But some statisticians are skeptical that these analyses would produce a more accurate count. The bureau's error estimates "are all wrong," contends David Freedman, a statistician at the University of California, Berkeley, who is a vocal opponent of using ICM in the 2000 census. A variation on the ICM, Freedman points out, was used after the 1980 and 1990 censuses to estimate how many people slipped through the cracks. The Commerce Department, which oversees the Census Bureau, opted not to adopt corrections from the ICM calculations. That was a good move, Freedman says, because the corrections turned out to be wrong: In 1990, he says, the bureau found that a computer bug in the ICM software had erroneously inflated the corrections by about 1 million people. "In 1980 and 1990, it was very hard to tell if the adjustment would have moved us closer to the truth," says Freedman, who favors a more costly but complete head count. The ICM is so complex, he contends, that it introduces errors that are larger than the ones it fixes.

Other statisticians disagree. Sampling is a time-tested technique, "and this is not a particularly unusual application," says John Rolph, who led an ASA panel that strongly endorsed the sampling plan. Others acknowledge shortcomings in the methods but contend that they are better than relying on a head count. "The debate is not over whether we have a perfect method, but whether we have a sensible method," says Fienberg.

The arguments for and against sampling will be put to a key test later this year. In April, the bureau will conduct a census of Sacramento, using all the techniques it hopes to use in the 2000 national census. Workers will contact about 90% of the city's 400,000 people, then use sampling to estimate the rest. This "dress rehearsal could have a major role in the debate," says Ed Spar, executive director of the Council of Professional Associations on Federal Statistics.

But some fear that the experiment could be an exercise in futility. The political costs of sampling are too high to justify the potential improvement in accuracy, contends Alan Heslop, a professor of government at Claremont McKenna College in California. "I suspect that a lot of ivory tower people don't understand the real world situation," he says: By correcting for the undercounting of predominantly poor, urban dwellers, sampling "pits states against one another for House seats and federal funds." Indeed, Congressman Miller told *Science* that while he agrees that sampling is "good in theory," he predicts it would cause fewer people to return the forms because they would assume that the statisticians will save them the time and effort. "The possibility of a failed census is very real," he says. Others contend that partisan politics, plain and simple, is thwarting sampling. There is a "deep distrust by some members of Congress" that the Clinton Administration would rig the data in their favor, says Rockwell.

Last summer, House Republicans tried unsuccessfully to tack a sampling ban to a disaster-relief bill. The next salvo, observers say, could come in the Commerce Department's 1999 appropriations bill, which legislators will start working on with this week's release of the Administration's 1999 budget proposal. It promises to be a year of intense debate on the frontier where statistics meets politics.

–David Kestenbaum

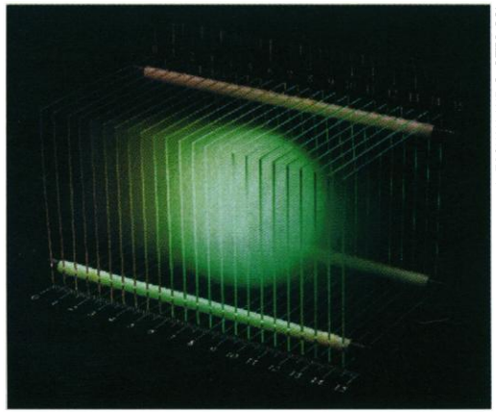
BIOPHYSICS

Blasting Tumors With Particle Beams

The physics of particle beams may seem like an esoteric branch of basic research, but two new research programs in Europe have begun exploring a down-to-earth use for two different types of such beams: treating patients with intractable brain cancer. Last week, the European Union's (EU's) commissioner in charge of research, Edith Cresson, inaugurated a five-nation program of tumor therapy using neutron beams from the high-flux reactor at the EU's Joint Research Center in Petten, the Netherlands. And later this month, two patients will get a first indication of whether a carbon-ion beam therapy developed at Germany's heavy-ion research center (GSI) in Darmstadt has halted growth of their tumors.

Researchers at Petten are the first in Europe to use a technique called boron neutron capture therapy, which builds on current work in Japan and at Brookhaven National Laboratory (BNL) in New York. Patients are injected with a boron-containing compound that selectively accumulates in the tumor tissue. Researchers then expose the patients to neutrons from the reactor, which are absorbed by the boron nuclei. The nuclei then emit damaging short-range ionizing particles that can kill the surrounding tumor cells while, in theory, leaving healthy cells comparatively undamaged.

The Petten team has already treated five patients and hopes to treat 40 more over the coming months. "There's an urgent need for controlled clinical trials to test the benefit of this treatment," says team member Wolfgang Sauerwein. The team plans to spread the radiation over four sessions to lessen damage to normal cells—BNL used just a single dose.



A. ZSCHAU AND G. OTTO/GSI

Depth charge. Varying beam energy alters the depth of energy deposition in tissue.

"We're very interested to see how that goes," says a BNL spokesperson.

In Darmstadt, GSI, in collaboration with the University of Heidelberg, the German Cancer Research Center in Heidelberg, and the Rossendorf Research Center near Dresden, has recently begun using highly focused beams of high-energy carbon ions to attack tumor tissue. Such heavy-ion therapy was first attempted at the Lawrence Berkeley National Laboratory in 1975, but its 1940s-vintage accelerator did not have a sufficiently stable beam or tunable energy, says GSI's head of radiation biophysics, Gunter Kraft. Japanese researchers at the National Institute of Radiation Research have also treated more than 150 patients with carbon ion beams. Although they have had some success, their beams cannot be focused entirely on the tumor, so some damage to normal tissue has occurred, says Kraft.

To overcome these problems, the German team has developed a new beam steering system. It divides the target tumor into layers and, starting with the deepest, scans each tumor layer in the same way an electron beam scans a TV screen. "By changing the beam's energy, it is possible to change the maximum dose at a particular depth very precisely," says Kraft. The ion bombardment produces gamma rays that researchers use to track the beam during treatment. "It's a very promising technique because of the selectivity of the target tissue," says radiobiologist Andre Wambersie at the Catholic University of Louvain in Belgium.

During the pilot phase, which began in December, two patients with tumors at the base of the skull were treated, and these will soon be followed by another 10 patients. A second phase will treat a larger trial group. The treatment proved that the beam can be manipulated with "millimeter precision," says Kraft. But the key test will come when the first two patients will be checked to see how much the treatment has shrunk their tumors.

–Nigel Williams