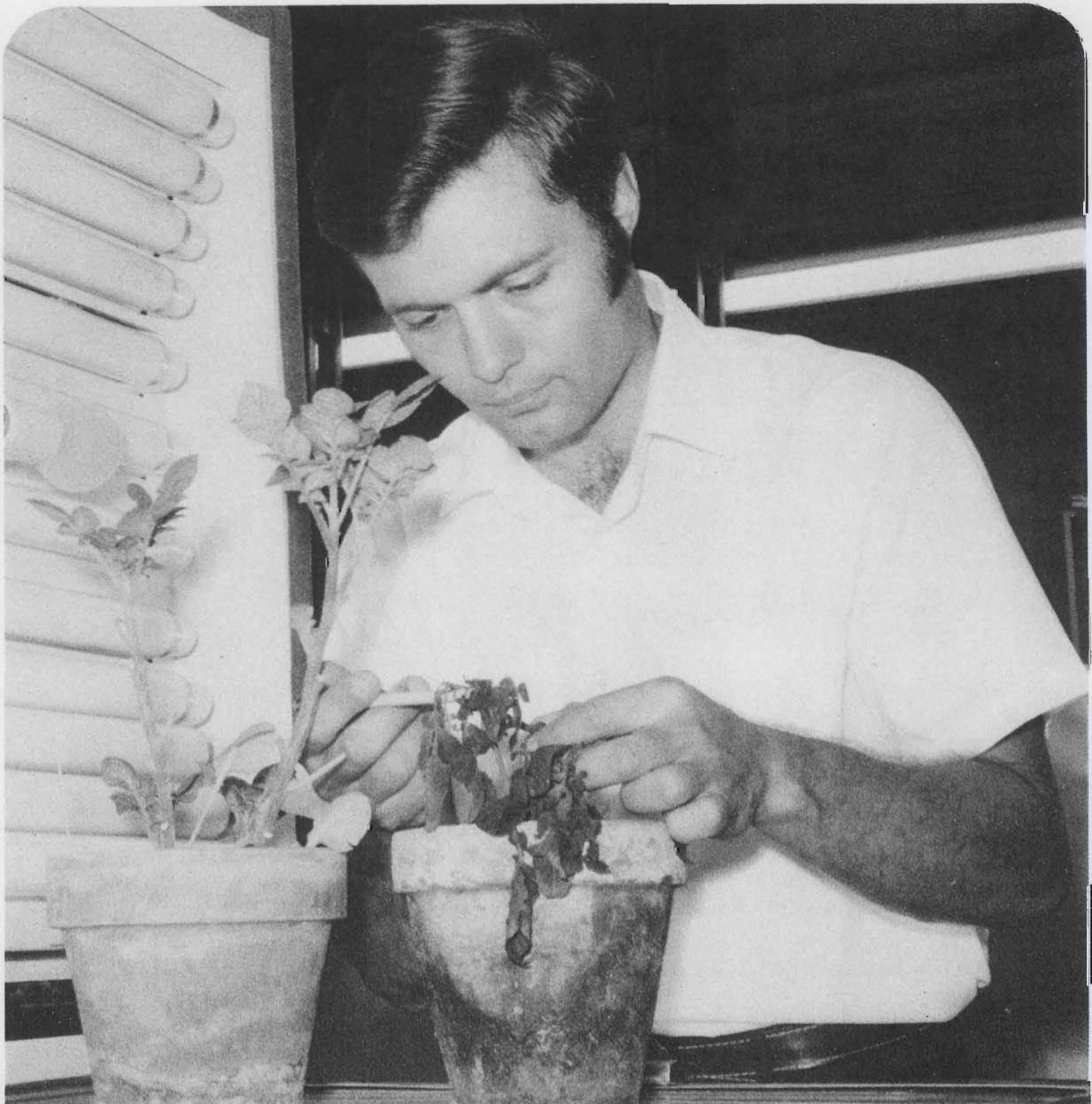


minnesota science



UNIVERSITY OF MINNESOTA  
AGRICULTURAL EXPERIMENT STATION



# interview with the DIRECTOR

Since the close of World War II, the U.S. scientific community has enjoyed widespread public support and unflagging governmental patronage. As the nation moves into the 1970's, however, that atmosphere of favor has clouded and become less certain. A handful of Congressional critics has even gone so far as to suggest that "research is an unproductive activity" and labeled it "a hobby too expensive for an age that calls for quick solution to immediate problems."

This changing attitude toward research has manifested itself in closer scrutiny of research programs by appropriation committees and tightened purse strings on public funds. Complicating matters further, research directors now find themselves faced with the task of stretching already taut budgets to cover ever-spiraling costs. Not only the scientist, himself, but laboratory assistants, equipment, and buildings all

carry the burdensome price tag of inflation.

Dr. William F. Hueg, Jr., director of the Minnesota Agricultural Experiment Station, recently addressed a group of research managers from private firms and public institutions on the topic of resource allocation in agricultural research. We asked him what bearing the present mood toward research will have on future programs.

**EDITOR:** Dr. Hueg, does the future look bleak for agricultural research?

**HUEG:** Prospects are not what you could call "bleak," but I think science has entered a not-so-Golden Era. Despite tremendous contributions to our nation's productivity, research budgets are being cut back all across the country.

**EDITOR:** Does this mean that there will be a corresponding cutback in agricultural research programs in the future?

**HUEG:** Not necessarily. There are several

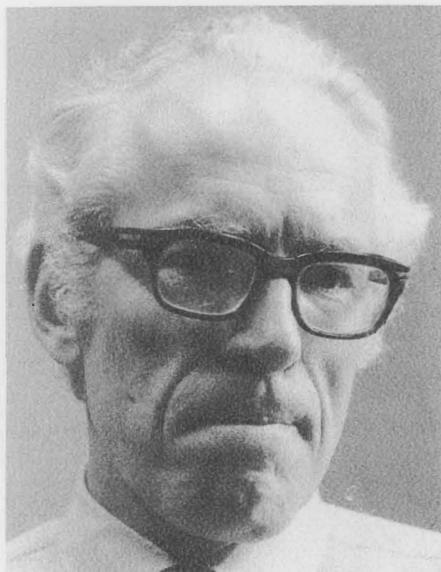
sets of alternative opportunities we can turn to in allocating resources—provided our program shifts are well planned in advance.

**EDITOR:** Shifts such as terminating several projects?

**HUEG:** Yes. But you should realize that every Station project is subject to annual review. The rate of turnover at Minnesota each year is 15 to 20 percent. In a sense, each project is on a predetermined timetable with a built-in system for reporting progress. This system works well, but we're not a factory that stamps out a fixed quota of parts. We're a complex organization whose product is knowledge—produced by people.

**EDITOR:** All right, let's suppose for a moment that your research program is faced with a cutback in funds—and you've already cut things to the bone. How would you eliminate projects from a program committed only to top priority research?

**HUEG:** The answer to that hypothetical situation lies in cooperative planning among federal agencies, state experiment stations, and research units in private in-



"Prospects are not what you could call 'bleak,' but I think science has entered a not-so-Golden Era. Despite tremendous contributions to our nation's productivity, research budgets are being cut back."



"A certain amount of duplication in research is probably unavoidable or necessary, but no longer can we afford all federal, state, and industry research in the same areas."



"We must develop a 'center of excellence or emphasis' approach to research. Industry and state and federal agencies would carry out research best suited to their capabilities, resources, and interests."

dustry—to an even greater extent than is now practiced. A certain amount of duplication in research is probably unavoidable or necessary, but no longer can we afford all federal, state, and industry research in the same areas. We need to better inventory what research is currently underway and being planned. We need to detail our research objectives and procedures, and know what inputs—man-years, dollars, equipment and buildings—will be required.

**EDITOR:** Do you believe that industry is better equipped to handle certain types of research?

**HUEG:** No doubt about it, just as public research units are better equipped to handle other types of research. I believe that we must develop a "center of excellence or emphasis" approach to research. This means industry, state experiment stations, and federal agencies would carry out different programs of research best suited to their capabilities, resources, and interests. Details as to who, what, where, when, and how much could be coordinated by an organization such as the Agricultural Research Institute, which is composed of research managers from private and public sectors.

**EDITOR:** Then cutbacks in public funding—if I understand you correctly—may require increased support from industry as well as adjustments in present public research efforts?

**HUEG:** That's a possible direction we could take. Other changes might include revising the method by which new funds are appropriated by Congress, such as the Hatch Act grant. As I said earlier, these are alternative opportunities—but they remain opportunities only as long as we are willing and able to act on them—rather than having decisions forced on us.




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Researcher H. H. Yap tests toxicity of PCB compounds.

## PCB's: A NEW MENACE?

DDT may soon be joined by PCB's in the alphabet of chemicals under fire by governmental agencies. PCB is the acronym or "nickname" for polychlorinated biphenyls, chemical compounds marketed in the U.S. under the trade name 'Aroclor.'

Like DDT, PCB compounds are toxic, remain in the environment for long periods of time, and present no short-term danger. PCB's are sometimes mixed with chlorinated insecticides, the chemical relatives of DDT, to suppress vaporization and extend their "kill-life."

Unlike DDT, PCB's are used in some floor tiles, inks, asphalt, paints, varnishes, brake linings, flame retardants, electrical products, resins, and a host of other everyday products.

"The most toxic PCB compound is probably about half as toxic as DDT on a long-term basis," according to Experiment Station entomologist Laurence Cutkomp. Cutkomp, along with D. Desai and H. H. Yap of the University and R. B. Koch of the Honeywell Research Center, has been testing the effects of PCB's on the enzyme systems of fish and insects. Enzymes are complex chemical substances vital to several biological functions.

Minnesota entomologists found that as little as 25 parts per billion (ppb) of the most toxic PCB compound in water kills laboratory minnows in 4 days. Twenty-five ppb is roughly equal to about 25 smutty wheat grains mixed with 1,280 bushels of wheat.

In other studies, researchers have discovered PCB compounds in various species of birds as far away as the Arctic and some Pacific islands. Concentrations of PCB's in the fatty tissues of young Peregrine falcons were found to be 160 parts per million (ppm) and as high as 1,980 ppm in adult falcons.

The U.S. Department of Agriculture earlier this year barred processors from marketing more than 30,000 pounds of frozen eggs contaminated by PCB's in North and South Carolina. Tainted lots of eggs were found to contain 0.6 to 2.2 parts per million of PCB's. The level considered harmful by the USDA is 0.5 ppm.

PCB's are often compared to DDT. The way in which they poison animals bears a striking resemblance. Both reduce a bird's capacity to reproduce and cause egg shells to be thin and break easily.

But at the cellular level, resemblance between the two chemicals ends. DDT primarily reduces enzyme activity inside a part of the cell called the mitochondria. In some experiments, however, PCB's reduce activity in that same enzyme system, only mostly outside the mitochondria. Either effect—along with other responses to the poisons (in wildlife and humans)—can kill.

Presently, no tolerance levels have been set by the federal Environmental Protection Agency (EPA) on PCB compounds.

Cutkomp feels that the place to

restrict the compounds—should further research show a need for that—is near to the source.

"The approach here would be to find out which PCB compounds are most toxic and then for the EPA to place restrictions on the use of PCB's in certain products commonly used by the public," he said.

## HARDIER POTATO STOCKS SOUGHT BY RESEARCHERS

Minnesota potato growers can expect long-range benefits from Experiment Station research underway near Bogota, Colombia, in the high Andes Mountains. University researchers hope to develop a high protein, frost-resistant potato for Andean peasants who depend upon it as a staple item in their diets.

The horticultural research effort is supported in part by a \$117,600 Rockefeller Foundation grant. Researchers are screening several frost-resistant species in search of one or more suitable varieties. In 1967 a harsh frost caused an estimated \$50 million loss to Colombian potato growers.

"Fortunately, many growers in the Andean region planted small insurance crops of wild-type potatoes that possess substantial frost resistance," according to Daryl Richardson, a horticultural research assistant.

But the frost-resistant native Andean potatoes are not suitable for eating. "Peasants go to considerable trouble drying them in the sun, grinding them up, and leaching them with water to eliminate their extremely bitter flavor. The result is less than satisfactory," Richardson says.

Although Upper Midwest and South American climates are quite different, growers in the Red River Valley are also troubled by frost damage. Minnesota researchers believe that cultivated frost-resistant Andean varieties could be incorporated into North American stocks to develop a hardier variety for the Red River Valley and other potato-growing areas of the state.

Colombian scientists are working with University horticulturists on the 5-year project. The small, tasty potatoes are crossbred in Colombia and laboratory analysis is being done on the St. Paul Campus. Research has been underway for only 2 years, but horticulturists say that the potential to increase protein content and frost resistance looks promising.

## SPACE FOOD INVASION

Nutritious bits of food that look and taste like meat are being developed by University food scientist Ted Labuza for space travel and use in the home. Labuza, who came to Minnesota from the Massachusetts Institute of Technology (MIT), says the meat-like products contain low amounts of moisture but are not dehydrated and won't spoil without refrigeration. The intermediate moisture foods are a mixture of meat, dairy products, soy protein, and sugar. They contain about 20 percent moisture and are already on the market to a limited extent in the form of dog food that looks like chunks of meat and a breakfast item that looks like a flat tart.

The new intermediate moisture foods will not be part of the astronaut's regular meals on the next space flight since contracts already have been let for food on this voyage. But there is a possibility that intermediate moisture foods will be tested on the flight, Labuza says.

Astronauts will not be the only ones benefiting from development of outer space dining products: Mothers will be able to give their children sweet substitutes for candy that are highly balanced in protein, fat, sugar, and vitamins.

Future astronauts—those who man the nation's orbiting space laboratory—will enjoy greater variety in their diets thanks to the new foods. However, the staple food items for occupants in the orbiting space laboratory will be canned goods with high surface tension, which prevents food from floating away once cans are opened. The phenomenon of weightlessness in space is due to the absence of the earth's gravitational pull.

Labuza began space food research under a NASA contract in 1965 at MIT where he received his doctorate degree in food technology. There, Labuza's research included developing a process to determine what type of packaging was needed to preserve dehydrated food for a given storage time. Excess baggage was something the Air Force wanted to avoid, especially in the space program's early days when the going rate to lift a single pound off the ground was a sky high \$100,000. Since then the cost has been reduced to a more down-to-earth price of about \$1,000. However, some dehydrated foods have 2 pounds of packaging that is essentially "garbage," Labuza says. Unfortunately, NASA never incorporated

the MIT findings into its program because the packaged food had been contracted well in advance and there were too few space flights left to try out the new method.

Depending on future funding of their project, Minnesota food scientists will be testing intermediate moisture foods for flavor and storability. NASA astronauts may visit the University's St. Paul Campus to taste the foods or the foods will be sent to the NASA Space Center in Houston, Texas, for flavor tests.

## MAKING MILK PALATABLE FOR MILLIONS OVERSEAS

Milk may be "nature's most perfect food" for millions of Americans, but in many foreign nations it causes stomach cramps, nausea, diarrhea, and bloating. The fault is not in the milk, but rather in the fact that many Latin American, Asian, and African children and adults cannot tolerate lactose, milk's principal sugar.

This strange reaction to milk is most common among non-Caucasians and is generally caused by an inherited defect, by some other dietary deficiency, or by a related disorder or disease, according to food scientist Ronald Richter. Despite this fact, University food scientists believe milk is one of the best weapons to combat malnutrition in less developed countries.

"It contains all the amino acids essential for good health and is still the most nutritive food that can be supplied," Richter says.

One of the most promising ways to make milk acceptable to undernourished children in foreign nations may be the addition of the enzyme lactase to milk. Lactase breaks down lactose chemically, converting it to a new form that can be absorbed by the body, instead of causing illness.

Food scientists are growing bacteria that will manufacture the enzyme lactase, which will then be added in varying amounts to milk. The mixture will be tested on rats whose tolerance to lactose has been predetermined. Blood sugar levels in the rats will be measured before and after feedings to see how much lactose the rats can digest and absorb with the aid of the supplemented enzyme.

If test results show promise, the modified milk product might replace less effective milk substitutes currently being used to combat malnutrition abroad.

## SEWAGE DISPOSAL STUDY TESTS SLUDGE ON CROPS

How do you dispose of tons of sewage sludge collected from nearly 3½ million Minnesotans every day? Most of the syrupy sludge now is either burned or dumped in sanitary landfills and covered with dirt. Both practices are questionable from the standpoint of pollution, but are far superior to the method commonly used in many communities—dumping sewage into nearby streams or lakes.

Experiment Station soil scientists believe that a possible solution to the sludge disposal problem might be to use the syrupy material as fertilizer on cropland, lawns, and gardens.

At selected sites around the state, the nutrient-rich sludge is being used on commercial crops such as corn, wheat, and peas. Small amounts of sludge are also being tested on Twin Cities golf courses and parks, and on home gardens and lawns at Hastings, Minnesota.

"Use of sewage nutrients has long been practiced in Europe, the Far East, and elsewhere," according to William Larson, Experiment Station and Agricultural Research Service soil scientist.

"With environmental laws becoming tougher and tougher, the federal Environmental Protection Agency may eventually ban putting sewage in rivers or in the air by incineration," Larson said.

University soil scientists are approaching the sewage-fertilizer study with a "check everything first" attitude. Among potential dangers in using sewage as fertilizer are harmful bacteria, viruses, and nitrates. Bacteria present a risk in handling the sewage, viruses are a threat to consumers of sewage-grown foods, and nitrates can pollute underground water supplies. Sewage may also contain heavy metals such as zinc, cadmium, lead, and others. Metals such as these can cause long-term ill effects in people eating sewage-grown foods and might reduce the soil's capacity to produce crops.

Different amounts of wet and dry sludge are being tested on experimental plots—alongside other plots fertilized with commercial chemicals. Researchers will compare corn crop response and soil and plant analyses from the various treatments. Tests will also be run on nitrates and heavy metals in the soil and plants.

## HELP FOR THE POOR

# Revamping the Welfare System

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With passage of the Economic Opportunity Act of 1964, the nation committed itself "to eliminate the paradox of poverty in the midst of plenty." Jobs, education, training, and increased political power for the poor have been major elements in attempting to fulfill this goal.

In the early 1960's, economic policy geared to reducing poverty sought to stimulate the economy sufficiently to lower unemployment. Unemployment fell from 6.7 percent in 1961 to 3.5 percent in 1969, and the number living in poverty dropped from almost 40 million in 1959 to 24.3 million in 1969. However, as the nation moved into the 1970's, millions remained in poverty. And partly because of rising unemployment since 1969, the number of poor increased by 1.2 million between 1969 and 1970.

Along with the drive toward full employment, the nation sought to eradicate poverty through other measures intended to raise the earning potential of the poor. The Department of Health, Education and Welfare expanded its commitment to adult basic education. The Department of Labor instituted retraining programs under the Manpower Development and Training Act of 1962 and during the sixties, it increasingly focused attention on particular requirements of the poor. Programs authorized by the Eco-

nomic Opportunity Act of 1964 also attempted to improve educational opportunities of minority and other disadvantaged groups through Head Start, Neighborhood Youth Corps, and the Job Corps.

The Office of Economic Opportunity helped the poor gain access to the political decision-making process. This gave them greater control over their immediate environment and a larger role in shaping anti-poverty programs. Emergence of the poor as a political force undoubtedly was viewed as a threat by many traditional power holders in both urban and rural areas. And many people became concerned over the more disruptive aspects of this emergence.

The current administration is abandoning attempts to facilitate political change. The mission of OEO has been diverted from that of an action agency to research and experimentation, and money now spent on Community Action Programs may be included in special revenue sharing for urban community development. Despite this change in policy, the process of developing political power among the poor has generated its own momentum and is expected to continue.

During the past decade much of what has been done for the poor was aimed at improving their long-run opportunities. Less emphasis was placed on the most obvious and present need of the poor—money.

The problem of reducing the number of people who live in poverty has become more resistant to measures designed to stimulate the economy and thereby increase employment opportunities of the poor. For example, since 1959 the number of poor families headed by men has declined by one-half, but the number of poor families headed by women has remained almost unchanged. Eradicating poverty will require measures directed to particular conditions and needs of the poor.

Access to employment, in itself, will not assure an end to poverty. Many of the poor already work. Many cannot work. Almost two-fifths of the poor are children under 16 years of age. Another one-fifth are 65 years old and over. Obviously, poverty can no longer be attributed to the refusal of the poor to work if major segments of the poor are either working or unable to work.

Welfare budgets across the nation have been rising at a staggering rate. And public opinion is mounting against present public assistance programs, which many believe have neither served the poor nor society very effectively. Some programs have had such perverse effects as encouraging husbands to leave their families and discouraging recipients from seeking work to supplement their public assistance payments. Several Presidential commissions have urged major changes in the nation's welfare system.

### WHO ARE THE POOR?

More than 25.5 million Americans were poor in 1970. About four-fifths of the poor were in family units. The other one-fifth (5 million) were individuals not living with relatives.

Since 1959, the number of persons living in poverty has declined significantly. However, between 1969 and 1970 the number of poor persons increased by 5 percent. The long-term decline in poverty has been confined largely to poor families. In 1970, the number of poor persons not in families was larger than 10 years ago. More than half these individuals were 65 years old or over.

Of the 20.5 million poor living in family units, 10.5

million were children under 18. About 11.2 million of the poor were women not living with relatives and members of families headed by women. Of the 5.2 million poor families in 1970, 1.2 million were headed by an individual 65 years old or over.

The popular conception that the poor avoid employment is not supported by factual evidence. "Sixty-one percent of poor male family heads and 43 percent of poor female family heads worked in 1969. About 90 percent of poor male heads who did not work were either ill or disabled, or can be presumed to be retired. About 72 percent of poor female heads who did not work gave family and home responsibilities as their main reason for not working."<sup>1</sup>

Several factors contribute to poverty. Many of the poor cannot earn enough to escape poverty because age or disabilities impair their ability to work. Another element is family size: In 1970, 704,000 of the families in poverty had five or more children to support. About 30 percent of all U.S. families with five or more children are poor. Many working poor have low productivity due to low educational and skill levels. They are unable to support their families adequately for these reasons, not because they lack incentive to work.

Since such a large number of poor families are headed by a female or someone over 65, it is not surprising that income other than earnings is a very significant amount of their total income. In 1969, for instance, 48 percent of the income of the poor came from sources other than earnings, compared to only 10 percent for the non-poor. Nineteen percent of the income of the poor came from Social Security and other government retirement programs, and another 19 percent came from public assistance programs. For poor families with a female head, 67 percent of their income came from sources other than earnings. Public Assistance, alone, accounted for 39 percent of this income.

#### CURRENT PROGRAMS

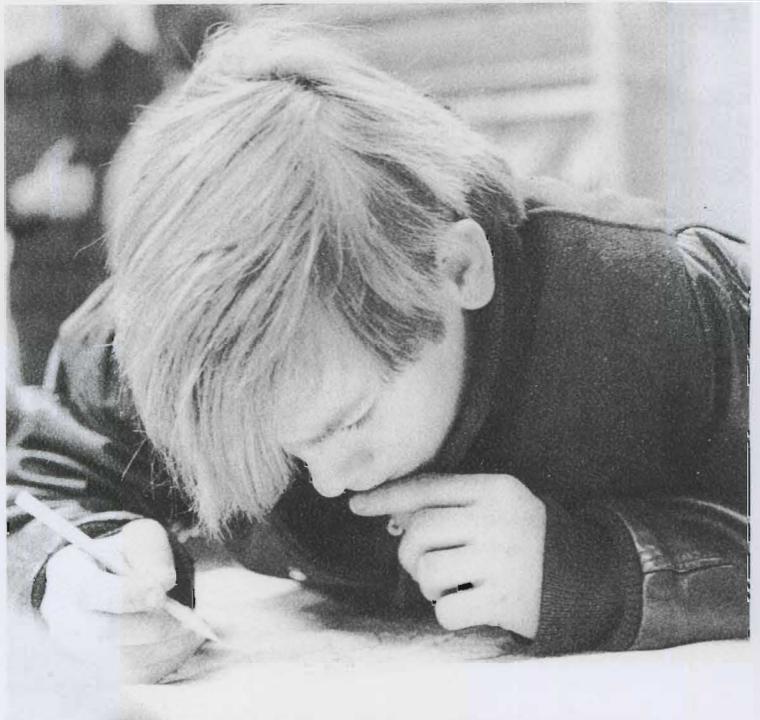
The U.S. income maintenance system, which began in the mid-1930's, includes two types of programs. One type is designed chiefly to help stabilize income. Major programs in this category are Social Security and unemployment insurance, which seek to prevent a complete collapse of income when an individual retires, is disabled, or is laid off. The other group is comprised of programs in the system of public assistance, which was established to supplement social insurance programs by providing income grants to certain categories of people in poverty.

#### SOCIAL SECURITY

Social Security is a transfer from those presently working to the retired or disabled—with the understanding that upon retirement those presently working will be supported by future workers. It is similar to private insurance programs since it is financed from trust funds created by a payroll tax levied equally on employees and employers. Taxes paid into the Social Security trust fund are based upon the assumption that wages and benefit levels will not increase in the future. Hence, present benefit payments tend to exceed past contributions plus accumulated interest.

In 1970, Social Security (Old Age, Survivors, and Dis-

1. U.S. Bureau of the Census, *Current Population Reports, Series P-60, No. 76, "24 Million Americans—Poverty in the United States: 1969,"* (Washington: U.S. Government Printing Office, 1970), page 2.



Who are the poor? Statistics indicate that over half those living in family units are children under 18 years of age. In 1970, 704,000 of the families in poverty had five or more children to support.

ability Insurance), excluding hospital and medical insurance, paid \$29 billion in benefits to 25 million recipients (see table 1). It has been estimated that 60 percent of these payments go to those in poverty before the transfer. Federal outlays for health care in 1970 totalled another \$9.6 billion.

Social Security paid in 1970 an average monthly benefit of \$96 to a retired worker, \$95 to his survivor, and \$93 per month to a disabled worker. These benefits have been gradually increasing: Since 1960 the average monthly benefit to a retired worker has risen \$22. Over time, minimum payments of the Social Security program have been directed more toward an individual's need and related less closely to his past contributions. Nevertheless, the current minimum benefit levels, or even the higher levels, provide a low level of basic income support.

#### UNEMPLOYMENT INSURANCE

Unemployment insurance operates mainly from trust funds collected from employers. The program most benefits those who have steady employment and experience only brief periods of unemployment. This is because states limit the length of time over which benefits may be received. Often payment amounts are tied to the length of previous employment. Most states pay up to 26 weeks of benefits, although the maximum period of coverage has now been extended to 39 weeks under certain conditions. In all states, benefits depend upon previous earnings. Some states provide additional allowances for dependents; hence, the program is a compromise between an insurance program and a program based on the needs of the worker's family.

About three-fourths of the civilian labor force was covered by some type of unemployment insurance, before the Employment Security Amendments of 1970 extended cov-

\$2,400. All families of four with earnings of less than \$4,800 would receive benefits under the plan (see figure 1).

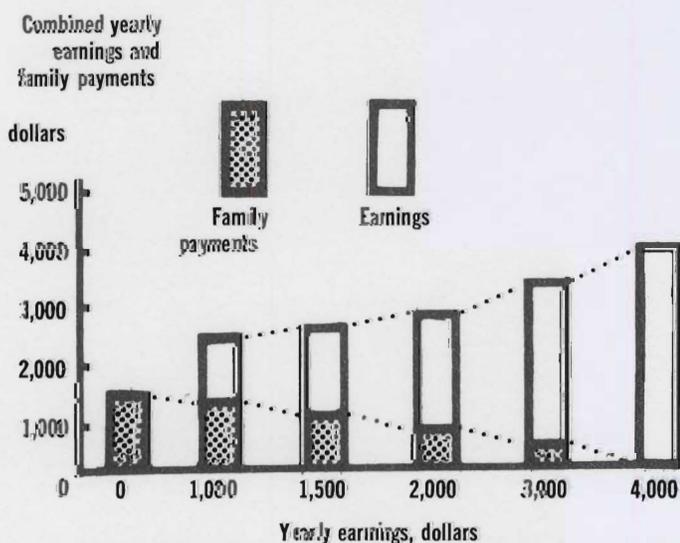
Using the negative income tax principle to provide cash assistance to the needy gives the poor an incentive to increase their income through work. This incentive exists because additional earned income always results in an increase in total family income. However, this method of providing a work incentive also leads to a difficult problem: The income of the poorest of the poor, even after including the government income payment, would still be less than the earned income of the not-so-poor who are eligible for income payments. As figure 1 shows, the plan would provide an income grant of \$2,400 to a family of four with no earned income. This would leave such a family more than \$1,500 below the 1970 government-defined poverty threshold. At the same time, a family of four with an earned income of \$4,000, which is slightly above the poverty threshold, still would be eligible to receive an income grant of \$400. This illustrates the basic problem of negative income tax. In attempting to maintain the incentive for the poor to work, it fails to bring the poor out of poverty and it makes some payments to the near-poor.

### FAMILY ASSISTANCE PLAN

President Nixon proposed an income maintenance program in a message to the Congress on August 11, 1969. The Administration's proposal, known as the Family Assistance Plan, would broaden the coverage of current public assistance to include families of the working poor, provide nationwide minimum levels of assistance with greater uniformity in benefits between states, and increase federal participation in financing public assistance.

The Family Assistance Plan was designed to replace and expand coverage of the present AFDC program. Until recently, AFDC payments were made only to poor families with a dependent child in which one parent (usually the father) was absent or incapacitated. Because of the requirement that one parent must be absent (or now in

Figure 2. Benefit schedule for a family of four (husband, wife, two children) under the proposed family assistance plan.



Source: U.S. Bureau of the Budget, "Welfare Reform Tax Sheet." Released August 8, 1969.

Table 2. Benefit schedule for a family of four (husband, wife, two children) under the proposed family assistance plan

Earned income	Benefit	Total income
	----- dollars -----	
0	1,600	1,600
720	1,600	2,320
1,000	1,460	2,460
1,500	1,210	2,710
2,000	960	2,960
2,500	710	3,210
3,000	460	3,460
3,500	210	3,710
3,920	—	3,920

Source: U.S. Bureau of the Budget, "Welfare Reform Fact Sheet." Released August 8, 1969.

some states, unemployed) for an AFDC applicant to be eligible for assistance, the present system has been accused of breaking up families. Furthermore, the families of only 40 percent of the nation's poor children receive public assistance benefits. About half of the states now have elected to extend eligibility to families in which both parents are present but are unemployed and unable to provide adequate support for their family. The Family Assistance Plan would pay benefits to all poor families with children.

The present welfare system also has been charged with discouraging people from working. The Family Assistance Plan would include a work requirement and a schedule of benefits designed to increase work incentives. The Administration's proposal provided a basic annual grant of \$500 per adult and \$300 per child to families with no other income.<sup>2</sup> The head of a poor family would be allowed to earn \$720 per year without any reduction in benefits. For those who earn above \$720 annually, benefits would be reduced 50¢ for each additional dollar earned. (See table 2 and figure 2.)

Under the proposed Family Assistance Plan, the federal government would pay the entire cost of benefits required to achieve the national minimum income level. States now paying levels of public assistance above the proposed federal guarantee would be required to maintain a certain percentage of their expenditures so that benefits to those presently receiving public assistance would not fall.

Although the Family Assistance Plan was intended to replace the AFDC program, it will primarily benefit the working poor with children. Only in 8 states in 1970 would the proposal have increased the payment levels for families with dependent children who presently are receiving public assistance. It still is a categorical program, since eligibility is limited to those who have children and earn a poverty income. Neither the 5 million poor individuals nor the 1.8 million poor families without children would be helped by this program. Nevertheless, the program would take a large step toward a public assistance program based

(Continued on page 15)

2. Besides cash grants, low income families also would be eligible for food stamps. The cost of food stamps would vary directly with the amount of earned income received by the family. The Administration's initial proposal called for a net addition to family income in the form of food stamps that would vary from \$720 for a four-person family with no earned income to \$320 for a four-person family with an earned income of \$3,920.

# MILK REPLACERS BOOST LAMB PRODUCTION

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Economics has a strange way of changing attitudes and stimulating research to find solutions to problems. Such is the case with our nation's sheep production. A decade ago western sheepmen preferred a single lamb to twins. They reasoned that many twins would die and those



Animal scientists used individual pens to gather their data on protein and energy requirements of lambs. Researchers found that feeding a high quality ewe milk replacer fortified with minerals, vitamins, and antibiotics cut losses of twin and triplet lambs.

that didn't would be lightweight and bring less money at market time.

Minnesota sheepmen might boast about a 150 to 175 percent lamb crop, but the facts suggest that they raise less than a 120 percent lamb crop. In many instances, the high mortality rate is largely due to starvation. Many twin-born lambs die because they are smaller at birth, the ewe may refuse to accept one of them, or she either produces milk in only one-quarter of her udder or simply does not provide adequate milk to nourish two lambs. When a set of triplets is born, usually one and frequently all three die. A 20 to 25 percent lamb mortality rate due to starvation is a loss our sheepmen couldn't afford in the past and certainly can't under existing economic conditions.

Past attempts to save these lambs meant bottle feeding them for 3 to 4 months on a "milk" diet. Often this resulted in potbellied, thin lambs that cost more in time and milk than they were worth. Children might have raised two or three successfully, but certainly no one contemplated bottle-feeding 20 lambs out of every 100 ewes that lambed. Today, sheepmen are successfully feeding hundreds of day-old lambs a ewe milk replacer to minimize these losses and are realizing a profit of \$10 to \$12 on each lamb.

This new practice owes its success to research work at Minnesota and other experiment stations as well as by industry. All worked to develop the best diet formulation, method of feeding (to minimize labor and mortality), and equipment. For example, the fat level in milk replacers, while it has a major effect on the energy intake and (therefore) weight gains of lambs, may not be any more critical than the amount of lactose the replacer contains. Large intakes of lactose, such as would occur with feeding dried skim milk, result in scours and digestive difficulties. This is one major reason why bottle feeding "bum" lambs with dried skim milk or even calf milk replacers has met with disappointing results. In addition, the protein level of the diet has as great a bearing on weight gains as the fat level. The composition of some experimental milk formulations we have used successfully is shown in table 1.

Table 1. Composition of diets by percentage

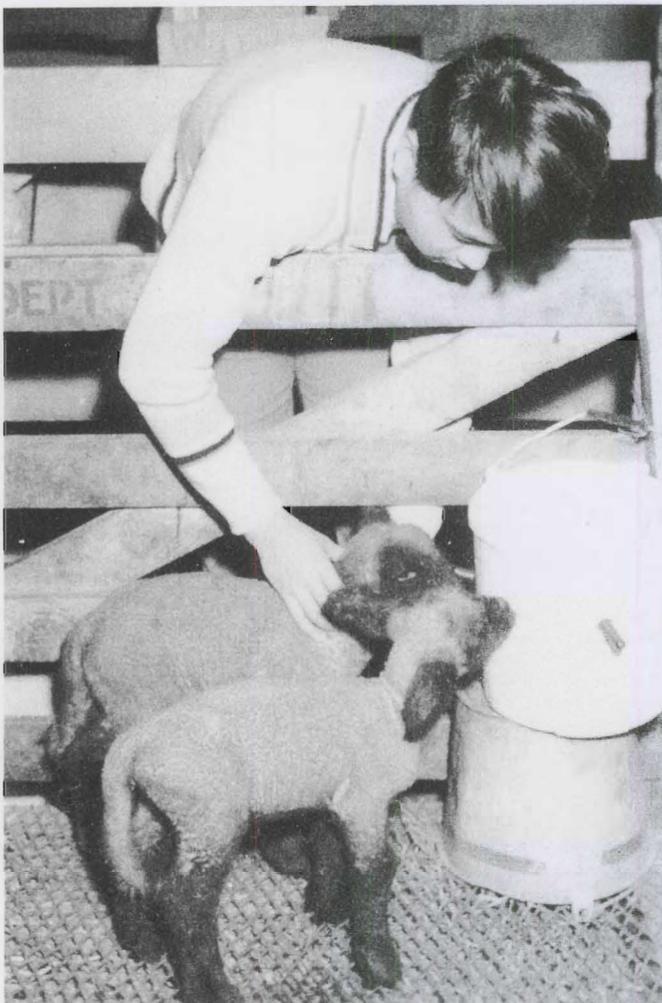
	Ewe milk replacer		Ewe milk*		
			Colostrum	Milk	
Fat level, percent	15	25	32		
Dried 40-60 skim†	36.5	62.5	80.0		
Dried skim	26.2	10.2	—		
Sodium caseinate	17.3	17.3	17.3		
Cerelose (glucose)	20.0	10.0	2.7		
Vitamins††					
Analysis, fluid basis§					
Total solids	20	20	20	33.0	20.4
Crude protein, percent	6.0	6.0	6.0	15.0	5.5
Crude fat, percent	3.2	5.3	6.7	15.4	8.7
Lactose, percent	5.3	5.2	5.3	2.4	5.8
Cerelose, percent	4.0	2.0	.54		

\* Ewe milk composition (Perrin, 1958).

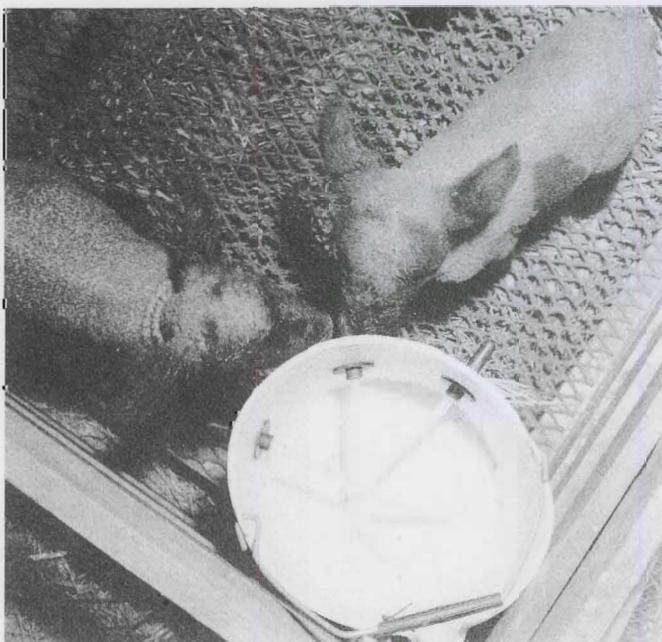
† A formulation of dry skim milk plus 40 percent fat.

†† Vitamin additions included 300,000 I.U., 100,000 I.U., and 3,000 I.U. of vitamins A, D<sub>3</sub>, and E/100 lb., dry matter, respectively.

§ One part of milk replacer powder and four parts of water (by weight).



Week-old lambs are gently coaxed to nurse from rubber nipples inserted into the side of a plastic pail containing ewe milk replacer. Below is a closeup of the plastic lines that feed the replacer to the nipples.



## PROCEDURE

During the last 4 years the following systems of feeding day-old lambs have been followed at Minnesota:

- 1) The lambs were either permitted to suckle their dams for at least 1 day or were given a 1-day feeding of cow's colostrum.
- 2) On the second day, a warm ewe milk replacer (one part powdered ewe milk replacer and four parts water by weight) was fed with a bottle and nipple to train lambs to suckle. The younger the lamb, the easier it was to train. Thereafter, we fed lambs either a given amount of milk per day or permitted them to self-feed using self-priming nipples (K and K Mfg. Co.) or nipples in which the level of the milk was below the nipple.
- 3) During the first week, we fed lambs three or four times daily. Thereafter, if we bottle fed a specific amount, we fed them twice daily. In studies using the self-feeding system, milk was in front of the lambs at all times, but we normally added fresh milk twice daily. Usually the major portion of the daily intake of milk occurred shortly after fresh milk had been added. With a self-feeding system, milk may sour before the lambs have consumed it. We avoided this problem by feeding the amount they would normally consume in 3 or 4 hours.
- 4) Both warm and cold milk were used, but lambs were always started on warm milk replacer.
- 5) Lambs were arbitrarily fed milk replacers for only 28 to 30 days. Normally, during the last 2 weeks of this period, supplemental grain and hay was fed. This made the transition from a milk replacer diet to a grain and hay diet easier.
- 6) The milk replacer diet should promote normal development during the first 30 days, but will not necessarily result in maximum gains. Such a lamb will make maximum and efficient gains on an inexpensive grain and hay diet following the milk-feeding period.

## RESULTS

Results of a portion of the nutrition work with baby lambs are shown in tables 2 and 3. These data warrant further comment:

- 1) In the 1969 trial the intake of dry milk replacer powder was restricted. During the first 2 weeks the lambs consumed from .37 to .43 pounds of dry milk powder per head. Lambs fed the low-fat diet consumed more than those fed higher fat levels. Apparently, they were attempting to compensate for the lower energy content of the diet. Daily fluid intake averaged about 25 ounces per lamb. In 1970 lambs were self-fed. Daily intake of dry milk powder ranged from .66 to about .83 pounds per lamb during the first 2 weeks and an equal amount during the second 2-week period.
- 2) In both trials, average daily gains were satisfactory and resulted in normal development. Restricted intake of milk (1969 trial) resulted in lambs weighing about 21 pounds at 4 weeks of age. In the 1970 trial in which milk was not limited, they weighed 28 to 31 pounds.
- 3) The cost of the milk fed to lambs was approximately \$2.50 per lamb in the 1969 trial and

about \$4.50 to \$5 in the 1970 trial. Neither cost figure is excessive. The practice prevents lambs from starving to death and results in their normal development to 4 weeks, at which time they can consume grain and hay.

- 4) Unless lambs are accustomed to eating dry feed (grain and hay) during the milk-feeding period, weight gains will decline during the first weeks following milk feeding. In the 1969 trial (table 2) daily weight gains averaged .24 to .41 pounds per lamb during the first 4 weeks following the milk-feeding period. Obviously, a satisfactory job of adjusting these lambs to grain and hay feeding was not accomplished. However, during the next 4-week period (8 to 14 weeks of age) daily weight gains were very satisfactory (.53 to .59 lb. per lamb daily). In the 1970 trial, lambs were heavier at the end of the milk-feeding period and made very satisfactory performance during the grain and hay feeding period (.48 to .54 lb. per lamb daily). This is the time that the major and most economical gains can be made.

Many problems are still unsolved, and research continues to raise new questions. Based on our experience

Table 2. Performance of baby lambs fed ewe milk replacer (1969)\*†

Level of fat, percent	15	25	32
First 2 weeks			
Birth weight, lb.	10.9	8.6	9.3
Weight at 2 wks., lb.	16.9	15.4	16.6
Daily gain, lb.	.43	.49	.52
Daily milk consumed, fluid oz.	27.6	23.6	24.3
Daily dry milk powder, lb.	.43	.37	.38
Second 2 weeks			
Weight at 4 wks.	21.2	21.2	21.3
Daily gain, lb.	.31	.41	.34
Daily milk consumed, fluid oz.	23.9	23.8	23.5
Daily dry milk powder, lb.	.38	.37	.37
Birth to 4 weeks			
Weight gain, lb.	10.3	12.6	12.0
Daily gain, lb.	.37	.45	.43
Daily milk consumed, fluid oz.	25.7	23.7	23.9
Daily dry milk powder consumed, lb.	.40	.37	.38
Milk powder cost per lamb, birth to 4 weeks (milk powder @ 22¢/lb.)	\$ 2.49	\$ 2.29	\$ 2.31
Post-milk feed performance††			
4-8 weeks			
Daily gain, lb.	.41	.24	.31
Daily feed, lb.	.65	.54	.58
8-14 weeks			
Daily gain, lb.	.59	.53	.54
Daily feed, lb.	2.31	2.07	2.03

\* All figures are averages.

† Ten lambs per treatment.

†† A pellet containing 75 percent corn and 25 percent alfalfa was self-fed from 4 to 8 weeks. From 8 to 14 weeks the ration consisted of 60 percent corn and 40 percent alfalfa hay.

and visits with other research workers, the following procedures for rearing day-old lambs are suggested:

- 1) Allow lambs to suckle their dams for 1 day. On the second day make the decision which lamb of a set of twins or triplets to remove from its dam.
- 2) Give the lambs nothing to eat for 6 to 8 hours so they are hungry. Put them in a pen with access to milk (self-priming nipples are particularly effective). A little encouragement and steering will start the lamb suckling on this type of nipple.
- 3) Several lambs in the same pen tend to teach each other to suckle. Groups of 10 to 12 lambs about the same size and age seem to work best.
- 4) The nutrition of these lambs is very critical and calls for a ewe milk replacer of high quality (25 percent protein, 25 to 30 percent fat, plus fortification with minerals, vitamins, and antibiotics). The quality of a product will affect how easy the milk is to get into solution; the amount of milk the lambs will take, and, equally important, the performance that can be obtained. High quality milk replacers are now available commercially.

With the introduction of such breeds as Finnish Landrace, for which lambing percentages of 200 to 300 percent are commonplace, the feeding of ewe milk replacer to day-old lambs to maximize the potential of highly prolific breeds will logically become an essential part of a sheep management and feeding program.

Table 3. Performance of baby lambs self-fed ewe milk replacer (1970)

Fat level	15 percent		32 percent	
	Warm	Cold	Warm	Cold
Environment*				
First 2 weeks				
Initial weight, lb.	12.2	12.2	10.6	14.4
Avg. wt. 2 weeks, lb.	22.7	18.1	20.2	21.7
Avg. daily gain, lb.	.75	.42	.69	.52
Avg. daily milk consumed, fluid oz.	53.1	42.0	43.8	49.4
Daily milk powder intake, lb.	.83	.66	.69	.78
Second 2 weeks				
Avg. wt. 4 weeks, lb.	29.9	28.1	29.8	31.1
Avg. daily milk consumed, fluid oz.	43.2	49.8	50.7	53.1
Avg. daily gain, lb.	.51	.71	.69	.67
Daily milk powder intake, lb.	.68	.78	.80	.83
Birth to 4 weeks				
Avg. daily gain, lb.	.63	.57	.69	.60
Avg. daily milk consumed, fluid oz.	48.3	45.9	47.3	51.4
Avg. daily milk powder intake, lb.	.76	.72	.74	.81
Milk cost/lamb for 4 weeks (milk powder @ 22¢/lb.)	\$ 4.66	\$ 4.43	\$ 4.57	\$ 4.96
Performance post-milk feeding (28 to 56 days)				
Avg. daily gain, lb.	.51	.54	.51	.48
Avg. feed intake, lb.				
Grain	.99	.99	.94	1.18
Hay	.83	.57	.52	.71

\* Warm 60-65° F.; cold 20-45° F.

# NEW DIP REDUCES MASTITIS

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Dipping the teats of dairy cows in an iodine solution after milking reduced the incidence of new cases of mastitis by an average of 32 percent at the Rosemount Experiment Station and by an average of 33 percent at the Grand Rapids Station. The Rosemount herd is comprised of 70 Holsteins, 44 Guernseys, and 28 Milking Shorthorns and has a low incidence of the disease. The herd is housed in a cold, loose housing set-up, and cows are milked in a double-six herringbone milking parlor. The 44 Guernseys in the Grand Rapids herd are in tie stalls and have had a high incidence of mastitis, mostly the staphylococcal type.

Our project was set up in September 1968 to check out reports from other research stations of dramatic reductions in the incidence of mastitis when teats were dipped in a commercial iodophor solution after milking. At Rosemount only the teats on the left side of the cows were dipped. Those on the right side were left untreated. Soon after the project was underway the treated teats began showing some erosion. Since it caused the cows some discomfort the treatment was stopped. A new mixture called No. 10 teat dip was then compounded by Williams. It is composed of the following:

- 150 ml Super San (25 percent tamed iodine)
- 2100 ml water
- 450 ml glycerine
- 450 ml methanol
- 450 ml propylene glycol

This solution was first used on all four quarters of the Guernsey herd to check for chapping and erosion. Since none was detected after 7 weeks of treatment, we resumed the project. Milkers noted any clinical cases of mastitis and these were treated. Persistent cases were treated with an antibiotic when the cow had been dried off.

Every 4 months milk samples were taken from each quarter, and bacteriological tests were made to determine any new infections (results are shown in the table above).

The Grand Rapids herd was similarly handled except that cows were housed in a warm barn. Also, the right

Comparison of numbers and types of new mastitis infections in treated and control quarters, Rosemount herd (560 quarters), November 1968 to September 1970

	Treated	Controls	Reduction
Strep agalactiae .....	4	7	43%
Staph aureus .....	13	16	19%
Strep non agalactiae .....	5	9	44%
Coliform .....	1	2	50%
Total .....	23	34	32%*

\* Average reduction

teats of cows on one side of the barn were treated, while on the other side the left teats were treated.

Results were quite similar, with an average reduction of 33 percent in new infections. However, there was a 50 percent reduction in staph infections in the Grand Rapids herd.

In 1966 when Farnsworth began taking milk samples and treating infected quarters 36 percent of the Rosemount cows had one or more quarters infected with mastitis-causing organisms, mostly strep agalactiae. This infection rate dropped to less than 9 percent by the time teat dipping started. Even with this low incidence of infection, teat dipping further reduced new infections an average of 32 percent.

Farnsworth found that at least four organisms continued to cause new infections. These organisms probably are present in the environment of all cows. When conditions are right they will cause an infection. Among factors that lead to mastitis, the most important one is the introduction of organisms into the udder. Then if the organism has the ability to cause disease and the udder tissue is injured, mastitis will result. Mastitis lowers production in the infected quarter. Sometimes the quarter will be completely and permanently ruined; other times only partial damage results.

Milk is "fertile ground" for growing many organisms. A film of dried milk or a few droplets on the end of the teat will hold and permit the growth of infectious organisms. Injuries to the end of the teat result in many cases of mastitis. But the shape of the teat may reduce the likelihood of infection, and some cows possess an inherited resistance to mastitis-causing organisms.

Milkers' hands, milking machine inflations, and possibly flies can spread organisms from one cow to another. It has been shown that staphylococci and some other organisms grow on the skin of the teat for some time before being introduced into the teat canal. The practice of dipping teats in iodoform after every milking discourages bacterial colonies from forming and growing on the outside of the teats. This reduces the number of bacteria entering the teat and causing an infection.

Reports from researchers in other states have shown that dry treating of quarters infected with staph organisms is effective in reducing infections. Dry treating is accomplished by infusing an antibiotic into the udder immediately after a cow has been turned dry. The combination of teat dipping after milking and dry treating is recommended to complement good milking practices such as stimulating milk letdown 1 minute before attaching milking machine units, getting the machines off as soon as the milk has been removed, and maintaining an adequate and stable vacuum in the pipelines.

only upon need.

The Family Assistance Plan considered in 1970 would have increased cash transfers to poor people by an estimated \$2.5 billion annually. It would have helped lessen the inequities in payment levels between states and between categories of the poor. The proposal would have removed about one-fourth of the poverty gap (i.e., the difference between present income and the poverty income definitions). Since the cutoff point of \$3,920 for a family of four is very close to the poverty definition, there would be very little leakage to the near-poor. This is either a program advantage or disadvantage, depending upon the society's evaluation of the adequacy of the poverty income definitions.

The Family Assistance Plan was passed by the House on April 16, 1970. However, on May 1, after three days of hearings, the Senate Finance Committee sent the House-passed bill back to the Department of Health, Education and Welfare for revision.

A compromise welfare reform measure was agreed upon by the House Ways and Means Committee on May 12, 1971. The bill provides a national minimum income of \$2,400 for a family of four with no other income. To be eligible, the family must have children and earn less than the breakeven income of \$4,320. The entire cost of the basic grant would be borne by the federal government. Under the plan, recipients would not be eligible for food stamps. Cash grants to poor families would be reduced by \$2 for every \$3 of earned income above \$720 per year. It is estimated that the new program would increase federal spending by \$5.5 billion over current public assistance expenditures, but would bring \$1.6 billion in fiscal relief for state and local governments. The bill provides for separate treatment and agency administration of families considered capable and incapable of obtaining employment. For the eligible poor, capable of working, expenditures are authorized for child care, job training and placement, and public service employment. The comprehensive welfare reform bill also calls for complete federalization of public assistance programs for the aged, blind, and disabled, and raises minimum benefit levels to \$130 per month.

The present fate of the House-passed bill is uncertain. President Nixon, who had earlier given strong support to the measure, asked in his economic message on August 15, 1971, that implementation of a new welfare plan be delayed for 1 year.

### REDUCING RURAL POVERTY

Poverty is often thought to be a less significant problem in rural areas than urban areas. Housing costs are lower in rural areas, and many rural residents can produce some of their own food. Also, densely populated urban areas impose more pollution, traffic congestion, noise, and other unpleasantness on its residents. However, sparsely populated rural areas often lack social services. The number and quality of health facilities and personnel, the number of institutions offering post-high school education, and the range of consumer goods tend to be less in rural areas. Hence, the lower cost of living may be partly due to the fact that rural inhabitants are forced to do without many of the goods and services available to urban residents. Moreover, the cost of some consumer goods is generally higher in rural areas, since many retail establish-

ments pay higher transportation costs. Many rural stores do not have the sales volume to offer prices as low as those in city discount stores. When all goods and services, including the quality components, are considered, living costs may even be higher in the country than the city.

The federal definition of poverty income allows a 15 percent discount for reduced housing and food costs of farm residents. Even with this adjustment about one out of five farm families lives in poverty. However, since the total farm population is small, farm residents in poverty account for less than 10 percent of the nation's poor. Poverty is a serious rural problem, but most of the rural poor do not live on farms. Although only about one-third of all U.S. families live in rural areas, these areas accounted for nearly half of all poor families in 1970. By way of comparison, the incidence of poor families ranged from 5.7 percent in the suburban rings to 10.9 percent in the central cities. In rural areas, 13.8 percent of all families were poverty stricken. To the extent that the 15 percent discount for living on a farm overstates the lower living costs, the importance of poverty in rural areas and of rural areas in the composition of the nation's total number of poor is underestimated.

Passage of a program such as the Family Assistance Plan would be especially important in combating rural poverty. Almost two-fifths of the 3.6 million families eligible for family assistance payments in 1971 would be rural residents. They would receive an average of approximately \$1,000 per family annually. This would increase income payments to rural areas by \$1.5 billion. The impact on rural economic development would be substantial. Higher incomes for the rural poor and increased spending in rural areas would be expected to encourage expansion of rural trade and service sectors. Increased local tax revenues also could lead to more public investments that might encourage industries to move into rural areas.

The economic impact of the proposed Family Assistance Plan on metropolitan areas would be expected to be less for several reasons. Since a higher percentage of the poor live outside metropolitan areas, the multiplier effects from their increased incomes would be less in metropolitan areas. Moreover, the Family Assistance Plan is designed to remove the categorical discrimination against the working poor with children. A higher percentage of intact families of the working poor is found in rural areas than metropolitan areas. This is partially offset by the older age structure of the rural poor, since the Family Assistance Plan excludes the poor without children.

The economic stimulus provided by the increased purchasing power of rural residents combined with the higher proportion of poor families in rural areas would be expected to make rural areas the primary beneficiaries of an improved income maintenance system. The President committed himself in his State of the Union Message of 1970 to making rural areas prosperous enough so that rural-to-urban migration flows will be reversed. While the Administration is unlikely to attain this objective, the proposed Family Assistance Plan, if adopted, would represent significant improvement in the economy of many rural areas.

### PROS AND CONS

Most advantages of the Family Assistance Plan have been discussed. They include increased work incentives for public assistance recipients, a large step toward removing the categorical approach to poverty reduction with the ultimate objective of grants based only on the recipient's

family income, a reduction in administration costs through more automatic operation of public assistance income transfers, increased investment in the children of the poor, and assistance for the working poor. The program also introduces increased stabilization to the economy in a manner similar to unemployment compensation. As unemployment increases, the number of recipients would increase. The increased income of the poor from family assistance would help stabilize consumption, thereby pushing the economy back toward full employment.

The Family Assistance Plan, however, has several disadvantages. The Senate Finance Committee was especially concerned that, when the Family Assistance Plan is integrated with other programs such as Food Stamps, public housing, and state and local assistance, the marginal tax rate can become higher than the 50 percent rate initially proposed by the Administration. Since most taxpayers pay less than 50 percent of their wage earnings in taxes, it was argued that it would not be fair for the poor to pay such a high rate in the form of reduced public assistance benefits. The bill approved by the House Ways and Means Committee set the reduction in family assistance benefits at 66 2/3 percent.

Another persistent criticism is that Family Assistance isn't enough. The 1971 revised Plan would only remove about 28 percent of the poverty gap and the new proposal passed by the Ways and Means Committee would remove a maximum of one-third of the poverty gap. The Administration's position is that once the principle of welfare reform has been established, expenditures and basic coverage can be gradually increased. The original proposal would not have helped present recipients of public welfare except in the eight states of the South with the lowest public assistance benefit levels. The new House proposal would increase the basic grant in 22 states. Nevertheless, even with the higher income floor set by the House Ways and Means Committee, incomes of AFDC mothers in most metropolitan areas would not be raised, although state and local governments would get more fiscal relief.

Still another criticism is that the proposal creates an inferiority complex among the poor due to special treatment in determining eligibility. An alternative way to benefit the children of the poor would be to give an allowance to all families with children and then use positive tax schedules to aim allowances specifically at poor children. This proposal would have essentially the same effect as the Family Assistance proposal except that it removes the "means test" and would be administered differently.

Finally, the stress on work in the proposal seems excessive. The working poor are already working and special measures could be taken to maintain their incentive to

work. It is not clear that the expenditures on day care centers and the requirement that female heads of households be required to work if their children are 3 or older are either socially beneficial to the mothers and their children or justifiable economically (given the high cost of day care centers and the marginal, dead-end jobs for which many of the AFDC mothers would be qualified).

## CONCLUSIONS

The pressure of rapidly rising public assistance costs and increasing public discontent with the present welfare system is forcing long overdue reform. The non-poor are the principal beneficiaries of the U.S. system of transfer payments because the primary emphasis of the system has been on income stabilization, not eradication of poverty. Integrating income transfer proposals into the system to eliminate poverty offers the present major challenge.

Much of the opposition to spiraling public assistance expenditures has been due to the fiscal crunch on state and local tax bases. The basic problem of our present system of taxation and expenditure is that the demand for local and state services increases with income growth more rapidly than the tax base available to these branches of government. This is not true for the federal government, where the tax base increases at a faster rate than income growth. Unfortunately, an adequate system for sharing federal tax revenue with state and local governments has not been developed. Consequently, much of the state and local frustration with mounting taxes has been directed toward welfare recipients. The welfare reform bill passed by the House in May 1971 is a type of revenue sharing and would relieve some of the fiscal pressure on state and local governments.

The nation's attack on poverty in the mid-sixties operated under the assumption that the poor could be changed in such a way that they would be better served by existing economic and social institutions and thereby gain access to the mainstream of American society. Poverty has been reduced significantly, despite the fact that resources which might have been devoted to the War on Poverty were diverted to another war.

Past anti-poverty programs have taught us a great deal about both the poor and American society. There seems to be an emerging consensus that further progress in reducing poverty will require less emphasis on changing the poor and more emphasis on changing present economic and social institutions. Welfare reform is the first step. The next steps will involve basic reforms of educational and health delivery systems so that they will more effectively serve the poor and the rest of American society in the seventies and beyond.

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