"We have been measuring the wind velocity for seven years. We should know how fast the wind will blow."

Thomas considered himself to be the principal judge of the NSF budget and, in 1963, was disturbed to find that the White House science office, under Jerome Wiesner, was playing a larger role in developing the budget. Said Thomas, of Wiesner:

"I thought I saw his fine hand in at least two important aspects of this budget."

Thomas relentlessly badgered NSF to spread its funds throughout the country. Cal Tech was his bête noire *on the subject of equitable distribution, and his references to its seeming affluence were frequent. At the 1963 hearings, he remarked*:

"The more we spend for national defense, the more Cal Tech gets." And in reference to Lee DuBridge, president of Cal Tech: "He had about $30 million in 1962. No telling what it will be in 1964. You can tell the doctor to go to other fields. He has already conquered this one."

When an NSF official said, "I simply don't know how to answer" the demand for broader geographical distribution of fellowships, Thomas replied:

"We will answer it for you"—which he did, by specifying that no more than 10 percent may go to residents of any one state.

NSF's friends regularly complained that Thomas was unduly restricting its budgetary growth. But in the course of 15 years the Foundation went from an annual budget of $225,000 to over half a billion dollars—a spectacular rate of growth. Thomas did not provide sympathy or pressure for expansion, but for this country's first venture into government support of science for the sake of science, he may well have been the most suitable political overlord.—D.S.G.

Northeast Corridor: Transport Project Gains Headway

The Northeast Corridor Project, gaining fresh momentum as the result of favorable attention from Congress last year, is an unprecedented venture in comprehensive transportation planning on a regional scale. Conducted by the U.S. Department of Commerce, the project is an ambitious and exciting undertaking by an agency better known for its solid bourgeois virtues than for its glamor.

If all goes well, the project will foster new technologies such as automated highways and trains capable of speeds up to 300 miles per hour or more. It could lead also to the first overall regional transportation system carefully planned, perhaps by an intergovernmental agency, to encourage patterns of economic activity and population distribution deemed socially desirable.

Although a wealthy region, the Northeast is faced with pressing transportation problems and an urgent need to improve the lot of its less favored inhabitants, particularly those of the explosive Negro ghettos. Stretching along the east coast from Maine to Virginia, the corridor is the nation's most striking example of the way in which urbanization can produce a megalopolis. Frequent highway traffic tie-ups and increasing congestion at air terminals already portend a troubled future for the Northeast megalopolis unless a more efficient transportation system is developed for the region.

Senator Claiborne Pell of Rhode Island, the chief congressional proponent of a high-speed ground transport (HSGT) system for the corridor, noted recently that, on the Sunday following last Thanksgiving, 217,783 cars tried to use the New Jersey Turnpike, causing traffic jams 10 miles long. There is comparable, and in some respects more serious, congestion in the air above the corridor. As Pell recalled, 5 years ago two airliners collided over Staten Island at a cost of 132 lives; a collision last December caused one of the airliners involved to make a fiery crash landing in which four people died.

In addition to having clogged roads and crowded airways, the Northeast's present transportation "system," according to a study conducted for the Department of Commerce by M.I.T., generally reinforces the familiar residential and job-location pattern. Higher-income groups live more or less comfortably in the suburbs and go daily to well-paying jobs in the city, while low-income slum dwellers, often too poor to own a car, have difficulty reaching good blue-collar jobs in suburbia and, in many cases, must accept less desirable jobs in the city. The suburban jobs, though becoming increasingly plentiful, are widely scattered and not easily reached by public transportation, even if the city worker hears of them, and often he does not.

Conscious of the close relationship between transportation networks and economic and residential patterns, the Commerce Department is conducting some studies, and contracting for others, in which engineers collaborate to varying degrees with economists, sociologists, planning specialists, and other social scientists.

For example, the M.I.T. study, though essentially a survey of the technology for HSGT systems, was a step toward an interdisciplinary approach. The project "task force" was directed by William W. Seifert, assistant dean of the M.I.T. School of Engineering, and Robert J. Hansen, professor of civil engineering. Most members of the task force were engineers, but several were political scientists or city planners, and an economist was a project contributor. The principal coordinating device was a steering committee on which the various disciplines were represented. Robert C. Wood, formerly chairman of the political science program at M.I.T. and now undersecretary of the U.S. Department of Housing and Urban Development, was the senior social scientist participating.

The M.I.T. study, commissioned in September 1964, was completed last October, and the results were made public in December. The task force recommended careful consideration of the indirect impact any HSGT system is certain to have on the Northeast. A system designed to permit easy circulation throughout metropolitan areas, for instance, could encourage Negroes and other low-income people living in down-

Senator Clairborne Pell

town slums to take advantage of the better jobs and housing outside the central city.

Moreover, the study group observed that more middle-class people might be encouraged to take up residence within the cities or their older suburbs, giving these areas a better racial and economic balance and arresting the decline in taxable values, municipal services, and the overall quality of local government.

At the same time, an HSGT system with a network of main-line and feeder stations designed to promote a more rational pattern of growth for the suburbs might help discourage haphazard development practices that mar the natural landscape, make efficient public services difficult, and create other problems, such as poor drainage and stream pollution.

Such suggestions are likely to meet with the objection that government—Big Brother—has enough influence over people's lives without adopting comprehensive transportation planning as an instrument for reshaping society. However, even a transportation network that develops haphazardly, as most have done, exerts a powerful influence on people's job opportunities and living habits. Indeed, the philosophic objection to comprehensive planning may be less relevant than questions one might raise as to the efficacy of such planning as a means of redistributing activity in predictable ways.

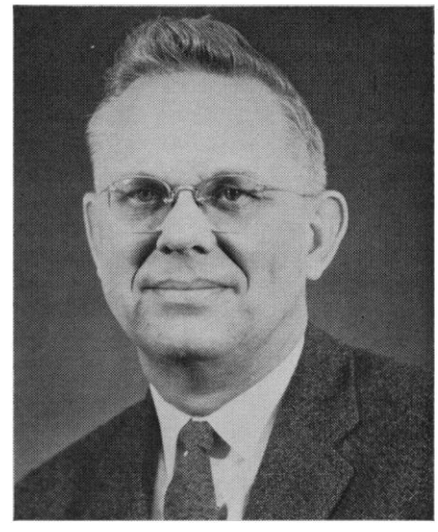
A step toward easing the Northeast Corridor's transportation problem—and those social and economic problems affected by transportation—may have been taken last 30 September. On that day President Johnson signed the HSGT Act, which authorized a 3-year, $90-million program of research, development, and demonstrations. Although its purpose is to develop systems concepts applicable nationwide, the program will, for the most part, focus on the Northeast Corridor, in the expectation that many of the lessons learned there will be useful in meeting the needs of other regions. (The program's "HSGT" label is somewhat misleading inasmuch as, in investigating possibilities for a regional transport system, air and highway travel modes are being considered as well as ground transport with special guideways, such as rails or tubes.)

An $18-million demonstration program will seek to determine whether existing rail service between Boston and Providence and between New York and Washington will attract significantly more passengers if the trains are faster (with speeds of 125 miles per hour or better), more comfortable, and equipped with snack bars, television, and other amenities.

However, the really far-reaching part of the HSGT program will be the search for entirely new transport systems. Research on the possibility of developing new systems began in a small way some time ago under the Commerce Department's regular program of transportation research, which is supporting some of the investigations related to HSGT. The genesis of HSGT goes back to December 1962 when the late President Kennedy, at Senator Pell's urging, asked Commerce to begin studies on the Northeast Corridor transportation complex.

Since then, a number of contract studies have been undertaken, including the M.I.T. survey of HSGT technology, an M.I.T. study of short-haul air transportation, and a study by Cornell Aeronautical Laboratory, Inc., Buffalo, of the technology applicable to the Northeast Corridor's future highway system. These, as well as many other engineering studies now under way or to come, will serve as "inputs" for analyses of various alternative transportation systems. The systems will be analyzed in terms of their response to, and effect on, demand (for movement of freight as well as of passengers) and their impact on regional economic activity and population distribution.

The Commerce Department's HSGT and Northeast Corridor Project staff, which is responsible for the study program, is directed by Robert A. Nelson, an economist who was formerly professor of transportation at the University of Washington. Nelson hopes that by the summer of 1968 (though it is likely to be later) his office will be ready to submit to the Secretary of Commerce a report describing from six to a dozen possible transportation systems for the corridor. Each system will consist of a combination of transport modes.



Robert A. Nelson

According to Nelson, one possibility might be a system depending heavily on VSTOL aircraft (aircraft capable of *v*ertical or *s*hort *t*ake-*o*ff and *l*anding) and automated highways, perhaps with speed, spacing, and handling of cars all controlled automatically. Some short-haul rail transit might be part of such a system.

Another possibility might be a greatly improved railroad operating primarily between downtown terminals, together with a somewhat improved highway system and an air transport system similar to what now exists except perhaps for the introduction of giant "bus" type aircraft each capable of carrying 700 or more passengers.

A third possibility might be a transport combination in which the key element would be an "air-bearing" HSGT system. The vehicles would be borne on a thin layer of air along controlling guideways, perhaps consisting of a "porous" or partly open tube.

"We will describe the alternative systems in terms of their operating and cost characteristics," said Nelson, in an interview last week with *Science*. "We will indicate the extent to which each of these configurations meets the demand for transportation. Further, we will look at how they would affect population distribution, economic growth and location, income, land use, safety,

air pollution, and social and political structures."

Assisting in this extraordinarily complex analytical task are Edward J. Ward, Nelson's assistant director for engineering, and Henry W. Bruck, assistant director for transportation systems planning. Ward, with a current budget of about $8.5 million, is managing the research and development for the HSGT systems and the systems engineering for other transport modes that might be used in the Northeast Corridor.

The systems engineering, for which the first contracts will be placed this spring, is expected to provide estimates of the performance and cost of advanced systems which could be developed by the 1980's. Universities, industrial firms (such as aerospace companies and transportation suppliers), and research institutes will be solicited to do this work.

According to Ward, the systems engineering will be performed by interdisciplinary teams, which will include social scientists. Moreover, Commerce will provide the contractors with such guidelines as route structures based on forecasts of demand, economic activity, and population growth and distribution.

Contracts thus far awarded for research and development on HSGT systems have been placed with M.I.T. and Rensselear Polytechnic Institute. Rensselear is investigating a tube vehicle and will construct a model test facility. M.I.T. is studying a broad range of subjects, including questions of rock fracture and soil mechanics involved in tunneling, the air dynamics of vehicles in tunnels, air flow in tunnels, stresses in bodies in rolling contact, headway control, and scheduling.

These efforts to develop the technology for HSGT systems will have to continue at least several more years before it will be possible to build an operational system, always provided the Johnson administration, Congress, and the Northeast states decide that such a system should be built. The process of deciding what to build, who should build it, and under whose authority it should be operated may require as much time as the technical problems, if not more.

Bruck, who describes himself as a hybrid social scientist who has done work in sociology, political science, and economics, will take the systems engineering studies which Ward provides and use them in preparing various transport-system alternatives. These alternatives will be used in simulation model and cost-benefit studies.

Bruck describes his research concept as a "grand circularity." Beginning with the Northeast as it is, these studies forecast regional conditions and transportation demand for an incremental period of, say, 5 years. Various alternative transport systems are played against the demand, then the system's impact on movement and activities within the region is analyzed. The impact analysis, in turn, is used to restructure the demand.

Bruck expects to spend, during a 4-year period, about $6 million on contracts and "in-house" studies for the Northeast Corridor Project. Passenger demand studies are being made by Mathematica, Inc., Princeton, New Jersey. The two principal investigators are William Baumol and Richard Quandt, Princeton economists.

Consad Research Corporation of Pittsburgh is making the impact studies. Consad's president, Wilbur Steger, an economist, will lead the investigation. The simulation model for the corridor project is being developed within the Commerce Department, by the National Bureau of Standards.

Another approach to designing a regional transport system is to start, not with the Northeast as it is, but with a conception of it as one might desire it to be in the 1980's. Then the system is designed so as to contribute to regional development along the lines desired. According to Bruck, mathematical techniques for developing a simulation procedure for this kind of study are being investigated, but it will be at least 10 years before a model can be built.

Nelson is wary about prejudging the public's desires, though the corridor project must be based in part on such prejudgments. But he believes that, in undertaking transport system studies, the difference between starting with the region as it is and starting with it as one wants it to be is more illusory than real. However the study is performed, assumptions must be made as to how the public will react to changes in technology. "You may wind up with as extensive a set of assumptions about public tastes with one approach as you do with the other," Nelson said.

Bruck is also skeptical enough not to treat any of the corridor project's research methods as an article of faith. He suspects, for example, that many "interdisciplinary" studies are made with the representatives of the various disciplines working more or less in isolation from one another. Civil engineers and social scientists have long since removed the wall that stood between them, Bruck believes, but, in his view, a wall still stands between the social scientists and engineers in some other categories, such as electrical, chemical, and mechanical engineers. "I think collaboration between the engineers and the social scientists will develop," he said. "But what we are doing and what M.I.T. is doing is just a baby's step." (Bruck's view would be disputed by some, perhaps many, faculty members at M.I.T., at least as applied to the institute. Interdisciplinary graduate course work on transportation problems has been praised by several M.I.T. faculty members as well-integrated research of high quality.)

Bruck also views with skepticism such suggestions as the one in the M.I.T. study that a regional transport system, coordinated with other public programs, could be used as a weapon against racial segregation. "Transportation has a tremendous effect on location and activity, but it's a gross effect," he said. "An intercity system is not an appropriate device for doing something about segregation. It's like using a meat axe to take out an appendix."

However the transport system proposed for the Northeast is viewed—whether as a panacea for regional social ills or simply as a better way to get where one is going—the ultimate decision on building the system will be made by the politicians. This fact opens up an abundance of questions which Nelson and his associates will be studying along with the problems of system design.

A central question is, How would the corridor system be owned and operated? Various ideas are being considered. Something akin to the Communications Satellite Corporation, a once-controversial device designed to merge and harmonize public and commercial interests, is one possibility. An interstate compact, or even something like the Appalachian Regional Commission, in which both the states (collectively) and the federal government hold the power of veto, is another idea.

In any event, the Northeast Corridor Project seems, for the moment, to have a good head of steam. If it can keep its boilers fired and mount the grades ahead, the corridor project could become a legend in the annals of technological advance and in imaginative planning on a regional scale.

—LUTHER J. CARTER