have created roles for users at regional levels. As we develop our research programs, we have a fairly broad spectrum of input, not just from the researchers or the federal system, but from users. It is kind of hard to develop for you the pattern of action which reveals a conscious policy. . . ."

A fundamental impediment to the rational coordination of agricultural research is that the 53 state research systems are able to operate independently of each other as well as of the structurally similar federal system. Long agreed that "this department cannot direct any one state to do anything" but said that the states had voluntarily shifted 20 percent of their workload in the last 2 to 3 years. (He did not know to what budget or manpower category the 20 percent referred.) Should federal research be different in character from that conducted by the parallel and overlapping state system? On the completion of an inventory of such research, Long said, the department will determine just what the lines of separation should be.

Long does not seem particularly receptive to the ideas proposed by the various recent critics of the agricultural research establishment. Of criticisms by John A. Schnittker, who served as Director of Agricultural Economics and later as Under Secretary of the USDA, Long comments: "I am told that during the time he was here he never did have much time or sensitivity for research, and maybe justifiably so, I don't know." *Hard Tomatoes, Hard Times*, a study by the Agribusiness Accountability Project which argues that agricultural research benefits the large grower at the expense of the consumer and small farmers, Long dismisses with a barnyard epithet. (The study's paradigm case is how tomatoes, despite consumers' preference for softness, have been bred for hard skins so as to be harvestable by machine. Asked what research was conducted by the Irvine Company, Long's former employer, its public relations director said, "We are coming up with tomatoes with harder skins so that they can be harvested.")

Long is certainly in favor of research in general—"My biggest job is to try to bring more consciousness [about the value of research] to the people who relate to us to bring these efforts to the levels that are necessary" —even if he seems more aware of the "users' " needs than of the research

FPC's Gloomy Outlook on Gas

In a deeply pessimistic analysis of the nation's natural gas resources, a new report from the Federal Power Commission staff concludes that U.S. natural gas production peaked last year and has begun what may be an irreversible decline. The report*, prepared by the FPC's Bureau of Natural Gas, says that U.S. gas production grew at an annual rate of about 7 percent for the 25 years prior to 1970, then flattened out as the first winter shortages appeared. Now, preliminary data for 1974 show a decline in production of about 3 percent.

This decline, and a worsening shortage that has already started pinching the economy, are viewed by the FPC staff as possible symptoms that the United States literally is running out of natural gas—that "the nation may indeed be experiencing the early effects of a resource being pushed toward exhaustion."

The FPC report lends substantial credence to charges by several prominent petroleum researchers that the U.S. Geological Survey has consistently and hugely overestimated the amount of economically recoverable oil and gas left to be discovered in the United States (*Science*, 12 July 1974). According to the FPC, the Geological Survey currently estimates that between 725 trillion and 1450 trillion cubic feet of gas remain to be found and added to proved reserves in the lower 48 states. The critics have independently come up with numbers that range between one-third and one-half the Survey's lower estimate.

Chief among the challengers is M. King Hubbert, a senior researcher with the Geological Survey. Hubbert is widely known for having correctly predicted in 1962 that U.S. oil production would peak between 1966 and 1971 (in fact, it peaked in late 1970). Hubbert also predicted that gas production would peak in 1976, and it looks as if he was very nearly right again.

The FPC staff refrains from endorsing the Survey's critics but urges that the government immediately undertake an impartial study to see who is right.

In the meantime, the FPC staff notes that current gas discovery statistics make the lower numbers seem more realistic. Between 1966 and the end of 1973 successful exploratory drilling for gas rose from 24 million feet to 36 million feet. But while drilling increased, discoveries fell, with annual reserve additions going from 16 trillion cubic feet in 1966 to a paltry 4 trillion cubic feet in 1973. Thus the all-important "finding rate" for new gas fell from 662 thousand cubic feet per foot of exploratory drilling to 104 thousand cubic feet in 1973.

The shrinking discovery rate is reflected as well in figures compiled by the American Association of Petroleum Geologists. According to the AAPG, the number of "significant" new gas fields found annually fell from a peak of 99 in 1957 to 41 in 1967, the last year for which data are available. A significant field is one estimated to hold more than 6 billion cubic feet of gas, based on a 6-year history of development.

If in fact the United States is reaching down to the dregs of its natural gas resources, as these statistics seem to suggest, then, says the FPC staff, the implications for national energy policy are "drastic" and "momentous." The main implication is that government efforts designed to stimulate exploration and development "are not likely to bring about a sustained increase in reserve additions or forestall a decline" in production, currently about 22 trillion cubic feet annually.

The report nevertheless urges that development of gas resources proceed with urgency even though it may not be possible to hold production at its present level. Beyond that, national conservation and allocation programs are seen as mandatory. "The hour is late," says the FPC. "From here on we must make do with less gas, in absolute terms."—R.G.

* "A Realistic View of U.S. Natural Gas Supply," Federal Power Commission, Bureau of Natural Gas, Washington, D.C., December 1974; 21 pages.