

AMERICAN ASSOCIATION FOR
THE ADVANCEMENT OF SCIENCE

Science serves its readers as a forum for the presentation and discussion of important issues related to the advancement of science, including the presentation of minority or conflicting points of view, rather than by publishing only material on which a consensus has been reached. Accordingly, all articles published in *Science*—including editorials, news and comment, and book reviews—are signed and reflect the individual views of the authors and not official points of view adopted by the AAAS or the institutions with which the authors are affiliated.

Editorial Board

ROBERT L. BOWMAN	WILLARD F. LIBBY
MELVIN CALVIN	GORDON J. F. MACDONALD
JOSEPH W. CHAMBERLAIN	EVERETT I. MENDELSON
FARRINGTON DANIELS	NEAL E. MILLER
JOHN T. EDSALL	JOHN R. PIERCE
DAVID R. GODDARD	COLIN S. PITTEENDRIGH
EMIL HAURY	KENNETH S. PITZER
ALEXANDER HOLLAENDER	ALEXANDER RICH
ROBERT JASTROW	DEWITT STETTEN, JR.
EDWIN M. LERNER, II	EDWARD L. TATUM
	CLARENCE M. ZENER

Editorial Staff

Editor

PHILIP H. ABELSON

Publisher

DAEL WOLFLE

Business Manager

HANS NUSSBAUM

Managing Editor: ROBERT V. ORMES

Assistant Editors: ELLEN E. MURPHY, JOHN E. RINGLE

Assistant to the Editor: NANCY TEIMOURIAN

News and Comment: DANIEL S. GREENBERG, JOHN WALSH, ELINOR LANGER, LUTHER J. CARTER, MARION ZEIGER, JANE AYRES

Europe: VICTOR K. McELHENY, Flat 3, 18 Kensington Court Place, London, W.8, England (Western 5360)

Book Reviews: SARAH S. DEES

Editorial Assistants: ISABELLA BOULDIN, ELEANORE BUTZ, BEN CARLIN, SYLVIA EBERHART, GRAYCE FINGER, NANCY HAMILTON, OLIVER HEATWOLE, ANNE HOLDSWORTH, ELLEN KOLANSKY, KATHERINE LIVINGSTON

Advertising Staff

Director

EARL J. SCHERAGO

Production Manager

RAYMONDE SALAMA

Sales: New York, N.Y., 11 W. 42 St. (212-PE-6-1858): RICHARD L. CHARLES, ROBERT S. BUGBEE

Scotch Plains, N.J., 12 Unami Lane (201-889-4873): C. RICHARD CALLIS

Chicago, Ill., 6 W. Ontario St. (312-DE-7-4973): HERBERT BURKLUND

Los Angeles 45, Calif., 8255 Beverly Blvd. (213-653-9817): WINN NANCE

EDITORIAL CORRESPONDENCE: 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Phone: 202-387-7171. Cable: Advancesci. Washington. Copies of "Instructions for Contributors" can be obtained from the editorial office. ADVERTISING CORRESPONDENCE: Rm. 1740, 11 W. 42 St., New York, N.Y. 10036. Phone: 212-PE 6-1858.

Barriers to Innovation

Two acts recently passed by Congress and two radical proposals for improving transportation, when considered together, illustrate some of the difficulties of introducing major technological changes into the civilian sphere. The congressional actions are the Technical Services Act (*Science*, 24 September, p. 1485), which will aid colleges and technical schools to serve as centers for economic planning and industrial innovation in their areas, and the High-Speed Ground Transportation Bill, which is intended to stimulate research and to aid in the development of faster transportation along the high-density Boston-Washington axis.

One of the transportation proposals was made by Barnes Wallis, chief of the department of aeronautical research and development of the British Aircraft Corporation, in his presidential address last month before the engineering section of the British Association for the Advancement of Science. Wallis reminded his audience that a deeply submerged submarine requires less power than does a surface vessel of equal displacement, and went on to encourage Great Britain to take advantage of her position athwart the major transportation routes of the world by developing a fleet of submarines that could travel free of weather disturbances and that could use the shorter Arctic Ocean route to Pacific Ocean ports as well as conventional routes elsewhere. Submarine freighters could be navigated by very small crews, and perhaps with no crew at all except while surfaced to leave and enter ports.

The other transportation proposal was made by L. K. Edwards of the Lockheed Missiles and Space Company, who argues persuasively in the August *Scientific American* that an evacuated tunnel carrying tube trains would be the best way to handle passenger traffic along the Boston-New York-Washington route.

Whether these bold schemes would work as well as their proponents hope is a question that may never be answered. In new and undeveloped areas such as space exploration, only cost, ingenuity, and technological feasibility place limits on innovation. But innovation in civilian industry encounters a number of other barriers. Both of these proposals would be costly. If successful, they would threaten existing transportation systems. Legal amortization rates may require long usage of existing equipment. Regulatory agencies and policies are organized around established transportation methods rather than around the primary function of transporting goods and people by whatever means appear most satisfactory under given circumstances. Labor union rules and jurisdictional disputes may hamper change. Institutional rigidities and the vested interests of existing arrangements seem to become stronger as the costs of major changes increase. Any or all of these factors may make it impossible to find out whether the technological difficulties could be overcome in an economic and satisfactory fashion.

There are, however, some hopeful signs. The legislative history of the High-Speed Ground Transportation Bill gives promise that, although the initial efforts will be devoted to conventional trains, later work will examine the feasibility of developing trains which will run on air cushions or in pneumatic tubes. And the Department of Commerce has undertaken a study of the relations between industrial research, development, and innovation and the complex web of regulatory, antitrust, and tax policies that can sometimes make innovation difficult or uneconomic. Such studies are greatly to be encouraged. The lack of bold new ideas is not the only barrier to major technological development; it is time for a hard look at the others: government regulations, tax policies, labor union policies, and certain forms of industrial organization, any or all of which may prevent the adoption or even the fair trial of attractive but costly new ideas.—DAEL WOLFLE