Staff Paper

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As long as a new technology works, Americans maintain a troubling tendency to believe that adoption is inevitable.[1] This might be best termed roll-on theory, the widespread belief that technical advancement rolls on and over any obstacles getting in the way. Roll-on theory is blessed by its simplicity, a condition that Don K. Price (1969:135) summed up two decades ago by agreeing with the platitude "knowledge is power."

Price, however, was not of the opinion that technology prevails because it makes winners of all society. Rather, as he suggests, technology wins because the institutions that provide it are involved with "the centers of political and economic decision" (136). This paper, based on careful analysis of a single production innovation, is in fundamental agreement with that view; but it also suggests a changing context that calls into question whether or not specific technological adoption will take place with the same likelihood as in the past. Our analysis contends that there can be very little that is simple in the adoption of present and future technology, especially in agriculture. On the contrary, the following seems increasingly true: technological innovation will be accepted only when supporters possess strong economic incentives to promote their good and when they generate equally strong political incentives to accompany adoption.

AGRICULTURAL RESEARCH: ITS CURRENT PROBLEM

If economics and politics are major factors in the diffusion of technology, the explanation lies in the imprecision with which society understands what it wants in relation to what science can provide. New products and techniques can work, that is satisfy certain functional requirements, but still not satisfy social wants. Likewise, innovations may produce unwanted consequences that, despite major contributions, call new things into question. As a result, it becomes quite unclear as to who will win--and lose--if technology should roll on. In the absence of certain answers, other factors become persuasive.

The history of agricultural research reveals that there have long been difficulties in gaining acceptance for technological change (Marcus, 1985). More immediately, that history indicates that political allies, such as the National Grange, have been invaluable in converting farmer opinions toward scientific innovation. There has never been a consensus among potential recipients of agricultural research that new service institutions, arrangements for diffusion of knowledge, techniques, applications, and products were beneficial.

To that extent, the present uncertainty as to whether or not agricultural technology will satisfy basic wants, and be widely accepted, is nothing new. As Marcus (1985:221) points out, there have been round after round of attacks on research institutions for their failure to solve whatever farmers see as their greatest farms problems, almost all of which have been caused by low prices and oversupply. These recurring attacks take place because the inability to manage oversupply has inextricably pushed the farm sector toward financial stress, generating fewer but larger farms as survivors were required to become larger and more specialized in order to lower costs.

There are several features of the U.S. food system that are new with regard to the present lack of consensus over proper directions for agricultural research and technology. First, biological technology--especially in its latest manifestation, biotechnology--no longer emanates only from a research establishment of federally supported land grant colleges and research stations (Doyle, 1985; Kenney, 1986; Buttel and Kenney, 1987). Non-land grant institutions, especially those related to human medical research, have become important players. So too have private and other public universities. The private business sector is an increasingly active participant and vested interest, both in doing and financing research. Second, there exists a resourceful and politically legitimate set of nonfarm critic organization (ex/al interests) whose representatives are, in terms of

their agricultural concerns, mostly involved with the externalities of and alternatives to technology (Hadwiger, 1982; Browne, 1988). Third, opposition to present research activities and arrangements are broadening beyond these ex/al interests and now encompass a wide range of non-allied critics: including farmers who see a better use of federal funds, family farm advocates, and numerous market-oriented agribusinesses (Browne, 1987a). Each of these new features brings forth new motives, other than farm prices, for opposing the products of agriculture research. This combination represents a significant departure from past patterns of opposition to agricultural technology, primarily because both the institutional conditions of policymaking and the market conditions that influence them are increasingly complex.

A fourth feature, and an even more immense point of departure from past concerns, is no less important. Agricultural technology always benefited from the prevailing Malthusian fear that the world, burdened by an exploding population, would run out of food. While in the short-term American farmers were chronically plagued by overproduction, their long-term salvation was always to be that eventual day of reckoning when agriculture would be called upon to make an heroic effort to feed a universally food-short world (Ruttan, 1982). This contextual advantage for those who promote agriculture research has changed. As Lipman-Blumen and Schrom (1984) contend, research goals and priorities are unclear. For many reasons of increasing agricultural productivity, massive food shortages are no longer feared.[2]

In that sense, agricultural technology has, through its successes, become more susceptible to challenge because it no longer represents social values that mandate acceptance. The political discourse surrounding conflicting interests in agriculture portrays several alternative production routes, all leading to a sufficiently sustainable agriculture. From that perspective, no single

innovation has compelling support. With alternatives available, massive efforts are often required to mobilize support for adoption and to overcome the wide range of potential opponents for any single one of them.

Agricultural technological success has also reconditioned the benefit cost calculus apparatus of U.S consumers. With only around 30 percent of the consumer food bill being for the actual agricultural commodity, food buyers generally see no direct benefit to them from any particular technological innovation. In reality, changes in packaging or preparation technology are eminently more important to the perceived will-being of most consumers than are agricultural innovations. Increasingly the benefits of agricultural research are diluted and diffused to the point where they are unrecognizable by their ultimate users. Likewise with over 15,000 items in a typical grocery store, the consumers most often have many alternatives if they believe that the new technological innovation generates any actual or perceived risk to them. Only if the innovation does affect a product or class of products with few substitutes or alternatives will consumers consciously applaud the appropriateness of that innovation's use.

Since consumers are both the final users and the majority of the taxpayers who fund agricultural technology, their longer term wishes may well prevail. In essence, the dynamics of the modern U.S. food system as they act to dilute and diffuse the benefits of the successes of agricultural research make opposition to new technology both compelling and virtually without cost to many individuals. This brings forth an important hypothesis which we, in a preliminary sense, test and confirm with this interview based research: the risks of technological product failure in agriculture will continue to increase as political and economic support fragments in an increasingly complex arena.[3]

THE CASE OF BGH, BST

A growth hormone (bGH), found to increase the milk production of lactating cows and extractable from bovine pituitary glands, was first reported in the early 1930s (Baldwin and Middleton, 1987). Until recently, bGH had to be extracted from the pituitary glands of slaughtered bovine animals. The extraction methods and limited natural supply made commercial application of this known technology impossible. Genetic engineering research changed that possibility in the 1980s as scientists reproduced large amounts of bGH genes from bacterial hosts to which extracted genes has been linked. The bGH technology was just another application of the general gene splicing-fermentation extraction technology being used in human medical research (Longworth, 1987:188).

The product, now more widely called bovine somatotropin (bST), has the potential to increase milk production by an average of ten to twenty percent per cow, perhaps slightly more. Recombinant DNA procedures have been employed by four United States firms to develop bST for farm use. American Cyanamid, Elanco Products, Monsanto, and Upjohn are all working with university agricultural scientists to perfect both the product and establish the parameters for its use (Browne, 1987; Rauch, 1987:820).

Since bST is a substance naturally produced by a dairy cow and occurs in her milk output, the federal Food and Drug Administration (FDA) has ruled milk treated with bST to be safe for human consumption. But as yet, the FDA has not ruled it safe for dairy cows; nor have FDA mandatory determinations of "environmental safety" been addressed (Teske, 1987:31). Therefore, at the earliest, bST will not be commercially available to most diary farmers until 1989, probably not before 1991.

Not a great deal is known about what will happen when, and if, bST becomes available. Both the competitive secrecy surrounding product development and the likely variability among farm user skills create this uncertainty (Buttel,

1986). Uncertainty, as we shall demonstrate in the following sections, is magnified when the probable productivity increases are factored, as they must be, into an agricultural sector with some unique economic and political conditions.

CHARACTERISTICS OF THE U.S. DAIRY INDUSTRY: MARKET COMPLEXITY

Technology driven productivity increases are nothing new for a constantly evolving dairy industry that encompasses many market issues. Mechanical milking machines, artificial insemination, nutrition research, and many other innovations have helped push average production per cow from 5,314 pounds in 1950 to 13,786 pounds in 1987 (United States Department of Agriculture, 1950-1987). Productivity increases for the U.S. dairy industry have averaged about two percent a year for most of this period. Increases have accelerated in recent years to a point where serious surpluses developed in the dairy industry. In 1983, the USDA purchased 16.8 billion pounds of surplus milk equivalent or about 11 percent of U.S. production. Since that peak, federal diary policy has been revised several times and two forms of voluntary supply management have been used. All this has been accompanied by serious political controversies over the cost and tactics of dairy programs (Hamm, 1987:7-11).

Amidst this controversy, dairy price supports have declined 20 percent since 1983 and have caused severe financial stress to many dairy farmers. The current dairy legislation contained in the 1985 Food Security Act, including 1988-89 drought relief, assures that milk prices will fall another $1.00 per hundredweight if surplus continues.

If bST is adopted and only increases production 15 percent over a five year period, productivity increases from bST alone could be three percent a year; or higher than the historic trend. Given the current dairy income environment, bST technology will become part of ongoing federal policy debates over dairy pricing. Three set of attitudes toward bST, ranging from standfast opposition

to great enthusiasm, already have developed among our respondents and other dairy farmers (Stanfield, 1987; Schneider, 1988). Recognizing that bST will, in practice, probably be large farm biased, many small and limited resource dairy farmers view bST as a livelihood threatening technology and argue against it on the basis of social values of the family farm. Another group of highly progressive producers actively seeks the technology in order to be ahead of the pending price impacts of future adoption. A third large segment of the industry, perhaps the majority of producers, recognizes the need to adopt bST but these farmers are uneasy about the technology. Because dairying is a proportionately higher fixed cost industry than other farm commodities, bST will have to be used to spread the fixed overhead of the operation if it becomes available to anyone. These producers feel economic trends will soon force them to jump on a rapidly moving technological treadmill.

The attitude of dairy producers is also conditioned by another unique characteristic of the U.S. dairy subsector, one that transforms most individual preferences into a collective one. The initial market for milk is controlled by dairy farmer-owned and controlled marketing cooperatives. Dairy cooperatives market about 78 percent of all producer milk in the U.S. In addition, cooperative dairy farmers own nearly 90 percent of the butter/dry milk powder processing plants, about 55 percent of the cheese manufacturing plants, and around 15 percent of the fluid milk processing plants (United States Department of Agriculture, 1984). Therefore, most producers must evaluate, as did our respondents, the impact of bST on their own marketing/processing investments as well as on their farming investments.

Since dairy cooperatives are producer controlled, most of the leadership of the dairy industry that we interviewed can and does view the variable impacts of bST on an industry-wide rather than individual basis. The impacts on the

overall dairy industry of widespread bST use are straightforward. Surpluses will drive prices down. Since the short/intermediate term demand elasticities for milk (the relevant ones for policy discussion) are highly inelastic, milk consumption will not increase proportionately. BST use will lower dairy industry receipts substantially and pass most of the gains through to consumers. It is doubtful that the dairy price support program in effect since 1949 could survive politically such a traumatic industry revenue upheaval (United States Department of Agriculture, 1987:54-64).

Therefore, the dairy industry is unique. For most past agricultural research innovations, only the individual farm or micro impacts drove producers' conscious economic and political actions. In the dairy industry, the broader macro-economic impacts are also understood and are within the purview of dairy producers. Because accepting bST will be a collectively determined act for most producers who make rational individual choices, dairy industry marketing and government institutions will be forcibly readjusted due to overdemand. Dairy leaders know this. Our respondents understand how much political and economic capital such a redesign will take. And they ask, should dairy producers be forced to pay this high institutional support cost simply because a very few multi-national chemical companies may make a profit on one of their hundreds of product lines?

This attitudinal posture is important. Most of the diary cooperatives in the U.S. are linked together in an umbrella cooperative known as the National Milk Producers Federation (NMPF). A Washington DC trade journal recently rated NMPF as the fourth most effective lobbying group in Washington (Solomon, 1987:1706). The NMPF effectively oversees the industry-wide perspective of issues effecting the industry. To date, NMPF has refused to endorse the widespread adoption of bST technology and has vowed to continue with this position until the market-wide uncertainty of bST is clarified.

Another critical dairy sector participant, one of great importance to attaining the goals of NMPF, is the retail-wholesale grocery store industry. Most fluid milk is sold through retail grocery stores. Therefore, the most lucrative segment of the dairy industry is directly influenced by the actions and policies of food retailers, a factor that brings compatibility in goals between producers and those who market.

In the food inflation years of the early 1970s, news reports showed consumers picketing their local markets to protest high food prices. To prevent themselves from being on the wrong side of the consumers again, the food retailing industry has positioned itself on public relations matters to be the defenders of consumer interests rather than champions of what farmers want to sell (Browne, 1988:110). If any agricultural technology is deemed not to be in the consumer's best interest (that is, acceptable), the retail sector uses its procurement powers to resist the implementation of that technology. This gatekeeper role is so significant that food processors and manufacturers also follow with a similar posture.

The operation of the modern food system operates in ways which shift the costs of economic change and financial risk up and down the vertical food chain (Hamm, 1981). If consumers decide not to bear any food safety risk (real or perceived) and reward economic risk takers, food chains will transfer their financial risks to processors and manufacturers. If the processors have sufficient power, they will shift their financial risk to producers. The producers have sufficient power to either shift the cost back up to processors or down to bST suppliers. The preferred shift is obviously downwards; one that rewards old allies, minimizes uncertainty, and restrains threatening technological innovation.

As agricultural technology confronts this vertical food chain and becomes entangled in health and safety regulation, the political economy facing the

new innovation becomes the unit of analysis. Regulation and risk shifting are fundamentally done by defining property rights of "who gets to do what to whom?" It is, therefore, left to the interplay of political issues to determine the ultimate legitimacy of a new technology such as bST. As shall be demonstrated below, this political interplay is not much kinder to technological innovators than is the market economy of the dairy industry.

CREATING POLITICAL ISSUES: INSTITUTIONAL COMPLEXITY

It should be no surprise that the introduction of bovine somatotropin generated considerable political controversy both within and apart from the dairy program. There were always many institutional implications. First, as noted earlier, an extensive array of newly institutionalized organized interests have recently raised policy questions about the agricultural sciences. Second, as stated above, the new product was not likely to be scale neutral in its effect on dairy producers. Rather, as an imperfectly received collective good (Guttman, 1978), bST was likely to be adopted by the most efficient and generally the largest producers, lead to production and price disadvantages for non-adopters, and through their attrition, reinforce structural trends toward fewer and larger dairy farms (United States Department of Agriculture, 1987). Also technology will likely lead to less gross income to the dairy sector as a whole and a threat to the U.S. basic dairy policy.

As explained in an article on the emergence of the bST controversy (Browne, 1987b), three rather independent but related issues focused wider policy attention on FDA deliberations over the growth hormone. From the perspective of proponents, who wanted to market bST, the issue was one of protecting property rights and investor profits through government regulation. But opponents, their attentions

focused on social rather than economic values, first defined the issue as one of opposing technology. Later they bolstered their opposition to bST by infusing technology into the broader issue of the declining family farm. On both fronts, the intensity of the disagreements resulted from the likely importance of bST as a precedent setting genetic engineering product. Instigators of these policy debates, unlike many of the allies who joined the fray, were less interested in bST on its own marketplace merits. The presence of both immediate and long-term policy implications created an especially cantankerous and often clouded controversy, one where an increasing range of social values were touched.

Biotechnology Proponents

Given a choice, proponents of genetic engineering research would have preferred that bST was never addressed in any contentious issue. Indeed executives of the four producing firms, in varying degrees given the differing attention to politics within the corporations, worked toward a consensus of support for their innovation. Their efforts paid off in quick FDA acceptance of milk from bST-treated cows as fit for human consumption (Browne 1987b:78). Compelling research demonstrated that biologically inert bST residues are digestively destroyed, leaving no trace in consumers. No evidence to the contrary has yet to surface (Teske, 1987:31).

This success notwithstanding, farm and business leaders agree that consensus tactics have accomplished little more than the hoped for assembly of a lobbying infrastructure and a reputational expertise for addressing pending policy decisions about biotechnology in general and bST in particular. To this end, firms worked quietly on several matters: they lobbied collectively on what were first thought to be the obscure policies of patenting intellectual property and developing internationally agreed upon regulatory standards; Monsanto sought added agricultural credibility by participating in farm bill debates during 1985; the Industrial

Biotechnology Association (IBA) was created in 1981 and efforts were made to expand its member base; massive education efforts to inform diverse diary policy participants were cooperatively initiated; opinion polls were commissioned; and very unusually, the FDA was urged to discuss publicly the human safety aspects of bST while the product was still under investigation.

No quiet campaign of information-based lobbying was sufficient to keep policymakers in USDA and the Congress from becoming wary, rather than supportive, of bST as the FDA prepared its ruling, however. For one thing, critical regulatory agencies such as FDA and the Environmental Protection Agency were not well prepared to address the impact of biotechnological innovations (Stanfield, 1987). Industry complaints were made to Congress and the Administration about bureaucratic ineptitude and the negative affects of delays on new and costly product lines. Second, these went to a Congress already made wary of biotech firms by earlier complaints of member states of the International Organization for Cooperative and Development (OECD) in 1985. Several OECD officials accused United States corporations of both delaying proceedings and co-opting U.S. participants to an OECD report on the safety and regulation of biotechnology. Complaints about FDA and EPA only heightened congressional suspicions of what, in a very hazy set of circumstances, bST innovators really want (interview data).

While such problems might well have been overcome by the formidable array of information and lobbying resources of bST proponents, other domestic interests were not allowing biotechnology advocates time to do so effectively. Even as the IBA was expanding and while participating firms were making commitments to work together in providing information (Rauch, 1987:820), opponents were popularizing a negative view of bST that had little to do with the lobbying initiatives set forth by it proponents. As a result, neither international nor domestic issues of biotechnology standards have been resolvable.

Biotechnology Opponents

The catalyst for domestic opposition to bST was Jeremy Rifkin, the persona behind the Foundation on Economic Trends. As one of the many ex/al organizations with a policy interest, the Foundation directed its earliest and greatest efforts toward biotechnology (Rifkin, 1983). At the onset, Rifkin carried on a dispute with biotech corporations, including Monsanto and American Cyanamid, over plant technology. At issue was the release of genetically engineered bacteria into the environment and the likelihood of genetic collapse should these bacteria spread.

Foundation tactics embraced judicial litigation as a means of delay, public confrontation with genetic engineering proponents, cultivating support--both active and passive--from other ex/al interests, using the media to communicate its message, and depicting worst case scenarios to elicit public attention. Rifkin also benefited from two specific sources of support: the Humane Society of America attracted the attention of animal rights activists to what were not obviously animal issues; and, the Agricultural Resources Project under Jack Doyle (1985) of the Environmental Policy Institute asked questions about whether science could remain neutral in the face of the concentrations of wealth found in research sponsoring genetic engineering firms. While the former became an active ally against bST, Doyle's research, even during its early stages, was widely cited as a reason for skepticism about the claims of bST producing firms.

Opposition to bST, and the selection of a specific public policy contest over product approval, was based on its precedent setting status. Genetically engineered products following after bovine growth hormone would be advantaged by precedents established through regulatory decisions and procedures designed to determine bST safety. From the ex/al position, a successful bST introduction would make the challenge of later products far more difficult. As a consequence, ex/al critiques of plant and seed product innovations were refined toward the dairy industry.

The issue of technological dissent, while not ignored, was not met with the approval that many critics hoped for. While the Humane Society aided the Foundation in litigating against using bST on cows in 1986, basing its case on the stress of increased milk production, other ex/al interests provided little active or passive support.[4] Many consumer and environmental activists, interested in food prices and land use problems, found biotechnology potentially important to those concerns. In particular, reductions in farm acreage and animals could: limit use of fertilizers and pesticides, lower irrigation use of water, and remove fragile lands from production. In some instances, our respondents hoped, genetics could replace chemicals and reduce the water consumption needs of plants.

The impact of this division among environmental and conservation activists, in addition to further confusing policymakers about the acceptability of environmental risk factors meant that bST gained greater attention as a farm policy issue than an environmental one. An unusual alliance between ex/al opponents of bST and the Wisconsin Family Farm Defense Fund generated national publicity. Media and public attention was directed to the farm structure consequences of large farmers being the most able and likely to adopt bST. Wisconsin contacts with other state farm protest groups through the National Save the Family Farm Coalition spread farmer dissatisfaction with bST. Our respondents emphasized that many of these state activists, especially those working together on both farm bill and farm credit legislation, found the anti-corporate warnings of Rifkin and Doyle quite compatible with they own neo-populist and anti-agribusiness rhetoric. Through their efforts, bST became a grassroots issue within the American Agriculture Movement (AAM), National Farmers Organization (NFO), National Farmers Union (NFU), and some regional dairy cooperatives. An exceedingly vocal minority, using communication tactics similar to Rifkin's, trumpeted

bST as another vehicle for destroying the family farm. Many farmers who shared the skepticism and who came to be seen as moderates on bST were more restrained in their opposition, reserving their hostility to the likelihood of an increase in milk supplies overburdening and thus collapsing the federal dairy support program. In that sense, bST was portrayed as generally incompatible with either the mandatory production control policy demands favored by large grassroots segments of farmers in the mid-1980s or the more general problem of agricultural oversupply.

The Hormone Question

The opponents of bST could have been dismissed as sadly resourceless in comparison to corporate proponents. The opponents after all were just those natural casualties of scientific progress whose outcries were predictable and whose proposed solutions were un-American and anti-free market. The ex/al lobby, under the most favorable circumstances, has major problems in winning on agricultural issues (Berry, 1977:216; Browne, 1988:chapter 7). Divisions over the benefits of bST create less than favorable conditions for a Washington-based assault on policymakers. The grassroots farm lobby has little visibility inside Washington and, so, can do little by ways of adding support. Membership divisions within the AAM, NFU, and NFO precluded their lobbyists from working against bST. Even if they did lobby, representatives of these organizations have little legitimacy and credibility as the most effective voices of United States agriculture (Browne, 1988:chapter 5). So their assistance would not have been formidable.

If roll-on theory were operative, few would have questioned whether major bST opponents had created a burden of proof question. But because the new technology was perceived to present a food safety risk, the question for producing firms of who must bear that risk was still able to be brought to the political arena. Societal experience with past broken promises from technology (the

safety of nuclear energy for example) and the advent of better understanding of indirect consequences of technology have shifted the burden of proof to the advocates of technology, at least in the eyes of an attentive public that regularly scans the news for symbols of risk and hazard.

So the playing fields of public policy are not level, to be tilted toward a victory for one side or another on the basis of somewhat superior institutional and lobbying resources. In the case of those with a new technology, there are numerous legislative and administrative hurdles that many be raised and need be overcome. Opponents, on the contrary, need only one effectively blocked hurdle to doom a product or halt a proposal. This, compounded with the burden of proof that falls on the advocate, is the major defensive advantage held by opponents of innovations that require government intervention before rolling on.

One such hurdle, raised by the media conscious and public directed opposition to bST, is the image of the product. The label "hormone," in the course of this controversy, became identified with the product by at least part of the population. In becoming important, an already addressed (at least by FDA) subset of food safety risk factors came to life just as the mainset of environmental risk discussions bogged down. No amount of emphasis on using the phrase bST rather than bGH could keep opponents from reminding consumers that the inert residue they ingest remains that of a hormone, a substance of great scientific mystery and health uncertainty for many (interview data).

By late 1986, a few California consumers discovered they were drinking milk from bST-treated cows being used for safety experiments to generate data required by the FDA. These consumers complained to their grocery stores and, in essence, said they would not bear any of the risks associated with this new technology. Food retailers, given their protector of the consumer posture, immediately demanded assurances from their milk suppliers that none of the

milk stocked in their stores contained milk produced by bST treated cows (interview data).

Accordingly, with the threat of the California experience escalating, food retailer's zero financial risk position had been shifted to that of full risk for fluid milk processors. The processors (some of whom are vertically integrated food chains) requested formal written assurances from raw milk suppliers (mostly producer controlled cooperative) that they would be receiving no bST treated milk. When the California experience was reported in the national dairy press, processors around the country asked for and received similar assurances from their cooperative suppliers. The market demand risks by then rested clearly on the shoulders of dairy cooperatives and their dairy farmer owners. Producers were exposed to the supply risk (What will bST do to our cows? To industry? And to government policy?) and the demand risk (What will bST do to the image of milk as nature's most perfect food?).

As can be seen in the character of the U.S. dairy industry, supplier/producers had no choice by to comply. Dairy farmers currently spend, from funds collected from themselves, about $200 million a year just to promote the image and sale of milk and in extensive health and nutrition education. They must do so because of oversupply and their weak market position. The nation's 160,000 commercial dairy farmers, as this entire bST controversy was played out, saw themselves exposed to most of the costly consequences of an experimental biotechnology that was primarily in the interest of four biotech conglomerates.

In much of agricultural technology, the market risks would have stayed on the producers. However, dairy is unique. The NMPF, representing the vast majority of producers, decided to take a neutral stance on the value of bST (Rauch, 1987:820). Its leadership, farm group respondents claim, then went even further to demand that their neutrality would be removed only if the biotech firms would undertake a nation-wide effort to educated successfully all segments

of society about the nature of bST. The joint public relations efforts are funded through the Animal Health Institute (AHI). The AHI is, among other things, communicating with all opinion leaders in the food industry, universities, extension services, and media. It also is undertaking a plan to establish bST advisory groups of key leaders in all major dairy states in the United States.

The dairy industry has also funded through their own marketing organizations independent consumer attitude studies to determine for themselves how damaging the "hormone issue" might be to the basic consumer demand for their products. Through their actions, dairy producers have shifted the burden of proof and its associated costs back to the technology's advocates and founders. All this may be little more than the first stage in saying "no" to technology as a means of avoiding the treadmill.

TAPPING SOCIAL VALUES: A CONCLUSION

In the process of shifting the burden of occurring the costs associated with technological risk and uncertainty, a major portion of the food system has been exposed to many core issues surrounding the emergence of genetic engineering technology. The technology of bST is now burdened by the yoke of normal resistance plus the increasing policy uncertainty created almost spontaneously when both the affected institutional and market forces are so complex.

Moreover, policy controversies, prompted both by business needs and by policy opposition, have brought forth and reinforced important symbols associated with bST: corporate control, hardship for family farmers, government ineptitude, and food safety. These symbols have been linked by opponents, and to an important extent by the public as it judges arguments, to develop a powerful rhetoric against bST.

The litany of statements, premises, and postulates--no matter how flawed or fallacious--serve to intensify the debate. The United States society and its belief in environmentally riskless innovation assures the potential for tight political control of biotechnology. Increasingly the burden of proof will be on the producers of technology, adding to the upfront and documentable costs of techological change. The process moves the technological acceptance process further toward state control where only the most economically viable biotechnologies with the most widely appreciated societal benefit-cost equations will be successful. As this happens, the American belief in the inevitable roll-on of new technology will become another relic of the folklore of American history.

NOTES

1. Those in the physical sciences are certainly exceptions to that belief. Most fully comprehend how much politics matters to their work.

2. Critics, nonetheless, do exist; and they raise questions about sustainability (Cornucopia Project, 1981; Doyle, 1985).

3. This research is based on over 100 extensive interviews with dairy industry leaders and farmers as well as congressional, administrative and private interest participants in the policy process. We have also made considerable use of generally available data on the dairy industry and dairy program.

4. These allies, in a related display of dairy interest, also co-litigated the facial branding provisions of the whole herd buy-out program of the 1985 Food Security Act.

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