SYNCHROTRON RADIATION

Swiss Plan Next-Generation X-ray Source

VENICE, ITALY—Swiss physicists are hailing a decision by their government last month to allocate $1.5 million to study the construction of a new x-ray source that would put Switzerland in the big leagues of synchrotron radiation research. The planned facility, called the Swiss Light Source (SLS), would use a circulating beam of electrons with an energy of up to 2.1 gigaelectron volts to produce lower energy "soft" x-rays. If the government follows through on the planning grant with construction funds—as many now expect—the $135 million facility could be up and running by 2001.

SLS planners say that the machine would use superconducting bending magnets to produce the world's brightest and most coherent x-ray beam—some have dubbed it the first fourth-generation synchrotron source. What is important, says Wilfred Hirt of the Paul-Scherrer Institut (PSI) in Villigen, who originally proposed the project, is that "the SLS will be pushing current techniques to their physical limits, maximizing the brilliance."

Synchrotron radiation, the light given off by particles as they speed around a curved path, was originally considered a nuisance by the designers of particle accelerators. Now researchers are building accelerators for the express purpose of exploiting the intense beams of x-rays they produce. The past several years have seen a profusion of new third-generation sources, which use banks of magnets known as insertion devices to coax the circulating electron beam into producing ever finer and more intense x-ray beams. Three giant sources of higher energy "hard" x-rays have all come online during the 1990s: the U.S. Advanced Photon Source, the European Synchrotron Radiation Facility, and Japan's SPring-8. And these have been joined by new soft x-ray sources such as the Advanced Light Source in Berkeley, California, and Elettra in Trieste, Italy.

The SLS is going to go one step further, says PSI's Gottfried Mulhaupt, who was named head of the SLS project earlier this year. Although brilliance increased by three or four orders of magnitude going from second- to third-generation machines, Mulhaupt explains, the coherence of the x-ray beams—the degree to which all the waves move in step—produced by these machines has been low. It is hoped that the superconducting magnets of the SLS will bring about significant improvements in brilliance and coherence. With these features, Mulhaupt says, "you can carry out experiments like [x-ray] holography, opening up structural analysis and the study of complicated molecules or proteins." SLS planners are also designing in the possibility of using the machine as input into free-electron laser sources, further boosting the machine's potential (*Science*, 16 February, p. 902).

Switzerland's Interior Department will produce a formal proposal for the SLS later this year, and a final decision is expected in December. Researchers are confident it will give the green light: According to Giorgio Margaritondo of the Ecole Polytechnique Fédérale in Lausanne, who was recently elected coordinator of Elettra's experimental division, the planning funds are "a significant decision, given that Switzerland is traditionally quite careful in its research investment, even at the planning stage."

–Susan Biggin

Susan Biggin is a writer in Venice, Italy.

TOXICOLOGY

Chemicals Behind Gulf War Syndrome?

Ever since the Gulf War ended in February 1991, another type of battle has been raging: over what—if anything—might have caused "Gulf War syndrome," the mysterious collection of symptoms, including headaches, fatigue, short attention spans, aches, and rashes, reported by many of the men and women who served in that war. Indeed, there have even been questions about whether the syndrome is a true disease. Barely a month ago, for example, the U.S. Department of Defense announced that an $80 million evaluation of long-term health problems in soldiers who served in the Persian Gulf War had failed to identify a specific disease that could account for their complaints, let alone a single cause.

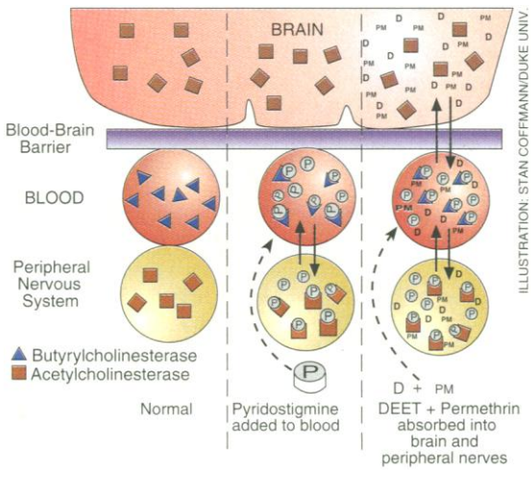
But a privately funded team of toxicologists and epidemiologists may have hit upon an explanation for at least some of the problems experienced by Gulf War vets. Last week, at the annual meeting thrown by some of the societies of the Federation of American Societies for Experimental Biology,* the team, led by Mohamed Abou-Donia of Duke University Medical Center in Durham, North Carolina, and Robert Haley of Texas Southwestern Medical School in Dallas, presented the first of a series of experiments designed to pin down Gulf War syndrome. They found that simultaneous exposure to two or more of the insecticides and drugs used by Gulf War soldiers damages the nervous system of chickens, even though none of the chemicals causes problems by itself. Combinations of the chemicals had been tested in animals before, but only in acute toxicity studies aimed at determining their LD_{50}s, the amount required to kill half the animals exposed.

The new results, which will also appear in the May issue of the *Journal of Toxicology and Environmental Health*, look promising because the range of symptoms the chickens develop is similar to those the veterans describe. "What we see in the chickens resembles very much what humans show," says Abou-Donia, the animal study's leader, who presented the group's results at the meeting.

Researchers caution that the study's relevance is far from certain; the afflicted veterans, they say, may not even have been exposed to the chemicals at issue. "The Abou-Donia study has an unknown relationship to Gulf War illnesses," says neurotoxicologist Peter Spencer from the Oregon Health Sciences University in Portland. Haley agrees: "It's one study, the implications of [which] are still uncertain."

But even if the work, which was funded by Texas billionaire and erstwhile presidential candidate H. Ross Perot, doesn't solve the mystery of Gulf War syndrome, toxicologists say it highlights another important problem: the need for more research on the potential toxicities of multiple chemical exposures. "I see the [work] as something of a warning flag," says Raymond Yang, a toxicologist at Colorado State University in Fort Collins.

For their study, Abou-Donia and his colleagues worked with adult hens, an animal the U.S. Environmental



Stymied protectors. If enzymes get bound up by an anti–nerve gas drug (P), insecticides (D, PM) can sneak into the brain and nerves.

* Experimental Biology '96 was held in Washington, D.C., from 14 to 17 April.

Protection Agency considers to be well-suited for testing for neurological toxicity because its nervous system is highly susceptible to toxic damage. The Duke researchers exposed the animals to the pesticides DEET and permethrin—chemicals meant to protect soldiers from malaria and other insect-borne diseases—and to an anti–nerve gas agent widely used in the Gulf War called pyridostigmine bromide, both individually and then in all possible combinations. The doses were equivalent to three times what Gulf War veterans should have been exposed to.

The symptoms the animals developed as a result of these exposures varied but were reminiscent of the headaches, fatigue, gastrointestinal problems, and other symptoms reported by the Gulf War veterans. While hens given just one chemical showed no ill effects, any two chemicals made them become weak, short of breath, and unable to fly correctly. They lost weight, stumbled frequently, and had tremors. And some of the chickens exposed to all three chemicals became paralyzed or died. Microscopic studies of the animals' nerves sometimes revealed swollen and damaged nerve endings, Abou-Donia says. Adds Haley: "There were not only clinical effects, there were enzymatic and neurological effects."

The researchers hypothesize that the multiple chemicals overwhelmed the animals' ability to neutralize them. The enzyme butyrylcholinesterase, which circulates in the blood, breaks down a variety of nitrogen-containing organic compounds, including the three substances tested. But the anti–nerve gas drug, in particular, can monopolize the enzyme, possibly preventing it from dealing with the insecticides. Those chemicals could then sneak into the brain, causing damage they would not produce on their own, the researchers suggest.

The big question, of course, is whether something similar happens in humans exposed to the Gulf War chemicals. In fact, earlier studies had not found nerve damage in ill Gulf War veterans. But recently, Goran Jamal of the University of Glasgow, Scotland, using more sensitive tests, has found subtle differences in nerve function between unaffected and affected individuals, evidence that has convinced Spencer that his group should also start looking for these changes. Spencer cautions, however, that there is currently no way of telling whether those changes are due to Gulf War chemical exposures: "We have no idea whether symptomatic subjects had special exposure, or any exposure, to pyridostigmine bromide."

To pin down any link between multiple chemical exposures and Gulf War symptoms, Haley, Thomas Kurt, also of Southwestern, and their colleagues have examined Gulf War veterans themselves. In the first phase of the work, they devised comprehensive surveys, including both a detailed questionnaire about Gulf War chemical exposures and symptoms, and found a psychological test to assess if any of the symptoms the veterans report might have a psychological, instead of a physical, basis. They then performed extensive neurological tests on 26 individuals who met their criteria for Gulf War syndrome, as well as on 20 controls, to see if they showed signs of the same kind of damage the chemicals induced in the chickens. If the work pans out, it could provide some consolation for Gulf War veterans, who have long been dismayed by a lack of explanation for their problems. But it would also be a sobering finding for agencies that regulate toxic substances.

–Elizabeth Pennisi

MICROBIOLOGY CAREERS

ASM Report Sees a Mixed Future

With federal research budgets shrinking and managed care squeezing medical costs, graduate students planning a career in biomedicine would be justified in wondering whether they are likely to find any jobs. Now one group of graduate students—microbiologists—and their future employers and educators have at least some idea of the employment prospects in their chosen field.

After a year-long effort, the American Society for Microbiology (ASM) this week released the first firm data on future demand for microbiologists: a survey of 1849 employers of microbiologists—from medical centers, clinical laboratories, and pharmaceutical companies to food manufacturers, universities, and government agencies.* Employers were asked to assess job prospects in their field over the next 3 years. Their answer: Yes, there is a future in microbiology, but not necessarily the future that microbiologists-in-training may have envisioned. And that, in turn, may have implications for the training programs themselves.

The good news is that overall, the number of doctoral-level jobs for microbiologists is projected to grow at a rate of 6% annually. "This certainly goes against the [conventional wisdom] about the need to downsize Ph.D. programs across the board," says Gail Cassell, chair of microbiology at the University of Alabama, Birmingham, and a past president of ASM. The caveat is that much of the growth will be in nontraditional positions, outside the basic research arena, and students today are not always receiving training for the kinds of jobs that will be most widely available.

For some, this will mean jobs teaching in undergraduate and community-college classrooms; for others it will mean positions in such fast-growing biotech disciplines as molecular immunology, bioremediation, industrial microbiology, and anti-microbial chemotherapy. Industrial employers were most bullish about employment prospects, with 57% forecasting increased hiring, but they also told the surveyors that future hires must be more flexible and less specialized in their abilities than their predecessors were.

By contrast, employers in clinical-medical centers and the government forecast more belt-tightening ahead. They predict that the type of bench research most familiar to experienced microbiologists will not be expanding very much in the immediate future. In addition, more than half the jobs likely to emerge outside industry will be postdoctoral fellowships rather than permanent jobs. Indeed, despite the study's relatively sunny outlook, ASM found that 68% of academic managers surveyed said their students were encountering difficulty in finding a job.

The shift toward industry, some observers say, is a double-edged sword. ASM officials are pleased to see industry picking up the employment slack just when it's needed most. But some worry about putting all their eggs in one employment basket. Says Rockefeller University virologist Stephen Morse, "While the biotech sector is a good thing, I personally worry about how sustained it will be, because it's highly dependent on the interest of venture capitalists and chance events. If it's blown off course—and that could happen at any time—we would have to change our rosy view."

Still, despite the worries, the shift in job patterns means that the universities training future microbiologists may have to revise their programs, says John McGowan, director of the division of extramural activities at the National Institute of Allergy and Infectious Diseases and a participant in some of the survey's focus groups: "Scientists training young researchers need to recognize that not all students should go into the kinds of research posts they traditionally might have." But he adds there's no point in trying to fight the employment trends. "Science, like Wall Street, is a smart market," McGowan says. "People move to the jobs."

–Louis Jacobson

* The survey results will be available after 1 May on the ASM home page (http://www.asmusa.org/pasrc/empoutlk.htm).

Louis Jacobson is the associate editor of National Journal *magazine.*