Giving spin to technology spin-offs

A basic assumption in the budgets of Government R&D laboratories is that transfer of the technologies they produce—"spin-offs"—take care of themselves. Now a report from the National Academy of Engineering challenges that assumption.

Radar, jet aircraft and antibiotics were all largely developed through narrowly funded, mission-oriented Government projects and certainly had no trouble reaching commercial markets. But these are notable exceptions, not the rule, concludes the NAE Committee on Technology Transfer and Utilization. In most cases, the report states. adaptive engineering and marketing research are required before a new discovery can benefit the public, and with the financial risks of this sort of technology "brokerage" becoming steeper, the transfer is not going smoothly.

In general terms, the difficulties have been recognized for some time. The National Science Foundation has been actively seeking new ways to facilitate technology transfer through its Experimental Research and Development Program, and the NAE conducted the present survey at NSF's request. The problem is urgent: At stake is America's commercial competitive position in economic growth, industrial productivity, employment gains and foreign trade.

Part of the remarkable recent advancement of several industrial countries, especially Japan and Germany, has come through active participation of their governments in helping their private industry adapt new technologies to commercial products, in order to better compete in world markets. This action has placed a new strain on American commerce, already facing a growing balance-of-trade deficit, for while the United States Government spent some $17 billion on R&D last year and $1 billion on publication and dissemination of technological information, only $43 million was spent on helping industry transform and utilize the developed technology to make new products.

"Technology in the form developed by mission-oriented Federal laboratories is almost never quite right for transfer into the marketplace," the report concludes. The committee cites a study conducted by Arthur D. Little, Inc. and Industrial Research Institute, Inc. showing that the largest single impediment to the transfer of inventions and ideas is marketing risk.

To help overcome the apparent lack of communication between Federal technology developers and potential commercial users, the NAE study recommends budgeting $1 billion specifically for technology transfer. The proper role of the Federal Government, the report says, includes seeking out and calling together potential users of new technology, offering them financial support for adaptive engineering, while sponsoring studies of probable markets and the cost-benefit ratio of transfer.

To provide specific incentives, the committee recommends that exclusive licenses for Government patents be granted to private companies willing to risk their development. It also suggests giving technical assistance during the start-up phase of operation. And, of course, there is the hallowed tradition of Government pump-priming—christened "imaginatively bold financing to users" in the report's recommendations.

The NAE committee accepts the assumption that plenty of new technology of potential commercial benefit exists in the industry reports of Government labs, but cautions that this assumption should be checked occasionally.

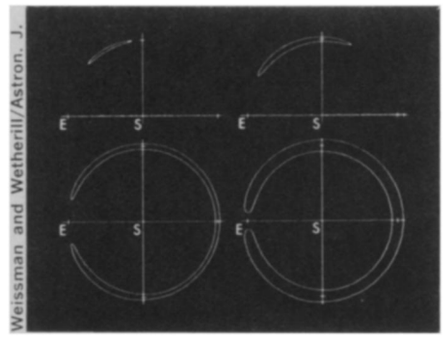
Most of all, the report presents an attitude that the U.S. Government can no longer maintain its passive role in technology transfer—screening, indexing and storing information in hopes that potential users will find it. Rather, a whole new "environment for fostering effective secondary utilization" of technology is needed, including explicit programs within Federal agencies, financed by line items in agency budgets and manned by specially appointed new Civil Service personnel. □

Loop-de-loop in the solar system

When the total gravitational field is calculated for a two-body system in which one body orbits the other in an ellipse, there appear several equilibrium points, locations where the contributions of the two bodies to the gravitational field exactly cancel each other out so that there is no net force there. These are called Lagrangian points. The two most stable such points, called L_4 and L_5, are located on the orbit and precede and follow the orbiting body by 60 degrees.

Theoretically matter put at the Lagrangian points should stay there. If matter comes into the system slightly off one of the points, it may be captured into a librating orbit, one that involves a kind of back-and-forth motion around the Lagrangian point. Such motions are certainly observed in the sun-Jupiter system, and a new calculation by Paul R. Weissman and G. W. Wetherill of the University of California at Los Angeles, presented in the latest ASTRONOMICAL JOURNAL, shows that they are possible for the earth-sun system also.

Consideration of the problem goes back to the early part of the century. In 1911 E. W. Brown predicted that large-amplitude orbits around Lagrangian points were possible. They would be tadpole-shaped if they went around one equilibrium point and horseshoe-shaped if they encompassed both points. The question was whether such orbits could be stable. No sun-planet system exists in isolation. The total system has nine planets and numerous satellites and minor planets. Each two-body system suffers perturbations from the gravitational pulls of the other bodies, and these perturbations might render librating orbits unstable.



Weissman and Wetherill/Astron. J.

Tadpole- and horseshoe-shaped orbits in coordinate systems rotating with earth. "S" is the sun, "E" the earth.

E. K. Rabe studied the sun-Jupiter system during the 1960's. There stable orbits are both theoretically and observationally manifest. Fifteen of the so-called Trojan asteroids have been found to exist in librating orbits. Weissman's and Wetherill's calculation for the earth-sun system now shows that theoretically stable tadpole orbits can exist from the infinitesimal one (virtually sitting on the equilibrium point) with an aphelion at one astronomical unit (one a.u. is the mean sun-earth distance) to 1.00285 a.u. Horseshoes can range from 1.0029 to 1.0080 a.u.

Whether there is anything in those orbits depends on whether there is material floating around in the inner solar system to be captured. If there is any captured material, its discovery depends on how big it is and how well it reflects light. Stable libration orbits have been predicted for Saturn, but nothing has yet been found in them. Nor have any ever been found for Mars. Nevertheless Weissman and Wetherill have initiated a photographic search for objects in the libration orbits of the earth-sun system. They expect that objects as small as two kilometers in diameter could be detected with the 48-inch Schmidt camera at Mt. Palomar Observatory. □