

RESPONSES TO QUESTIONS OF THE SUBCOMMITTEE ON SCIENCE, RESEARCH,
AND DEVELOPMENT BY DR. ARTHUR M. BUECHE, GENERAL ELECTRIC
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Question 1: Is the military space R. & D. on fuel cells and batteries compatible with specifications for these devices in transportation, or will special additional work be necessary?

Answer: The contribution to commercial fuel cells by space R. & D. is mainly the establishment of a technical base and a competent electrochemical development and production organization that can be re-oriented to commercial fuel cell development after completion of space R. & D. There is the possibility of using a small portion of the materials and components, but modification is almost always necessary.

The contribution to commercial fuel cells by military R. & D. is greater than that from space R. & D. since the former R. & D. is usually oriented to air instead of oxygen operation. However, military R. & D. is usually directed toward fuel cells that use logistically available fuels, which are generally very "dirty" (containing lead or large amounts of sulfur). Also, military fuel cells must operate in a water-conservative manner. As a result of this required complexity, the fuel cells developed will be too expensive to penetrate the price-sensitive, transportation industry.

Specific R. & D. funds oriented toward power systems utilizing fuel cells to meet the different and less complex requirements of the commercial transportation industry will have to be spent by private industry or the Government before any significant strides can be made for commercial transportation. A substantial service test program similar to the military and space programs will be necessary to prove applicability to commercial vehicular systems.

(For additional information, please note the following article, "Fuel Cells and Fuel Batteries. An Engineering View.")

FUEL CELLS AND FUEL BATTERIES—AN ENGINEERING VIEW

(By H. A. Liebhafsky, General Electric Research and Development Center, Schenectady, N.Y.)

This is a welcome opportunity to attempt a paper on fuel cells primarily for electrical and electronic engineers, who may some day be joined by a new kind of engineer—the *electrochemical engineer*—if fuel batteries attain their expected usefulness. The kind of problems the new engineer will have to face are implicit in the questions and answers below.

WHAT IS A FUEL CELL? A FUEL BATTERY?

Fuel in its classic sense ought to be the key word in these definitions. Fuel cells and fuel batteries ought to react *conventional* fuels by which we mean the fossil fuels and substances readily derived therefrom) electrochemically with oxygen, preferably from air. A fuel cell thus is an electrochemical cell in which energy from such a reaction is converted directly and usefully into low-voltage direct-current electrical energy. Fuel cells electrically connected (in series, parallel, or series-parallel) make fuel batteries. The most common type of fuel cell is shown in Figure 1.