tion 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.

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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.

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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.

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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!

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George is indeed correct.—ED.