vulnerable to somatic disorders, so that a correction factor derived from attrition data for the general population may not be appropriate for XYY's. The draft-board rejection data are not considered in detail here because of some ambiguities in the rejection classification used. Even if somatic difficulties are more common among XYY's, however, this in itself is probably not a contributing factor to their elevated frequency of criminal offenses. In our XY's a χ^2 test showed that the difference in frequency of criminal offenses between men rejected by their draft boards for health reasons (9.8 percent) and men not rejected on such grounds (12.4 percent) was not significant.

31. This question deserves particular attention because some of the subgroups in the unexamined sample have unusually high crime rates, as might be expected. The rates were 17.2 percent for men who declined to participate in the study, 17.4 percent for those who emigrated or were away at sea; 44.0 percent for the destitute men; and 31.7 percent for those who were not living at their address of record. The differences between these values and the 9.3 percent rate of the tall XY men examined are all statistically significant (χ^2, $P < .003$). If XYY's do tend to have higher crime rates, then according to these data XYY prevalence rates may be higher in the unexamined group than in the examined group. The number of unexamined tall men is relatively small, however. Further, if we apply to the unexamined group the finding for the examined group of a 1.3 percent XYY rate among all tall men with criminal convictions, then the probability is that among the 97 men with one or more criminal convictions in the unexamined tall group there is only one XYY. Because the crime rate of the unexamined group may understate the case, and because of uncertainties about some of the extrapolations made, this pattern of results cannot of course be taken as definitive.
32. In fact, in our individual case study we do have data from a wider assortment of cognitive tests for the probands and their matched XY controls which indicate that this may be true. These data suggest that more of the difference in rate of criminality between the XYY's and the XY's might have been accounted for had they been tested for an additional cognitive factor, figure fluency (FF) [R. B. Ekstrom, J. W. French, H. H. Harman, *Technical Report No. 8*, Office of Naval Research contract N 00014-71-C-0117, HR 150 329 (1975)]. A test of the FF factor was included in the battery used in the individual case study, but this factor is not well represented in the BPP, as is shown by a low, nonsignificant correlation of .28 between scores from the test of this factor and BPP scores. After adjusting for BPP and other background variables by the analysis of covariance, we find FF means of 32.5, 24.0, and 26.0 for XY's, XYY's, and XXY's, respectively. The F test for difference of means is significant at the .05 level. Especially significant ($P = .02$, two-tailed) is the t-test for the difference between the XYY adjusted mean and the XY adjusted mean, indicating that the average scores of XYY's on FF are lower even with BPP and the other background variables controlled. Furthermore, among the 49 XY controls the 8 men with records of convictions for one or more criminal offenses had a mean FF score of 29.0, while the mean for the 41 noncriminal XY's was 36.0 ($P < .05$, one-tailed t-test).
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NEWS AND COMMENT

Breast Cancer: Second Thoughts About Routine Mammography

The auditorium of the National Institutes of Health (NIH) has been redecorated recently, its once "institutional pale" walls now covered with a fabric of vivid Chinese red. A subtle but perceptible glare makes you blink a couple of times as your eyes adjust to the startling light.

On the afternoon of 29 July, there was in that auditorium an event as startling as the surroundings. The director of the National Cancer Institute (NCI) was standing on a stage before an assembly of some 400 female NIH employees, asking them what he should do about a controversial breast cancer screening program.

At issue was the use of mammography (x-rays of the breast) as a tool for detecting cancer in asymptomatic women between the ages of 35 and 49. The NCI, in collaboration with the American Cancer Society (ACS), supports breast screening programs at 27 centers throughout the United States. During the past 4 years, some 270,000 women have had one or more breast x-rays and numbers of experts have pronounced mammography an invaluable technique for finding breast tumors while they are still small enough to cure.

That happy assessment of mammography was challenged recently by a panel of scientists who were appointed by the NCI itself to assess the benefits of breast x-rays versus the risks. Led by epidemiologist Lester Breslow, dean of the School of Public Health at the University of California at Los Angeles, that panel saw more evidence of risk than of benefit when it comes to younger women and, with no equivocation, called for "Immediate cessation of routine mammography for screening women under 50 years of age."

However, interpretation of the available data is very much a matter of judgment. So far, NCI director Frank J. Rauscher, Jr., who must decide whether to accept the Breslow recommendation or not, is not sure what course to take. He calls the data "frankly confusing," and said as much to the women of NIH. "I said in my memo [calling this meeting] that 'I need your help,' and I do," Rauscher declared in his opening remarks.

For those who are so used to the all-knowing physician telling an uncomprehending but compliant patient what to do—the doctor as God—the sight of the NCI director, standing in that bright red room, asking so-called "ordinary" women to contribute their two cents worth to a difficult decision was something extraordinary.

The script for the unprecedented meeting was simple. Rauscher, a Ph.D., and NCI deputy director Guy R. Newell, an M.D., would tell the women all the reasons they had for continuing the screening program in its present form and all the reasons for modifying it, which would mean calling a halt to routine mammograms for asymptomatic women who are younger than 50. There would be questions from the floor (which, as often as not, were answered, "We just don't know.") Then, the women could fill in a questionnaire, reporting whether, on the basis of what they had heard, they would or would not have a mammogram, or whether they were too confused to decide.

This was not meant to be scientific decision-making by plebiscite. Rauscher made it clear that the women's views would simply be one of many "inputs" to a decision that is his responsibility, but he also made it plain that he asked because he really wanted to hear. This was no pro forma concession to public participation and many of the women present, including those who found the whole thing terribly confusing, agreed with one participant who said, "I think everyone appreciates the fact that we were being taken into the equation."

The breast cancer screening program is the largest and, in many respects, the most important of the so-called "demonstration" or "cancer control" programs that owe their existence to the "war on cancer." It represents everything that is supposed to be good about "taking the results of research to the people," and when it gets in trouble, there is a lot at stake.

The joint Cancer Institute–Cancer Society breast cancer screening program got under way a few years ago. For its first 2½ to 3 years, it sailed along according to plan, by all evidence an apparent success. Women, responding to announcements in local newspapers and the like, flocked to the screening centers as they opened. Then, after Mrs. Ford and Mrs. Rockefeller had breast cancer surgery, the centers were veritably inundated with women who wanted to have a mammogram. In some places, the waiting list was months long.

By now, more than 270,000 women have had an initial mammogram and many have had seconds or thirds, the plan being to have 5 mammographic examinations in 5 years, and then remain in the study for follow-up for an additional 5 years. So far, the results have been encouraging, in the sense that a number of very small, and presumably very curable, cancers have been picked up by mammography that could not be detected by breast palpation. "About 1100 cancers have been found," says Rauscher. "Over 300 of these have been detected in women under 50, and one-third of them would not have been found without mammography." Among women over 50, 280 cancers have been found by mammography alone.

Making Waves

It all seemed very promising. Then, about a year ago, John Bailar began making waves. Bailar, an M.D./Ph.D., is editor of the *Journal of the National Cancer Institute*. Bailar believes that for women under 50, the risk of getting cancer from exposure to radiation equals the chance of finding a cancer early that could not be found by clinical examination. Therefore, he argues, younger women who have no symptoms of breast cancer and who are not at high risk of getting it (for example, who do not have a mother or sister who has the disease) should not be part of mammography screening program.

The origins of the breast screening program go back to 1972. The National Cancer Act (signed in December 1971) was just taking effect and Congress had given the NCI a mandate to do more than support basic research. Hence, the "Cancer Control Program," which now has status as a full "division" of the NCI, was born. To ensure its livelihood, Congress gave it several million dollars for its very own, much to the distress of many members of the National Cancer Advisory Board, who hated to see money they wanted spent on basic science "diverted" to what in their opinion amounted to patient care.

Well, whether the research community favored cancer control or not, Congress wanted it, and there it was. One group that *was* enthusiastic about the control program was the ACS, which had lobbied on its behalf. The ACS wanted a prominent role in the war on cancer and cancer control was something it understood well.

In February 1972, the board of directors of the ACS approved a plan to launch a major breast cancer screening program that would include establishing 12 centers. Women would be examined free of charge.

It was shortly after this plan was drawn that cancer control money became available to the NCI. So, in September 1972, Cancer Society officials went to NCI with a proposal for a joint, and much larger, breast cancer screening program. It was agreed.

In an interview with *Science*, Rauscher recalled the factors that led to his decision to launch the NCI-ACS breast cancer screening program that is now under fire. "To begin with," he said, "breast cancer is a hell of a problem. It is a major killer of women, many of them in the prime of life. And for years, the incidence of the disease and its mortality have been the same—awful." Breast cancer is diagnosed in about 90,000 American women every year and every year about 33,000 women (not necessarily those whose tumor is newly diagnosed) die of breast cancer. Obviously, breast cancer amounts to a clear and present danger to an enormous sector of the population. By 1972, it seemed, perhaps for the first time, that it might be possible to reduce that danger.

During the 1960's, there had been significant advances in mammographic technique, as developments enabled radiologists to take better pictures of the breast with lower and lower dosages of radiation. There was a solid body of opinion that mammography was a technology whose time had come. In addition, attitudes about breast cancer surgery were changing, leaning in some cases in favor of simple or moderate excision of a tumor rather than radical excision of the breast and underlying chest muscles. And there was a feeling that the use of chemotherapy in conjunction with surgery would greatly extend survival. The logic in favor of screening was compelling.

To top it off, there was the HIP (Health Insurance Plan of Greater New York) study, initiated in the early 1960's as a controlled trial of the value of breast cancer screening. Altogether, it involved 62,000 women between the ages of 40 and 64, who were divided into a study and a control group. Those in the study group were offered breast x-rays; women in the control group "maintained their usual health care practices." The data from the HIP study unequivocally show that the addition of mammography to routine checkups is of real benefit to women over the age of 50, which is when the natural occurrence of breast cancer rises sharply. Even though the HIP data show no advantage of mammography to younger women (the mortality rate for women in the study and control groups was the same in women under 49) a decision was made to include younger women in the NCI-ACS screening program in hope of discovering that there is some benefit.

As far as the risk from radiation exposure was concerned, no one thought it a real problem. The matter had, of course, been raised, but radiologists assured the leaders of the NCI and ACS there was no need to worry. Women in the HIP study had been exposed to radiation dosages in the range of 7 rads. For women in the new screening program, the dosage, at least in theory, would be much lower than that.

For all these reasons, Rauscher says, he decided that there should be a major, national breast screening program, and that the Cancer Institute and the Cancer Society should sponsor it jointly, with the NCI picking up two-thirds of the bill and the ACS one-third. It now costs a total of $9.5 million a year.

The NCI-ACS program is meant to be a "service" program rather than a scientific study, even though doubts about the benefits of mammography for younger women clearly existed in 1972. The design, or lack of design, of the present program precludes the possibility that it will provide an answer. Why didn't anyone think of that then? The answer is not entirely satisfactory. Rauscher recalls the momentum behind the idea of "moving ahead" with the application of technology and adds, "Besides, there already had been a controlled study—the

HIP study. We felt we had enough. In retrospect, of course, I wish we'd done it differently." No doubt. One possibility now is to turn the present program into a full-dress controlled clinical trial, but no decision has been made as yet.

Bailar's first challenges to the breast cancer screening program came during the spring and summer of 1975 when the draft of a critical paper he had written was circulated among NCI and ACS officials. They became a matter of public record when he presented a paper at a scientific meeting in the fall that received what agency officials considered an untimely airing in the press. In a paper that was published in January of this year, Bailar said that some of the HIP data that had been used to justify mammographic screening were "misinterpreted" and, citing radiologic studies, suggested that "radiation hazards [from mammography] may be of the same order of magnitude as the benefits." He pointed out that the Canadians recommend mammography only for high risk women in the under 50 age group and concluded that "Promotion of mammography as a general public health measure is premature."

There were those at NCI who wished that Bailar would keep still but, in the face of his persistent challenge, the institute did the only responsible, and predictable, thing. It appointed committees (in this case, three of them) to evaluate all relevant data, old and new, on the benefits and risks of mammography.

Breslow of UCLA was asked to reevaluate the data from the HIP study.

In 1972, NCI officials looked at the fact that the HIP data show no benefit of mammography to younger women, but said that because of newer and better x-ray technology and better forms of cancer therapy, it made sense to include younger women anyway. In 1976, Breslow looked at the HIP data and saw it in a new light. He placed considerable emphasis on the fact it showed "no benefit" of mammography to younger women, added to that his assessment of new data about radiation hazards, and leaned toward Bailar's position. "As the radiation dose approaches and exceeds 1 rad [as it often does] it becomes less and less clear that the benefits outweigh the losses," Breslow wrote in a report to NCI officials.

(Because the HIP data and all subsequent evidence confirm the value of mammography in detecting cancer early in women over 50, no one is recommending that its use be curtailed among these women. Nor does anyone suggest that breast x-rays not be used diagnostically, in cases in which a tumor is suspected.)

Breslow's group was the first of the three NCI committees to complete its evaluation and there was consternation when it arrived at NCI headquarters in early summer. His conclusions were not exactly popular; nor had they been fully anticipated. Problems were compounded when the Breslow report was leaked to the press in mid-July.

Controversy Aired at Open Meeting

Rauscher decided that the best course of action at that point would be to air the issue publicly. An open meeting was hastily called for 19 July. At that time, Breslow's recommendation that routine mammography for women under 50 be dropped was endorsed by the chairman of another of the NCI committees, radiobiologist Arthur Upton, dean of the School of Basic Health Sciences at the State University of New York at Stony Brook. Upton and members of his committee evaluated all known data on the risks of radiation exposure to the breast. Much of it, Upton reports, has been compiled since 1972. His committee analyzed recent statistics on the incidence of breast cancer among women surviving the bombing of Hiroshima and Nagasaki, as well as new data from studies of women who had had fluoroscopy for treatment of tuberculosis. The women had been exposed to radiation at doses of from 50 to 100 rads. Extrapolating downward to the kinds of dosages employed in mammography, Upton postulated a 1 percent additional risk at a 1-rad exposure. The so-called normal risk of getting breast cancer is put at 0.07 over a lifetime (one of every 15 women develops breast cancer). Thus, according to Upton's hypothesis, a woman who had one breast x-ray at an exposure of 1 rad increases her total risk by an added 1 percent to a lifetime risk of 0.0707.

It is a very, very small risk to the individual, and it is only hypothetical. However, when applied to the entire female population, it translates to six added, avoidable cases of breast cancer per million women per year after a latent period of 10 years. If you weigh that against a judgment that there is "no benefit," it seems logical to come out against mammography.

(The third of the NCI committees, appointed to review the pathological tissues of all women in the HIP study who had breast cancer, will not complete its analyses of the slides until late August and, so, gave no substantive report.)

Rauscher went into that 19 July meeting prepared to accept the Breslow-Upton position but during the course of the day, he became less sure that they were right to conclude women under 50 derive no benefits from mammography. Several of the directors of the existing 27 NCI-ACS breast screening programs gave highly emotional, unscientific, but not altogether unpersuasive speeches, pleading that the program continue. They talked about the psychological benefits of mammography to women who need to be reassured that they do *not* have breast cancer, and they implored Rauscher not to discount the fact that early detection of a small tumor means less traumatic, less mutilating surgery. "Reduced mortality," several of them declared, "is not the only measure. Reduced morbidity means a lot." And, of course, early detection may mean longer survival, even cure. No one knows. But when Rauscher considered reduced morbidity, and the fact that the screening program so far has picked up early cancer by mammography alone in more than 100 younger women, he concluded, "I don't see how you can say there is no benefit. To those individual women whose cancer is detected, there certainly is a benefit."

The poll of the NIH women offers Rauscher little help in coming to a decision, except in that he was surprised that so many women said they *would* have a mammogram in spite of the risk. Of almost 300 women responding to the questionnaire, 45 percent were in favor of routine mammography, 32 percent said they would not have a mammogram, and the rest checked "I don't know."

In all the debate on both sides, it seems that one important fact of life has received inadequate attention. There has been a good deal of emphasis on the "hypothetical" and "trivial" nature of Upton's estimate of a 1 percent added risk of getting breast cancer from mammography. But what Upton is talking about is an ideal world in which the radiation dose is limited to a maximum exposure of 1 rad. But, in actual fact, that is seldom the case. X-ray equipment varies; so does the amount of irradiation necessary to get a good picture in different circumstances. Even at the 27 NCI-ACS centers, where equipment is said to be carefully calibrated and well-monitored, exposure ranges from 0.3 to 6.5 rads per examination. There is little doubt that radiologists in private practice may use more. All of which is to say that, for the majority of women, the 1-rad maximum does not apply, and the amount of radiation exposure, especially for the woman who has annual mammograms, may well

come close to dosages that are known to be hazardous.

Rauscher has said he will make a decision about what to do by the end of the month, perhaps in hope that the report of the third NCI committee will somehow provide a clear-cut answer, unlikely as that may be.

Rauscher is under considerable pressure to take a conservative position right now and call a halt to federally sponsored routine screening of women under 50. In fact, many critics believe that he should have made a clear-cut decision weeks ago. Within the NIH hierarchy, sentiment is running in favor of a conservative stance and the appropriate letters that must go out if the program is to be modified have already been drafted.

But opposition to a change in the program is also strong, and is particularly forceful from the ACS. Cancer Society officials, who do not like the way the whole thing has been handled and who do not share the conviction that there is a serious radiation risk from mammography, thus far are unwilling to go along with a major change in what, they emphasize, is a joint program. So the public waits.

It does seem that, for now at least, the only prudent thing to do is to stop recommending routine mammography, as a matter of public health policy, for women under 50 who have no physical symptoms of breast cancer (such as a lump) and who are not in any high risk group.

—BARBARA J. CULLITON

Stever: White House Appointment Will Create Vacancy at NSF

Unless the unexpected occurs, the Senate will shortly confirm the appointment of H. Guyford Stever and President Ford will gain a full-time science adviser, but lose a National Science Foundation director.

Stever underwent generally friendly questioning at a confirmation hearing on 28 July and a unanimous committee recommendation that he be confirmed was filed the next day. A vote on Stever's appointment was viewed as possible on 30 July, but conservative critics of the nomination secured a delay, apparently in order to prepare statements of opposition. When *Science* went to press on 3 August, supporters of the Stever appointment said that they have the votes necessary for favorable action and expect an early vote.

Stever has been serving as both NSF director and science adviser since 1973, when President Nixon relocated the top science advisory office in NSF. When confirmed, Stever will resign as NSF director.

This opens the directorship at an awkward time on the political calendar. With a President to be elected in November, the selection of a leader for NSF becomes difficult in several ways.

In principle, the director's job is apolitical. The legislation creating NSF in 1950 provided a six-year term for the director, differentiating him from other top appointees who serve at the pleasure of the President and are expected automatically to submit their resignations when a new President takes office.

The NSF directorship did become politically enmeshed in 1969 when President Nixon spiked the nomination as NSF director of Franklin A. Long (*Science*, 25 April 1969) apparently because of Long's opposition to an ABM program advocated by the Administration. The short-circuiting of the Long appointment caused a furor in the scientific community and Nixon publicly conceded the White House had erred. He offered the post again to Long, but Long declined.

The incident seemed, if anything, to reinforce the nonpolitical status of the post. William D. McElroy, the next director, was a veteran of the science advisory network and a reassuring choice to the scientific community. After the 1972 elections, Stever, who had succeeded McElroy as NSF director, was not among the many agency heads who were asked to submit their resignations for what proved to be a severe post-election purge. Nevertheless, few observers feel that a President would pick an NSF director with whom he felt incompatible in political outlook and policy attitudes.

The process of selecting a new director of NSF does require that the National Science Board (NSB), the policy-making board of NSF, recommend candidates for the director's post to the President—more insulation against partisan influence. But the President may pick a nominee not on the NSB list.

Perhaps the most important dampener now is that the best candidates for the job are likely to be least receptive during the political twilight of the next few months. And even if the White House sends a nomination to Capitol Hill, there is no guarantee that the Democratically controlled Congress would have the time or the inclination to act. In the interim before a new director is chosen, NSF deputy director Richard C. Atkinson is expected to serve as acting director.

The dominant themes at Stever's confirmation hearings on 28 July were bipartisan gratification at having restored the science advisory machinery to the White House and support for the Stever nomination. A decidedly dissonant note was struck offstage, however, by Senator Jesse Helms (R–N.C.) who did not attend the hearing but read a statement of opposition into the *Congressional Record* that day. Helms is one of four conservative Republican senators who urged President Ford not to name Stever as science adviser because of poor management by NSF in its science education program (*Science*, 2 July). In his statement, Helms largely elaborated on charges made in the past about NSF handling of curriculum revision programs and argued that Stever was involved in a "cover-up" of manipulations by NSF officials and should not be confirmed.

None of the senators at the hearing presided over by Senator Frank E. Moss (D–Utah) chairman of the Committee on Aeronautical and Space Sciences, alluded to difficulties with the education program. But the matter is the subject of studies by both the General Accounting Office and the staff of the House Committee on Science and Technology and there is a general awareness that the state of the NSF education program is a serious item of unfinished business for Congress and for the next director of NSF.

As for reestablishment of a science office in the White House, care has been taken to make the transition go smooth-