findings on the incidence of the disease. In this study 5 to 10% of transfusion recipients developed hepatitis and more than 90% of the hepatitis was non-A,non-B.

On the basis of all the U.S. data on the disease, Alter estimates that those who receive more than 3 units of blood run a 5 to 6% risk of developing non-A,non-B hepatitis. Although there is clearly something in the serum that transmits this disease, no one has been able to isolate a virus or other infectious agent. Yet, says Harvey G. Klein, director of the NIH blood bank, "this has been a high research priority for years. It's not as though no one has tried."

"What has made this more significant, in my eyes at least, is that when we continue to watch the patients, more than half have persistant transaminase elevations. Their transaminase levels go up and down, but they are abnormal all the time," Alter says. "It looks like chronic hepatitis." Moreover, when the researchers biopsy the livers of those with elevated serum transaminase, the livers look like livers from patients with viral hepatitis.

Finally, 10 to 20% of those with chronically elevated transaminase levels go on to develop cirrhosis of the liver, with significant scarring. "That's what we are concerned about," says Alter. It seems to be different from alcoholic cirrhosis, which follows a rapid downhill course, leading to death from liver failure. "In this disease, the cirrhosis is more indolent," Alter says. "It goes on for a long time and the patients are relatively well." But about 5% have died of liver failure after about 10 years of follow-up. "My gut feeling is that the cirrhosis may take a long time," Alter remarks. He cites Japanese data showing that the average interval between transfusion and cirrhosis was 23 years.

There is no specific test for the non-A,non-B virus and no way to treat the disease once it occurs. The patients generally feel fairly well. Fatigue is the most common complaint. "Most just don't quite get their strength back, but some patients are severely fatigued. A few patients are incapacitated by fatigue and are unable to work," says Alter. "But most patients lead a relatively normal lifestyle."

No one takes these findings lightly. "It's scary to me, certainly," says Klein. Yet the only way to reduce the incidence of the disease seems to be with two very nonspecific tests.

One test looks for elevated serum transaminase in donor blood. Those with non-A,non-B hepatitis have, on average, abnormally high levels of this enzyme, but since the enzyme levels fluctuate, they may not always be picked up by the test. In addition, donors may have elevated transaminase levels although they have no disease. The list of persons who might have high concentrations of the enzyme, according to Klein, include those who are obese and so have fatty livers, marathon runners, persons taking certain medications, and those who had a few drinks the night before.

A second test looks for antibodies to a core protein from hepatitis B. It is not clear why these antibodies would correlate with a likelihood of transmitting non-A,non-B hepatitis, but several groups find that they do. One possible explanation is that those who have been exposed to hepatitis B are more likely to have been exposed to non-A,non-B hepatitis. Another possibility is that the two diseases are caused by related viruses. In any event, investigators find that the core protein test is independent of the transaminase test; for maximum efficiency in detecting non-A,non-B carriers, it is best to use both tests, and the blood banks intend to do so.

As many as 60 to 70% of those who test positive with one of these two tests will not have non-A,non-B hepatitis. And the test is expected to detect only about 30% to 40% of those donors who may transmit nonA, nonB hepatitis. Moreover, Alter emphasizes, "these are *predictions*. No one has done a controlled study of the incidence of non-A,non-B hepatitis when you directly compare tested with untested blood." It would take 2 to 3 years to complete such studies, according to Alter. The blood bank organizations decided that the problem was serious enough to go ahead without them.

With such a high rate of false positives, the blood banks will have to find a way of notifying donors that their blood cannot be used without unduly alarming them. One possibility is simply to discard blood that tests positive the first time a donor comes in. If the same donor's blood is positive a second time, the blood banks would notify the donor that he may have non-A,non-B hepatitis and ask him to refrain from donating blood.

The non-A,non-B tests will make blood more expensive—Bove of Yale estimates that they will add about $5 to the price of a unit of blood. And they will exacerbate the sporadic shortages of blood that the country now experiences. "I think we are entering an era where it will be very difficult to keep the blood supply adequate nationally," Bove says. ■ GINA KOLATA

Will Growth Hormone Swell Milk Surplus?

A debate is raging over whether commercial introduction of bovine growth hormone will exacerbate the financial problems of small dairy farmers

FIFTY years ago, scientists discovered that injections of a crude extract of bovine pituitary gland could boost a cow's milk output. Ever since, many have searched unsuccessfully for a way to mass-produce the key substance, bovine growth hormone. Now, with the aid of biotechnology, four American companies can churn out the hormone by using genetically engineered bacteria, and they are racing to win marketing approval from the federal government. But even though the hormone is not yet for sale, it is the subject of growing controversy because some experts say its use will profoundly change the American dairy industry.

The main concern centers on whether widespread use of bovine growth hormone will drive small and medium-sized dairy farms out of business. At a time when milk in America is already in massive surplus and the U.S. Department of Agriculture is buying and slaughtering excess dairy cows, critics question the need for the hormone. "There are those of us who believe in the family farm, and we're concerned about dislocations," said Representative James Jeffords (R–VT) during a recent hearing by the House livestock, dairy, and poultry subcommittee. Hormone manufacturers—American Cyanamid, Elanco (a subsidiary of Eli Lilly and Company), Monsanto Company, and Upjohn Company—say that the use of the hormone will help the dairy farmer by

reducing his costs while producing more milk.

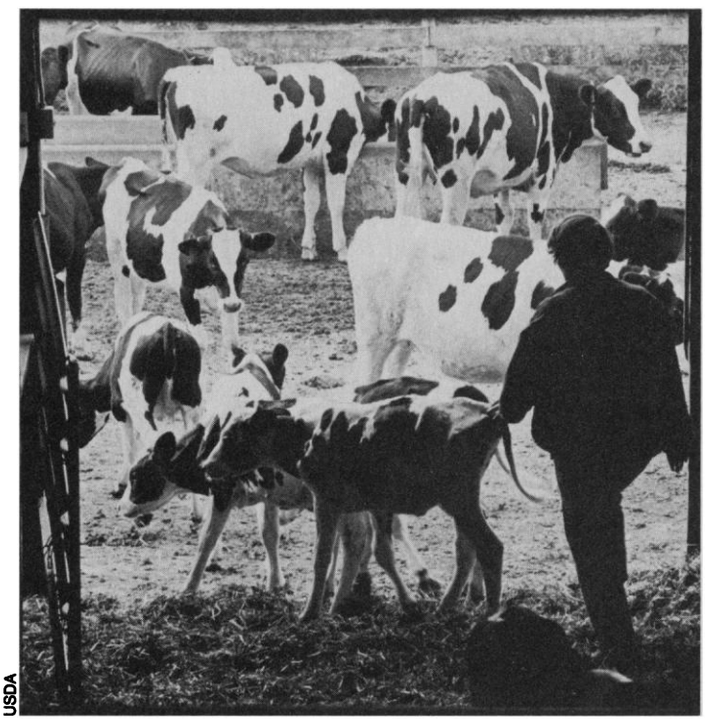
Debate about the hormone and its potential economic impacts was sparked a year and a half ago by the publication of a lengthy analysis funded by New York state and conducted by Robert Kalter, chairman of the agricultural economics department at Cornell University, and colleagues. Kalter described his findings in an article last fall in *Issues*, a journal published by the National Academy of Sciences. According to these reports, the dairy industry will be transformed by the use of bovine growth hormone, which can increase the milk production of a well-managed herd by 10 to 30%.

Kalter says there "will be clear winners and losers" as bovine growth hormone is adopted. He predicts the following scenarios for the individual farmer and the dairy industry as a whole: The efficient farmer can cut his operating costs because, by using the hormone, he can use fewer cows to produce the same amount of milk. Feed costs will increase because treated cows require a more nutritious diet. But the jump in milk production will offset the added feed expense. Kalter predicts that the inefficient farmer with a small herd, who is already likely to be in trouble financially, will be pushed over the edge into bankruptcy because management ability is "critical" to the successful use of bovine growth hormone.

For the dairy industry, milk production will increase across the nation and push down milk prices. The number of cows and dairy farms could decline by as much as 25 to 30%, and land-use patterns will change. As a boon to soil conservation, he says, farmers will cut back on the use of marginal land, such as highly erodible acreage, for foraging because they will trim the size of their herds and switch to higher nutrient feeds.

This spring, the controversy over the hormone's impact on dairymen reached a new pitch after Jeremy Rifkin, an avowed foe of genetic engineering, petitioned the Food and Drug Administration to block approval of the hormone. Citing Kalter's work, Rifkin contended that "entire dairy communities could well be economically and socially devastated by the widespread commercial use" of the hormone. In addition, use of the substance will create "additional surpluses for an industry already plagued by overproduction."

In the petition, Rifkin wants to compel the agency to perform an environmental impact statement as part of its review process, on the grounds that the hormone will affect land use and the cow's "internal environment." He asserts that cows injected with the hormone will be more subject to stress and disease. Among the cosigners of the petition were the Humane Society of the United States and the Wisconsin Family Farm Defense Fund, a group of five farmers who run small dairies. FDA has not yet responded to Rifkin's petition.



USDA

With the use of bovine growth hormone, there will be "clear winners and losers" among dairy farmers, says Cornell economist Robert Kalter.

Kalter, claiming that Rifkin took his comments out of context, has issued a press release challenging Rifkin's arguments. He says that use of the hormone would simply accelerate a trend in which medium-sized and large dairy farms are beating out small ones. During the past two decades, the number of dairy farms has dropped 77%, and "this has happened without the hormone technology."

Kalter's thesis is buttressed by an analysis in a report published in March by the Office of Technology Assessment. The report, "Technology, public policy, and the changing structure of American agriculture," says, for example, that other technologies here or on the horizon will also reshape the dairy industry, independent of the marketing of bovine growth hormone. To maximize production, dairy farmers will rely increasingly on computers to keep exact records of a cow's milk output and to monitor its feeding requirements. Microbes can be added to silage to break down feed, making it easier for cows to digest. Improved pest and disease control will also help to increase a cow's milk production.

According to the report, the bottom line is that "survival for any dairy depends greatly on its initial financial position. Neither interest subsidies nor opportunities for debt restructuring greatly improve the chances of high-debt dairy farms remaining solvent."

At the recent House hearing, representatives of the four hormone manufacturers argued that the hormone will help a farmer stay competitive. According to marketing surveys by the companies, most farmers want to use the hormone, or at least give it a try. The companies add that studies indicate that, over the short term, treated cows do not differ from untreated controls with regard to disease, temperament, and reproduction. Long-term studies are still being conducted.

The companies say that bovine growth hormone will not change the nation's total milk production and consumption. It will only affect the farmer's efficiency and costs, testified David Petrick of American Cyanamid. They and Kalter say the root of the surplus problem is the long-standing price support system by the federal government. Kalter warns that unless federal milk supports, which amounted to $3 billion in 1983, are adjusted before the hormone is marketed, milk prices will fall more steeply in the short term, magnifying the financial pressure on operators of small and medium-sized farms. Kalter adds that the use of bovine growth hormone may help the dairy industry remain competitive with manufacturers of other beverages, such as soft drinks.

FDA commissioner Frank Young says that the agency expects to decide whether to approve the hormone no earlier than a year from now. Company representatives at the hearing said that the more likely date will be closer to 1989 or 1990. ■ **Marjorie Sun**