Letters

Genetic Vulnerability

A common misconception is implied in John Walsh's article "Genetic vulnerability down on the farm" (News and Comment, 9 Oct., p. 161). According to this belief, an increase in the size of a germplasm collection will substantially decrease genetic vulnerability for that crop. In most cases, particularly for the major crops, this is not so.

The term genetic vulnerability refers to the risk incurred when large areas are planted with the same crop variety or with varieties having the same genes or cytoplasmic factors. If conditions arise which cause the genes or cytoplasmic factors to be harmful to the variety or varieties in which they are found, production of the crop is affected, sometimes drastically, as in the case of the southern corn leaf blight. However, this vulnerability is the result of genetic uniformity in commercial fields, not in germplasm collections.

The status of wheat, of great importance both nationally and internationally, illustrates this point. A report (*1*) by the National Academy of Sciences (NAS) on genetic vulnerability shows that in 1969 there were 269 wheat varieties planted on a total of 44 million acres. Over 50 percent of this acreage was planted with just nine varieties. Therefore, genetic uniformity existed even though there were a large number of varieties available.

At the time the NAS report was written, the Department of Agriculture's wheat collection maintained at Beltsville, Maryland, consisted of 19,500 accessions. The collection now contains 36,000 accessions that have been collected from almost every country in the world. This indicates a substantial response to the needs stated in the NAS report. As sources of new genes or outstanding gene combinations become available, they will be valuable additions to the wheat germplasm collection. However, there will be diminishing returns to genetic diversity with future additions to the collection. The 85 percent increase in the collection size after 1972 most likely did not result in so large a percentage increase in diversity in farmers' fields.

It seems paradoxical that Donald N. Duvick's survey, which is mentioned in Walsh's article, showed that breeders feel elite lines have sufficient genetic diversity to provide the pest resistance required. Yet they indicate that germplasm collections, which should have much greater genetic diversity than the elite lines, are not large enough.

Substantial increases in the number of accessions is an easily stated goal, and one that could be achieved, although at a large cost when the evaluation, maintenance, and storage costs are considered. It would be unfortunate if a disproportionate share of germplasm resources are spent on this particular solution to genetic vulnerability at the expense of other, probably more important, factors, many of which the NAS report notes are economic and legislative in nature. The National Plant Germplasm System needs guidelines for regulated, cost-effective growth of germplasm collections.

WAYNE M. PORTER
DAVID H. SMITH, JR.
Small Grain Collection,
Germplasm Resources Laboratory,
Agricultural Research Service,
U.S. Department of Agriculture,
Beltsville, Maryland 20705

References

1. Committee on Genetic Vulnerability of Major Crops, *Genetic Vulnerability of Major Crops* (National Academy of Sciences, Washington, D.C., 1972).

Coal Conversion Processes

The recent article by Arthur L. Robinson regarding the American Physical Society's panel on coal technology (Research News, 25 Sept., p. 1484) was read at General Atomic with great interest. The panel's recommendations regarding physical modeling of coal conversion processes are consistent with our own experience over the last 12 years in developing fluidized-bed combustion processes.

In past years, a persistent problem with fluidized-bed coal combustors has been the utilization of fine coal and limestone (a sorbent for sulfur released from coal) that is elutriated from the fluidized bed and cleaned out of the flue gas, typically using cyclones and fabric filters. Five years ago, a group of physical scientists at General Atomic initiated a combustor modeling effort to determine the optimum method for recycling these powdery fines that contain a significant fraction of coal and limestone. A straightforward physical model was formulated, based in part on earlier work on pure carbon combustion by O. Levenspiel at Oregon State University. It was necessary to work with this model numerically using a digital computer in order to handle the wide variety of conditions that the fine particles encounter as they progress up through the fluidized-bed combustion chamber.

The model was initially applied to a pilot-scale, fluidized-bed graphite combustor, operated by General Atomic for the Department of Energy on a nuclear spent-fuel treatment program. Operating the combustor at the optimized recycling conditions determined by the model resulted in combustion efficiencies greater than 99.9 percent. This model was subsequently used by the Electric Power Research Institute (EPRI) to help determine the required fines recycling conditions for the Tennessee Valley Authority's 20-megawatt (electric) fluidized-bed coal combustor pilot plant. Recent coal combustion tests at General Atomic have shown that, in addition to increasing combustion efficiency, a 60 percent reduction in limestone addition may be realized by using high rates of fines recycling. We are now correlating these results for EPRI with a modified version of the model that is specific to sulfur capture by limestone.

Our subsidiary Pyropower Corporation has taken advantage of the greatly improved performance and economics that fines recycling has to offer and is actively marketing circulating-bed combustors in North America for a wide variety of solid fuels, including high- and low-rank coals, petroleum coke, peat, and wood waste. Using advanced European technology, augmented by the modeling techniques mentioned above, they are able to offer coal combustors meeting the most stringent U.S. emissions standards while attaining very high combustion efficiencies and low limestone sorbent requirements. This technology has been proved on industrial-scale coal boilers of up to 65 megawatts (thermal).

Because of our very positive experiences using computer-based physical models of fluidized-bed coal combustors, we strongly support the American Physical Society's recommendations for further work toward improved instrumentation and dedicated test facilities for model verification. We believe that such programs can efficiently guide process development activities into areas of further performance optimization and second-generation process definition. This is in direct support of the Reagan Administration's fossil energy developmental goals of basic studies toward future advanced coal technologies. As Robinson suggests, properly applied physical modeling can indeed help coal technology developers to "get it right the first time." It has worked for us and it can work for others.

HAROLD M. AGNEW
General Atomic Company,
Post Office Box 81608,
San Diego, California 92138

Biomass Conversion Technologies

The article by Rathin Datta and Gautam S. Dutt (14 Aug., p. 731) serves a very useful purpose in pointing out the potential to the less-developed countries of using producer gas heat engines. The reference to Stirling engines and their performance is, however, based on data applicable only to very small (less than 1 kilowatt) machines and might be misleading to the reader.

Solid biomass, such as wood chips and agricultural residues, can be used as a fuel for Stirling engines in two different ways. The first method is based on the combination of a gasifier and a Stirling engine. The second method is to burn the solid fuel without previous gasification in an enlarged combustor that forms part of the Stirling engine proper. Both ways are being pursued (*1*) in current R & D programs aiming at a near-term application in 30- to 60-kilowatt units. The indirect (gasifier-engine) method has the potential of allowing the use of a wide range of solid fuels. The direct method requires the use of a fairly well defined fuel (size, shape, moisture content) but offers the benefit of a higher overall conversion efficiency.

System conversion efficiencies of state-of-the-art 30- to 60-kilowatt Stirling engines are much higher than those indicated by Datta and Dutt for small engines. Actual measurements on liquid-fueled engines combined with component data for the auxiliaries needed in the biomass version form the basis for a predicted overall efficiency of at least 35 percent for the direct combustion method (recent measurements on liquid-fueled 50-kilowatt engines which are being developed for automotive use have verified a peak efficiency of 37 percent).

The Stirling engine has not yet been mass-produced. Recent cost analyses (*2*) have, however, concluded that large-scale production would facilitate a manufacturing cost of about $19 per kilowatt for an automotive version of the Stirling engine.

LARS G. ORTEGREN
United Stirling, Inc., 211 The Strand,
Alexandria, Virginia 22314

References and Notes

1. *Bio-Energy '80 World Congress, Proceedings* (Bio-Energy Council, Washington, D.C., 1980).
2. *Automotive Stirling Reference Engine Design Report* (NASA CR 165381, National Aeronautics and Space Administration, Washington, D.C., 1 June 1981).

Our reference to Stirling engines and their performance on biomass fuels in the villages of less-developed countries is based on small (1 to 5 kilowatts) engines. We made this quite clear in our article (p. 735). The power outputs sustainable from renewable resources in the villages of less-developed countries are small and so are their agricultural power needs. Thus, the cost and efficiency of only small engines were discussed in the article. The costs of large internal combustion engines are considerably lower than those shown in table 3 of our article. The current cost of automobile-size (50 kilowatts) internal combustion engines is $15 per kilowatt and is lower than the anticipated cost of mass-produced Stirling engines ($19 per kilowatt) quoted by Ortegren.

RATHIN DATTA
Chemical Sciences Laboratory, Exxon
Research and Engineering Company,
Post Office Box 45,
Linden, New Jersey 07036

The Right Westinghouse

In an article by Eliot Marshall on Nikola Tesla (News and Comment, 30 Oct., p. 524), it is stated that "Tesla himself showed little interest in developing these inventions for commercial application; that he left to his partner, Edward Westinghouse."

Are we rewriting history? Who is Edward Westinghouse? Surely Marshall meant George Westinghouse!

HENRY F. IVEY
Systems Planning and Technology
Assessment, Research and
Development Center,
Westinghouse Electric Corporation,
Pittsburgh, Pennsylvania 15235

George is indeed correct.—ED.