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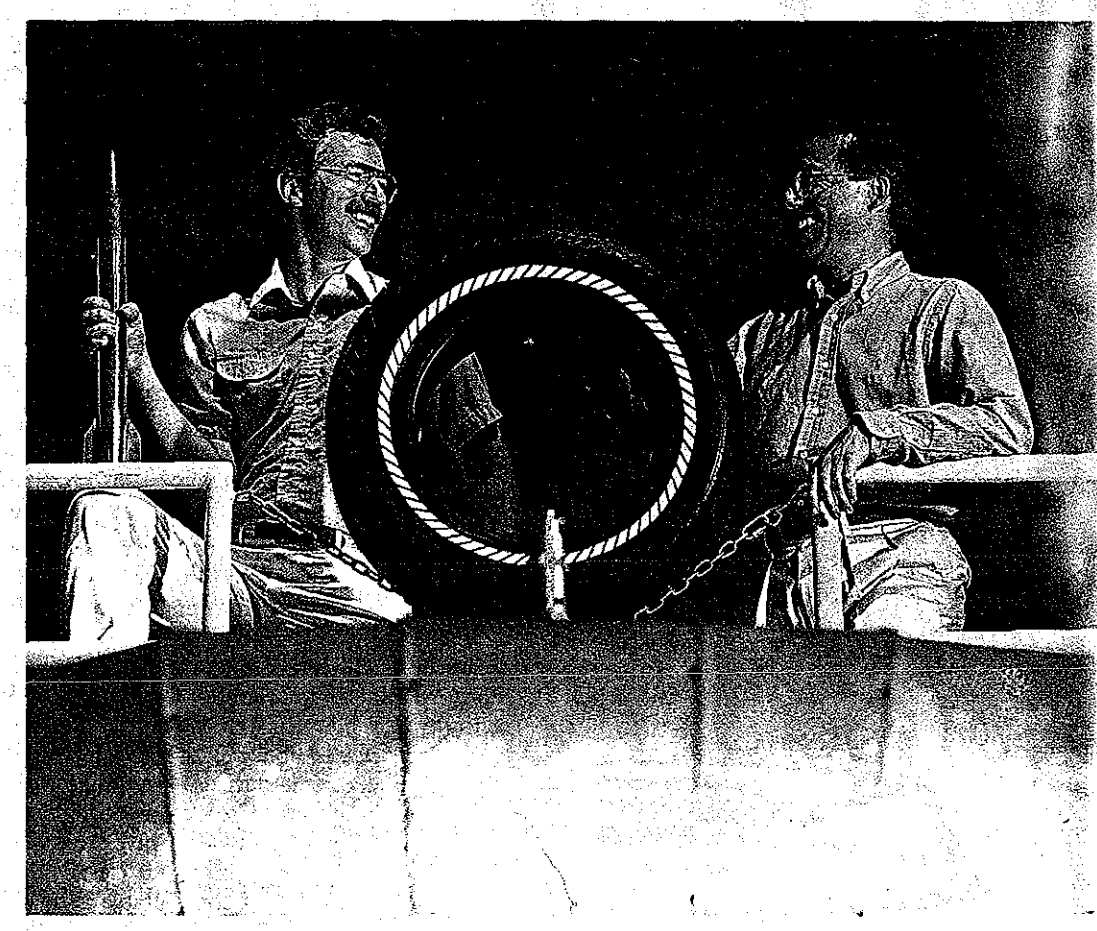
by Gene Bylinsky

WILL OUTSOURCING SAVE CORPORATE R&D?

In this era when research budgets are going through the wringer, reaching outside the company for R&D help can give a crucial lift to productivity.

RESEARCH BUDGETS may be shrinking at many companies and scientists may be feeling insecure, but the duo pictured at right have good reason to grin. They've taken technologies once used for aiming U.S. nuclear weapons and for listening for Soviet submarines and harnessed them to a purpose every civilian can relate to: reducing the tendency of tires to hydroplane on a slick roadway and throw your car out of control. On the left (holding a model of a B-61 hydrogen bomb symbolic of his work until recently) is Robert Benner, 39, a chemical engineer and self-styled computer jock at Sandia National Laboratories in Albuquerque. On the right is John Blinka, 43, a Ph.D. in theoretical and applied mechanics at Goodyear Tire & Rubber in Akron. Blinka is one of more than two dozen Goodyear scientists and engineers who work with experts at Sandia.

Reaching beyond company walls for scientific talent and high-tech facilities—in universities and private institutes as well as in government labs—is the hot new trend in corporate R&D. "Today, bringing in a product that rings the cash register requires a very multidisciplinary technology," says Blinka's boss, Nissim Calderon, Goodyear's VP for corporate research. "I don't care how big you are, you can't do it all alone any-



Sandia's Robert Benner, left, helped Goodyear's John Blinka make a less skid-prone tire.

PHOTOGRAPH BY ALAN LEVENSON

more. You have to do what makes sense. You look at your core competencies, where you are good. You employ as many resources there as are needed to be the best. And then you make alliances, buy from the outside, license, go to the national labs." Since rival tiremakers like Michelin and Bridgestone don't have analytical and modeling equipment to match Sandia's, Calderon figures that his company's $15 million investment in the project with Sandia gives Goodyear a competitive advantage far beyond that price. He says, "These are technologies that you can't buy anyplace."

Other R&D chiefs agree that going outside the company is the way to win in today's global economy. "As corporations continue to implode, technology is exploding," says Lewis S. Edelheit, senior VP for corporate R&D at General Electric. "If there's a better idea somewhere else in the world, that's where we want to go." Working jointly with a German, a British, and a U.S. company, GE recently developed a method for making ultrapure superalloys. It could make possible the production of hubs for jet aircraft engine blades at significantly lower costs. Edelheit also backs up his words with small technology teams that troll for R&D ideas in faraway lands like China, India, and Russia. Corning, Monsanto, Chevron, 3M, and other companies also have globetrotting teams of technology scouts.

The hunt for technology beyond the corporate labs, known as "outsourcing," is not to be confused with the hiring of outsiders for routine services such as materials testing or software development. It also differs from the traditional use of consultants, which often ends after a single project. At its best, the outsourcing of R&D involves nothing less than a long-term collaborative effort that complements and extends a company's capabilities in science and technology. By eliminating some of the fixed costs of equipment and buildings, to say nothing of some researchers' salaries, it saves big money.

Whether outsourcing can compensate for the decimation of many companies' R&D staffs—down by 14% in the past five years at Du Pont, for example, and by 15% at General Motors' big research center near Detroit—is another matter. The U.S. for some time has

REPORTER ASSOCIATE *Alicia Hills Moore*

COURTESY OF THE ARCHIVES, CALIFORNIA INSTITUTE OF TECHNOLOGY

The great man on a break from brainwork

LET'S NOT STARVE TOMORROW'S EINSTEINS

BASIC RESEARCH faces a meager diet these days. As companies keep slashing projects with no short-term payoff and look to government to take up the slack, Washington's budget balancers are getting ready to cut federally financed R&D—which supports the bulk of fundamental scientific inquiry—by roughly a third in real terms during the next six years. For an idea of how this could come back to haunt us, consider what flowed from the work of the greatest basic researcher of this century, Albert Einstein.

Most people associate the great physicist's name with such ethereal mind leaps as a new understanding of the relationship between space and time. But the practical results range from optical fibers that speed talk, data, and entertainment beneath earth and oceans to tiny lasers that play music and extract information from CD-ROMs.

Burton Richter, director of California's Stanford Linear Accelerator Center, recently traced how Einstein's work led to photoelectric cells, fiber optics, lasers, and other opto-electronic devices. First came Einstein's theoretical research, with his brain as his laboratory, on how light is absorbed and emitted by various materials. Others subsequently did considerable laboratory exploration of these interactions, followed by applied work on the development of the laser. Finally, solid-state lasers were combined with advanced materials—hair-thin strands of glass and plastic—through which lasers pump the photons that carry coded digital information.

Head-in-the-clouds science and workaday technology are linked in ways much more complex than is commonly imagined. Most people see science and technology as a horse and carriage, the first pulling the second. In fact, the two often work in tandem or reverse roles. Says Richter: "Today's technology is based on yesterday's science; today's science is based on today's technology." By this he means that even as products like optical fibers and lasers are growing out of earlier scientific breakthroughs, modern theoretical advances depend on high-tech—and in some instances hugely expensive—tools such as electron microscopes, supercomputers, and particle accelerators.

Herein lies a lesson for Capitol Hill lawmakers. Don't follow the advice of one of your predecessors, Representative Joe Evins of Tennessee, who in the late Sixties made a statement remarkable for its ignorance of how science and technology interact. Said Evins: "It's time to turn science into a workhorse for the American people instead of a hobbyhorse for scientists." Einstein's hobbyhorses, and those of other basic researchers before and since, opened entire new sectors of industry. Cut back on the hobbyhorses and, in the end, you'll get fewer workhorses.

lagged behind Japan and Germany in industry-financed research spending as a percentage of GDP. Meanwhile, some of the very outsiders to whom business is turning worry that basic research is getting shortchanged. Says MIT President Charles M. Vest: "Industry's near-total R&D focus on rapidly commercializing products, when combined with growing constraints on support of university research, could devastate our national innovation system."

Penny-wise or not, U.S. industry for the moment is looking more competitive than it has in a long time. One reason given by Du Pont, which has been stepping up outsourcing, is that it delivers more bang for the R&D buck. In 1995 the chemical giant spent $45 million of its $1 billion R&D budget outside the corporation, double the outlay two years earlier. Joseph A. Miller Jr., Du Pont's senior VP for research, figures that by using outside specialists and facilities, Du Pont gets research that would cost $80 million to duplicate in-house.

For the outside parties, many of which are also going through lean times, outsourcing is a boon. The trend has brought major changes in industry's relationships with its principal extramural collaborators. These include:

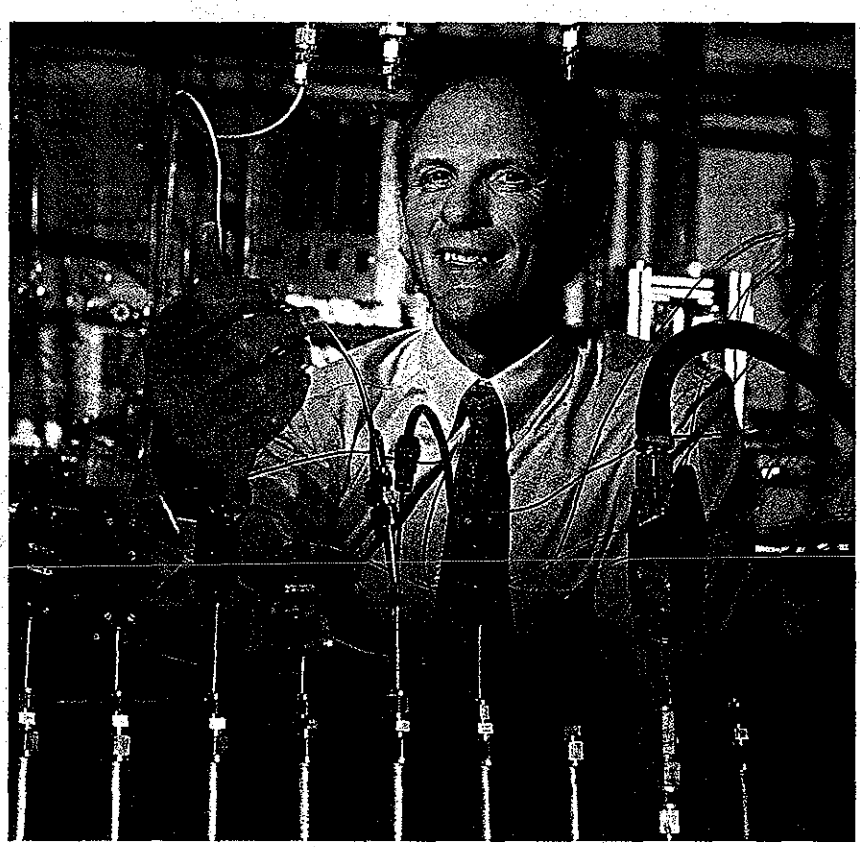
► **Universities.** In the past, dealings between corporations and academia were generally informal, with companies often giving money with no strings attached in the hope that something worthwhile would result. In the new cost-conscious era, support for university research has become much more directed. "Everyone is now interested in the question, 'What's the value of doing this?' " says Thomas R. Moebus, who runs MIT's corporate relations program.

Hoping that the corporate rush to the campus will partly make up for the decline in federal research grants, universities are working to match industrial needs more closely. MIT, which long operated a product development program for small companies, is setting up a much bigger one for large corporations. Where in the past a relationship might have existed between a single professor and a company, now as many as a dozen profs and graduate students get involved in a corporate project.

Caterpillar's success in developing a computerized language-translation system shows how a university can serve as a company's advanced R&D outpost. Working with Carnegie Mellon and with the Carnegie Group, a Pittsburgh high-tech company set up by professors, Caterpillar launched the project five years ago and assigned 20 researchers to it. The payoff came late in 1995 when the company began delivering operating and maintenance manuals for its machines in French. By 1998 the computer will be translating the manuals into 13 other languages. Humans, of course, are needed to smooth out the clunkiness of machine prose. Still, says James Roppa, Caterpillar's technology-information department manager, the company is expecting a fivefold to tenfold improvement in productivity compared with purely human translation. That's a real boon in a company churning out every day 800 new pages of material that needs to be rendered into a Babel of tongues.

► **National laboratories.** Though relative newcomers at supplying industry, the more than 750 federally owned labs boast some of the best scientific and technological brains and facilities in the world. According to Grant Stockdale of Technology Publishing Group, which keeps track of the data, corporations have pumped $4 billion over the past five years into 3,500 cooperative research and development agreements with the labs. Industry has found the labs' advanced computer simulation capabilities especially helpful. Alcoa, for instance, was able to cut the amount of aluminum in soda and beer cans while increasing their ability to withstand pressure by running designs through simulated stress tests at the government's Pittsburgh Supercomputing Center.

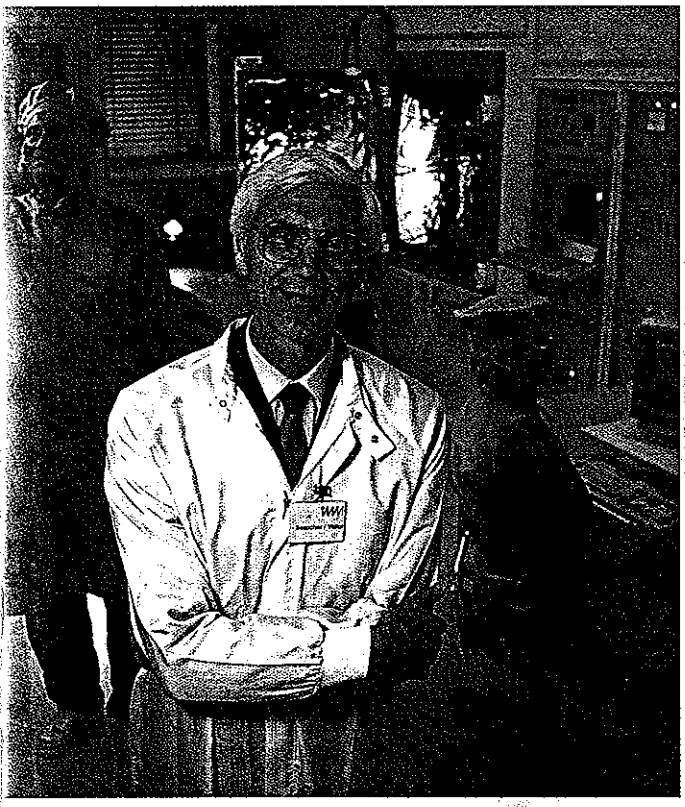
In a survey of 219 companies that have worked with federal labs, Georgia Tech researchers recently found 89% satisfied that their money was well spent. Sixty percent of the corporations were marketing new products or developing them as a result of the collaborations. Furthermore, the companies on average figured they were getting $3 worth of benefits for each dollar they spent, and a few happy customers valued the benefits at more than $10 million.


ANDY FREEBERG

CEO Ricardo Levy's Catalytica has helped turbine makers curb air pollution.

How do you find the experts who can fix a complex technical problem? Call 800-678-6882. You'll reach the National Technology Transfer Center in Wheeling, West Virginia, established by Congress in 1992 as a gateway to the federal labs. Specialists man phones from 8 A.M. to 8 P.M., EST, from Monday through Thursday (they knock off at 5 P.M. on Friday). The Center's Internet address is http://www.nttc.edu. The Transfer Center folks will quiz you on your problem and put you in touch with

the appropriate specialists at the national labs. They'll also help arrange a visit by as many as five experts from the federal labs to your company for as long as a week, at no charge. Recently the Transfer Center helped a small Pittsburgh-area manufacturer, E.A. Fischione Instruments, find a specialist at California's Lawrence Berkeley Laboratory. He helped design a $40,000 device called an ion mill, which prepares ultrathin samples of materials for examination in an electron microscope. This particular bit of tech transfer, with the bill footed by the U.S. taxpayer, was done entirely by phone.



PATRICK LABANCA

Physicist Heinz Hefter of Du Pont's technology transfer team scours Europe for ideas such as chipmaking advances in Germany.

► **Small high-tech companies.** For oil companies and turbine manufacturers, one of the most successful R&D suppliers has been Catalytica Inc. of Mountain View, California. With GE, Allison Engine Co., and other collaborators, Catalytica is developing a combustion system that practically eliminates one of the biggest banes of the electric utility industry, nitrogen oxide emissions from gas turbines powering electric generators. The first turbines employing the system will be marketed in 1996. Catalytica is also working with Conoco and Neste Oy, a Finnish oil company, to find safe substitutes for toxic chemicals used in gasoline refining. In collaboration with a Japanese automaker that declines to be named, the company is developing a virtually pollution-free gasoline engine.

► **Private research institutes.** The biggest of them, Battelle Memorial Institute in Columbus, Ohio, has drastically changed its mission. "We used to do such things as small elements of product development," says CEO Douglas Olesen. "Now we take products from start to finish, all the way through to pilot manufacturing." Recent examples: an electric toothbrush for Teledyne Water Pik and a new ditch digger for the utility industry's Electric Power Research Institute. Battelle worked with Concept Engineering Inc. of Indianapolis on this machine, called the Soft Trencher because it minimizes damage to buried wires.

Battelle's biggest rival, SRI International of Menlo Park, California, until recently handled all the R&D needs of Dura Pharmaceuticals, a 200-person biotech startup in San Diego. Dura's aim is to become a world leader in devices for administering drugs that are inhaled. But to develop its Spiros inhaler, which unlike some devices made by rivals does not employ harmful chlorofluorocarbons (CFCs), Dura faced huge R&D hurdles. It would have had to come up with chemical and engineering expertise and conduct clinical trials, all well beyond the capability of a fledgling company. Dura found people with the necessary skills at SRI International. "It made an enormous amount of sense for us to do all that with SRI without investing in fixed costs," says Cam L. Garner, Dura's CEO. According to SRI chief William P. Sommers, jobs like the one for Dura have boosted the institute's outsourcing revenues to $70 million a year, nearly half of what it takes in from nongovernmental clients.

Companies are not going to master the art of outsourcing overnight. The Not Invented Here syndrome inhibits many corporations from buying R&D. "It's a monumental problem," says CEO George Heilmeier of Bellcore, the Morristown, New Jersey, research and consulting company whose biggest customers are the Baby Bells. Once companies embark on outsourcing R&D, they must handle it more deftly on a day-to-day basis than when an automaker, for example, farms out seatmaking. Says Heilmeier: "You have to watch the whole situation from the highest levels of the corporation."

ONE of the stickiest questions is who gets the patents. In cooperative research agreements between companies and national labs, the patent generally goes to the party whose people did the actual work. As added protection, the details of any joint research are kept under wraps. In its project with Sandia, for example, Goodyear gets exclusive use of jointly developed technology for three years before the government makes the findings available to all comers. Deb Chatterji, technology chief at the BOC Group, an oxygen-equipment maker in England and the U.S., says that companies buying R&D can prevent nasty conflicts only if they go in with clear agreements about dividing up intellectual property.

How far can the outsourcing trend go? Some companies see nothing wrong with dispensing entirely with their own R&D. But overdependence on purchased research can leave a company far behind and unable to buy quickly the new technology it failed to develop on its own. Japanese electronic companies found this out when they tried through outsourcing to catch up to their American rivals' advances in digital signal-processing chips that eliminate the need for tapes in recording telephone messages.

Many big companies count R&D as a strength to be guarded as ferociously as a mother bear guards a cub. Says Goodyear's Calderon: "You've got to hang on to your core competencies or you'll be giving away your sustainable advantage." But as Goodyear found out in its work on those skidding tires, there's plenty to be gained by getting a little help from elsewhere. F