and so on. We have similar activities in universities. If we merge these two ministries, big science will get stronger support and we can avoid duplications and inefficiencies.

[The idea of keeping STA as a separate agency under Monbusho] could happen. In that case, the different cultures will be preserved. We also have a project team that is [discussing whether] to merge, say, the Institute of Space and Astronautical Science with the National Space Development Agency.

On educational reform:

We're very good at elementary education. If you look at international comparisons, Japanese students do very well—third in the world in science and mathematics. However, the problem is that students have to learn [by memorizing] and have no chance to practice their knowledge. So we decided to close schools on Saturdays. We will also try to increase the number of [educational activities] outside school. I hope kids will have more chance to learn by themselves and to develop their individuality, creativity, and originality.

At the same time, our Central Committee for Education has recommended two things. If there are certain students who learn things slowly, our teachers should educate those slow students more carefully. At the same time, we should give [bright students] an advanced education.

–DENNIS NORMILE

APPROPRIATIONS

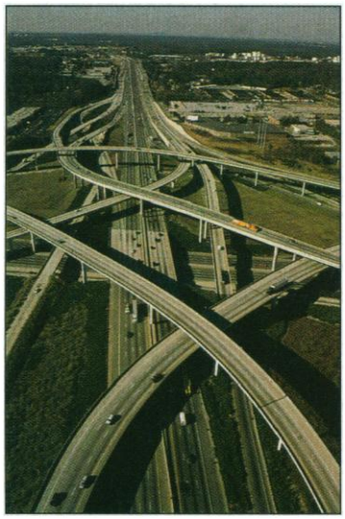
Legislators Get Creative With New Crop of Earmarks

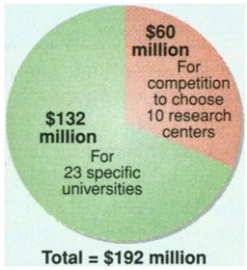
A budget surplus and a fall election invigorate the traditional practice of channeling money to specific universities

A researcher who wins a multimillion-dollar federal grant can usually recall in excruciating detail exactly what it took to prevail over some stiff competition. But not Jim Bose, an engineer at Oklahoma State University in Stillwater. Bose says he can't explain the intricacies of how his lab received a $2.5 million grant earlier this year to design a "smart bridge" that automatically energizes ice-melting heat pumps when the weather turns nasty. The reason: The project didn't have to go through the labyrinthine peer-review process, because one of his state's senators tacked the 3-year award onto a mammoth federal transportation spending bill signed into law in June.

"I'm not sure how it happened, but the university is real pleased, and so am I," Bose says about getting a chance to work on the innovative concept. He is, however, a bit uncomfortable about how the windfall came about. "When you get the money, you think it's a great way to go," he says. "But when you see someone else get it, you kind of wonder about the process."

Bose isn't the only scientist with mixed emotions about the long-controversial practice of earmarking. Each year thousands of researchers benefit from such efforts by well-positioned lawmakers to funnel money to local institutions, often over objections from Administration officials. Budget woes and efforts by Republican leaders to make good on promises to cut government waste had curtailed such spending in recent years. But legislators' taste for bacon has been revived by a predicted budget surplus, the Supreme Court's rejection of the president's authority to veto individual items in a spending bill, and the fall election campaign. "The political trend is very strong; ... there is a tendency toward spreading the largesse," says Nils Hasselmo, the new president of the Association of American Universities, a group of 62 leading research institutions that has taken a strong stand against earmarking. Congress won't finish work on the 1999 budget until next month, but its actions so far suggest that earmarks for science projects are running close to last year's total of a half-billion dollars which, according to a survey by the *Chronicle of Higher Education*, represented a 67% jump from the 1995 level.





Peer-review bypass. The new federal transportation act provides nearly $200 million for research projects, but legislators have already chosen most of the winners.

Exhibit A in this year's panoply of pork is the $2.3 billion Transportation Equity Act for the 21st Century. In addition to providing funds for campus buildings with no apparent connection to transportation studies, the law created what amounts to a mega-earmark: $132 million to 23 specific institutions—including Oklahoma State—interested in studying everything from global warming to auto accident injuries. Although projects like the self-heating bridge may have merit, says Tom Maze, head of the Center for Transportation Research and Education at Iowa State University in Ames, the earmarks mean that a growing share of a stagnant transportation research budget is not subject to peer review. In a nod to the value of academic competition, Congress did stipulate that the department spend another $60 million for 10 university-based centers chosen by peer review. But that doesn't compensate for the growing restrictions on the research budget, says Maze: "They used to hand out bridges; now they are doling out transportation research centers with a minimum of oversight."

Just how much fat is added to a bill often depends on the temperament of the committee chairs who oversee the 13 individual appropriations bills that fund all federal activities. For instance, relatively little biomedical research pork has made its way into the House version of the key spending bill, mainly because Representative John Porter (R–IL), who chairs the appropriations subcommittee for education, labor, and health and human services, persuaded his colleagues that they should allow peer reviewers to make funding selections. Indeed, the report his subcommittee produced in June—which recommended a 9.1% increase for the National Institutes of Health—pledges to give NIH staffers "no directives" on centers or on "particular diseases." But the Senate version of the bill, to be crafted this week by a panel led by Pennsylvania Republican Arlen Specter, is expected to be more explicit about its preferences.

Even the relatively clean NIH bill, however, indicates that lawmakers are getting more sophisticated about avoiding earmarking controversies by using seemingly vague recommendations. The House report, for example, calls on the National Cancer Institute (NCI) to fund a new center for proton beam therapy,

PHOTO: NELSON / UNIPHOTO SOURCE: TRANSPORTATION EQUITY ACT

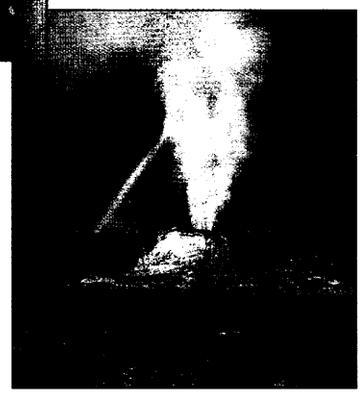
Big Bucks for Big Sky Country

Researchers at Montana State University studying the geology and biology of Yellowstone National Park, just across the Wyoming border, are expecting a $2 million geyser of federal funding, thanks to the kindness of a U.S. senator. If it materializes, the money would almost double their current budget. And that's not all. The funding joins three other Montana earmarks—unrequested funding targeted to a specific institution—in the Senate's version of the 1999 spending bill for NASA that total $7.5 million, and another project intended to benefit Montana that's included in a portion of the bill that covers the National Science Foundation (NSF).

These earmarks come courtesy of Senator Conrad Burns (R–MT), a member of the appropriations subcommittee that funds NASA and NSF and chair of the panel that authorizes spending for both agencies. "Our senator made it clear he wanted to do something," recalls Steve Running, a forest ecologist at the University of Montana (UM), Missoula, which is in line for one of the earmarks, a $3.5-million-a-year natural resources center to apply data from NASA's Earth Observing System to everything from fire detection to rangeland productivity. "I could have kept quiet, but my university president encouraged me to come up with ideas." Adds Bob Swenson, the recently retired vice president of research at Montana State who helped with the Yellowstone proposal, "Everyone else is doing it, so we're figuring out how we can do it, too." The university's efforts to secure funding have been assisted by Van Scoyoc Associates, a Washington lobbying firm.

RICK KOZAK

UNIPHOTO



Funding eruption. Senator Burns has opened up federal spigots for Montana researchers working in nearby Yellowstone Park and other sites.

Burns's prominence makes space agency managers reluctant to criticize his pet projects, despite the fact that NASA—which has a declining budget—did not request the project funding. NASA Administrator Dan Goldin has, in fact, assiduously courted Burns, visiting Montana in a bid to influence his agency's annual budget and the space station program. And 2 years ago a bevy of top federal science officials, including Neal Lane, then NSF director and now the president's science adviser, visited the university's biological field station in Flat Head Lake for the annual meeting of a federally funded program to boost the state's research capacity.

Burns is not the first politician to bring home the federal research bacon to Montana. But he has become one of the more active participants on the national science scene. MSE-Technologies in Butte, for example, has received pork funding for several years to work on a variety of aerospace engineering efforts. Its latest slice, $2 million for "high-priority aerospace technology," continues that arrangement. "Congress feels this particular organization is the best venue for the government to do this work," says Dennis Bushnell, chief scientist at NASA's Langley Research Center in Hampton, Virginia, which oversees the work.

In addition to the Yellowstone-related research, Montana State is in line for $2 million to further develop a technology that could someday help record the simultaneous actions of thousands of neurons. Swenson says the technique has attracted some commercial interest but that the main goal of both projects is to carry out good research. "The bottom line is that we can't embarrass ourselves or our senator by doing crappy science."

The NSF earmark is less obvious—and less welcome. The committee orders NSF to fund, "through a competitive process, an additional LTER site for the study of a pristine, inland, mountain wilderness area. Preferences should be given to sites with established research facilities." LTER stands for Long-Term Environmental Research, a network of 21 sites from Alaska to Antarctica at which scientists collect and exchange data on biodiversity in a variety of ecological settings. In fact, the language was tailored by Burns's staffers to cover work going on at Flat Head Lake led by UM ecologist Jack Stanford, who already has NSF funding for a range of ecological studies.

But Stanford says his team "doesn't need any special arrangement" to extend its work. Although he says he has discussed his research with Burns and believes that the LTER program "has holes in the northern Rockies," he says any LTER competition should be open to anyone. He says he was not aware of the language in the Senate bill. NSF officials say they welcome the "vote of confidence" in the program but have no plans to hold a competition anytime soon. Indeed, says Doug Collins, who runs the program, "we're gearing up for a 20-year review ... and it wouldn't make sense to add new sites just before we do that." But Collins says NSF will abide by any congressional mandate.

Whatever the ultimate fate of the earmarks, Swenson, Running, and other Montanans argue that they are simply trying to level the playing field. "It's our turn," says Running. "That's probably not a really legitimate justification, but we've not been benefiting like others have." Adds Jon Lindgren, Burns's deputy press secretary: "We have people who can do excellent research. So if it can be done in Montana, we will try to make sure it is." —ANDREW LAWLER

With reporting by Jeffrey Mervis.

an exotic type of surgery that uses high-energy particles for scalpels. Two such centers already exist, one on each coast, so the committee encouraged NCI to "assist in efforts to convert an existing online accelerator into a proton beam therapy center to serve populations which do not have access to this therapy." Translation: NCI should help Indiana University convert its old physics cyclotron in Bloomington to a medical unit. University staffers say they have been searching for a backer for the project ever since the National Science Foundation (NSF) began to trim support for nuclear physics a couple of years ago.

One traditional argument in favor of earmarks is that they channel funds to institutions, states, and regions that have received less than their fair share of federal R&D support (see above). This year, that argument underpinned a Senate panel's attack on an elite group of schools that get the lion's share of peer-reviewed NSF grants. Lawmakers on the panel, which sets spending on NSF and other independent agencies, approved language that would restrict the "top 100" from competing for $18 million in funding for a half-dozen new, university-based research and training centers, three focused on information technology and three on applied molecular biology. Such a competition, according to the committee, will help to overcome "any bias toward more established institutions."

The restricted competition is intended to

stem a geographic brain drain that shrinks the country's overall R&D capacity, says Gary Strobel, a microbiologist at Montana State University in Bozeman. "Most universities in rural states are better positioned to do work in biotechnology than in any other field because of their roots as land-grant agricultural schools," he says. "But the problem is that most of our young people get trained and go elsewhere for jobs because there aren't enough opportunities at home."

NSF officials, who point out that geographic diversity could be one of several factors in making an award, say barring the top universities from a competition is a bad idea. "We'd never do it," says Mary Clutter, head of NSF's biology directorate. "It would be sheer folly to exclude the best universities in the country."

A better alternative to earmarks, say some scientists and policy-makers, would be for Congress to provide funds aimed specifically at improving the research capacity of so-called "have-not" institutions and regions, and then use peer review to select individual award winners. NSF began such a program almost 20 years ago, called the Experimental Program to Stimulate Competition in Research (EPSCoR), and it has grown to a $100 million effort at eight agencies. "You might call EPSCoR an earmark, but it's not damaging to the system," says Erich Bloch, a former NSF director now at the Council on Competitiveness in Washington, D.C.

Such programs are unlikely to dampen the taste for scientific pork, however, and Maze believes researchers must learn to live with the practice. The rush to adorn the transportation bill with earmarks, he believes, "clearly demonstrated the power of winning university sponsorship through political muscle rather than through superior intellectual resources." **–DAVID MALAKOFF**

With reporting by Andrew Lawler, Eliot Marshall, and Jeffrey Mervis.

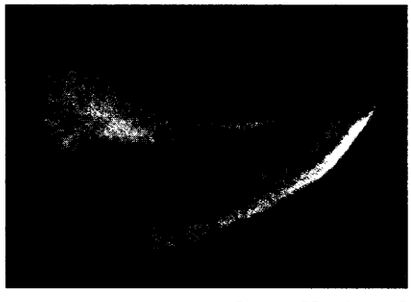
CELL BIOLOGY

How a Growth Control Path Takes a Wrong Turn to Cancer

As researchers work out how the Wnt pathway controls growth and development, they are getting a better grasp on the causes of cancer

Biologists these days often find themselves exploring isolated corners of the cell's molecular labyrinths. But every so often, the trails they have been following converge unexpectedly, and a unified picture emerges of a previously mysterious cell function. Recently, researchers studying one of the cell's key developmental and growth regulatory pathways—called the Wnt pathway after the protein that sets it in motion—have had that happy experience.

Over the past year or two, a confluence of evidence from molecular and cell biology as well as from research on development, cancer, and the immune system is providing a good look at how the pathway conveys signals all the way from the cell surface, where the Wnt protein binds to its receptor, to at least one gene in the nucleus. Out of this confluence is coming a better understanding not just of embryonic development in species ranging from fruit flies to humans but also of cancer.



Wnt pathway awry. Excessive Wnt signaling, caused by a defective *axin* gene, produces two-headed frog embryos (*left*). A normal embryo is at top.

CREDIT: ZENG *ET AL. CELL* 90, 181 (1997)

Because activation of the Wnt pathway stimulates cell growth, researchers had long suspected that too much Wnt signaling could cause problems. The new work bears out those suspicions, showing how damage to a well-known tumor suppressor gene could turn on an equally prominent oncogene via the Wnt pathway and lead to cancer.

The tumor suppressor is the adenomatous polyposis coli gene (*APC*), which is lost or inactivated in some 85% of colorectal cancers. And as described on page 1509, the oncogene is the c-*MYC* gene. Although researchers linked inappropriate c-*MYC* activation to Burkitt's lymphoma and lung, colon, and other cancers 20 years ago, they hadn't been able to figure out exactly what causes c-*MYC* expression to go awry in most cases. But cancer geneticists Tong-Chuan He, Bert Vogelstein, Kenneth Kinzler, and their colleagues at Johns Hopkins University School of Medicine in Baltimore, Maryland, now report that they have identified one of the genes turned on by Wnt signals—and it's none other than c-*MYC*.

Normally, it seems, *APC* instructs the Wnt pathway to keep c-*MYC* expression in check until the right signal comes along, say, to stimulate the cell growth needed for embryonic development. But if *APC* is missing or inactive, c-*MYC* will be active all the time, causing tumor growth. "This paper is a major, unexpected contribution to our understanding of not only normal c-*MYC* control but [also] how the loss of a tumor suppressor can result in abnormal activation of c-*MYC*," comments Kenneth Marku, a molecular biologist at the State University of New York (SUNY), Stony Brook.

As they learn more about the Wnt pathway's involvement in cancer, researchers are also becoming more optimistic that they can put their results to work developing new anticancer drugs that act by blocking c-*MYC* activation. "We have a pretty good shot at doing something about colon cancer, now that we know a lot about this pathway," says Paul Polakis, a biochemist at Onyx Pharmaceuticals Inc. in Richmond, California. The potential benefits may not be limited to colon cancer, because other recent work suggests that Wnt pathway malfunctioning may contribute to the development of additional cancers, including the dangerous skin cancer melanoma and cancers of the prostate, liver, and possibly the breast.

Following the Wnt trail

Cancer researchers originally discovered the gene for Wnt, a protein that conveys growth and developmental signals between cells, 16 years ago in mouse mammary tumors. At the time, the gene was called *Int-1* because it became activated when the mouse mammary tumor virus inserted—or integrated—next to it in the genome. This abnormal activation led to tumors in the mice, marking *Int-1* as an oncogene. But a 1987 discovery showed that the gene has a role in normal embryonic development as well: It is the mouse version of *wingless* (*wng*), a developmental control gene first found in the fruit fly. Since then, much evidence has shown that *Int-1* (which was subsequently rechristened *Wnt-1*, a melding of *wingless* and *Int*) and its relatives control such aspects of development as the