ing our own production costs may be offset by an increase in these barriers. This is why an analysis of "private firms operating in extremely competitive industries" is not very useful for understanding global agricultural competitiveness.

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REFERENCES

1. H. Banks, *Forbes* (19 October 1987), p. 27.

Holt describes an R&D strategy to make U.S. agriculture more competitive. I agree with him that U.S. agriculture needs "much stronger programs of on-site and situation-specific agricultural research" and that with production-related research "all other agricultural research activities come to fruition." I take issue, however, with some of his other implications.

Holt states that "site- and situation-specific research and extension programs benefit producers in other nations relatively little." This assumes that other areas of the world do not have soil and climactic conditions similar to those found in the United States. He also states that "The United States should create a superior delivery system for its agricultural production technology and farm management information, so that information is used earliest and most effectively by U.S. farmers." Both of these statements imply that the United States is isolated from the rest of the world or, more dangerously, that the United States should endeavor to become isolated.

Holt makes a clear distinction between "basic" and "production-related" research. He goes so far as to state that "adaptive research has little glamour, especially compared to such fields as biotechnology." The distinction between basic and applied research is arbitrary and depends on one's perspective. In addition, all agricultural research should be "production-related." No research, at least for the majority of scientists, is glamourous, unless one considers the satisfaction of doing quality research glamorous. Holt goes on to argue for a substantial increase [$2.8 billion per year; approximately one-half the total funding for the National Institutes of Health in 1987 (*1*)] in federal and state funds for "adaptive agricultural research and related extension programs." Rather than argue the merits of "basic" versus "applied" research, perhaps agricultural researchers should take a lesson from medical research, in which both basic and applied (clinical) studies are vitally important, one depending on the quality of the other.

Quality of research is, to me, the heart of the matter. In considering a competitive strategy for agricultural research, the United States should emphasize quality in both basic and applied research, rather than emphasizing one type of research over another. To accomplish this, a portion of funds for agricultural research should be awarded on a competitive basis. The U.S. Department of Agriculture has already taken a step in this direction by expanding its Competitive Research Grants Program. Such programs need to be further expanded and include funding for both basic and applied research to ensure that U.S. agriculture will remain competitive in a global market.

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REFERENCES

1. *Fed. Am. Soc. Exp. Biol. Publ. Aff. Newsl.* **20** (No. 8), 4 (August 1987).

Holt's comments on the need for a "Competitive R&D strategy for U.S. agriculture" should be of concern to all public administrators involved in the establishment of funding priorities for research in agriculture.

Oversight committees and panels have criticized agriculture for conducting too much "site-specific" research, for inadequate emphasis on basic research, and for poor coordination among disciplines and commodity-oriented research programs, or both. Some but not all of this criticism has been justified. Conversely, basic research has had a significant role in agricultural research; and few would deny the opportunities that could be exploited through advances in biotechnology.

One cannot help but ask, however, if in our haste to meet the challenge of the future, we have overlooked the primary mission of agricultural research? The answer seems apparent when one encounters agricultural research locations where 20 to 30 scientists are working on various aspects of plant biotechnology, but where not a single agronomist is available to devote his or her efforts to the efficiency of agricultural production systems.

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Response: Basic research is essential, as pointed out by Piazza, Reynolds, and Hanson, and holds great potential for eventually improving the quantity, quality, and affordability of agricultural products. Both agricultural and nonagricultural institutions and agencies should be involved in this important activity. Basic research alone will not, however, provide U.S. farmers a competitive edge in international agricultural markets, for reasons explained in my Policy Forum.

Achieving competitive advantage is important. The United States can probably afford to buy its agricultural products from other nations, but it needs the economic activity generated by its agriculture, including production agriculture and the infrastructure it supports. Also, to conserve the world's natural resources, crop commodities should be produced on naturally productive land that is least susceptible to soil erosion and that receives ample natural rainfall. The United States possesses larger areas of such land than most of its competitors. Other things being equal, farmers producing on such land should compete well.

Piazza suggests the "USDA extension service" provides the essential site- and situation-specific information for farmers. The Cooperative Extension Service, largely supported by states and counties, relies heavily on State Agricultural Experiment Stations and the Department of Agriculture's Agricultural Research Service for the information it disseminates, which is generated by adaptive research. The extension service has many other clients besides farmers and faces many new demands, including helping rural municipalities develop economically, retraining displaced farmers, and addressing a host of agriculture-related urban concerns.

Many programs in the extension service have been cut substantially in the last 3 years (with a 17% staff cut in Illinois) because of dwindling federal support and increasing costs. The extension service cannot be expected to provide high-tech decision support for production agriculture, as Piazza suggests, without additional resources.

The U.S. loss of a share of the grain market is a real loss, not a percentage loss, as Piazza contends. U.S. exports of wheat, coarse grains (including corn), and soybeans decreased 50 million metric tons (20%) between 1984 and 1986 (*1*, p. 10). Piazza's "pleasant surprise" that overall farm income will be back to its long-run average is much less pleasant when one realizes that 40% of farmers' net cash income is being provided by subsidies in the mid-1980s, compared with about 3% in the mid-1970s (*1*, p. 15). Farmers' average debt-asset ratio increased about 50% in the same period (*2*).

Piazza worries that reduced production costs achieved by vigorous adaptive research and technology transfer programs would be offset by competitors' protectionist trade policies. A nation can keep exports out by

trade barriers, but it loses its own opportunity to export and thus becomes less competitive in world markets. Through supply and price management programs, we have tried to protect ourselves from competition and have changed from the primary supplier to the residual supplier of grain for the world. An aggressive, cost-competitive stance on the part of the United States would disable foreign subsidy programs and trade barriers. The resulting competition would improve the efficiency and quality of international agriculture, to the benefit of the world's consumers.

Piazza suggests that comparisons of U.S. agriculture with private firms facing international competition are not useful for understanding global agricultural competition. It seems to me that several general business principles established by the experience of private firms are useful in analyzing our problems and identifying appropriate strategies. For example, business people recognize that the basis of competition for commodity producers, both agricultural and nonagricultural, is the cost of production. They know that neither diversification nor vertical integration are effective competitive strategies if the additional enterprises are too small to be efficient.

It is hard to imagine a vice-president for research in a major manufacturing firm standing up at the monthly board meeting and saying, "We should stop improving our production technology because we're contributing to overcapacity in the industry." Equivalent statements are heard frequently, however, with regard to production agriculture. Business people know the difference between production and productivity. They know that a manufacturing firm cannot sustain asset values if the assets become less productive.

Business people know that average profit in a mature industry trends toward zero, which means that artificially high prices are associated with artificially high costs. When programs supporting artificially high prices are withdrawn, the artificially high costs will adjust more slowly, squeezing the industry and hastening the demise of participants with less than average (less than zero) profits. Whatever uniqueness U.S. production agriculture enjoyed as an industry is disappearing rapidly (*3*), which is probably for the best. We should view it now as a very large, very important, hi-tech manufacturing industry that can both learn from and instruct other industries.

I agree with Reynolds that we should not argue the relative merits of basic and applied research. They cannot be ranked or prioritized, anymore than one can prioritize the links in a chain. However, we definitely should distinguish between basic and applied research, not to say that one is better than the other but to recognize that they differ in important ways. They play different roles, serve different clientele, address phenomena with different scales of time and motion, require different training and experience, are supported differently, should be organized and managed differently, and need to be evaluated using different criteria.

Reynolds suggests that competitive grants should be directed to both basic and applied research. This provides a good example of why it is important to distinguish between them. The question is not whether researchers should compete for resources, but at what level the priorities for research funding should be set and allocations determined. Competition at the national level is not practical for adaptive research because of its site- and situation-specificity. If researchers from Iowa and Illinois presented proposals for similar adaptive research efforts, it would make no sense to rate one over the other, even if one were technically superior, because it is essential that the research be conducted in both environments.

Even at the regional and state levels, funds for adaptive research must be directed to programs that provide necessary information along a broad front. Allocation procedures must address economic, social, environmental, and even political concerns of locales, states, and regions, as well as scientific validity and investigator competence. Agricultural administrators in state institutions and USDA have effectively balanced these concerns, but are experiencing difficulties because of a general lack of appreciation for the nature and importance of publicly supported, applied agricultural research. Hanson shares my concern that this lack of appreciation has been translated into reduced program support at the very time when increased investment in adaptive research would yield such a high return.

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REFERENCES

1. *Outlook '87 Charts* (Economic Research Service, Department of Agriculture, Washington, DC, 1986).
2. *Agriculture Outlook* (Economic Research Service, Department of Agriculture, Washington, DC, 1987), p. 56.
3. D. Paarlberg, *Am. J. Agr. Econ.* **60**, 769 (1978).

The Federal Deficit

Back in the simpler days of World War II, a Bill Mauldin cartoon showed Army brass on a mountain road looking out on a glorious vista. The caption read, more or less, "And is there a view for the enlisted men?" Reading Robert Eisner's article "The federal deficit: How does it matter?" (25 Sept., p. 1577), I wondered, "And is there an economics for the middle class and the poor?" It is cheery to read, "we owe the debt essentially to ourselves," but in fact it is *all* of us who owe some 88% of the debt essentially to the *few* of us who hold most of the treasury bills, notes, and other negotiable government paper. As time, deficits, debts, and interest payments go on, *some* of us get richer and richer while *most* of us get poorer and poorer. Since most readers of *Science* are of the disappearing middle class, some will eventually get richer, but most will get poorer.

It is only common sense to invest one's capital in areas of high yield and to do the same with excess discretionary income. People of means will not support science unless the probable payoff exceeds that of other investments. The federal administration will only invest—enthusiastically—in projects which will enhance the image of national power. But who is empowered to be concerned with long-range planning for effective use of resources for human benefit? We evidently cannot look to government, nor can we look to the economics of wealth and power. Can we look to any science?

Presumably there should be a science of governance (not cybernetics!) and politics not dependent on a particular government or party. It should be a science for all the people.

I practice psychiatry, and most of my patients are rich. Yet I have also treated the poor, and F. Scott Fitzgerald is dead wrong: the rich are not different. They suffer from illogic and irrationality and emotional flooding just like everyone else. There is only one psychology, as there is one physics, one mathematics and, I hope, only one economics. But perhaps not yet.

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It may be presumptious for a physical scientist to argue with an economist about economic issues. However, I have to question the validity of a key assertion in Eisner's article, namely, that "federal deficits add to government liabilities that are assets—in the form of treasury bonds, notes, bills, and money—of the private sector (and of state and local governments). Paradoxical as it may seem, and contradicting the equivalence theorem, federal deficits thus make private individuals and businesses wealthier."

Surely, a government obligation does not