-7/24)].

Instead, Powel and his network of breeders created a new role, one that accounts for much of their success in domesticating and disseminating Britain's improved dairy techniques. One aspect of this role has been featured in secondary scholarship: the establishment by Powel's generation of new agricultural societies that featured livestock exhibitions [8, pp. 60-64; 19, pp. 15-31; 20]. However, these societies, including Powel's 1822

Pennsylvania Agricultural Society, have generally been dismissed as irrelevant because they were dominated by elite agriculturalists who garnered most of the premiums awarded at fairs [12, pp. 349-53]. Such criticism misses the point. Powel and his fellows were dissatisfied with the inactivity and patronizing attitude of earlier "gentlemen farmers," and they viewed exhibitions that promoted "emulation" as offering an alternative role for agricultural reformers.

Brooke Hindle's recent work has elucidated the meaning of emulation and documented its role in encouraging early American invention. A "word much more in currency then than today, ... [emulation] emerged from the manner of instruction in the arts and crafts" [13, pp. 12-13]. This important early American concept had two components: the notion of copying the work of a master in order to learn and the idea of ultimately surpassing one's mentor or model. Emulation appealed to Powel's generation of agricultural reformers because it could simultaneously foster education and innovation. As embodied in agricultural fairs, the two senses in which early Americans used the word "emulation" help clarify the practical purposes of the new elite agricultural societies. Knowing that pedigreed livestock were difficult and costly to import from Europe and breed in America, Powel and his peers did not expect common farmers to surpass wealthy breeders in competition. Rather, they recognized that existing "native" livestock, which reflected the poor care and "promiscuous breeding" of animals left to fend for themselves, did not provide farmers with models of the desirable qualities that might be achieved by applying recent British innovations in breeding and husbandry. Fairs could supply these instructive models. At the same time, because Powel and his competitors took the symbolic value of their premiums seriously, emulation, in the sense of attempts to surpass a model, promoted the continuing importation of English cattle as well as experimental breeding and improved animal husbandry by innovative specialists. In sum, emulation discouraged the passive and patronizing behavior of "gentlemen farmers." It forced elite reformers to test and refine their theories in practice and to expose their efforts to farmers' scrutiny, evoking either criticism or interest.

Although agricultural fairs have attracted most of the scholarly attention, they occurred infrequently and, in the case of Powel at least, evoked only short-lived enthusiasm. Most of the activities of the new agricultural reformers, their day-to-day decisions and long-term accomplishments, remain buried in their private papers, but they appear to have accomplished prodigious feats. And while the educational impact of the fairs on common farmers has been and remains difficult to assess, the educational influence of exemplary breeding and dairy farms may have been enormous.

My phrasing of these conclusions is tentative and designedly so. Gleaning information from private manuscript sources is a labor-intensive operation, and I have been able to examine thoroughly only the papers of America's leading dairy breeder. Nonetheless, my work on Powel and his network provides evidence that the study of individual specialists could complement and revise Bateman's work with agricultural publications and aggregate census data. The Powel correspondence indicates that the new techniques that underlay increases in dairy productivity after 1850

originated with elite specialists in the 1820s and 1830s; that once economic factors provided sufficient incentive for additional farmers to adopt new methods, specialized breeding farms acted as influential centers of diffusion; and that, given the methods of elite dairy reformers, breed improvement played a more important role in late nineteenth-century productivity increases than Bateman's sources could reveal. The concluding section of this paper treats these assertions in somewhat greater detail.

The Powel Papers document that the new role of agricultural reformer attracted a number of elite farmers to dairy breeding and specialized dairy agriculture in the 1820s and 1830s and that their accomplishments were substantial. Powel's correspondents repeatedly expressed their desire to surpass previous regional achievements and to adopt livestock and techniques that would appeal to local farmers. By 1840 these men had transferred Britain's innovative agricultural techniques to America and established a national network of specialized breeding and dairy farms. Elite agriculturalists from Maine to South Carolina and from Maryland's eastern shore to Kentucky purchased improved dairy Shorthorns from Powel, although his network was concentrated in the mid-Atlantic and New England states. The members of Powel's network of breeders also corresponded with him concerning the improved husbandry practices that Powel imported and domesticated along with his livestock: a longer milking season, balanced year-round feeding, better winter housing, and greater cleanliness.

These are the practices to which Bateman attributes most later dairy farm improvement. Powel himself equalled or exceeded Bateman's 1910 eastern farmers in each of these practices as early as the 1820s. By applying such techniques to animals bred for butter-fat, rather than maximum milk output, he achieved estimated average annual yields that were two and one-half times those achieved in Bateman's 1910 "best practice" states.[3] And Powel's correspondence indicates that a number of his contemporaries equalled or surpassed these yields using Milking Shorthorns or Shorthorn crosses.

These impressive accomplishments suggest that Powel's generation of innovators may have established the centers from which improved dairy farm practices diffused in the years between 1850 and 1910. In light of the prevailing arts and crafts pedagogy of emulation, dissemination by outstanding example certainly seems more likely than diffusion through agricultural publications. Moreover, as Gould Colman has shown, mid-nineteenth-century farmers with economic incentives to increase output remained unwilling to innovate, but were ready to adopt new practices once their viability had been demonstrated locally [6]. Given the extensive network of innovative breeders revealed by the Powel Papers, further research should confirm that by 1850 most farmers had ready access to

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[3] Bateman's "best practice" states achieved about 4,800 pounds per annum in 1910. My estimate of about 12,000 pounds per year is a conservative one. I have assumed forty pounds of milk per day, whereas Powel cites forty to forty-eight as typical, and I have used a 300 day milking season, although Powel reports milking cows on the eve of calving. Of course, since Powel operated a breeding farm, much of the milk went to calves [1; 23].

local dairy innovators, especially in the leading dairy states of 1850 where Powel's network was concentrated.

Powel's flexible and economically sensible approach to disseminating Britain's improved husbandry was designed to favor the diffusion of new methods. His Whig political views, which emphasized a regional division of labor and promoted a Philadelphia-area division of labor through transportation improvements, made him especially sensitive to regional differences and local factor endowments. In the case of feeding practices, for example, he encouraged his correspondents to tailor their methods to local circumstances rather than slavishly copy his system or that of British farmers. Writing to Boston agricultural editor Thomas Fessenden, he described how he cultivated feeds, then cautioned,

> You are aware that I am opposed to the soiling system in toto, except where land is very dear, and labor very cheap. I have recourse to it from necessity, although my crops of grass are much better than most of my neighbors, in consequence of my land having been very deeply ploughed. It is absurd in America, to have recourse to the expedients adopted in countries where land is dear, and the population surcharged. From a large field of Mangel Wurtzel, which had been very thickly dibbled, a vast number of small roots with ample leaves have been taken. On proposing to my fold man to give them to the cattle, he asked me whether he should pick the black cherries for the hogs too [23, 7/2/26].

In his correspondence with agricultural improvers, Powel offered advice that was specific to their region and to the nature of their enterprise. He urged a Maine dairy reformer,

> Do not rely upon root crops where you can grow corn successfully except for a <u>particular</u> purpose. I have increased the quantity of Mangel Wurtzel annually, as they are essential on a breeding farm.... Notice my remarks upon the value of root crops in Indian Corn country. On your new land where labour is very dear, land very cheap, and manure very scarce, the farmers should <u>try</u> them in small <u>beds</u> or in gardens [23, 5/10/28].

Similarly, Powel's private papers reveal a more practical and flexible approach to breeding than his polemical and promotional published works convey. Given the prevailing mediocrity of American cattle, Powel recognized the advantages of importing superior British dairy animals, but he did not advocate adoption of pedigreed dairy Shorthorns as <u>the</u> method of improving American dairy agriculture. Rather, he offered an approach to breeding that emphasized both the advantages of capitalizing on British achievements and the limitations of relying solely on "best to best" breeding.

As with his methods of agricultural reform, Powel's political and economic beliefs evidently shaped his views on livestock breeding. Like a number of his fellow breeders, his Federalist heritage and elite background encouraged him to appreciate the value of pedigree and to seek out superior British animals, rather than try to create an American breed. At the same time, however, his practical experience with men and cattle and his practical interest in economic development made him aware that simple breeding rules offered insufficient guidance and that observing the characteristics of siblings and progeny was also important.[4] He expressed his views most fully to a British breeder, Charles Champion, whose cattle did not meet his expectations for dairy breeding stock.

> In answer to your remark "it is not always the highest bred animals which obtain the best price" I would observe that a high bred animal may be bad, as there is always a tendency to go back ... I confess, although I am no democrat, I believe that the properties and propensities of the man, as well as the beast, are not always found in proportions equal to the jewells upon the coronet or scores of Mr. Collings' Herd Book. I know no reason why Mr. Champion after the experience of Mr. Collings [creator of the Shorthorn breed] and with much better materials, derived from an increased number of objects, cannot establish a family quite as good as any which have gone before. But I would contend, other things being equal, that I should most assuredly prefer an animal whose progenitors can be traced as marked by the definite characteristics which I most desire and I know from long observation that a coarse coal heaver is not likely to beget a chivalrous knight [23, 6/3/25].

Relying on his published writings, secondary scholarship has depicted Powel vigorously advocating one imported breed as the only alternative to mediocre American cattle [8, pp. 166-75; 25, pp. 176-79]. In his private correspondence, however, Powel took pains to correct this impression. To editor Fessenden he wrote,

> You have made one mistake in ascribing to me the notion, that native cattle as they are called should not be brought into the plan for improvement. I paid to Mr. Williams [a Massachusetts breeder] $100 for a half bred bull, and $600 for half and three quarter bred animals. I sent three half bred males into the

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[4]Powel's private correspondence suggests that secondary accounts derived from published sources are in error when they attribute simplistic pedigree-oriented or "best-to-best" breeding practices to nineteenth-century breeders. Powel's description of his practices makes clear that progress did not await the scientific and technical discoveries of Mendel and Babcock [25, pp. 18-57].

> wilderness of Maine. I placed my bulls for many seasons in different counties, to husband native cows. I had, until I was run down, allowed my finest males to husband native cows even here -- for four years I have given away all the half breed calves as breeders, twice as many as Col. Pickering [Massachusetts breeder and Powel's principal opponent in published debates] has raised in all his life. Yet I am supposed in your notices to think that the native cows should not be employed in the effort for improvement [23, 7/2/26].

Similarly, Powel's letters to breeders and improving farmers described his own sophisticated breeding methods, but offered advice that varied with the circumstances of the recipient. To a Connecticut customer Powel explained the methods that enabled him to sell consistently superior breeding stock to customers throughout the nation,

> I have ordered another bull from England, ... as I conceive it essential to have males of various families wholly distinct for the purposes of a farm devoted regularly to breeding. You are aware that it is not permitted always to put the finest male and finest female together, for if they should both have a tendency to the same defect, that defect would be augmented in the offspring [23, 4/5/26].

But he encouraged different strategies among breeders seeking to effect local livestock improvement. To one Maine correspondent he wrote,

> I commend your decision. Breed from Denton or Admiral's half breed heifers -- go on quietly, and take care to allow 50 per cent in all calculations for disappointment [23, 5/10/28].

And he advised a potential New York breeder,

> In reply to your inquiry for a calf, I must remark that a half bred animal would not be worth the expenses of conveyance for a breeder, unless it united the blood of two known and established breeds [23, 8/18/27].

In response to the same customer's request for a proven dam, he reviewed the history and cost of one of his cows, but concluded,

> A much better and cheaper plan for improving your stock would be to purchase a young bull of pure blood for two hundred dollars when nine months old. This is the actual cost of such an one bred upon my farm, estimating depreciation of dam, risk, food, etc., etc. [23, 8/18/27].

Replying to a working farmer, he was neither patronizing nor doctrinaire.

> You appear to have had an extraordinary cow, which, I have no doubt would be considered valuable in any country for family purposes. ... You ask the price of a family cow. I have no cow with which I am disposed to part at a price which I should conceive it proper to give for the use of her milk alone [23, 7/9/27].

He also offered the same man some general guidance in judging the claims of breeders.

> We do not estimate the weight of butter and of flesh in comparison to the weight of food; for it must be evident, that all products, whether of the soil, or of the animals, must be determined in all estimates by the cost, both of labour and of the nutritious matter supplied. ... Thus I have always contended, that pet crops or pampered beasts, however well fitted to furnish florid paragraphs for Cattle Show Committees, have no useful tendency, and generally fail not to bring those useful associations, called farmer's societies, into disrepute. The cow of whose product you have seen an account, must not be taken as the standard by which the families of dairy improved short horns are to be criticized. She is much the best I ever saw in milking properties; and is better than any one I ever hope to import. I consider twenty to twenty-four quarts the quantity which the family I most value yield [23, 7/9/27].

Powel's emphasis on breeding to suit economic circumstances, exemplified in his determinations that selling at cost and offering free and readily available stud service were appropriate for a breeder in a developing economy, gave subsequent breeders and dairymen better methods and numerous improved cattle with which to work. Thus, his private correspondence suggests that the spread of improved livestock probably played a greater role than Bateman's sources, published nineteenth-century agricultural literature, disclose. Like Powel's own publications, such sources are implicitly polemical or promotional and imply a single solution to breed improvement, in the late nineteenth century the adoption of "dairy breeds" (Ayrshires, Holsteins, Jerseys, and Guernseys) in preference to "dual-purpose cattle" (Shorthorns) [1; 2; 15]. As evidence they do not provide a basis for assessing the role played by the dissemination of dairy Shorthorns, which were superior to most "dairy breeds" in the early nineteenth century and set output records as late as the 1930s [25]. More important, agricultural publications and the records of breed associations ignore the half-breeds, crosses, and other economically sensible compromises that were Powel's principal legacy to American dairy farmers and breeders. Accounts of a few dairy farms and Shorthorn breeding farms in New York and New England indicate that at least some operations profited by

applying Powel's methods after 1850, confirming the need for further scholarship on actual practice [9, pp. 159-65; 25, pp. 175-85].

The availability after 1840 of numerous elite-operated breeding farms offering models of improved dairy practice also makes it likely that late neneteenth-century dairy specialists improved their cattle as they improved their methods of care. Judging from Powel and his network, early nineteenth-century agricultural reformers treated livestock husbandry and breeding as a technological system, an integrated body of knowledge and practice that included criteria for selecting animals, methods of cultivating feeds and of feeding, and techniques of housing and caring for animals. While theoretically, as in the polemics of the agricultural press, these practices are separable, in practice agricultural innovators did not treat them as separate either in their advice to correspondents or in their behavior. When agricultural reformers held cattle shows or established locally influential farms, the models they offered potential emulators were unified embodiments of better breeding and better husbandry. Indeed, unspecialized early nineteenth-century farmers often rejected improved livestock as requiring better care, a conclusion that was not literally true, but an economically sensible conclusion nonetheless, because both improved breeding and improved care were more profitable when practiced together.

What seems likely, then, is that the growing number of late nineteenth-century farmers who recognized the economic possibility of specialization in butter or cheese production looked to local innovators, breeders and dairymen, for techniques and dairy animals or sires. Like the men they chose to emulate, they improved their livestock husbandry in part because they acquired more valuable animals, often Shorthorn crosses or half breeds. They also learned to breed their stock more carefully, if only because they no longer left mating to chance. Judging from Bateman's calculations, a measure of breed improvement would have raised dairy productivity without simultaneously raising labor costs enough to diminish dairy farm profits. Breed improvement was no doubt far less pronounced among the less specialized family farmers who also increased their milk yields, but their behavior can be explained both in Bateman's terms, the low opportunity cost of family labor, and by the lure of the genuine profits reaped by the growing number of specialists who milked improved animals [2; 3].

Although Powel's generation of agricultural reformers supplied the animals and techniques that many subsequent breeders and dairy farmers adopted, the story of dissemination is probably not as straightforward as this sketch implies. As early as the 1830s Powel and his principal English breeder had indentified one American livestock importer, Felix Renick of Ohio, whose speculative motives resulted in higher-priced animals selected principally for form rather than function. Anecdotal evidence suggests that speculative Shorthorn breeders flourished into the 1870s and may have deterred dairy improvement in some regions. A larger number of breeders evidently continued Powel's tradition, but the activities of both groups of breeding specialists warrant attention if we are to understand the factors that shaped the dissemination of improved dairy farm technique. Likewise, some breeders and beef specialists reduced the pool of improved dairy cattle by mating dairy Shorthorn cows with beef Shorthorn sires, but most New England farmers and some breeders as far west as Kentucky did not

succumb to the lure of high beef prices. Again, the evidence at hand is anecdotal and inconclusive, and the issue warrants further study [8, pp. 166-75; 25, pp. 176-79].

For at least a generation, elite agricultural reformers played an influential role in early industrial America. If Powel and his correspondents are representative, both the business methods and the technology of these specialists abetted long-term agricultural development. Indeed, their choice of techniques assumed that specialists would gradually come to predominate over family farmers. Now that economic historians have uncovered important productivity increases in unmechanized agricultural sectors, historians of business and technology need to determine how innovation and diffusion occurred. Elite specialists may have figured less prominently in America than in England, but we will not know until we examine their private papers.

REFERENCES

1. Fred Bateman, "Improvement in American Dairy Farming, 1850-1910: A Quantitative Analysis," Journal of Economic History, Vol. 28, No. 2 (1968), pp. 255-73.

2. _____, "Labor Inputs and Productivity in American Dairy Agriculture, 1850-1910," Journal of Economic History, Vol. 29, No. 2 (1969), pp. 206-29.

3. _____, "The 'Marketable Surplus' in Northern Dairy Farming: New Evidence by Size of Farm in 1860," Agricultural History, Vol. 56, No. 3 (1978), pp. 345-63.

4. J. D. Chambers and G. E. Mingay, The Agricultural Revolution, 1750-1880 (London: B.T. Batsford, 1966).

5. Michael Chatfield, A History of Accounting Thought (Huntington, NY: R.E. Kreiger, 1977).

6. Gould P. Colman, "Innovation and Diffusion in Agriculture," Agricultural History, Vol. 46, No. 3 (1968), pp. 173-87.

7. Ruth Schwartz Cowan, More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave, (New York: Basic Books, 1983).

8. Clarence H. Danhof, Change in Agriculture: The Northern United States, 1820-1870, (Cambridge, MA: Harvard University Press, 1969).

9. _____, "The Farm Enteprise: The Northern United States," Research in Economic History, Vol. 4 (1979), pp. 127-91.

10. Albert Lowther Demaree, The American Agricultural Press, (New York: Columbia University Press, 1941).

11. Lucius F. Ellsworth, "Craft to National Industry in the Nineteenth Century: A Case Study of the Transformation of the New York State Tanning Industry," Ph.D. dissertation, University of Delaware, 1971.

12. Stevenson Whitcomb Fletcher, Pennsylvania Agriculture and Country Life, 1640-1840 (Harrisburg: Pennsylvania Historical and Museum Commission, 1971).

13. Brooke Hindle, Emulation and Invention (New York: New York University Press, 1981).

14. E. L. Jones, Agriculture and the Industrial Revolution (New York: John Wiley and Sons, 1974).

15. Eric E. Lampard, The Rise of the Dairy Industry in Wisconsin (Madison, WI: The State Historical Society of Wisconsin, 1963).

16. Charles T. Leavitt, "Attempts to Improve Cattle Breeds in the United States, 1790-1860," Agricultural History, Vol. 7, No. 2 (1933), pp. 51-67.

17. George F. Lemmer, "The Spread of Improved Cattle throughout the Eastern United States to 1850," Agricultural History, Vol. 21, No. 2 (1947), pp. 79-93.

18. Diane Lindstrom, Economic Development in the Philadelphia Region, 1810-1850 (New York: Columbia University Press, 1978).

19. Donald B. Marti, To Improve the Soil and the Mind: Agricultural Societies, Journals, and Schools in the Northeastern States, 1791-1865 (Ann Arbor, MI: University Microfilms International, 1979).

20. Wayne C. Neely, The Agricultural Fair (New York: Columbia University Press, 1935).

21. T. R. Pirtle, History of the Dairy Industry (Chicago: Majonnier Brothers, 1926).

22. Sidney Pollard, The Genesis of Modern Management: A Study of the Industrial Revolution in Great Britain (Cambridge, MA: Harvard University Press, 1965).

23. John Hare Powel, Letter Books, 1824-1843, Powel Collection, Historical Society of Pennsylvania, Philadelphia.

24. _____, Papers, Three Boxes, Powel Collection, Historical Society of Pennsylvania, Philadelphia.

25. E. Parmalee Prentice, ed., American Dairy Cattle: Their Past and Present (New York: Harper and Sons, 1942).

26. Jonathan Prude, The Coming of Industrial Order: Town and Factory Life in Rural Massachusetts, 1810-1860 (New York: Cambridge University Press, 1983).

27. Charles E. Rosenberg, No Other Gods: On Science and American Social Thought (Baltimore, MD: The Johns Hopkins University Press, 1976).

28. Margaret W. Rossiter, The Emergence of Agricultural Science: Justus Liebig and the Americans (New Haven, CT: Yale University Press, 1975).

29. _____, "The Organization of Agricultural Improvement in the United States, 1785-1865," in Alexandra Oleson and Sanborn C. Brown, eds., The Pursuit of Knowledge in the Early American Republic (Baltimore, MD: The Johns Hopkins University Press, 1976), pp. 279-98.

30. Hubert G. Schmidt, Rural Hunterdon: An Agricultural History (New Brunswick, NJ: Rutgers University Press, 1946).

31. Donald M. Scott, "The Popular Lecture and the Creation of a Public in Mid-Nineteenth-Century America," Journal of American History, Vol. 66, No. 4 (1980), pp. 791-809.

32. Philip B. Scranton, Proprietary Capitalism: The Textile Manufacture in Philadelphia, 1800-1885 (New York: Cambridge University Press, 1984).

33. David Solomons, Studies in Costing (London: Sweet and Maxwell, 1952).