tributable to a failure of the air bag system. In two instances, the crash was so severe the passenger compartment was destroyed; in another, a 6-week-old infant was fatally injured during pre-collision braking; and, in the fourth case, the victim was seen slumped over the steering wheel at the time of impact and may already have been dead.

Some people have worried that air bags might "go off" inadvertently, and this concern has been given some not very subtle encouragement from Detroit. A Ford Motor Company ad several years ago suggested: "Imagine driving along at 60 miles per hour and suddenly having an enormous pillow thrust in your face." The fact is, only six inadvertent deployments have occurred in some 240 million vehicle miles of experience with air bags. Three of the six occurred while the cars were being worked on by mechanics who were unfamiliar with the air bag system. One of the other deployments was attributable to a fire and explosion in the vehicle and the remaining two resulted from manufacturing defects.

Inasmuch as most of the operational experience with air bags goes back no further than 1974, the question has been raised whether they will remain ready to perform properly throughout the 10- or 11-year life of the automobiles in which they are installed. For instance, at the air bag hearing last month, Nicholas Perrone, director of the structural mechanics program at the Office of Naval Research, expressed the view that the public cannot be expected "to actively maintain the viability" of this system.

Yet, as air bag proponents point out, the problem of keeping air bag systems in working order might be no greater than that of maintaining belt systems, which can jam or fail if not properly looked after. In any case, the maintenance problem can perhaps be dealt with by the states through the same kind of vehicle inspection programs used in checking on brakes, lights, and other safety equipment. The air bag system offered by General Motors as an option came with a diagnostic circuit and warning light, and this would be an essential feature should installation of air bags be required.

If Secretary Coleman does in fact order air bags installed, it will necessarily lead to an increase in the price of new cars, and the only question is how much. Nader insists that it could be less than $100, while Ford Motor Company officials say it would be more than $300 (the NHTSA's estimates fall between $100 and $200).

Such an order by the secretary would also represent a restriction by government on the car buyer's, as well as the auto companies', freedom of choice. But much more is involved in auto safety regulation than the government's deciding for the car buyer what safety equipment will serve him best.

Car Poolers and Drunken Revelers

Cars are ridden in by the very young and the very old, by car poolers, by adolescent hell-raisers and drunken revelers, and by others who have had no say in how a particular vehicle is equipped. Moreover, small children and even many adults simply cannot or will not buckle up seat belts. In a collision, their fate may turn on whether the Secretary of Transportation has decided that every new car shall have passive restraint systems.

In addition, if hundreds of thousands of avoidable deaths and serious injuries occur every year from a failure of automobile safety regulation, the effects are widely felt, as in the added demand for health and welfare services and in the cost of insurance. At Coleman's hearing, Richard G. Chilcott, senior vice president of Nationwide Insurance Companies, said that his firm is allowing policyholders whose cars are equipped with air bags 30 percent off on coverage for personal injury, medical payments, and family compensation. "If air bags were installed in all cars for drivers and front seat passengers, consumers could save $1.9 billion in auto insurance costs annually," Chilcott said.

In taking his turn at the secretary's hearing, Nader was at his most provocative. What the pending rule-making on passive restraints really came down to, he said, was whether Coleman had "the moral fortitude to stand up to the giant auto companies and the White House that has served them so faithfully in the last few years."

As the situation is viewed by Clarence Ditlow, of the Center for Auto Safety, Coleman should even go beyond requiring installation of passive restraint systems by also calling upon Congress to make seat belt usage mandatory. Once passive systems are required, it will take more than a decade for cars equipped with such systems to replace those not so equipped. In the interim, a seat belt law might bring usage up from the present 20 percent to perhaps 70 percent, the level of compliance reportedly attained in Australia and some other nations that have enacted laws of this kind. Where new legislation is concerned, however, Secretary Coleman lacks the power of decision and can only resort to exhortation. But, as for issuing a passive restraint standard for new cars, the secretary already has the statutory authority to crack the whip over the lions in Detroit and all he need do is to use it.

—LUTHER J. CARTER

Crops and Climatic Change: USDA's Forecasts Criticized

How prepared is the United States for weather fluctuations and accompanying food shortages? This question is being raised more and more insistently by a number of leading climatologists who believe that weather in the Northern Hemisphere is worsening, and that the crop-estimating policies of the U.S. Department of Agriculture (USDA) are inadequate to deal with this new climatic situation.

The USDA makes monthly, seasonal, and annual forecasts of crop yields of the United States and the rest of the world. They constitute the most thoroughly researched and widely respected information on future food supplies available. USDA's projections are the model for similar ones made by the United Nations and other international groups. And, all the estimates are based on the assumption that the weather will be normal.

The forecasts, compiled at specific times in the growing season, are kept confidential until their release, when they have an undoubted impact on the commodity markets. The estimates of

United States and Canadian harvests are especially important because 90 percent of all grain sold outside the continent of its origin comes from North America. Hence, accurate predictions of U.S. crop yields are essential to estimating how much will be available for trade abroad.

The USDA system of forecasting, developed in the early 1950's, has been criticized by climatologists who argue that its reliance on past yields and normal weather is an erroneous guide to the future. Worse, they say, the USDA forecasting system tends to regularly overestimate crop yields. Among the government groups who have become alarmed about this situation are the National Oceanic and Atmospheric Administration (NOAA), the Central Intelligence Agency (CIA), and also the Defense Science Board. In August a group of experts at the National Defense University at Fort McNair, in Washington, D.C., began making a high-level study aimed at recommending solutions.

At the heart of the USDA forecasting system is the Statistical Reporting Service (SRS), which measures growing practices in the United States. SRS sends periodic questionnaires to more than 100,000 farmers and follows up with technicians' surveys of 16,000 randomly chosen plots of planted ground. The data are gathered before and during the growing seasons of different crops; actual yields are measured at harvest time. The data for each state are fed to local USDA offices, which draw up statewide projections, and to USDA in Washington, where the Estimating Division of SRS, headed by John Kirkbride, compiles a final, national projection. Similar procedures, although based on less extensive field reporting, are followed by most other countries.

Weather is included in this procedure in two ways, according to Kirkbride. First, past weather is included implicitly in farmers' and technicians' reports. If a drought is occurring in Iowa, for example, it will affect farmers' harvest estimates and what the technicians report. When USDA interprets the data, estimates are plotted on charts of past yields going back 10 to 20 years.

Second, USDA assumes, as a matter of policy, that all future weather will be normal. As Kirkbride explains, the field data will reflect the existence of a drought, but the interpretation suggests that the drought will end. "What we're saying is that we have no way of knowing that abnormal weather will occur," he says.

These assumptions have been criticized by Louis M. Thompson, Dean of Agriculture at Iowa State University and a leading developer of models of the relationships between weather, technology, and crop yields. Thompson has models which hold constant the level of technology—fertilizers, farm equipment, planting techniques, and other gains—but nonetheless showed distinct differences in yield. Thompson has concluded that U.S. yield improvements since the early 1950's have been due primarily to unusually favorable and steady weather, with technology as a lesser factor. In the early 1970's, he maintains, this favorable weather situation has changed for the worse, and yields have not continued to climb upward. "I've been darn critical of USDA for not recognizing the role of weather in increased crop yields," Thompson told *Science*.

Table 1. World cereal grain production in millions of metric tons.

Year	Projected 2.4% rise	Actual
1969–71 average		1120
1972–73	1174	1151
1973–74	1202	1252
1974–75	1232	1200
1975–76	1261	1220
1976–77 preliminary	1292	1287

A more recent convert to the theory that weather is becoming more variable is James McQuigg of the Environmental Data Service of NOAA. McQuigg claims that over a 44-year period in corn-growing regions of Iowa and wheat-growing regions of Kansas, the weather during the growing season has never been normal in the sense that USDA assumes. Moreover, in seasons with close to normal weather, yields tended to be higher than average. In a paper prepared for presentation last December, McQuigg said, "Large meteorological anomalies on either side of normal tend to depress yields." And, he pointed out, as have other climatologists, that the weather in the 1950's and 1960's, which is the period on which USDA bases its forecasts, was in fact abnormally good. "Projections of future yields which are based on extrapolations of the trend of yield over the most recent one or two decades are likely to result in forecasts [that are] optimistic." McQuigg urged the abandonment of the normal weather assumption.

Science's own look at SRS's forecasts for the four leading crops (winter wheat, corn, soybeans, and sorghum) for the period from 1953 to 1975 shows that, in the recent past, the estimates tended to be optimistic. During the entire 23-year period SRS tended to be high in its forecast approximately half the time and low the other half of the time. But from 1972 through 1975 the estimates were high most of the time, often in 3 out of the 4 years. USDA spokesmen confirm that the estimates in the early 1970's have tended to be high because the weather was not as good as anticipated.

Similarly, the long-term global food forecasts, issued by USDA's Economic Research Service and based on similar assumptions that the past, normal weather will continue, have tended to be too optimistic. In a 1974 major publication,* USDA projected that, at worst, world food production would increase by 2.4 percent each year through 1985. However, according to an ERS agricultural economist the world totals instead have fluctuated but generally tended to be low (Table 1).

Alternative Models

In defense of their methods, USDA spokesmen say they see no other way of estimating future crops until weather scientists can produce reliable forecasts. However, a number of scientists dispute this. Dr. Walter Orr Roberts, formerly Director of the National Center for Atmospheric Research, who has given presentations about the worsening weather problem to the Defense Science Board, says much can be done right away. Modeling weather anomalies, and the likelihood of their occurrence or persistence, is a problem of "medium complexity," Roberts says.

"If a drought occurs in the Great Plains in July, the probability of having normal weather in August is reduced. Abnormalities, once they occur, have specific likelihoods of persisting. One could go back through the historical records of weather, which are very detailed and could be extended farther, to look at how many July droughts persisted in a particular area and how many didn't." McQuigg in connection with the LACIE satellite project is working on more sophisticated yield estimates. In addition, Reid Bryson, a University of Wisconsin climatologist who has claimed that the climate is getting cooler, is also developing a model.

This debate over weather and crop forecasting might at first blush appear to be an erudite, remote matter, were it not for the fact that millions of dollars and substantial elements of U.S. foreign policy depend on USDA's crop forecasts.

The World Food Situation and Prospects to 1985, Foreign Agricultural Economic Report No. 98, U.S. Department of Agriculture, Washington, D.C., 1974.

For example, in 1972, the USDA overestimated the likely size of the Soviet wheat crop; as a result, the United States allowed the Soviet Union, which in fact was desperately in need of imports, to buy up U.S. grain at now-notoriously low prices. Bad weather reduced the Canadian wheat crop in 1970–71 and in 1974–75, each time increasing the demand for U.S. crop surpluses. In 1974, drought reduced the U.S. winter wheat crop and record-breaking cold reduced the supply of corn and sorghum.

Since taking office as Secretary of Agriculture in 1971, Earl Butz has been characterized as following policies of minimal interference in private food trade. He therefore allowed the sale of U.S. grain stocks and has refused to consider renewed government stockpiling on the grounds that this would constitute interference in the market. Similarly, it has been charged that the USDA's steady crop forecasts minimize the confusion in commodity trading. If the government announced sudden changes, according to one official, the "pits" of the exchanges where commodities are traded daily "would go crazy." Finally, Butz's critics argue, by predicting that there will be plenty of food for all, the department sidesteps the sensitive issue of stockpiling.

There has never been any evidence that USDA's crop forecast estimates are manipulated for these political goals; on the contrary, Kirkbride and his staff go out of their way to explain that they are isolated (and literally "locked up" in the USDA basement with disconnected telephones) when the estimates are compiled. However, it is clear that the USDA system of crop forecasting produces results which are supportive of overall USDA policy goals.

If climatic variability continues, or, as some climatologists say, if a cooling trend continues, the main grain-growing regions affected will be those in Canada and the northernmost grain-growing provinces of the Soviet Union. This fact has concerned security agencies for some time; for example, it is discussed in two reports written by the CIA in 1974 and released publicly last year.† One problem which has been mentioned is whether the Soviet Union would become "more militant" in its quest for food if climatic change diminished the productivity of certain key provinces.

A related security issue is the dependence of less developed countries on North American grain surpluses. Some of the unusual weather events of the 1970's have included a 1972 delay in the onset of the monsoon in grain-growing provinces of India. In 1974, bad weather diminished Indian corn, barley, rye, and oats crops by 15 percent; wheat harvests declined 10 percent. It is obvious that accurate grain forecasts—especially as drought and famine situations develop elsewhere in the world—would help both traders and the government decide how to allocate the much sought-after American crops.

Some solution to the argument between the climatologists and USDA, and to the concerns of security agencies, is being sought in a crash, 1-year study now under way at the National Defense University by a select group of meteorologists and agricultural economists. William Gasser, on leave from the USDA to work on the project, explains that the group will first try to resolve the debates within the climatology community as to the likelihood of increased weather variability. It will try to get the scientists to assign probabilities that unusual events will occur. "The scientists have made general statements about what's going to happen to the climate," says Gasser. "But they are useless to the policy-maker unless he has a number, a probability, that the event will occur." The study will examine alternative policies the government could follow, from revising USDA crop forecast methods to revamping the sponsorship and focus of climatological research.

In the internal government debate over the future of weather and USDA's food policies, a number of scientists and scientific committees have concluded that climatology is due for a massive infusion of funds similar to that given to meteorology in the 1950's. "Climatology has been the Cinderella of meteorology," says one prominent scientist, who, like others, advocates a major new thrust, more money for graduate students, and more projects for government research contract centers.

But, in claiming that yield forecasts can be made better, the scientists have leaped into issues involving millions of dollars in trade, the privateness of private industry, and sensitive aspects of U.S. foreign policy. It would be sad, and perhaps irresponsible, if the only solution they propose is that they be given more money.—DEBORAH SHAPLEY

†The most complete of the two reports is *Potential Implications of Trends in World Population, Food Production, and Climate*. Central Intelligence Agency, Directorate of Intelligence, Office of Political Research. Document Expediting Project, Exchange and Gift Division, Library of Congress, Washington, D.C. 20540.

Swine Flu Vaccine: A Component Is Missing

The vaccines that will be used in the swine flu immunization campaign this fall will be largely ineffective in stimulating one of the body's traditional defense mechanisms against the ravages of the disease.

The clinical trials conducted last spring revealed that, while the vaccines seem relatively successful in stimulating the body's first line of defense against swine flu, they largely lack an active component that would trigger the body's second line of defense. This component has apparently been inactivated somewhere in the process of manufacturing the vaccines.

Virtually all experts agree that the vaccines would be more effective if they contained components that would activate both defense mechanisms. But there is some uncertainty as to whether the lack of the secondary component is a significant failing. Some leading scientists involved in the mass vaccination campaign told *Science* that the diminution in effectiveness of the vaccine will be relatively minor. But a few other investigators are skeptical. "What else can they say?" commented one top researcher for a company that is manufacturing the vaccine. "We've got 150 million doses of vaccine without [the secondary component]. That has to be their stand."

The ingredient that is largely ineffective is neuraminidase, one of two key proteins found on the surface of influenza viruses. These proteins are tools which enable the natural virus to pene-