recent science newsletter

Center for History of Recent Science, The George Washington University — Vol. 3, No. 1— Fall 2001

Beyond the ivory tower

Science and Technology Studies at the Institute for Advanced Studies on Science, Technology and Society, in Graz, Austria

Maria Rentetzi

How, if at all, does the work in social and cultural studies of science and technology make a difference outside academia?[1] How do different approaches challenge, reproduce, or otherwise participate in everyday modes of theorizing about science? This two-part question, asked of me recently in my preliminary exams, is a graduate student's nightmare.

During my reading I came across an interview that Ivan Illich had given to Carl Mitcham.[2] Illich served as a Visiting Professor of Science and Technology Studies (STS) at Penn State and as early as the nineteen-seventies was one of the first scholars arguing for the importance of STS programs in the United States. Recently, however, he has claimed that science and technology studies have outlived their usefulness. Science and technology studies programs no longer have the authority they had during the sixties and seventies, he says: "By continuing to promote their original assumptions regarding science, technology and society, STS programs were no longer promoting insights, but illusion."[3] As Illich emphasizes, a central argument made by STS scholars in the seventies is considered obvious today: technologies are political choices with often catastrophic consequences. In the past, STS functioned as a reform movement of a number of left-wing intellectuals who harshly criticized governmental decisions, such as technological choices involving nuclear weapons. STS scholars had agendas of social reform, of resistance and political action. By the nineteen-nineties, STS had been transformed into an academic discipline and political involvement was marginalized.

Must we give up the idea that STS is a political arena and limit ourselves to theoretical conclusions about science and technology? Or, worse, is the field obsolete?

At a first glance Illich seems to have a point. Science-studies scholars have criticized their own field and work as being too academic. Their language tends toward jargon: social constructivism, actor-network theory, ethnomethodologies, strong program, standpoint theories. Their arguments are mostly with one another now, dealing with abstruse and technical points of interpretation rather than matters of wider social concern. The lines have been drawn on those bigger issues. Not surprisingly, the discussion remains mainly inside the field. This could justify Illich's assessment that "the very idea that education prepares people to exercise a public or citizen responsibility seems a thing of the past."[4] How then does this work inside STS make a difference outside of it? Must we give up the idea that STS is a political arena and limit ourselves to theoretical conclusions about science and technology? Or, worse, is the field obsolete?

I believe that STS was and still is a cultural and political project that can help society first to understand and then to

continued on page 10

[1] I would like to thank Gary Downey for posing the questions I discuss here and also for letting me borrow freely from his ideas. I am also grateful to Spyros Petrounakos and Nathaniel Comfort for their editorial comments and help. To Ines Oehme and Bernhard Wieser I owe my sincere thanks for discussing their work and views with me as well as for their hospitality.

[2] "The End of Science, Technology, and Society Programs: Report on a Conversation with Ivan Illich" in *Science, Technology and Society Curriculum Newsletter of the Lehigh University STS Program and Technology Studies Resource Center* Nos. 121/122, Fall/Winter 1999.

[3] Illich, "The End of Science, Technology, and Society Programs," p. 2

[4] Illich, "The End of Science, Technology, and Society Programs," p. 4.

Center News

Center Fellows

This fall, we were joined by Paula Viterbo. Paula received her Ph.D. from the State University of New York, Stony Brook, in 2000. She spent last year in Cologne, Germany, writing and doing consulting for the Max Planck Institute for the Study of Societies. She is revising her dissertation on the surprising history of the birth-control technique known as natural family planning, or the rhythm method. Her working title: *I Got Rhythm*.

Jim Strick, who spent last year at the Center as a Senior Fellow, is teaching at Johns Hopkins and Princeton.

Anne Fitzpatrick leaves the Center at the end of the semester to begin a new job at Los Alamos National Laboratory, where she will continue her research on the history of high-speed computing for nuclear weapons design, as well as pursuing her hobbies of safe-cracking and bongo-playing.

Sadly, we say goodbye to Akeisha Paxton. She brought light to the Center for a few short months, but now is relocating to Keflavik, Iceland. We wish her all the best—and hope she never gets surprised by a volcano.

recent science newsletter

Published by the Center for History of Recent Science, Department of History, The George Washington University

Editor-in-Chief: Horace Freeland Judson
Editor: Nathaniel C. Comfort
Design: Doug Behr
Administrative assistance: Akeisha Paxton

Center for History of Recent Science
Department of History
The George Washington University
801 22nd Street, NW, 4th Floor
Washington, DC 20052
202-994-1670 / 202-994-6231 (fax)
recsci@gwu.edu
RSN is posted on the Internet at
http://recentscience.gwu.edu/RSN

Geison agonistes

eulogy

The news, early last July, that the Princeton historian of science Gerald Geison had been found dead in his home was surprisingly affecting. I was not his student, wasn't particularly close to him, yet I was so shaken that I contacted all those I knew who had known him well. Several long conversations started, with others who also found themselves unable to concentrate or think of much else. Public obituaries soon neutralized this emotional acid like Pepto-Bismol: he was a brilliant scholar, a beloved teacher; he will be missed. None of this standard fare conveyed why Gerry's death had such a strong effect on people.

Gerry was a scholarly tragic hero. Not a hero in the vapid popular sense of a role model—few would consciously emulate many of his choices—but rather in the classical sense of possessing an inner nobility. The tragedy is that the very sensitiv-

Science Writing at MIT

MIT's Graduate Program in Science Writing is accepting applications for its first entering class, in September 2002. The program leads to a Master of Science degree and normally consists of one year of course work, a thesis, and an internship. Robert Kanigel, professor of science writing at MIT and author of *The Man Who Knew Infinity* and *The One Best Way,* is its director.

The program's other core faculty include:

B.D. Colen, Pulitzer Prize-winning medical writer.

Alan Lightman, author of *Einstein's Dreams.* Essays and short fiction in *Harper's,* the *New Yorker.*

Kenneth Manning, author of *Black Apollo of Science,* National Book Award and Pulitzer finalist.

James Paradis, historian of Darwinism.

Boyce Rensberger, formerly with *The New York Times* and *Washington Post*.

Applications will be accepted until February 15, 2002. For information, contact:

Graduate Program in Science Writing
Massachusetts Institute of Technology
77 Massachusetts Avenue, 14N-108
Cambridge, MA 02139
Email: *sciwrite-www@mit.edu*
Website: *http://web.mit.edu/sciwrite*
Tel: 617-253-6668
Fax: 617-452-5100

ity that gave integrity and depth to his work was ultimately his undoing. By his own public admission, he drank and smoked too much, lived too hard. The proximate cause of death was an enlarged heart, a product of his diabetes. He was 58; a healthy man might have had twenty years of scholarship ahead of him. But let's not succumb to the if-onlys—if only he'd stopped drinking sooner, if only he'd.... Like many musicians and artists, his weakness was part of him; a drain on his creativity, certainly, but it and his creativity had a common source.

According to the Princeton obituary, Gerry was born in Savannah, Illinois. In high school, he was a star basketball player (he wore basketball shoes to every jacket-and-tie function I saw him attend) and won a scholarship to Beloit College, in Wisconsin. He did his Ph.D. at Yale in the history of science and medicine, with Larry Holmes, taking his degree in 1970. He went directly to Princeton, where he spent the rest of his life.

He became a famous teacher. Students loved his candor, his compassion, his concern. His course on the history of medicine developed — this from a student in the course — into a stunning synthesis of the content of medical history and its impact on society. Through the muddle and struggle of the science wars in the nineteen-eighties and nineties, Gerry understood that there need be no conflict between internal and external influences on science and medicine. The sciences do in fact get at real principles of nature, even while they condition and are powerfully conditioned by social, political, and economic concerns.

Gerry's easy, seemingly intuitive balancing of realism and constructivism found its greatest expression in his masterwork, *The Private Science of Louis Pasteur* (Princeton, 1995). He began working on Pasteur not long after completing his first book, on the Cambridge school of physiology—a significant work, though its audience was specialists. Scrutinizing Pasteur's laboratory notebooks, he uncovered discrepancies between what the great man actually did and what he said he had done. Pasteur held an a priori commitment that spontaneous generation could not occur, which colored the experiments he performed and the way he reported them. He fudged on his famous anthrax and rabies vaccines, claiming he had developed them by one method when he actually had used another. Only the rabies incident really sustains a debate over Pasteur's scientific and clinical ethics, and none of Gerry's discoveries discount Pasteur's results.

Still, the result was iconoclastic. Gerry, like everyone else, practically idolized Pasteur. Catching Pasteur at his deception must have seemed like catching his father masturbating. Gerry spent a decade coming to terms with Pasteur emotionally. Ultimately, he refashioned Pasteur as not only a brilliantly intuitive scientist but as a canny and deliberate promoter. Neither Linus Pauling nor Edward Teller nor James D. Watson approach Pasteur in showmanship, use of the media, or selection of scientific problems with real candle-power. Self-promotion, Gerry wrote, was integral to Pasteur's fame; distasteful as it is, it is inseparable from Pasteur's greatness as a scientist. Though never sentimental or self-centered, Geison's Pasteur has more heart than any other book I know in the history of science.

For me, the book had two immensely salutary effects. It signaled the end in my mind of the science wars. Gerry showed that it was possible to engage the data of science while considering nonscientific influences on that science. He disentangled the social from the intellectual precisely because he trusted in a natural reality against which lab notebooks could be checked. The book also revalidated biography—or, rather, biographical studies—as a genre within the history of science. The study of a single individual needn't be hagiographic or distorting of history. Reading *The Private Science* as a graduate student, I suddenly saw biography as no longer stodgy but fresh and exciting. I, too, wanted to demystify without destroying, to create a portrait not in sentimental sepia but using the full spectrum of natural colors.

What a disappointment, then, to read Max Perutz's review of Gerry's book in *The New York Review of Books*.[1] Perutz is a distinguished crystallographer; his structure of hemoglobin in the 1960s was a masterpiece. He has developed a late career as a writer and reviewer, and he writes as a staunch and articulate defender of the empirical purity of science. For Perutz, Gerry was simply another academic vandal tipping over the marble statues in the Pantheon. Perutz could not have known Gerry or his struggle with Pasteur and written what he did. Gerry was reportedly deeply saddened by Perutz's review. He may have had his back turned to the Whigs. I would guess him to have been more worried about historians taking him to task for his insistence on Pasteur's greatness, a word very much out of fashion by then and Gerry's use of which stemmed from his emotional attachment to his subject.

Yet one might well bless a historian by wishing that he may be attacked from both sides. If one can make both the constructivists and the empiricists angry, one must be doing something right. The sad part of the story is not the fact of the review, which, in my circles at least, damaged only Perutz's credibility, but rather in how it hurt Gerry. The sensitivity that makes his book great became a vulnerability. That was Gerry Geison's tragic flaw.

—NC

[1] Max Perutz, "The pioneer defended," *New York Review of Books,* 21 December 1995.

Anthrax: A model organism

Nathaniel C. Comfort

Anthrax has gotten a bad rap lately. To be sure, for the last seventy years or so it has been associated with germ warfare. The notorious Unit 731, a Japanese outfit stationed in China in the 1930s, developed anthrax as well as cholera, plague, and other diseases as bioweapons. In 1979 it was released accidentally in the Ural mountains and on purpose in Rhodesia (now Zimbabwe). And yes, it has been a nuisance for sheep and cattle ranchers for centuries. It may even have been responsible for the biblical fifth plague of Egypt. But why has no one mentioned recently its distinguished position in the history of medicine? *Bacillus anthracis* can be fairly said to have inspired the modern germ theory of disease.

For centuries, the disease anthrax had been a real puzzler. Once established within a herd of livestock, it spread quickly, killing essentially every animal that contracted it. It thus fit the pattern of contagious diseases. Yet certain districts or pastures appeared to be associated with recurring but intermittent outbreaks; the disease evidently had something to do with soil conditions. Though it was mainly a disease of livestock, humans could get it, too; the worst form developed in the lungs and was known as "wool-sorter's disease." In 1863, the French scientist Casimir-Joseph Davaine isolated the rod-shaped bacillus we now associate with the disease, but it remained far from clear whether it was the cause, a cause, or a by-product.

In the early 1870s, Robert Koch, the District Medical Officer for Wollstein, Germany, began investigating the bacillus in his home laboratory. Thirty years earlier, Koch had trained with the great anatomist Jacob Henle, who believed that diseases were caused by microscopic organisms. Koch set out to determine whether in fact the bacillus discovered by Davaine was the cause of the disease anthrax, which was a significant agricultural nuisance in Wollstein and elsewhere. Koch dipped slivers of wood into the spleens of mice recently dead of anthrax and used the slivers to inoculate healthy animals; the mice developed anthrax. Next, Koch cultured the germs—in the vitreous humor of an ox's eye. He described the morphology and the life cycle of anthrax, and showed that this culture could still cause the disease even after several generations. Koch also described the anthrax life cycle, in which spores may lie dormant for long periods—months or years, as it turns out—before germinating into the infectious rod-shaped bacilli. He published these results in 1876, with further refinements and detail two years later. Out of these experiments grew Koch's famous postulates for determining whether or not a given germ causes a particular disease. Anthrax became the first germ to be specifically and uniquely associated with a disease. Koch then traveled to India, where he carried out research that led to his isolation of the cholera bacillus, published in 1883, for which he became world-famous.[1]

Meanwhile, France's principal advocate for the germ theory, Louis Pasteur, saw in anthrax the combination of scientific interest, economic importance, and public-relations appeal that he looked for in a research project. Pasteur was by this time famous as the debunker of spontaneous generation (and therefore of a radical materialist challenge to Christian theology) and preserver of French wine. On 29 April 1878, he read, before the French academy of sciences, that "The sciences gain by mutual support. When, as the result of my first communications on the fermentations in 1857-1858, it appeared that the ferments, properly so-called, are living beings, that the germs of microscopic organisms abound on the surface of all objects, in the air and in water; that the theory of spontaneous generation is chimerical; that wines, beer, vinegar, the blood, urine and all the fluids of the body undergo none of their usual changes in pure air, both Medicine and Surgery received fresh stimulation. A French physician, Dr. Davaine, was fortunate in making the first application of these principles to Medicine, in 1863."[2] Pasteur was endearingly chauvinistic. He meant that *French* science gains by mutual support. He made no mention of Koch's work; the German and the Frenchman in fact became bitter rivals.

when history me

At any rate, Pasteur had become convinced that diseases, like ferments, originated in so-called microbes—"the new and happy term introduced by M. Sedillot"— and that anthrax provided an excellent vehicle for testing this theory. So, after making it clear that Davaine's work derived from *his* and not the other way around, he too cultured the anthrax bacillus. Pasteur developed a vaccine against anthrax by gradually attenuating a strain of the bacteria. Although famously an example of attenuation by exposure to oxygen—the significance of which had deep theoretical connotations to early germ theorists and their opponents—Gerry Geison has shown that the attenuation was actually produced by exposure to potassium bichromate. In January 1880, Pasteur announced that he had discovered an anthrax vaccine.

[1] "Robert Koch," *http://www.nobel.se/medicine/laureates/1905/koch-bio.html.*

[2] Louis Pasteur, "Germ Theory And Its Applications To Medicine And Surgery," Comptes rendus de l'Académie des Sciences 86: 1037-43, translation by H.C. Ernst online at *http://www.fordham.edu/halsall/mod/1878pasteur-germ.html.*

policy matters

Scouting report: John Marburger

Michele S. Garfinkel

Little noticed in the recent terror-related business of Washington, on 21 September John Marburger was officially nominated by President Bush to head the Office of Science and Technology Policy. Confirmed on 23 October, he became the fifteenth person to lead OSTP and thus acquire the informal title of "science advisor."

Current events—including global warming, stem cells and cloning, and the distribution of anthrax through the mail—suggest that science advice is needed now perhaps more than ever. Yet interested observers have noted that the Bush administration's sluggishness on making crucial science and technology policy-related appointments—presidential science advisor, Commissioner of the Food and Drug Administration, Director of the National Institutes of Health—stands out in a field of slow appointments. Apparently confirming fears that President Bush values science perhaps less than any president since Richard Nixon, Marburger was denied the official title of Assistant to the President for Science and Technology.[1] This deprives him of the near-Cabinet-level status of, for example, the National Security Advisor. What does this apparent apathy mean both for John Marburger and for US science and technology policy?

American presidents have long sought advice, formally or informally, on science. The best known of the informal advisors was Vannevar Bush, whose official capacity was as chair of the National Defense Research Committee, under Franklin Roosevelt. V. was so powerful in his role that some have joked that the George Walker White House is actually the third Bush administration.[2] (There appears to be a collateral genealogical link, but W. is not a direct descendant of V.) Harry Truman appointed William Golden, then an investment banker but who just stepped down as head of NASA, to review science policy. He recommended against reconstituting the Rooseveltian Office of Scientific Research and Development, and instead advocated the appointment of a full-time science advisor and presidential science advisory committee. Oliver Buckley retired from the presidency of Bell Labs to take the post. In 1957, in the aftermath of Sputnik, Dwight Eisenhower appointed James R. Killian, yet another former president of MIT, as his science advisor. Though Killian was known as the "missile czar," by 1973 sentiments had changed; Richard Nixon abolished the post as a pre-emptive strike against anti-missile activists.

Established in 1976, OSTP is a peacetime creation. It is to "serve as a source of scientific and technological analysis and judgment for the President with respect to major policies, plans, and programs of the Federal Government."[3] Most generally interpreted, the purpose of OSTP is to coordinate and propagate cross-agency and cross-disciplinary approaches to science and technology, although there is little evidence that this mission has been successfully performed; territorialism still abounds.

Like many of his predecessors, Marburger is a physicist. When he was tapped, he was Director of Brookhaven National

continued on page 8

[1] C. Mooney, "The Bush Administration Snubs Its Science Adviser," *The American Prospect* 12 (December 3, 2001).
[2] C. Vest, "Welcome and Remarks," OSTP 25th Anniversary Symposium, 1 May 2001, Cambridge, MA. Transcript available at *http://web.mit.edu/newsoffice/nr/2001/ostpcmv.html.*
[3] Public Law 94-282, National Science and Technology Policy, Organization, and Priorities Act of 1976.

---

ets science

Pasteur's public test of this vaccine is among his most famous achievements.[3] Challenged by Hippolyte Rossignol, a veterinarian and opponent of the germ theory, Pasteur staged a demonstration at Rossignol's farm, near Pouilly-le-Fort, southeast of Paris. On 5 May 1881, he injected 25 sheep with his attenuated anthrax; on 17 May, he injected them again, with bacteria that were somewhat more virulent. Then, on 31 May, he injected all 25 vaccinated animals as well as 25 unvaccinated sheep with highly virulent anthrax germs. Pasteur predicted publicly that all the vaccinated sheep would survive, while all the unvaccinated animals would die. The 50 sheep were taken to Rossignol's farm to await their fate. On 2 June, the predetermined conclusion of the trial, Pasteur rode the train to Pouilly-le-Fort, having been assured in advance of the success of the trial by Emile Roux, his assistant. Indeed, the vaccinated sheep were still standing; the unvaccinated were all either dead or moribund. Never mind that the vaccine he used differed from that which he reported to the French National Academy. This, the first public test of a laboratory vaccine, was reported throughout France and across Europe. Anthrax, then, brought Pasteur more than fame: it established his reputation as one of the largest figures in the history of science.

Nathaniel C. Comfort is Deputy Director of the Center for History of Recent Science.

[3] This account is derived primarily from Gerald Geison, *The Private Science of Louis Pasteur* (Princeton, 1995), chap. 6.

Biography of a living molecule

Gunther S. Stent

By the end of the twentieth century, molecular biology had become the dominant discipline of the life sciences. Most other areas, not only of pure biological but also of applied medical and agricultural research, had come to depend on it for a basic understanding of the phenomena within their purview. Molecular biology now pervades the life sciences so completely that it is no longer identifiable as a particular research discipline. No wonder then that the historiography of molecular biology has turned into a major cottage industry, threatening to displace physics as the favorite topic for study by historians of science.

As a result of these historical labors, the lives and works of some the founders of molecular biology, such as Linus Pauling, Jacques Monod, James Watson, and Francis Crick, became so well known that their names can now be found in most introductory biology textbooks, along with such all-time greats as Carl Linnaeus, Charles Darwin, and Louis Pasteur. Thus, nowadays, young, aspiring historians of science in need of a respectable publication record must turn to other, hitherto less explored personalities who, though they too played vital roles in the rise of molecular biology and even enjoyed considerable fame in mid-twentieth century, no longer loom large in the canonical story of molecular biology presently retailed to the general public.

In her *The Life of a Virus*, Angela Creager, an Associate Professor of the History of Science at Princeton, reviews the importance of the studies of tobacco mosaic virus (TMV) by one such lately marginalized proto-molecular biologist, Wendell Stanley. He and his associates started this work at the Princeton laboratory of the Rockefeller Institute for Medical Research in the nineteen-thirties and continued it from the fifties into the eighties at the Virus Laboratory on the Berkeley campus of the University of California. TMV, the infectious agent of the mosaic disease of tobacco plants, was discovered in the closing years of the nineteenth century, as the first example of the category of subcellular infectious agents now known as viruses. They are too small to be seen in ordinary microscopes and cannot be grown in cell-free artificial bacteriological media.

book review

In the wake of the discovery of TMV, an ever-greater number of viruses were identified, which included the causative agents not only of several plant diseases but also of such human scourges as yellow fever, poliomyelitis, smallpox, measles, and rabies. Thus, the viruses responsible for many of the most dreaded ailments known to have plagued mankind since ancient times were finally identified and brought under control. But during that heroic medical era, the study of viruses contributed relatively little to the basic life sciences.

Creager provides an account of how Stanley, who had been trained as an organic chemist at the University of Illinois, decided to determine the chemical structure of viruses, to find the key to understanding how these subcellular agents manage to infect their host organisms and reproduce themselves. Stanley thought that of all the viruses then known, TMV would be the most suitable for his intended structural analyses. And so he set out in nineteen-thirties to isolate and purify the infectious agent from the juice of TMV-infected tobacco plants. By 1935, Stanley had managed to obtain a crystal of proteinaceous particles that were endowed with the infectious pathogenic power of TMV.

Wendell St tobacco r opened th long, the r reproducti terms of

Stanley's discovery that TMV is a protein (for which he shared the 1946 Nobel Prize in chemistry) caused a tremendous sensation. It seemed to many biologists that, if their structure is so simple that they can be crystallized like so much table salt, viruses must be so-called living molecules rather than organisms. Indeed, Stanley's finding, more than any other prior to elucidation of the DNA double helix by James Watson and Francis Crick, paved the way for the rise of molecular biology. It suddenly opened the prospect that, before long, the nature of biological self-reproduction might be understood in terms of molecular structure. The finding made shortly thereafter in England, by Frederick Charles Bawden and Norman Wingate Pirie, that the crystalline TMV particle isolated by Stanley is not really a pure protein but comprises about three percent percent RNA, did not greatly diminish the general excitement over Stanley's identification of a living molecule.

In the nineteen-forties and fifties, Stanley's associates, as well as others inspired by his pioneering work, applied some novel biophysical methods, such as ultracentrifugation, X-ray diffraction, and electron microscopy to the structural characterization of the TMV particle. These studies showed that TMV is an oblong tube 300 nm in length and 18 nm in diameter, whose wall is formed by a helical array of many identical protein subunits and whose hollow central core accommodates a single RNA molecule. In the presence of alkali or acid, the

The Life of a Virus: Tobacco Mosaic Virus as an Experimental Model, 1930-1965

by Angela N.H. Creager, University of Chicago Press, 352 pp., $80 (cloth) /$27.50 (paper).

TMV particle was found to dissociate into its protein subunits and RNA molecule and to lose its infectivity. Further study of the products of this dissociation process by Heinz Fraenkel-Conrat and Robley C. Williams, two of Stanley's associates, led to their making an exciting discovery in 1956. Upon returning the solution containing a mixture of dissociated TMV protein subunits and isolated TMV RNA molecules to neutral pH, they found that the virus particles not only reconstitute their native tubular structure but also regain their erstwhile infectivity. This reconstitution experiment, like Stanley's crystallization of TMV twenty years earlier, made a big impact in its time, because it appeared to mean that in the Berkeley Virus Laboratory a living molecule had been crated *in vitro* from nonliving ingredients.

tanley's crystallization of mosaic virus suddenly e prospect that, before nature of biological self- on might be understood in molecular structure.

Besides being rejected *ex cathedra* by Pope Pius XII, this exciting interpretation of the TMV-reconstitution experiment was also weakened by a perplexing observation. Although the dissociated TMV protein subunits were devoid of any infectivity, the same could not be said for the isolated TMV RNA molecules. Their fraction always contained a low but significant capacity to cause the mosaic disease. This led Fraenkel-Conrat to conjecture in 1956 that the free TMV RNA alone is capable of initiating virus growth and that the increase in infectivity observed in his and Williams's TMV reconstitution experiment was to be explained by a more prosaic notion, namely that incorporation of the viral RNA molecule into a protective helical array, or shell, of viral protein merely increases its chance of actually infecting the tobacco plant. In that same year, Alfred Gierer and Gerhard Schramm, working in the Institute for Virus Research of the Max-Planck-Gesellschaft, in Tübingen, Germany, had independently reached the same conclusion and demonstrated more definitively than had Fraenkel-Conrat that its RNA *is* the "living" component of the infectious TMV particle.

Upon the discovery in 1956 of the autonomous infectivity of TMV RNA it became necessary to revise the secondary role ascribed to RNA in the 1950s by the first generation of molecular biologists. Contrary to the accepted view, RNA turned out to be more than a mere transient, intermediary transcript of genetic information permanently encoded in DNA and serving only as the template for the orderly assembly of polypeptide chains. RNA, no less than DNA, turned out to be capable of self-replication. Thus an "RNA world," a life without DNA, had become at least conceivable.

Creager's *The Life of a Virus* is a thoroughly professional, well-researched historical account of an important, hitherto insufficiently examined aspect of the rise of molecular biology. Moreover, she is especially qualified to treat the history of TMV research, since she carried out her doctoral studies in molecular biology in Berkeley at Stanley's virus laboratory. One of the outstanding features of Creager's account is her extensive use of archival material, especially of unpublished correspondence and research and administrative reports made publicly available by many protagonists of her story. Her most important archival source was the collection of Stanley's papers deposited in Berkeley's Bancroft Historical Library. Although I consider myself an expert on Wendell Stanley's person after my professional association with him for more than twenty years, there were many things I learned about my former chief from Creager's diligent and intelligent analysis of that material. I strongly recommend *The Life of a Virus* to anyone interested in the origins of molecular biology.

Gunther S. Stent is Professor Emeritus of Neurobiology, University of California, Berkeley, CA. His Nazis, Women, and Molecular Biology: Memoirs of a Lucky Self-Hater *(Briones Books, 1999) was reviewed in* RSN 2.2 *(Fall 2000).*

continued from page 5

Laboratory; he was also president of the Stony Brook campus of the State University of New York for 14 years and has a longstanding interest in science education. Further, he has expressed concern about being responsive to a public that is "increasingly concerned about the undesirable side effects of technology." Marburger was for a while perhaps the most well-known head of a national laboratory. He dealt with two public and controversial aspects of Brookhaven: the debates over shutting of the reactor and over the Relativistic Heavy Ion Collidor (RHIC). Concerns about the safety of the Brookhaven reactor received special attention in the press because of the worries of Brookhaven's activist—and in some cases famous—neighbors (the Lab is just miles from the Hamptons, that bastion of celebrity, conservative portfolios, and liberal politics). The RHIC report received international media attention. The *Times* of London, for example, reported that collisions at the subatomic level produced at RHIC would have the capability to create a black hole, which would subsequently suck up the earth. Many scientists might counter such concerns with charges of scientific illiteracy. Marburger, however, ordered a study and report on RHIC in 1999.[4] His willingness to confront such challenges suggests that he may be genuinely interested in the interactions of science, scientists, and the public. Further, it suggests an understanding that public policy should not necessarily be dictated by science, no matter how weighty or exciting that science is.

What does a US president's science advisor do? Who would want such a job?

Marburger says he will stick to providing scientific and technical, not ethical, advice. On stem-cell research, for example, he says "no one doubts stem cells are valuable to research and hold tremendous promise—on that, there's no scientific controversy." But he adds that the matter "is not going to be decided by science."[5]

What is this OSTP head's job, then, if these matters of public policy will be decided by criteria other than the science itself? There is no reason to suppose that Marburger will be any more or less involved than earlier OSTP heads. Whether that is a good or a bad thing remains to be seen. Science advice is readily available from many outlets: the National Academies, RAND, various think tanks, etc. Further, the needs of small sectors of society are already well represented in Washington. For example, industry's concerns can be voiced through the President's Council of Advisors on Science and Technology; researchers' concerns through various lobbying efforts (and, in the case of researchers at the National Institutes of Health, through a devoted Congress). What needs most to be emphasized in the role of head of OSTP is the representation of society as a whole.

Marburger's potential for this, judging from, for example, his record of concern for his Brookhaven neighbors, is high. Still, a peek into how he might actually approach particular issues may be had in his first nomination hearing, which took place before the House Committee on Science on 9 October.[6] He mentioned the necessity of making choices within the parameters of limited resources (money and talent) and of course alluded to the desire to use science to promote health and peace. But what comes through most strongly in the text is a belief in the totems of modern science: peer review, increasing funding for R&D, the value of economic spillovers from such investment, and so forth.

Further, his view of the relationship between science and policy (that is, that science should inform policy, with no mention of the inverse) indicates that he will work to maintain the status quo. This is particularly clear in the area of health. "Genetic medicine offers us the greatest hope, but the ethical, legal, and social implications of human genome research must also be addressed," he says. "Our newest technologies must always incorporate our oldest and most cherished human values." Even limiting this analysis to the domestic American situation, it is flatly wrong to assume that genetic medicine will cure what ails us. Our ills are derived from a crumbling public-health structure and an appalling lack of access to medical care; the science advisor should not—cannot—ignore these issues. But even with the current awareness of the globalization of health and environment problems, Marburger does not seem to acknowledge, at least in this opening statement, that these matter and that we, as a society, should concentrate on them. This is perhaps not entirely unexpected for a potential OSTP head, but it is disappointing, considering earlier hints that he understood how science and technology proper should fit with societal needs.

Michele S. Garfinkel is a research scholar at the Center for Science, Policy, and Outcomes, in Washington, DC.

[4] J. Marburger, "Committee Report on Speculative 'Disaster Scenarios'" at RHIC," (6 October 1999) *http://www.bnl.gov/bnlweb/rhicreport.html.*
[5] A. Lawler, "President's New Adviser Ready to Put Science in Its Place," *Science* 292 (2001): 2408-2409.

[6] The text of Marburger's statement is available at *http://www.aip.org/enews/fyi/2001/127.html.*

Online History

The History of Recent Science and Technology Project

Michael R. Dietrich

For historians of science and technology, the internet is already a source for expanding digital libraries and archives. Under the auspices of the Sloan Foundation and the Dibner Fund, the History of Recent Science and Technology Project (HRST) is also contributing new online collections. However, unlike most passive digital collections, the HRST sites use the internet as a place of active collaboration between scientists and historians. The goal is not to produce an authoritative historical narrative, but to engage scientists in the historical process and stimulate them to contribute to their own recollections and analyses. Given the number of scientists engaged in recent science and the pervasiveness of digital communication, the HRST project seeks to develop new tools for collecting and creating the history of recent science.

saving the sources

Begun in the spring of 2000, the HRST project focuses on five areas of recent scientific and technological research: bioinformatics, materials science and engineering, the physics of scales, molecular evolution, and the Apollo guidance computers. While each of these areas has its own collaborative activities and content, they are integrated and presented through a primary website (*http://hrst.mit.edu*). Similarly, each area has its own staff and advisory board. Jed Buchwald serves as the project's principal investigator and Babak Ashrafi is the project manager.

For the historians engaged in each of the five sites, the HRST project has presented a number of challenges. For many of us, mastering the science we were trying to understand took a back seat as we learned new computer programs, new computer languages, and more about copyrights and permissions than we thought possible. Because the websites are intended to be ongoing sites of collaboration, we also had to reconsider the nature of the sites vis-à-vis history. The temptation to create a comprehensive historical narrative had to be replaced with new ways of soliciting contributions from scientists and from other historians. The sites that result will contain a wide range of sources, narratives, and analysis.

Although the five subject sites in the HRST project share similar structural features, the strategies pursued by each team are slightly different. The physics-of-scales site, for instance, is experimenting with a type of online commenting system for historically significant documents. This system would allow authors to comment on the development of key papers and allow audience members to comment on their recollections of historically significant lecture or conferences. Tim Lenoir's group, working on the bioinformatics site, is experimenting with an interactive timeline as a format for organizing collaboration. Bernadette Bensaude-Vincent and Arne Hessenbruch's materials-science site presents the input of a number of scientists in interview transcripts and digital video clips of scientists and their laboratories. The Apollo guidance computer group, working with David Mendel, have brought together scientists and historians in small conferences to discuss specific historical questions. Transcripts of the meetings have been edited and posted and digital videos of portions of the discussion are being prepared.

As a member of the molecular-evolution site, I have been involved in the creation of a digital archive and static webpages, as have members of other sites. In order to make our subject area more manageable, we decided to focus our attention initially on the neutralist/selectionist controversy. Because this debate continues today, we hoped that scientists would be more willing to contribute. Accordingly, we are emphasizing online discussion forums as places for participants to comment about various key events in the controversy. We are beginning with a discussion of the early responses to two papers, one by Motoo Kimura in 1968 and the other by Jack King and Thomas Jukes in 1969. These papers first championed neutral molecular evolution, or, as it was then called, non-Darwinian evolution. Using citation analysis as a guide, we have invited 150 scientists to share their recollections of how and why they responded to these two papers. If this experiment is a success, other discussions will follow. Undoubtedly, as the sites develop over the next two years each will learn from the others' experiments and together we will articulate new strategies for creating online history of science and technology.

*Michael R. Dietrich is an Associate Professor in the Department of Biological Sciences at Dartmouth College and a Co-Investigator on the Molecular Evolution site of the History of Recent Science and Technology project (*http://hrst.mit.edu*).*

continued from page 1

solve problems involving science and technology. The difference between the STS scholarship in the early period of the nineteen-sixties and seventies and that of today has to do with the different ways in which scholars attempt to achieve these social ends. Theorizing about science and technology is as political as demonstrating in the streets against the use of a certain technology. In other words, to borrow from feminist activists, the personal is political and resistance need not have the shape of a big movement.

Today I see STS as the intermediate space where exchanges of ideas and experiences are taking place, where senior scholars and young students discover their own ways of resistance to everyday challenges of computerization, of biotechnology, or medicine—to name just a few. They add to their agenda the theorizing of the pathways through which new ideas and modes of resistance travel into the outer world and then scale up, gaining force and, legitimacy at the same time.

STS is no longer a reform movement, if by this one means that it changes the big politics of recent science and technology.

My model for this application of STS is the Institute for Advanced Studies on Science, Technology and Society, in Graz, Austria, where I had the opportunity to spend a year on a fellowship. The Institute is academically connected to two others. The first, the Institute for Interdisciplinary Studies of Austrian Universities—Klagenfurt, Vienna, Innsbrück and Graz (IFF)—was established in 1979. It emphasizes interdisciplinary research on social issues, with a focus on education and teaching methodologies including science. A decade later, the Inter-University Research Center for Technology, Work and Culture (IFZ) was formed as a unit of the IFF's Department of Research on Science and Technology. At the time a few politically-aware students of the Technical University of Graz organized a series of lectures dealing with technology assessment. Viewing technology as a social project, they claimed that the choice of a technology could have political consequences and often a harmful impact on society. On their initiative, the informal lectures grew into a newly established institute that supported interdisciplinary research on the social shaping of technology. Their first project was in collaboration with the mayor of the city of Graz, advocating the use of "greener" products for the municipality. At that time IFF offered them academic affiliation.

To develop and refine theoretical approaches to science and technology is one aspect of science and technology studies. However, IFZ researchers try rather to intervene in the process of technological change and to develop practical strategies to interfere with and influence decision-making procedures. This is why they needed an organizational and institutional framework that could support the development of socially and environmentally sound technology.

Research at IFZ is highly practical and focuses on the assessment of ecological products and environmentally sound procurements, energy and climate, modern biotechnology, women-technology-environment, history of technology, and environmental history. I had the chance to interview Ines Oehme, a German chemist working at IFZ since 1997 and the coordinator of the ecological-product assessment group. In this group, four chemists and a sociologist with training in philosophy work together to develop assessment criteria for products and technologies used by private companies and public institutions. Ecologically sound procurements are not only a necessity imposed by the European Union but an initiative of politically aware and ecologically sensitive researchers. As Oehme argues, "the impact of our work is not that big, but as long as people ask for our support—if, for example, purchasers are using the criteria we develop—we have an effect on society."[5] Often this sort of political strategy, adopted not in the sense of big politics but as everyday practices, make a real difference outside academic disciplines and sterile intellectual groups. Insofar as science and technology are inextricably intertwined with politics, economics and ethical issues, STS research is not value-free and cannot be circumscribed in scholarly discussions.

Indeed most of the IFZ's projects reach the public, stimulate a discourse among scientists, industrialists, academics and politicians, and propose an alternative way of dealing with both science and technology. The IFZ group that works on biotechnology is an instructive example. The biologists Armin Spoek and Andreas Loining and the pedagogue Bernhard Wieser look at modern biotechnology and especially genetic engineering as an issue of public understanding of science and adult education. According to Wieser, their "idea of doing it is

[5] Interview conducted by the author on 5 February 2001

not to have a deficit model where you think the public does not have knowledge and should receive it from the science side but rather an interactive model. Such a model is crucial for our understanding of education. Knowledge does not go from A to B but it is a dialogue, an interactive process."[6] Through their projects, the biotechnology group tries to motivate the relevant players, to stimulate networking among them and to democratize the decision-making process.

Gender issues are also central for the IFZ researchers. Christine Wächter, a founding member of IFZ who has studied the history of art, linguistics, and technical engineering, runs an annual one-week technology information program in collaboration with the Technical University of Graz for female secondary school students. Motivated by the low percentage of women in engineering, Wächter runs this program and organizes women-specific workshops and research projects with the aims of motivating women in technical training and undercutting gender biases related to technology.

While research at IFZ has a more practical orientation, the Institute for Advanced Studies on Science, Technology and Society, the *Kolleg* as we call it, is its academic face. Austrians have a unique ability to create complicated academic structures and mingle theory with practice. The Kolleg was formed in 1998 as a fellowship program aiming to attract young researchers in the field of science and technology studies. Funded by the Federal Ministry of Science and Transport, the Province of Styria, and the city of Graz, the core of the Kolleg is the six or seven international fellows who study there each year. As Wieser, the executive manager of the Kolleg, describes it, "Our interest was to attract the academic community. It is institute policy. With an academic background it is easier to acquire a project. That is a practical reason. The other one is a matter of interest. We have quite a variety in our researchers and some of us are interested in both the practical and the academic aspects of STS at the same time."[7] Moreover, as most of the IFZ researchers admit, they saw the Kolleg as a chance to come into contact with other research institutions through the fellows.

I started my fellowship last October. From the first moment I was overwhelmed by the charm of Graz, a lovely city filled with students as well as impressive Baroque and Renaissance architecture. I enjoyed the hospitality of the IFZ researchers and the intellectual challenge that the institute offered. Six other fellows arrived within the next two months, from different countries and with different research projects. A sociologist, an economist, a political scientist, a gender-studies scholar, a philosopher of technology and a "pure" STSer came together in what at first seemed a tower of Babel. Juggling so many different research themes forces us to overcome the boundaries of our own disciplines and understand the research problems and the agendas of our colleagues. Babel turns into an interdisciplinary forum where ideas are exchanged and a critical scholarly dialogue emerges. Twice each month the fellows meet and discuss their work progress and their interests. Wieser, the soul of the Kolleg, joins our discussions regularly and shares his knowledge and experiences as an STS scholar in Austria. He is the active link between the two affiliated institutes. The information about our interests and work flows both ways from the IFZ researchers to the fellows and back. The fellows' discussion usually continues at a local bar where, as all academics have experienced, real and interesting exchanges can take place in a more relaxed and informal way.

In its bulletin, the Kolleg is described as a place where "international fellows can make valuable contributions to exploring the complex issues related to science, technology and society." Technology is not simply a tool or applied science, says the mission statement, nor is science simply an accumulation of knowledge. Rather, science and technology are always characterized by their entrenchment in society. Scientists researching into the links and interactions between science, technology and society will find ideal conditions and a stimulating research environment at the Institute." Indeed, I have experienced strong encouragement to deal with the fear of thinking and writing my own ideas.

A few months after my first day in Graz I realized that in an important sense Illich is wrong. I acknowledge that STS is no longer a reform movement, if by this one means that it changes the big politics of recent science and technology. I see it as an intermediate domain where scholars and other researchers meet in order to exchange ideas, experiences, ways of living and of resisting dominant images of science and technology. It is this cultural, intellectual, and political arena where personal practices gain the support of other colleagues, are criticized, and are transformed. Theorizing about science and technology, in all of their aspects, emerges from this exchange within "Babel towers" where boundaries are drawn and abolished every day by each of us.

Maria Rentetzi is a Ph.D. candidate in Science and Technology Studies at Virginia Polytechnic and State University.

[6] Bernhard Weiser, interview with the author, 27 February 2001.
[7] Weiser interview, 27 February 2001.

recent science newsletter

in this issue...

recent science newsletter
Center for History of Recent Science
Department of History
The George Washington University
Washington, DC 20052

Non-Profit Org.
U.S. Postage
PAID
Washington, DC
Permit No. 593