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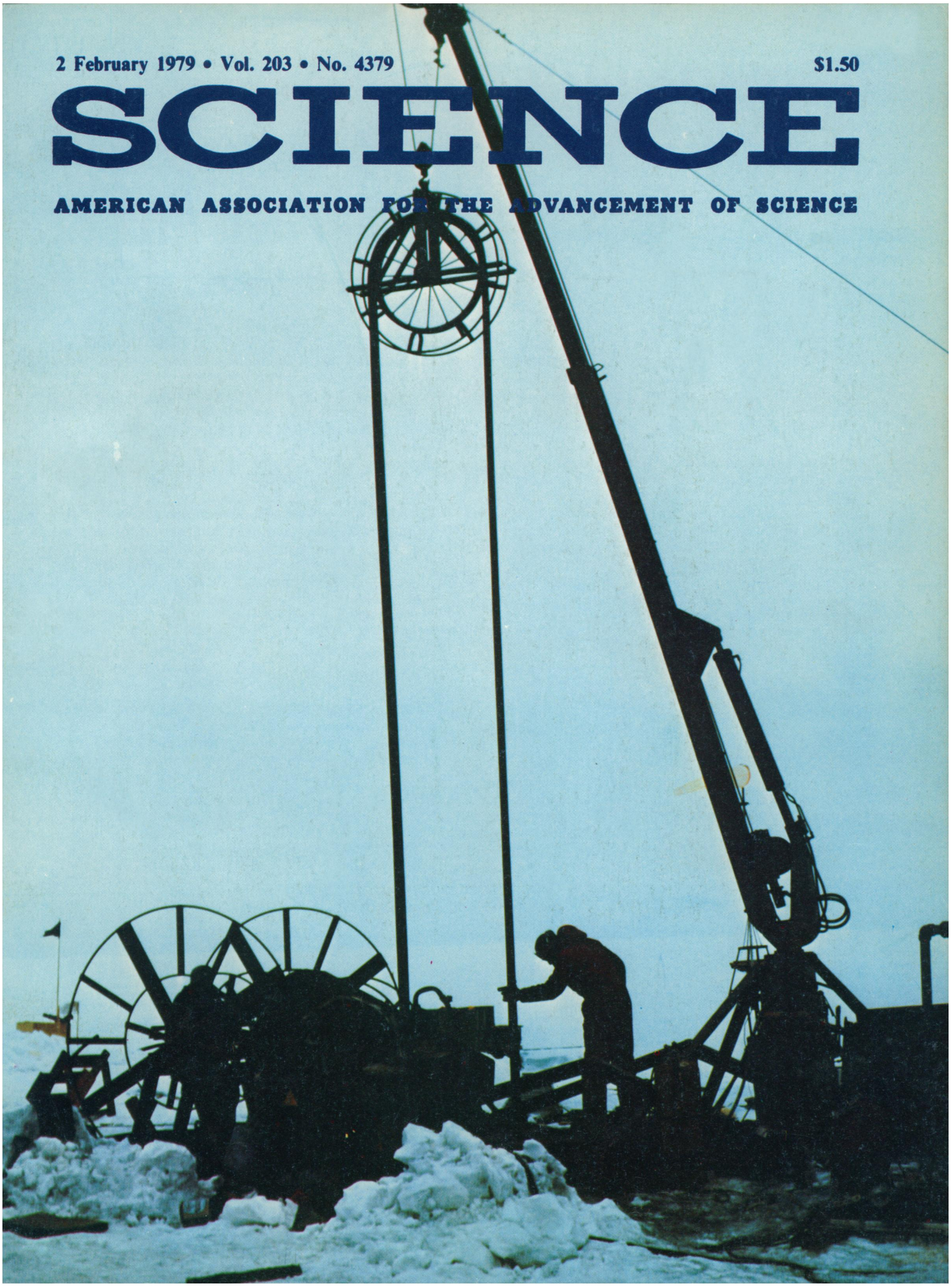

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COVER

Equipment being lowered through the 30-inch diameter access hole in the Ross Ice Shelf, Antarctica. Water, fuel, and air hoses that supply the jet flame for melting the ice are lowered into the hole over a pulley with the aid of a bulldozer. See page 449. [James A. Raymond, State of Alaska Department of Fish and Game, Fairbanks]

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The yield: 3,000 pounds of pure gold.

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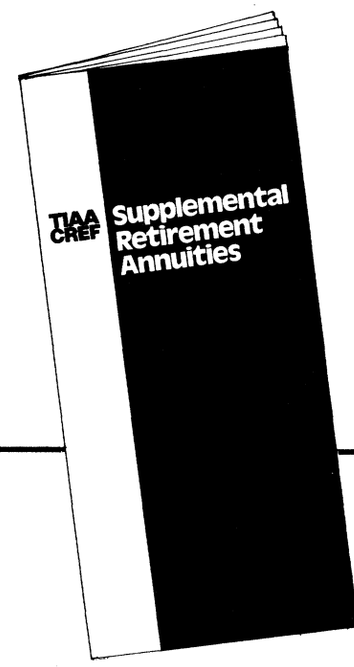

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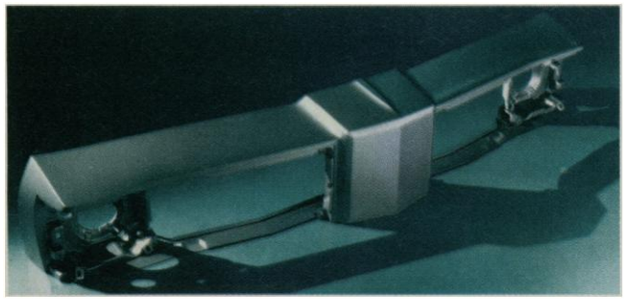
SMC, or sheet molding compound, is a stiff, lightweight plastic composite consisting of resin, powdered filler, and randomly oriented chopped fibers. With the continuing trend toward lighter automotive materials, SMC is becoming a promising replacement for steel.



But can this plastic compete with metal? In light duty it can. In fact, thanks to redesigning, some SMC parts outrival their steel counterparts.

However, for structural application where stiffness is paramount, redesigning the part may not be enough. That's why engineers here at the General Motors Research Laboratories addressed the problem of "redesigning" the material, too.

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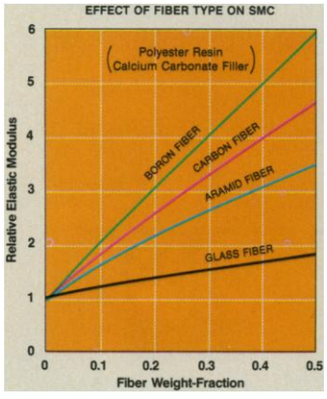

This unique analytical tool has two potent capabilities. It enables designers to determine an SMC composition that meets structural and cost goals — in other words, to tailor the material to the need. And it aids our engineers in exploring the cost-effectiveness of lighter, stiffer components such as glass microsphere fillers and carbon fibers.

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Concerning the Technology Base

With an aggregate national outlay for scientific research and development of almost $50 billion in current (inflated) dollars, it might seem that we are renewing and augmenting the knowledge base on which future problem-solving and technical innovation will draw. Such may be the case, but it is not clear that anyone really knows. Even more troubling is the lack of a workable process for estimating the current state of the U.S. technology base.

The patent system might seem to provide a proximate representation of the advancement of practical knowledge, but it falls short. Attempts to tally and categorize innovations can tell us something about the climates of risk-taking and new product development, but very little else. At the basic research end of the spectrum, published papers furnish a wealth of clues to the directions of science, but we rely on consensus peer evaluations to judge the degree of vitality or inertia from discipline to discipline.

The pluralism of the American research, development, and innovation enterprise also obscures our line of sight. With the bulk of federally financed R & D being contracted out to private industry, disclosures of advances in background knowledge are limited. Independent R & D, performed by contract organizations with government approval and cost-sharing, may be the liveliest source for improvement of the technology base, but the results tend to be closely held. In the competitive industrial sector, which puts up half of all the money spent on R & D, proprietary constraints of necessity serve to shield the most important evidence as to what is being contributed to the technology base.

What it comes to is that we are in the dark about the facts needed to reach any kind of judgment about the technology base. It might not matter, except that the technology base counts for a great deal in terms of national security, competitiveness in trade, and expectations for economic growth. It could make a big difference if the base were found to be softening over time, rather than firming up. If, for instance, the prevailing consensus that something has gone wrong with U.S. technological innovation also hints at the watering down of the technology base, policy-makers would face very serious questions with long-run consequences. But as matters stand now, it is doubtful that we have anything like a handle on the facts.

The task of assessing the nation's total technology base looks unmanageable, for some of the reasons already mentioned. It is afflicted with all of the conceptual and institutional hazards and estimating dilemmas that have dogged the evolution of science indicators, plus some others. Even so, there are cogent reasons for tackling it, and large risks in taking the technology base for granted. We are not ready for a presidential review memorandum on the state of the technology base, in the absence of an analytic framework. But it is not too much to propose that the Office of Science and Technology Policy, perhaps in cooperation with the Industrial Research Institute, the congressional Office of Technology Assessment, and the General Accounting Office, take a serious look at methods for estimating strengths and weaknesses in the technology base. If it can be done, it could provide another valuable window for the purpose of R & D investment planning and, eventually, for targeting a family of incentives to innovation.

Science and technology policy, as it is practiced here, is still a consensus mix of historical forces laced with political interventions. Despite its implicit limitations, it gets the job done. But it stands on unsteady legs insofar as solid information and qualitative analysis are concerned. To this extent it runs on momentum and incrementalism, and they are not enough.

—WILLIAM D. CAREY