the agency should steer clear of "the development of pilot courses" and implementation activities.

There was little show of sympathy for this narrow view of NSF's role among the three subcommittee members who attended the hearing—Symington; Representative Charles A. Mosher (R–Ohio), the ranking minority member of the full committee; and Representative Don Fuqua (D–Fla.). Symington had said earlier in a statement accompanying release of the GAO report that "the Subcommittee has long been a supporter of National Science Foundation programs to improve education in science for the Nation's children and young adults. The Subcommittee will continue its support." Fuqua took exception to Conlan's choice of language in using words such as "deceit" and "corruption" to describe actions which the GAO report characterizes much less vividly.

It appears that the subcommittee's first concern is to improve NSF program management. Even Conlan conceded that some constructive steps had been taken. These steps, according to a policy statement by Stever, include (i) establishment of award review boards in all grant awarding directorates of the NSF, including the education directorate (these boards are made up of foundation officials not directly involved in the programs they are reviewing); (ii) making available verbatim reviewers' comments at NSB programs committee meetings when proposals are up for recommendation to the full board (this should preclude a repetition of the ISIS controversy); (iii) as announced earlier (*Science*, 11 July 1975), making available verbatim peer reviews to a project's principal investigators on request, with reviewer's identities removed.

Stever also noted that "two of our most capable staff members" have been assigned to head the education directorate. These are Harvey Averch, acting assistant director for education, who appeared at the hearing to present the budget request of the science directorate in uneventful testimony, and Jack T. Sanderson, Averch's deputy until he returned to the planning office as acting director to replace the newly departed Snow.

Averch and his colleagues have been conducting an evaluation of 19 current projects in his directorate using outside experts in the exercise. The results of the study are to be communicated to the National Science Board, and action by the board may well indicate to what extent the board intends to rethink NSF policy on its education role.

There is little firm indication of whether Congress will be disposed to chastise NSF sternly for the ISIS incident. Except for the travail of the education directorate, NSF appears to be doing well in the budget authorization hearings. Conlan himself praises other parts of NSF's operations but concluded his criticism of "mismanagement" in the education program by asking, "How extensive is it? That's the question."

So far, Conlan's colleagues tend to congratulate him for his "provocative" contributions but indicate that they think he is overstating the problem. There is no question, however, that Conlan has shaken up NSF and that the tremors continue.—JOHN WALSH

Color Additives: Is Successor to Red Dye No. 2 Any Safer?

One of the ironies of the recent decision to ban the controversial color additive Red No. 2 is that the dye deemed most likely to replace Red No. 2—a compound produced by Allied Chemical Corp. and known as Red No. 40—has not been subjected to the kinds of tests some experts consider necessary to establish its safety.

Alexander M. Schmidt, commissioner of food and drugs, came close to admitting this in a 28 December appearance on CBS-TV's interview program, "Face the Nation." When a reporter badgered Schmidt to explain why he had not yet banned Red No. 2 when there was "an acceptable substitute" available, namely Red No. 40, Schmidt replied: "I would quarrel with your assumption that we have Red Forty. We don't . . . we know much more about Red Two than we do about Red Forty."

He then went on to assert, however, that the studies which are available on Red No. 40 "show that it is safe." That was the basis on which the Food and Drug Administration (FDA) gave Red No. 40 a "permanent" approval in 1971 for use as a coloring agent in foods and drugs and similar approval in 1974 for use in cosmetics.

But the Canadian government's health experts looked at essentially the same data (with some updating) and reached a very different conclusion. The Health Protection Branch of the Canadian National Health and Welfare Department ruled in 1974 that Red No. 40 could not be introduced in that country because, in the words of a recent press release, "evidence submitted by the manufacturer with respect to the safety of the product was inadequate."

Thus the United States and Canada have reached opposite conclusions on the suitability of the two most broadly applicable red color additives. The FDA here has banned Red No. 2 and given Red No. 40 a clean bill of health. The Canadians have continued to allow use of Red No. 2 while refusing, thus far, to admit Red No. 40. Elsewhere, according to Allied Chemical, Red No. 40 has been approved in Australia, Brazil, Colombia, Denmark, Guatemala, Mexico, Peru, and the Philippines, but the World Health Organization has called for more studies before granting its blessing.

A. B. Morrison, assistant deputy minister in charge of the Canadian Health Protection Branch, told *Science* that Red No. 40 was not approved in Canada because there were "not enough chronic long-term studies relating to its safety." He declined to elaborate on the grounds that the government's negotiations with the manufacturer were of a confidential nature.

However, Allied Chemical told *Science* that the Canadians were concerned about a long-term feeding test in rats that was designed primarily to determine whether Red No. 40 causes cancer. The test had been cut short when pulmonary disease ravaged the test animals, leading some experts to question its adequacy as a safety demonstration.

The test was conducted in the 1967–1969 period by Hazleton Laboratories, Inc., of Falls Church, Virginia, which conducted all of the toxicity testing of Red No. 40 under contract with Allied Chemical. A total of 300 albino rats of the Charles River strain, half of them male and half of them female, were divided into a control group and three other groups that were fed Red No. 40 as part of their diet, the amounts ranging from 0.37 percent of the diet to 1.39 percent to 5.19 percent.

The test was originally supposed to last 24 months—the length of time then recommended by the FDA for long-term studies

in rats. But at the 21-month mark, according to James W. Anderson, product control manager for Allied's Specialty Chemicals Division (which produces color additives among other products), pneumonia swept through the rat colony, threatening to confuse the analysis of the effects of Red No. 40. As a result, Anderson said, it was agreed by the FDA, Hazleton Laboratories, and Allied, in consultation, that all of the remaining rats could be sacrificed at the 21-month mark to enable close pathological study.

The only significant effect found by the study, according to a summary prepared by Hazleton, was that the highest test level of Red No. 40 caused "moderate growth suppression" during the first year of the test. (Spontaneous disease problems caused the body weights of all rat groups, including controls, to fluctuate during the second year.) The scientists at Hazleton concluded that Red No. 40 had no effect on physical appearance, behavior, food consumption, clinical laboratory values, organ weights, tissue sections examined microscopically, the incidence or severity of spontaneous disease, or, most significantly, the incidence of tumors.

These findings were not accepted by the Canadians for two main reasons, according to Anderson. One was that the number of test animals surviving to the end of the test was too small. Of the 300 rats that started the test, only 90 were still alive at the 21-month mark. The others had either been sacrificed at key check points or died during the course of the test. The Canadians did not specify precisely how many animals would be enough, Anderson said, but they indicated that 90 was far from sufficient.

The second reason the Canadians were dubious, Anderson said, is that 21 months was not deemed long enough for a test aimed at detecting such long-term effects as cancer. Indeed, Morrison, of Canada's Health Protection Branch, told *Science* he thinks "21 months is pretty short for a cancer study."

An FDA official told *Science* that 21 months was deemed adequate here because any significant increase in tumors would be expected to show up between 18 and 21 months and because other studies submitted by Allied, notably a 2-year feeding study in 32 dogs, found no cancer.

The question of how long such cancer studies should last is subject to continuing debate among toxicologists. Up until a few years ago the FDA recommended 24 months on the theory that that would provide enough time for tumors, which generally develop long after the initial exposure to a carcinogen, plenty of time to appear in the test animals. But now the FDA rec-

Science Adviser's Powers at Issue

The Senate and the White House are headed for a collision over the powers to be assigned to the proposed new presidential science advisory apparatus.

On 4 February, the Senate unanimously passed (despite grumblings from some Republicans) a bill known as S.32, the National Policy, Organization, and Priorities for Science, Engineering, and Technology Act of 1976. This is the Senate's version of legislation that is meant to resurrect the science advisory office that was banished from the White House environs by President Nixon.

The House passed its own version last fall—a much vaguer bill that leaves the organization and utilization of the proposed science office largely up to the White House. President Ford has endorsed the House bill, which was prepared in close collaboration with his assistants. But the Senate bill contains two sets of provisions that raise the hackles of Ford's aides.

One portion of the Senate bill seeks to give the new advisory office—called the Office of Science, Engineering, and Technology Policy—a clearly defined role in the budget process. It provides that the new office must prepare 5-year forecasts of federal investment in science, engineering, and technology, and that it must prepare each year a set of priority options for use by the Office of Management and Budget in preparing the Administration's budget. These estimates and proposed priorities would also be reported to Congress.

This portion of the Senate bill is deliberately designed to ensure that the new office gets a hearing in the budgetary process and is not simply a "cosmetic change"—a sop to the scientific community—with no real powers. However, such explicit powers are anathema to the Administration, which fears that the new office might develop an "adversary relationship" toward the President—that is, it might become an advocate for higher funding for science and technology and seek to enlist Congress as an ally against the President.

The Administration also contends that spending for science and technology cannot be considered "in isolation," as an end in itself, but rather must be considered as a "means" to help achieve particular national objectives. This approach conflicts somewhat with the Senate bill's philosophy that federal funding for science is "an investment in the future" and that the technical manpower pool is "an invaluable national resource which should be utilized to the greatest extent possible."

The second feature of the bill that disturbs the Administration involves a proposed state and regional science and technology program. The bill would create a new federal-state advisory panel and a new grant program to provide one-time seed money of up to $200,000 to each state to establish science and technology advisory offices in the legislative and executive branches. The rationale is that if science advice is good for the White House, it must be good for state governments too. However, the Administration objects to such "categorical grant" programs—that is, programs which specify how a state must spend federal money—as "excessive federal meddling in states' organization and advisory matters." The Administration also objects to other provisions of the Senate bill, but not strongly enough to raise a big fuss.

The Senate bill would make the new science adviser a member of the Domestic Council, thereby seeking to guarantee him a key role in civilian affairs, and a statutory adviser to the National Security Council as well, thereby restoring his role in military matters, a domain from which he was essentially dismissed by the Nixon Administration. The bill also would require an annual presidential report on science and technology; would solidify the interagency coordinating group, now known as the Federal Council on Science and Technology, by giving it a statutory base; and would create an advisory committee to conduct a comprehensive survey of federal organization for science and technology. The director of the new office would be at the same salary level as the director of OMB—$44,600.

The Senate and House versions must now go to a conference committee of the two chambers which will seek to reconcile the differences. Senate aides say some senators feel strongly about the disputed provisions and may dig in their heels and refuse to yield to the House conferees. Should the Senate's version largely prevail, President Ford would have to decide whether he felt strongly enough about the disputed provisions to veto the whole bill.—P.M.B.

ommends that such studies not be arbitrarily ended at the two-year mark but instead be continued over the "lifetime" of the rodents, defined as the point when only 20 percent of the starting group is alive. For rats, that is more apt to be around 2½ years than 24 months.

There is responsible speculation that some of the major studies conducted on the recently banned Red No. 2 failed to detect evidence of cancer because they lasted only two years. That, at least, is the proposition put forth by David W. Gaylor, principal biological statistician at the FDA's National Center for Toxicological Research in Arkansas, who performed the statistical analysis that was most instrumental in knocking Red No. 2 off the market. Gaylor concluded that high doses of Red No. 2 administered in a recent FDA study resulted in a statistically significant increase in the incidence of cancer among aged female rats, with most of the cancers being detected after 24 months. Similarly, a Russian study which concluded that Red No. 2 is a carcinogen lasted 33 months. In contrast, a massive feeding study of 800 rats at the FDA in the 1950's, which found that Red No. 2 posed no hazard, lasted only 24 months. That led Gaylor to suggest in a 31 December memorandum that "possibly, the reason cancer was not detected" in the 1950's rat studies "was that those experiments were terminated at 24 months."

Anderson, of Allied Chemical, says that the Canadians also declined to approve Red No. 40 until a life-time feeding study in mice is completed. Our own FDA now generally recommends life-time studies in two rodent species, but back in 1971 it approved Red No. 40 based on such studies in only one rodent species, the rat.

In an effort to meet the Canadian requirements, Allied is sponsoring new long-term tests at Hazleton Laboratories in both rats and mice, with the dye being administered initially to the parents and then through the life-times (or close to it) of the offspring. The parental generation had not received the dye in the original tests.

Anderson stresses that no one has claimed any of the test data generated so far indicate that Red No. 40 is a hazard. The only question is whether the tests are adequate to demonstrate the dye's safety. He also notes that the standards used in toxicity testing are under constant revision as the science develops. The data submitted by Allied were considered adequate evidence of safety by the standards of 1971, he said, and Allied has since subjected the dye to additional testing to keep toxicity information current.

Anderson estimates that Allied has spent more than $500,000 testing Red No. 40, including studies of acute and subacute toxicity in rats and dogs, a two-generation feeding study in rats to measure effects on reproduction, skin tests in rabbits, mice and humans, metabolic studies in dogs and rats, and a teratology study in rabbits. None of the tests, says Anderson, have suggested a hazard.

Allied launched the research that led to development of Red No. 40 in the mid-1960's because one red dye had been removed from the market in 1961 and another was restricted in 1965. The company screened some 90 synthetic chemical compositions, picked out a handful for further testing, and finally settled on Red No. 40 (trade name: Allura Red AC) as the best of the lot. The bulk of the safety testing was performed at Hazleton between 1965 and 1970. Upon its completion, Allied petitioned the FDA to approve the color, and the FDA granted a "permanent" approval in 1971. In that same year, Allied submitted a petition to the Canadians, only to have it turned back three years later after prolonged review and negotiations.

Allied has a patent on Red No. 40 but is said to have licensed at least two other manufacturers—H. Kohnstamm & Co., Inc., and Warner-Jenkinson Manufacturing Co.—to produce the dye. If Red No. 2 finally disappears from the market (it has been banned by the FDA but the manufacturers have appealed the decision to the courts), Red No. 40 is expected to attain widespread usage in foods, drugs, and cosmetics. Unless, of course, the searchlight is now turned on Red No. 40 and flaws are found in *its* safety pedigree as well.

—PHILIP M. BOFFEY

Recombinant DNA: Guidelines Debated at Public Hearing

After the first atomic devices were successfully developed, Robert Oppenheimer made the perhaps sententious remark that physicists had now known sin. That biologists may at least be moving out of an age of innocence was a point made at a hearing held on 9 and 10 February on the new method of genetic manipulation afforded by the recombinant DNA technique. "The research we are talking about," observed Robert Sinsheimer of the California Institute of Technology, "marks a transition from a primarily analytic base to a much more synthetic base, and I don't know if the implications of that have sunk in for any of us."

The hearing was convened by Donald S. Fredrickson, director of the National Institutes of Health, to review the draft guidelines for use of the technique that were drawn up last year by an NIH committee (*Science*, 19 December 1975). The technique has been under a virtual embargo since July 1974, when a National Academy of Sciences committee under Paul Berg of Stanford University called for a worldwide moratorium on certain of the experiments the technique makes possible.

Last week's hearing pitched both defenders and critics of the present draft guidelines in debate before a special advisory committee to the NIH director. The 20-member group included David L. Bazelon, chief judge of the District of Columbia Court of Appeals, Peter B. Hutt, former general counsel of the Food and Drug Administration, and Philip Handler, president of the National Academy of Sciences.

The prime significance of the hearing was probably that it created the first opportunity for people other than scientists to comment on the rationales and procedures developed within the scientific community for handling the new technique. The reaction was predominantly favorable. Hutt, for example, who had mastered the salient issues as quickly as anyone on the director's committee, remarked that the scientific community merited "enormous praise" for bringing the matter to the fore and that "if Berg and his colleagues don't deserve the Nobel prize for medicine, they deserve it for peace."

At the same time Hutt and other members of the committee clearly attached considerable weight to the positions taken by critics such as Richard Goldstein of the Harvard Medical School, and Allen Silverstone of the Massachusetts Institute of Technology, who spoke for groups that be-