Will U.S. Skip Neutron Scattering Derby?

A DOE review panel reluctantly recommends against a new neutron source at Argonne National Laboratory because there is not enough money

Although it is forking out over $20 million per year in federal funds on the subject, the United States is losing its lead in an important area of basic research. A recently released report from the Department of Energy (DOE) says that the United States is on the verge of falling behind the rest of the world—the Europeans in particular—in neutron scattering research because the country has not invested enough on research, development of new instrumentation, and exploratory work leading to new, higher intensity neutron sources since the high-flux reactors at the Oak Ridge and Brookhaven National Laboratories were commissioned in the mid-1960's. Neutron scattering comprises a family of techniques that has in many cases unique capabilities, including the simultaneous identification of atoms and location of their positions in complex biological molecules such as proteins.

The report, written by an ad hoc panel chaired by William Brinkman of Bell Laboratory, predictably calls for an increase of $6 million yearly to get the U.S. neutron scattering program back on track. In a much more controversial finding, the panel recommends closing down a medium-intensity neutron source soon to be operational at Argonne National Laboratory so that DOE's other neutron facilities do not have to skimp by on a bare-bones budget if this increased funding is not forthcoming.

Being strapped for cash is no badge of distinction these days, but the plight of neutron scattering seems to have some special features. First and foremost, neutron scattering is a highly interdisciplinary area of research. Its practitioners span the range from biologists to physicists. And, except that all start with a beam of neutrons as a radiation source, many of the techniques gathered under the umbrella of neutron scattering do not have a lot in common. Such an unorganized, heterogeneous community of users lacks the clout to look after its interests. Except for one small boost associated with work on the new pulsed source at Argonne, for example, budgets for neutron scattering research have not increased in real dollars for several years.

Like synchrotron radiation research, neutron scattering is a curious mixture of big and little science. The sources are few and expensive, with prices running from the tens to hundreds of millions of dollars. Yet the experiments carried out at these facilities are not much different in character and cost from those done in an investigator's own laboratory.

Perhaps more significantly, neutron scattering grew up in the United States in the 1950's under the patronage of the old Atomic Energy Commission (AEC), which had as one of its charters the exploration and promotion of peaceful uses of nuclear energy. Nuclear reactors have been the chief source of intense beams of neutrons for research. However, the research responsibilities of the AEC have ended up in DOE. And most DOE-sponsored research is at least in principle required to be tied in to the department's energy mission. Neutron scattering covers a wide range of research topics, some of which are energy-relevant and some of which are not. James Kane, director of DOE's Office of Basic Energy Sciences, which supports about 75 percent of all neutron scattering research in the United States, is worried that growing neutron scattering expenses will swamp his research budget at the expense of other energy-related programs.

> . . . it is one thing for the United States to deemphasize neutron scattering by choice, but it is quite another for it to drop out by default.

A further complication is that the sources of neutron beams are not facilities dedicated solely to neutron scattering, so that responsibility for their operating costs are divided among several offices of the DOE. At present, for example, there is a great deal of interest in a new type of neutron source that produces intense pulses of neutrons, rather than the steady stream that emanates from a reactor. Such a pulsed neutron source is slowly edging toward a 1986 completion date at the Los Alamos National Laboratory. But DOE's Office of High Energy and Nuclear Physics operates the existing proton accelerator that is the heart of the source, which does not depend on a reactor. And DOE's Office of Military Applications is building the part of the facility that transforms the proton beam into pulses of neutrons; and the Office of Basic Energy Sciences is contributing the instrumentation needed for neutron scattering experiments.

Such multisponsored facilities make neutron scattering very vulnerable to shifts in the plans of the other offices. At Oak Ridge, the High Flux Isotope Reactor is also supported by several DOE offices, and neutron scattering is proportionately a small contributor to the $5 million per year expense of operating the reactor. A transuranic element chemistry program, which could be phased out if the United States were to decide definitely to forgo nuclear energy schemes that involve reprocessing of spent fuel from conventional reactors or plutonium from breeders, is the major supporter. The reactor could be shut down if such a decision were made.

Because of the stringent budget restrictions facing the department's research programs, DOE's charge to the review panel was not to make a wish list for the optimum development of the field, but to advise the agency on how best to spend the expected future constant neutron scattering allocations. Despite this charge, says panel chairman Brinkman, the members felt they had to make a strong statement in their report that the United States could not get by much longer coasting on the two aging reactors at Brookhaven and Oak Ridge. Systematic development of neutron scattering requires starting to work on a new high-intensity neutron source and expanding utilization of existing facilities.

In an effort to show the consequences of failing to take the necessary steps, the panel members assembled a chronological list of breakthroughs and other significant developments in neutron scattering from the 1950's to the present. Until the mid-1970's, the United States accounted for about two-thirds of the accomplish-

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ments cited, whereas afterward, the Europeans collectively accounted for about this proportion. The change was presumably brought about by the opening of a $95-million facility in Grenoble, France, in 1972.

The Institut Laue-Langevin is jointly supported by France, West Germany, and the United Kingdom. These three nations provided the Grenoble neutron facility with about $41 million last year as compared to the *total* U.S. spending on neutron scattering research of approximately $20.5 million. When all neutron scattering expenditures in the three European nations was totaled, the panel found that they were spending at the rate of $95 million per year, almost four and a half times the U.S. rate. Brinkman told *Science* that the United States has been keeping up by being clever, but this will not work forever. There is already a noticeable reduction in the flow of researchers from overseas wanting to use U.S. neutron scattering facilities. They are going where the money is.

Why should anybody mourn the loss of leadership in neutron scattering? The argument, in the recent DOE report and in a 1977 National Academy of Sciences study, is that neutrons provide a unique tool for exploring properties of matter that other techniques cannot easily probe.

Neutron scattering experiments roughly divide into two classes, according to whether the neutrons do or do not lose energy as they pass through a sample. The first case is called inelastic scattering and the second elastic scattering. Techniques based on inelastic scattering provide spectroscopic information about the energy states associated with such phenomena as vibrations and magnetic interactions in solids. Elastic scattering gives structural details about the arrangements of atoms in materials. One form of elastic neutron scattering, for example, is neutron crystallography, which is entirely analogous to x-ray crystallography. Another kind of elastic neutron scattering is small angle scattering, which gives structural information about disordered, partially ordered, or ordered materials with very large periodicities.

Two characteristics of neutrons have made neutron scattering especially useful. The first is that, in contrast to x-rays, neutrons easily penetrate solids made of heavy elements but are strongly scattered by hydrogen and its isotopes. This feature has allowed chemists and biologists to study the structure of polymers and biological macromolecules. The second characteristic is the small magnetic moment of the neutron, which allows the

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Most Additives Are Harmless

In a message of solace to consumers and industry alike, the Food and Drug Administration (FDA) has concluded that most common food additives are harmless. A review of 415 natural and artificial additives generally regarded as safe turned up few surprises. Only salt was targeted for restriction or possible removal from the food supply, because of its potential for increasing hypertension.

The review, conducted by the Federation of American Societies for Experimental Biology, suggests that additional study be made of more than a dozen additives, including caffeine, on which there was considerable disagreement. Additional information on BHA and BHT, two widely used preservatives, was also sought, as were data on the long-term effects of vitamin additives such as iron, zinc, vitamin A and vitamin D—each consumed in ever-larger quantities.

Sanford Miller, director of FDA's Bureau of Foods, says the agency will at first act only indirectly against salt. "We'd like to see more labeling, and then some voluntary reductions by the food companies. It would be extraordinarily difficult to ban salt or to establish appropriate levels for each individual product, but we will if there is no voluntary effort."

Revlon Funds Animal Test Research

Revlon, Inc., announced it will spend $750,000 on a search for alternatives to the Draize animal test, long the standard test for consumer products that may irritate the eye. The company made its decision in the midst of a consumer boycott and protest that brought 3000 letters into its New York headquarters.

The test, which consists of pouring chemicals into the eyes of rabbits, has been attacked by animal lovers. Revlon's announcement followed by a month the observance in Europe of "Remember the Revlon Rabbit Day" and by 2 months the placing of an ad in *The New York Times* that asked, "Is another Revlon shampoo worth blinding rabbits to you?" The ad's sponsor, an animal rights group, claimed that "we have documents showing that last year Revlon victimized 2210 rabbits without any pain relief." Revlon, which is only one of many cosmetics firms that rely on the Draize test to fulfill federal safety regulation, was placed in the uncomfortable position of denying at their recent press conference that it willfully tortured captive animals.

The $750,000 Revlon grant is to be spent over a 3-year period at Rockefeller University, probably on research with tests using tissue cultures and sensitive biophysical monitoring. Revlon is not above using pressure tactics of its own. Its chairman told the press he knows that the chief executives of other companies "share our concern for consumer safety and we trust they will participate with us" in financing the research. A bill has been introduced in Congress to order the financial participation of the regulatory agencies in a search for a Draize alternative.

The next target of the Coalition To Stop Draize Rabbit Blinding Tests is the LD-50 toxicity test. In the meantime, the coalition's organizers are trying to reduce the amount of Draize testing by urging consumers to "stick to tried and true brands; don't try anything new and improved that would require evidence of safety." An official of the Washington-based Institute for Animal Problems says with feeling that "we must stop reinforcing the hysteria of innovation that is a disease of this culture."

Too Much Congressional Direction?

The waning hours of the 96th Congress provided an opportunity for some extraordinary Capitol Hill muscle-flexing in the science area. Three science agencies were subjected to undue meddling, or aggressive congressional oversight, depending on the point of view. In one instance—the authorization for the National Science Foundation (NSF)—President Carter decried Congress' detailed instructions to the agency as "a dangerous turn. . . . These provi-

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Genentech: Is Its Glamor Gone?

Stock analysts predict the future of other biotechnology firms to come

Three months after its sensational debut on Wall Street, the stock of Genentech, Inc., the recombinant DNA technology company, now hovers at about half of its all-time high of $89 that it hit on its first day of issue in October. Has the glamor faded for Genentech? What is in store for similar companies, including Cetus, Inc., which is expected to make a public offering in the near future?

Stock analysts believe that investor interest is still high for Genentech despite its big drop in selling price. Others say, however, that part of the bloom is gone.

Michael M. LeConey, a vice president of Merrill Lynch, Pierce, Fenner and Smith, says that the company's selling price slid because the market cooled off and so did interest in the firm. "Genentech is such a confusing picture. A lot of things have to be worked out," LeConey says. There are some real barriers to using recombinant DNA technology because the biochemistry is still not completely understood. "There is still the big question: Is interferon important?" he remarks.

Another securities analyst, Scott R. King of F. Eberstadt and Co., Inc., in New York, says, "It's funny. You read comments in articles about Cetus that it's no longer blue sky and daffodils for biotechnology firms. That's good. We need a little realism in the market."

Genentech shares now sell at about $40, although, on the basis of revenues, they might be worth $20 to $25, remarks Nelson Schneider, a vice president of E. F. Hutton, who specializes in health care industry research. So despite its price plunge, current selling price indicates that "people love Genentech." The price has finally settled down and found its range, Schneider says.

The analysts predict that other biotechnology companies will have a tough time matching Genentech's performance in the stock market on its first day of issue because three ingredients of its October success add up to an unlikely encore. First, Genentech was offered during a particularly bullish market, Schneider says. The company also was the first biotechnology company to go public. And the young firm kept the number of issues relatively low at 1 million shares.

Based on these criteria, Cetus, for example, is not expected to fare as well as Genentech. However, Schneider predicts that shares of Cetus will sell out and that they will sell at a premium.

Says Stephen Handley, a vice president at L. F. Rothschild, Unterberg, Towbin, one of the co-underwriters of the Cetus offering, "There is a real investor appetite for biotechnology companies." He declined to make any specific predictions.

While the new biotechnology companies represent high-risk ventures, many investors are also turning to more established, reliable stocks as well.

Shares in medical technology companies such as Becton Dickinson and Co., and Baxter Travenol Laboratories are "looking good," says LeConey. He believes that companies that will be major players in immunodiagnostic testing are the best bets.

Schneider also says that medical technology stocks have a special allure for several reasons. Their price remains relatively static because profit is determined largely by what the market will bear and not the actual cost of the product. Capital needs are low and labor is not a problem. Therefore, most technology companies can sell at higher valuation than other industries can, he says.

Schneider estimates that roughly $250 billion is available to insurance companies and pension funds for investment. About 5 percent of that goes into high-risk shares. "The party has not yet begun for new high-technology stocks," he says.—MARJORIE SUN

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particle to interact with magnetic moments of ions in magnetic materials and permits both elastic and inelastic scattering studies of these materials.

The constant dollars budget constraint forced the panel to make a choice it preferred to avoid. But, when it came down to the crunch, the panel concluded that it was the two 15-year-old reactors at Brookhaven and Oak Ridge that would continue to be the mainstays of the U.S. neutron scattering program for the next decade. (Research reactors at the National Bureau of Standards, the University of Missouri, and elsewhere would play smaller but still significant roles.) Therefore, these facilities should get the first priority in funding, enough to guarantee their continued operation and to permit modernization of instrumentation and increased utilization by scientists outside the two DOE laboratories. DOE's Kane says it is his reading of the report that it is not worth sacrificing the two reactors to the as yet unproved pulsed sources.

One problem with the pulsed sources that may have caused the panel to restrain its enthusiasm for them, as reflected in its recommendation, can be seen by contrast to other techniques such as synchrotron radiation. The intensity of ultraviolet and x-ray radiation from synchrotron radiation sources is so much greater than that from conventional sources that qualitatively new types of experiments have been made possible. So far, pulsed sources do not even match the intensity of neutron beams from reactors. One skeptical observer found it noteworthy that the neutron scattering report failed to come up with a list of crucial scientific questions that could only be answered by use of a pulsed neutron source. In addition to a unified research community, such a list would seem to be required for justification of the $100 million or more needed to build an intense pulsed neutron facility.

If adequate funds were available, the panel would have liked to see the pulsed sources under development at Argonne and Los Alamos carried to completion. The intensity of the neutron beam from the Argonne source (Intense Pulsed Neutron Source or IPNS-1) would not be high enough to make it competitive in the international arena, but it would be valuable for developing new instrumentation and research techniques. The Los Alamos source (Weapons Neutron Research facility or WNR) would have a high enough intensity to be a world-class machine in the late 1980's but not beyond. For this reason, research lead-

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ing to a dedicated high-intensity pulsed source for the 1990's should begin soon.

Under the constrained neutron scattering budget, the panel felt that only one pulsed source could be supported. Largely because so much of the Los Alamos facility is supported by funds that do not come from the neutron scattering budget, the panel felt it would be more cost effective to carry the WNR to completion and terminate the IPNS-1 program, which takes a large chunk out of DOE's neutron scattering spending. Kane says the agency will take several factors into account in addition to the report's recommendations and is not ready to close down the IPNS-1 program. For one thing, observers point out, Argonne has a considerable investment in the facility, which is scheduled to open for business this spring. For another, Argonne has seen a reactor and an accelerator closed down in recent years and not gotten much in return; it might be politically unwise to come down on the laboratory again. Argonne is now at work preparing a rebuttal to the neutron scattering report recommendation, based on the notion that, without IPNS-1, the United States would lose 5 years of experience with pulsed neutron sources.

While the near-term promise of intense pulsed neutron sources remains a bit cloudy, nearly everyone agrees that the competitive position of U.S. neutron scattering research is hurt by the lack of a mechanism for national planning for large scientific research facilities. In the United Kingdom, the Science Research Council plays such a role. The National Science Board here is charged with a similar responsibility, but in practice the board has confined itself to overseeing the National Science Foundation. In an era of research budgets that have not grown much beyond cost-of-living increases and of mission-oriented federal agencies that are not required to look after the health of science as a whole, and at a time of greater competition from overseas, this missing planning capability is seen to be a liability. As DOE's Kane says, it is one thing for the United States to deemphasize neutron scattering by choice, but it is quite another for it to drop out by default, which is what is happening now. —ARTHUR L. ROBINSON

New Niche for Science on Reference Shelf

Dictionary of Scientific Biography *is complete, gives historians of science a kind of magnum opus*

When the *Dictionary of Scientific Biography* (DSB) was being planned in the mid-1960's, it was thought that a modest four volumes would suffice. Now, 17 years, 16 volumes, and an index later, publication is complete, at least until the next supplemental volume.

In scale, scope, and scholarly ambition the DSB seems a more likely product of the late 19th century than the late 20th. Indeed its collateral ancestor is clearly the *Dictionary of National Biography*, the great Victorian tribute to eminent Britons that established the genre. But, in addition to carrying on a literary grand tradition, the DSB is a landmark work in the history of science; it has helped shape that relatively new discipline and given dignified employment to its practitioners.

The DSB statistics are striking: some 5000 individual biographies and more than 1000 authors from 90 countries. The price, too, is impressive—$695 for the full set. The fact that it is selling well—an estimated 6000 sets so far—is itself a testimonial.

The idea for the DSB was put forward in 1963 by Charles Scribner, chairman of Charles Scribner's Sons, which publishes the DSB, and a great-grandson of the firm's founder. The project, however, became a joint venture in the mixed economy of scholarly publishing.

Sponsor and copyright holder of the DSB is the American Council of Learned Societies. The ACLS landed a National Science Foundation grant for $269,000, sufficient in 1960 to create the editorial apparatus and get the writing under way. An editor in chief, Charles C. Gillispie of Princeton, and an editorial board were appointed under ACLS and, in effect, ran the project.

Scribner's became publisher of the DSB by competing successfully for the job. The DSB volumes began appearing serially in 1970, thus generating revenue for the project and royalties for ACLS.

> A group of scientific supernovae are given "book-length" essays . . . .

The grant agreement with NSF provided for repayment of government funds by ACLS from royalties. Almost half of the original grant has been paid back, but along the way ACLS has negotiated deferrals of payment in order to finance work in the project as it expanded. Now a supplemental volume is contemplated to extend DSB coverage. Work is scheduled to begin after selection of a new editor in chief. Gillispie, now in Paris on his own scholarly business, resigned last year after shepherding the DSB to completion.

The scholarly work for the DSB has been carried out mostly by historians of science in this country and abroad. The close links between historians of science here and in other countries made it possible to achieve broad international cooperation.

Perhaps the most severe test of that cooperation occurred over biographies of Russian scientists. Soviet historians of science were amenable to participating. Under arrangements made through the Soviet Academy, Soviet scholars took principal responsibility for Russian entries. This gave the DSB access to experts on Russian science, of whom there are relatively few in Europe and the United States. The Soviets, however, insisted on the inclusion of essays on Marx, Engels, and Lenin, focusing on science in the works and thought of each. The editors acquiesced, though only on condition that all entries meet the same editorial standards. The biographies of Marx and Engels were written by Robert S. Cohen of Boston University.

Action on perhaps the thorniest ideo-

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