[back] SV40

Extracts from Edward Shorter's The Health Century about Dr. Bernice E. Eddy, whose lab tests found that the Cutter vaccine had been improperly inactivated and contained a cancer causing monkey virus--SV40.

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one must be immunized against all three. Various researchers, using Enders's new tissue culture techniques and supported by the polio foundation, figured all this out by 1951. After that, to prepare a workable vaccine one needed only establish how to neutralize the virus so that it wouldn't give its recipients polio, and the problem would be solved.

Among the various scientists who plunged now headlong into this mission, Jonas Salk of the university of Pittsburgh gained the lead: by 1953 he had shown that his vaccine of killed virus immunised safely against all three types. In a meeting in January 1953 of the March of Dimes Foundation's scientific advisers at Hershey, Pennsylvania, a distinguished virologist named Joseph Smadel urged Salk, "What are you waiting for? why don't you get busy and put on a proper field trial?" Salk then started large-scale testing of his vaccine, as O'connor beamed. Nobody outside foundation offices knew exactly what was happening.[25]

Rather than staging a long series of careful field trials with appropriate scientific evaluation, Salk darted ahead on his own in the remainder of 1953 and 1954. The trials were successful. The foundation released the results to the press, and such were the nation's expectations that from that point there was no turning back. In August 1954 the foundation ordered five drug companies to begin producing mass lots of vaccine, on the basis of a formula for inactivating the virus with formaldehyde, according to a procedure Salk himself had devised. It must be stressed that the NIH's own vaccine laboratory would certify the Salk inactivated vaccine as safe for distribution to the public. On April 12, 1955, the first lots of vaccine were shipped.[26]

James Shannon remembered very well what happened next. At this point he had become the associate director of the NIH. "I was working over the weekend and I got a telephone call from Los Angeles, and this is eight or nine o'clock on Friday night. It was the Hearth officer of the city of Los Angeles and he said they lust had two reports of polio in some children who had been vaccinated nine days earlier. He wanted to know what should be done about it?"

One of the companies that contracted to make the vaccine, the Cutter laboratories in Berkeley, California, had released several lots of vaccine that had been improperly inactivated. Live polio virus was being injected into children. The gratitude of the public turned to horror, as the cutter vaccine gave polio to almost 80 recipients; these children in turn went on to spread the disease to another 120 playmates and relatives; three quarters of the victims were paralysed and 11 died.[27]

We dwell upon this grim incident because of its impact upon the history of the National Institutes of Health: it shows why good scientific leadership, able to resist both the pressures of Congress and the media, is so important. It is little known that NIH's Laboratory of Biologics Control, which had certified the Salk vaccine, had received advance warning of problems. And that warning came from its staff microbiologist, Dr. Bernice Eddy.

Dr. Bernice E. Eddy, whose lab tests found that the Cutter vaccine had been improperly inactivated.

In 1954 Eddy was fifty-one years old. Born in a mining town in West Virginia, she got a Ph.D. in 1927 from the University of Cincinnati and came to Washington during the Great Depression to work at the Hygienic Laboratory, as she continued to call it. Her job from then until she retired in 1973 was the safety testing of vaccines.

In 1954 the rush was on. Her lab had gotten samples of the inactivated polio vaccine to certify on a "due-yesterday" basis. "This was a product that had never been made before and they were going to use it right away," she recalled. She and her staff worked around the clock. "We had eighteen monkeys. We inoculated these eighteen monkeys with each vaccine that came in. And we started getting paralyzed monkeys." She reported to her superiors that the lots were Cutter's, and sent pictures of the paralyzed monkeys along as well. "They were going to be injecting this thing into children."

William Sebrell, the director of the NIH, stopped by the animal house where they were working, not to thank her for blowing the whistle but to ask if she and her co-workers wanted their children immunized with the vaccine, as it was in short supply. "I thanked him but said that my children had escaped polio so far and that I preferred to wait until the testing program was over before having them immunized," said Eddy. "Everyone there turned down the offer."

She heard nothing more about her report and never got the photographs back. "They went ahead and released the vaccine anyway, a lot of it. The monkeys they just disregarded."[28]

To understand what happens later, the reader must have some notion of how traumatic the Cutter incident was for the entire Public Health Service, not to say the NIH. We left James Shannon in his office on a Friday night. That was just the beginning. Shannon called the Surgeon General Saturday morning. Additional cases of paralysis continued to occur. "It seemed obvious that we had a crisis on our hands, the magnitude of which was unknown." Late Saturday afternoon a working group of senior virus specialists, whose advice the polio foundation had started to ignore a year earlier, began meeting in Shannon's office. Note that Shannon had completely taken charge of the crisis. "Sebrell was not the man to manage this," DeWitt Stetten recalled. 'James Shannon was a man of quite different character."[29]

Shannon had brought in the Surgeon General, who called polio chief Basil O'Connor in New York. On Monday evening O'Connor and his advisers came down to Bethesda. Shannon wanted to withdraw the vaccine, "It was a very stormy meeting," he said. "O'Connor and the polio group in general disallowed any possibility of induced infections [as a result of the vaccine]. ... So Basil O'Connor stormed out with dire warning of what he was going to do to the NIH and the Public Health Service. Further vaccination was stopped. I had many sleepless nights."[30]

The basic problem had really not been the carelessness of the Cutter company, which rightly or wrongly was exonerated in a later report. It was the difficulty in jumping from Salk's lab experiments with killing (formalinizing) the virus to large-scale industrial production. And the polio foundation had been so secretive that NIH didn't realize until too late how inadequate the formalinizing was. "There was no need for this ever to have happened," said Shannon later. "So NIH was painted into a box and made very bad decisions. Industry was painted into a box, and it was the forceful personality

of O'Connor with the political support he had that was able to override some of the essential details of federal management of an important biological product."

But the government had to carry the can. "The fact was, everybody's head had to roll," said NIH's Alan Rabson in retrospect. "This was such a ghastly mistake." His wife Ruth Kirschstein, the director today of an important NIH institute, added, "The Cutter incident resulted in everybody up the line who had anything to do with it—very few people know this story—being dismissed because of it." All went out: the director of the microbiology institute lost his post, as did the equivalent of the assistant secretary for health. Oveta Culp Hobby, the secretary of Health, Education and Welfare (or Oveta "Culpable" Hobby, as she was known), stepped down. Dr. Sebrell, the director of the NIH, resigned. "And Shannon became the director," Kirschstein continued. "He said he would save the situation and he did.[31] The historic significance of the Cutter incident is that, among other things it made James Shannon the head of the NIH.

A Leader, Not a Coordinator

How typical of the federal government that the forty-odd buildings on the NIH campus of Bethesda are numbered in the order they were built. "Building One," the administration building, was thus the first, completed in 1938. Although everyone still refers to the administration as "Building One," the building itself no longer has a big red one on it, as all the other structures have numbers, but the words the James A. Shannon building. In the lobby, directly in front of the main door, hangs a huge oil painting of Shannon. To the right of it is an impressive bronze of Shannon's torso and head, "presented by his friends," then various collections of photographs commemorating the unveiling of the bust or the renaming of the building in 1983. Aside from that there is nothing in the lobby except a big scale model of the campus.

The directors who have come after Shannon's retirement in 1968 have not had insignificant egos. One cannot grasp why they would allow such a shrine to remain in place without knowing that it was James Shannon who made the NIH what it is today.

"What does that mean?" Alan Rabson was asked, one of many to express the opinion that Shannon had "made" the NIH.

"Money," Rabson said.

One of Shannon's historic accomplishments is that he wrung from the Congress, against the wishes of the executive, far, far more money for health research than one would ever have thought possible. When Shannon became associate director in 1952, his boss William Sebrell told him, 'Jim, one thing I can assure you is that [you need not] worry about budget. I will handle all the budget."32 This turned out to be completely wrong. Sebrell, with the reticence of his generation, had no idea of the sums Shannon wanted. "Although William had committed that he would take

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cross the blood-brain barrier. What to do? The solution is found at the St. Jude's Children's Hospital in Memphis, Tennessee: give radiotherapy to the central nervous system; participants in the project from other universities (group B) inject methotrexate into the spinal cord. This solves the hideaway problem. By 1963, scientists were reporting cure rates of 50 percent in this once-fatal disease of childhood.[26] Today, the long-term survival rate for children with acute lymphocytic leukemia is about 65 percent; for other childhood cancers cure rates are as high as 88 percent.[27]

What has been the secret of success? New drugs? Well, to some extent. The Eli Lilly company in Indianapolis donated supplies of vinblastine and, in 1961, vincristine as its scientists isolated them

from a kind of periwinkle bush. The jawbreaker, "6-mercaptopurine," had been available since 1952 from the Burroughs-Wellcome Company, then at Tuckahoe, New York.

But unlike penicillin for pneumonia, curing leukemia involved more than grabbing a bottle off the shelf. The key turned out to be how you applied the medicines already available: massive doses, given over long periods of time, in combination with other drugs. And that was an organizational question. In fact, Gordon Zubrod had spent some time at IBM in 1961 learning how to organize a task force. It was the leukemia task force he set up after returning that swept the team on to victory. Stephen Carter on Zubrod's role: "These ideas would never have come to fruition without the organization, the ambiance, the intellectual stimulation he gave, and his ability to sell the concept to NIH."

The success of Zubrod's team with childhood leukemia led Congress to demand task forces for every kind of cancer.[28] In the years ahead the backs would be broken of Hodgkin's disease, kidney cancer in children, and other feared blood cancers. But important though these victories have been, the real success of the NCI's cancer drug program in the 1960s was to prove that it could be done, on the model of James Shannon's antimalarial drug campaign or the antibiotic campaign before it. When DeVita reflected back upon the campaigns against Hodgkin's and against another adult blood cancer in which he'd been active, he said, "These cancers are easily curable, easily. I think the important part of these expriments was just to show you could do it, that you could cure cancer with drugs."

Cancer Viruses and Two Brave Women

We go back to an earlier incident, the story of Bernice Eddy and her blowing the whistle in 1954 on the presence of live virus in Jonas Salk's

supposedly inactivated vaccine. This discovery had not been well received at the NIH. Rather than promoting her and giving her charge of the polio vaccine program, the new administrators swept in by the Cutter incident took her off polio altogether and put her back on flu viruses. About this time Eddy started to become interested in cancer.

She'd always been interested in cancer. Back in the mid-1920's doing a Ph.D. in bacteriology at the university of Cincinnati, she remembered palling around with the med students: "I had an apartment so we'd have dinner down there and harangue about all kinds of subjects and cancer was one of them. We didn't see why it couldn't be some kind of organism." She had done most of the first two years of courses with the meds. "I saw some of these cancer patients from time to time and, oh, they were horrible. It was one of the worst-looking diseases, you know. They'd still be alive and yet just in such terrible shape. I guess it just stuck with me that there ought to be something you could do for them."

So we have in 1956 a restless Bernice Eddy, age fifty-three, resentful about being punished as a whistle-blower and endowed with a long-standing interest in cancer. Enter Sarah Stewart. She too had been trained bacteriologist at the University of Chicago, and she came to the PHS in Washington in 1936, one year before Eddy. Both women had been part of that group of female scientists having bag lunches in the sun on the steps of the Hygienic Lab in downtown Washington. They were fast friends.

Unlike Eddy in biologics control, Stewart had an appointment from 1947 onward at the National Cancer Institute. And she was extremely interested in possible viral causes of cancer. Up to this point cancer virology virtually did not exist. Then in 1953 Ludwik Gross, working alone in the basement at a veterans hospital in the Bronx, had discovered a virus, that produced tumors in mice. This officially had broken open the field. Using some techniques Gross had developed, Sarah Stewart published a paper in 1953 on an apparently viral agent that caused leukemia in mice. But in this kind of research she didn't have what scientists call an "assay system," a laboratory culture in which you could reliably grow your virus and do experiments with it. Precisely such cell cultures were Bernice Eddy's area of expertise, and around 1956 Eddy showed Stewart how to grow her suspect viruses in a mouse cell culture. The two women then in 1957 made a major discovery. They found that the virus Stewart had been working with caused cancer in every animal it was given to. They called : the SE polyoma

virus.[29] "SE" means *S*tewart and *E*ddy. "My contribution was the poly, and hers was the oma," said Eddy. The polyoma was particularly important because, up to that time, scientists had thought of viruses as causing cancer mainly in birds (Peyton Rous having discovered the first such chicken cancer virus in 1908).

Sarah E. Stewart. Working with Bernice Eddy in 1957, she found the first virus—named the SE polyoma virus—that caused cancer in a wide range of animals. Until then, scientists thought viruses caused cancer mainly in birds.

The name Ludwik Gross is now legendary in cancer virology. The name Sarah Stewart remains virtually unknown. Why is that? At least part of the answer lies in a certain disregard for the work of women that earlier dogged the culture of science. Alan Rabson, now a senior administrator at NCI, remembers the events: "When I got here in 1955, they told me that Sarah Stewart was an eccentric lady who thought that tumors were caused by viruses. No one believed her. .. She was what people called an intuitive scientist. She really did not know how to do science the way rigorous scientists do."

Apparently the established bacteriologists at NCI didn't like her work. Her experiments were thought badly conceived and carelessly conducted. Rabson says, "The thing that bothered them all was that she said she was going to prove that cancer was caused by viruses"'

The honchos explained to her that "you don't do science that way. You don't set out to prove something." Sarah said that she really didn't care. Rabson comments, "She thought that they were picking on her because she was a Ph.D. and not an M.D."

So Sarah Stewart went to med school. She enrolled in Georgetown Medical School at the age of thirty-nine and became the first woman M.D.

to graduate from there, interning at the same PHS hospital on Statten Island at which Joseph Kinyoun had been.

Rabson continues the story. "She came back and said now she was ready to prove that cancer is caused by viruses. The director said not around here you won't. so they wouldn't let her come back." Finally Burroughs Mider, the scientific director of the cancer institute, found her a lab in the PHS hospital in Baltimore.

"She did these classic experiments on the polyoma in Baltimore. She used to periodically come over to the campus and bring her slides and show them to the pathologists in our lab. They all thought she was very eccentric."

Why did these male scientists think Sarah Stewart eccentric? "First of all she was very secretive, because she thought Gross was trying to steal everything from her, and that everyone was trying to steal her work, which was true, because she was onto a very important discovery. She would show us slides but never tell the details of the experiments. So when she would show us a very unusual tumor which we'd never seen anything like before, we would ask how did you produce it?

"She would giggle and say it's a secret. she drove everyone crazy."

Stewart never did "controls," meaning study what happens to mice who didn't get the virus. She and

Eddy would grind up tumors from cancerous mice and isolate the virus from those tumors. The scientists wanted to know if the noninjected mice got cancer.

"I remember," Rabson continues, "that one day Sarah looked at me and giggled and said, 'I never do controls. They only confuse you.' In fact it turned out at that point that all the mouse colonies on the campus here were riddled with latent polyoma virus, and if she had done controls, would have gotten tumors with the controls. so she was right. It would only have confused her."

Sarah Stewart and Bernice Eddy's discovery of the polyoma in 1957 marked the real takeoff of theories about virus and cancer. It was a major major discovery," says Rabson. "All of a sudden real virologists jumped in. It could be destructive like polio, but produce tumors at the same time. Suddenly the whole place just exploded after Sarah found polyoma."

Although Stewart was later promoted within the cancer institute, she did not in her lifetime win the recognition she deserved. She died of cancer in 1976, Bernice Eddy remaining close to her until the end. "She was a forceful individual who did not let anything stand in the way if she could help it," said Eddy.

This is an interesting story, but in terms of drama it's nothing compared to what happens next. At the same time in the late 1950s that Eddy and Stewart were producing cancers in animals with the polyoma virus, Eddy had sneaked back to the polio vaccine. Remember from chapter three what a chamber of horrors Salk's inactivated polio vaccine had been for the NIH in 1955. Surely all the problems with the polio vaccine had then been cleaned up?

Not exactly. "I did things on the side which I wasn't assigned to do," Eddy said. One of them was starting to conduct safety experiments on the polio vaccine in June 1959, from which she had officially been removed four years earlier. In observing cells from the kidneys of rhesus monkeys under the microscope—the kind of cell preparation from which the polio vaccine was being made by private drug companies—Eddy had noted spontaneous degeneration, meaning that the cells would start to die without any apparent cause. She did more experiments with these cells, and on July 6, 1960, reported to her chief Joseph Smadel, that when she injected preparations from those monkey kidneys into hamsters, the hamsters got cancer. Tumors grew in newborn hamsters at the site of injection; probably a virus in the monkey cells was causing the cancer.

The story that follows is such a sad one, partly because Smadel himself was a distinguished scientist, not just a petty bureaucrat. Shannon had made him associate director of the NIH in 1956 to help clear up the polio vaccine mess following the cutter incident. Smadel had remained in Building one until the end of June in 196o, when, finally tired of administering, he became the virus lab chief at the biologics division where Eddy worked. Bur even in 1956 Smadel had taken a lively interest in the biologics division and was presumably well informed about the escapades of its members. Thus he was not pleased, just after assuming his new post in viral research, when Eddy threw this time bomb onto his desk: the possibility of a cancer-causing virus in the polio vaccine.

In August he sat down with Eddy, went over her data, and dismissed the findings as "lumps." He thought her rumps unrelated to the degenerative changes (vacuolation) that other scientists had observed in the kidney cells of other monkey species, and he dismissed the possibility that the lumps, might be cancer or cause the disease in humans. He must have been very nasty at the time, for he later wrote to Eddy, "It is my recollection that I was not even diplomatic in telling you that you had no basis for either statement." This was not out of character for Smadel , who was generally known as brusque and authoritarian, although his earlier relations with Eddy while he had been at Walter Reed had been cordial. Dewitt Stetten remembers Smadel as "a very difficult man to work under ... a heavy-handed man, arbitrary and difficult." [31] Even Maurice Hillemarr, a close friend and an admirer of Smadel's, said, "you only got along with Joe if

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you could outcuss him. Anybody who was bright didn't do so good; anybody who was a little bit retarded did very well because Joe felt sorry for them. Joe was very humanitarian'"[32]

The Eddy problem landed again on Smadel's desk when, in October of 1960, she gave a talk at the New York meeting of the Cancer Society. At the meeting she described finding a cancer-causing virus in the monkey cells from which the polio vaccine was grown. Thomas Rivers of the March of Dimes Foundation was in the audience and later told Smadel what Eddy had said. Smadel hit the roof. "Smadel called me up," Eddy said, "and if there was anything in the English language—any awful name—that he could call me, he did. Oh, he was mad. I never saw anybody so mad." Smadel wrote Eddy a letter later that day forbidding her to speak in public again without clearing a written text of her remarks specifically with him. That was just the beginning.

In the meantime, events were moving ahead in the outside world. Maurice Hilleman, developer of many famous vaccines, had gone at this point to the Merck company, one of the companies making Salk's inactivated polio vaccine as well as Sabin's activated variety. Sabin's vaccine was then in massive field trials in Europe and the Soviet Union. Quite independently of Bernice Eddy, Laurella McClelland, a viral specialist in Hilleman's vaccine division at Merck, had noted something funny in the monkey kidney cells on which the vaccine was being safety tested. These were cells not from the kidneys of rhesus monkeys, from which the polio vaccine was being produced, but from a species of African green monkey. Hilleman had asked the director of the Washington, D.C., zoo to bring some monkeys in for him other than rhesus because the rhesus variety were all infecting one another with these weird viruses en route from Africa to their American laboratory homes. So the zoo director was supposed to bring in some green monkeys via Madrid, where there was no other, animal traffic. The greens were flown to Philadelphia, where Merck drivers picked them up. Hilleman's team then put into the kidneys of the green monkeys extracts from the rhesus monkeys' kidneys, and the green monkeys' kidneys started to show pathological changes. For some reason the viruses the rhesus monkeys were carrying didn't destroy their other kidneys, but they destroyed those of the greens. (In Hilleman's view the AIDS virus reached North America via these African monkeys.)

So Hilleman had to give a paper on some subject of interest for the Sister Kenny Foundation, the counterpart for Sabin of the March of Dimes Foundation that was backing Salk. He decided upon "How to Detect Undetectable Viruses." It was clear to Hilleman that a number of different viruses remained in the vaccine. He warned Albert Sabin, who was to be in the audience, that bad news was coming.

“I said, listen Albert, you and I are good friends. But I’m going to talk about a virus that’s in your vaccine now. You’re going to get rid of the virus. Don't worry about it, you're going to get rid of it. So of course Albert was very upset with me."

Hilleman told Sabin there was something special about this virus. "I don’t know how to tell you this, but I’ve been around vaccines for a long time. I just think this virus may have some long term effects."

Sabin said what?

“I said cancer. I said Albert, you probably think I'm nuts, but I just have that feeling."

In the meantime, Hilleman said, "we had taken this virus and put it into hamsters.” Their hamsters got cancer, just as Bernice Eddy's had. "So the joke of the day was that we would win the Olympics because the Russians would be loaded down with tumors." (Sabin had field-tested his oral polio vaccine extensively in the Soviet Union.)

Hilleman presented his own findings formally at a conference in Copenhagen at around the same time Eddy was having her unpleasant conversations with Smadel. Hilleman, accepting the suggestion of a

colleague at Eli Lilly, named the virus responsible for the microscopic changes in the kidney cells SV 40, or simian virus 40, meaning that thirty-nine other of these monkey viruses had already been identified. A Yale group with an electron microscope then determined that SV 40 and Sarah Stewart's polyoma were basically the same virus, but one infected mice, the other monkeys. Nothing about SV 40 causing cancer had yet come out in either the scientific literature or the press, although insiders were aware. Alan Rabson, who with his wife, Ruth Kirschstein, attended the Copenhagen meeting, said, "Everyone in the grapevine knew that."

Since both polio vaccines had at this point been given to millions of children, members of the grapevine were now frantic to find out what was going on. "Everyone was very excited," said Rabson of the reaction at NIH. Hilleman had thought that the inactivation procedure used on the Salk vaccine probably killed SV40.[33] But it was only recipients of the Salk vaccine who became infected with the SV 40 virus because the inactivation procedure didn't kill it. Only they had antibody traces of the virus in their blood. Recipients of the Sabin vaccine had no SV 40 antibodies. The virus was killed in their intestinal tracts.[34] The Russians, supposed to show up at the Olympics dragging with tumors, were safe![35]

In the spring of 1961 all became clear. One of Eddy's co-workers published the news that indeed live SV 40 virus was present in the polio vaccine. The director of the biologics division, Roderick Murray, notified the Surgeon General that steps were being taken to ensure that future polio vaccines would be free of SV40.[36] Finally, in July 1961, Eddy herself established that the cancer-causing agent in hamsters was SV 40, although she was not permitted to publish this finding until a year later.[37]

Only at this point does the drama, under way for eighteen months in the corridors of power, begin to come out in the press. On July 26, 1961, the New York Times reported that Merck and Parke-Davis, another vaccine manufacturer, were withdrawing their Salk vaccines "until they can eliminate a monkey virus." Nothing was said about cancer. The story ran next to an account about overdue library fines on Page [33]. Not until February, 1962, did Times' readers, in a story on page 27, find out anything about cancer.[38]

Was this silence merely the incompetence of the press in the face of a complex scientific question, or was there a deliberate effort to keep a lid on the story? Albert Sabin was asked thirty years later why the silence? I think to release certain information prematurely," he said, "is not a public service. There's too much scaring the public unnecessarily. Oh, your children were injected with a cancer virus and all that. That's not very good."[39] One recalls how badly the whole public health system had been burned by the Cutter incident five years previously. A second hue and cry in 1960 might have shattered public confidence in vaccines so badly that the toll in unnecessary disease would have been far greater than the risk of the contaminant. Still, a cancer-causing virus had been identified but not announced.

Do all those people who received the contaminated Salk vaccine in particular between 1955 and 1961 have cause for alarm? As Ruth Kirschstein, director of one of the Bethesda institutes, has pointed out, there are people walking around today with antibodies for SV 40, meaning that the virus has entered their bloodstream.4o But while particles of SV 40 have been recovered from tumors in several humans, there is no evidence that the virus has caused cancer in the population. Those who received the vaccine, however, are still discretely being monitored by public health officials.[41]

Eventually, Bernice Eddy lost her labs. In successive measures she was denied permission to attend scholarly conferences, her papers were held up, and finally she was removed from vaccine research altogether. Her treatment became a scandal within the scientific community and was discussed in Senate hearings.[42]

What got Stewart and Eddy into trouble? Sexism within the PHS? Eddy didn't feel the men she

worked with were "sexist;" the very term clangs unfamiliarly in the mouth of this woman now in her mid-eighties. Ruth Kirschstein was asked if Sarah Stewart would have had an easier time of it as a man. "Sarah would say so," Kirschstein responded. "I'm not so sure."

It may be that these women were treated as they were not because of overt discrimination but because they evidenced a somewhat different scientific style than did many of their male colleagues. Stewart's intuitive sense that cancer was caused by viruses is a case in point, and her attempts to prove something that she felt in her heart to be true met with great skepticism.

Why had Smadel gone after Bernice Eddy? Maurice Hilleman: "well, because she never had definitive experiments. When you bet up an experiment, you set up the controls to go with it. You can't have public health being upset by experiments that may not be meaningful and that are not definitively run. They tore the hell out of her for that." In Eddy's defense, she was aware at the time that all the campus lab animals she might have taken as controls were contaminated with the virus. But what Hilleman and other men were saying, in essence, was that these women lacked rigor, lacked system, that they were too intuitive. "And yet she was right," added Hilleman.

By contrast, when Hilleman told Smadel the same thing that Bernice Eddy had told him, Smadel listened. Eddy and Stewart had soft scientific styles; Smadel and Hilleman had hard styles, and hard personalities to go with them. Whether Eddy and Stewart had the right style or not, their polyoma virus and SV 4o went on to form the basis of the revolution in biotechnology, which is the story of the scientific present and future.