and select the one which contains the gene for insulin (or more precisely, for the protein from which insulin is derived). But though there may seem to be no theoretical obstacles to such a procedure there are numerous practical problems which are nowhere near solution. For a start, it is not known how well, if at all, the genes of higher cells will be transcribed and translated by bacteria.

The utility of restriction enzymes is that they snip the enormously long DNA molecules of living organisms into manageable fragments which are of roughly the order of a gene in length. (This is because the specific sequence of bases at which each enzyme acts tends on the average to occur this distance apart). A second important feature is that some restriction enzymes, when they cut the double-stranded DNA molecule, slice one strand a few bases lower down than the other, leaving what are known as "sticky ends." Since any species of DNA cut by the same enzyme will have the same kinds of sticky ends, the lower part of one DNA molecule will stick back equally well onto the upper part of another molecule. This is the basic trick whereby two different species of DNA can be annealed into a hybrid molecule.

The way the hybrid is introduced into bacteria is to choose as one of its members—the other is the gene to be inserted—a piece of bacterial DNA known as a plasmid. The plasmid DNA is able to enter the bacterium and get itself (and its hybrid partner) replicated by the bacterium's machinery.

Whatever the prospects for genetic engineering, this is not the reason for the group's suggested embargo. "It is not to be lumped with the proposals saying, 'This is a research path down which we cannot tread because we can't live with the information we will get,'" observes NAS president Handler. The embargo is quite narrowly focused on the specific health hazards potentially raised by genetically altered bacteria, and is framed so as to command the maximum possible agreement among the scientific community. Quite possibly the embargo will be observed until the conference in February. Its real test will come when and if the conference decides the hazard is substantial enough for the embargo to be indefinitely extended. It could then become apparent that control of the new technique is not much easier than the containment of nuclear weapons.

—NICHOLAS WADE

Advising the White House: NSF Says the New System Works

H. Guyford Stever, who is the President's science adviser as well as director of the National Science Foundation, says that he sees President Nixon only on formal occasions and never engages him in "intellectual Ping-Pong games" over policy matters. But Stever regards this relationship as a reflection of Nixon's personal style of management and of the changing character of science-related issues, and not as an indication of a White House animus toward science.

Moreover, Stever contends that the NSF's two, semi-autonomous advisory units—the Office of Energy Policy and the Science and Technology Policy Office—have begun to establish close working relationships with key decision-makers in the Executive Office. And he says that in some areas the OEP and STPO have begun supplying the White House policy machinery with analytical reports and advice on a larger scale than did the old White House Office of Science and Technology.

This was the thrust of a recent interview with Stever and three of his top aides, following the National Academy of Sciences' release of a report criticizing the new science advisory apparatus Stever directs. The report, written by a special panel headed by James R. Killian, Jr., exempted Stever and his staff from criticism but concluded that the "two-hat" system under which he now operates is inherently unworkable. The Killian panel called instead for the creation of a new Council on Science and Technology in the President's Executive Office (*Science*, 5 July).

H. Guyford Stever

On 10 July, former science advisers to Presidents Eisenhower, Kennedy, Johnson, and Nixon joined the chorus of elders calling for a restoration of science advice in the White House. Seated together in the hearing room of the House Committee on Science and Astronautics, George Kistiakowsky, Jerome Wiesner, Donald Hornig, and Lee A. DuBridge echoed the Killian panel in contending that the NSF is too far from the center of action to effectively advise the presidential policy machinery. And they said the NSF lacks the bureaucratic clout to maintain discipline among the federal agencies.

Like the Killian panelists, the former science advisers pointedly refrained from criticizing Stever and his staff, and applied their reservations instead to the role in which the NSF has been cast since the demise of the OST. "The two-hat system is impractical," Wiesner noted. "When I was science adviser it was a 24-hour-a-day job and I wasn't trying to run an agency on the side." Kistiakowsky predicted that as "mistakes are made and irritations occur, Stever will become even less effective."

If the House science committee sticks to its present plan, Stever's side of the science policy debate won't be heard officially until the hearings are con-

cluded next spring. In the meantime, Stever says he has no intention of "defending one organizational relationship over another." But he's more than willing to make the point that NSF is already fulfilling many of the basic functions envisioned for the proposed science council. Joining in the conversation with *Science* were Russell C. Drew, the director of the STPO; Paul Craig, deputy director of the OEP; and Philip M. Smith, a special assistant to Stever.

While the President himself is not available for detailed policy discussions, Stever and his aides say that they have cultivated smooth and direct working relationships with the White House Office of Management and Budget, the "strongest lever arm" on policy, as Stever puts it. Channels are also being established, they say, with the National Security Council, the Domestic Council, and the Council on Environmental Quality. Stever says he has no trouble getting through to OMB director Roy Ash or to Treasury Secretary William E. Simon, who retains his role as energy czar. "In fact," Stever says, "he [Simon] interrupted my trout fishing in Colorado when the Saudis were here," in June.

Energy policy seems to have emerged as the NSF's strong suit. In less than a year, the energy policy office has acquired a staff of 10 and has let $2.6 million for some policy study contracts and grants to universities, nonprofit organizations, and industry. The STPO has a staff of about 15 and a budget of $1.5 million for outside work. Together, NSF's policy staffs are about the same size as the old OST and are spending four times as much on policy studies (*Science*, 12 April).

To Stever and his aides, the energy crunch epitomizes the changing character of science-related issues—a change they feel was not clearly acknowledged in the Killian report, and one that may make it less essential now than in years gone by to have a scientist down the hall from the Oval Office.

The traditional science advisory apparatus, they observe, evolved from the almost purely technological issues of the late 1950's and early 1960's, which centered on such things as the merits of weapons systems and the objectives of the space program. The Apollo program and the antiballistic missile are cases in point, where the government was the customer and the object of discussion was a clearly definable mission or piece of hardware.

Purely technical issues remain—the balance of basic and applied research in government programs is one such problem. But, more than ever before, Stever emphasizes that:

> The issues we're involved in now—energy, environment, food supply—are entirely different. Science and technology are only one component along with economics, politics, and social factors. When the President looks at one of these issues he wants a series of options that include every input. He has to have some mechanism for putting together the whole story. . . . The [proposed] Council could participate, if the President wants that kind of focal point, but I don't think anybody has come up with a structure which really does this well.

Implicit here is an attitude prevalent in the White House, and apparently

Science Adviser Stever: The View from 1800 G Street

Following are lightly edited excerpts from a conversation with National Science Foundation director H. Guyford Stever, taped on 11 July:

On relations with the President. There are several ways to get the voice of science and technology to the highest levels of government. There's no disagreement about its importance; the real argument is about how you put advice together and who receives it. Obviously, you have to have receptive ears.

This President, probably like the previous President, is not the kind of person to sit down and play intellectual ping-pong games to come to a conclusion. Mr. Nixon particularly felt these things should be done by his top aides. So I've seen him on formal occasions, when the Saudi visitors were here, for example, or for presentation of the National Medal of Science awards. But I don't sit down and argue details with him at all.

On the other hand, I do have a chance to talk with his top advisers. . . .

On relations with the science community. The federal government needs an analysis-study arm that taps the whole community in depth, and the backup of an agency that doesn't have a mission-axe to grind.

The best way to tap the scientific community is on an ad hoc basis. We've started to broaden our contacts through informal meetings with the heads of scientific societies and industrial research groups. This is a very practical route.

On weapons systems. The science adviser can become involved in this. If I wanted to raise my voice, I could. And we do get involved in some issues related to national security, such as monitoring the flow of science and technical information out of the country.

Look, the first 20 years of my professional life I was deeply involved in military science, so these things don't scare me very much. And there are many different ways to get this advice. The National Security Council could handle the problem, although whether it does, or will, is another issue. But there are many scenes for debate on weapons: In the agency, in the White House; and when it surfaces as a budget proposal, Congress can be involved and the debate can be completely open. . . . I think it's wise for this Administration or any other to tap the science and technology community before putting a position together. And I think the NSC should take an active role.

On openness in government. NSF is one of the more open agencies, and I'm almost completely accessible. Everybody's testimony (to Congress) has to be okayed by OMB, but we've battled successfully with them on some positions, and occasionally in the discussion afterwards I was essentially on my own.

We have a very good advisory panel on energy R & D, and it conducts its meetings openly. And you know, these advisory groups tend to work better when they know that the public is watching them.

On the permanence of the new science advisory structure. I view every government arrangement as an interim affair, although some are more interim than others. Now, I don't want to get into a debate over organization. It's up to the President. The White House is his.

shared by the NSF leadership, that the science adviser ought to be subordinate to the collection of Executive offices—such as the OMB, the National Security Council, and the Domestic Council—whose role is synthesizing "the big picture" of major issues and presenting him with tersely worded, multiple-choice policy recommendations. While this attitude doesn't rule out a science advisory council in the White House, it does mean that it isn't likely to have any more direct access to the President than do Stever and his staff.

One of the major weaknesses the critics see in the NSF's new advisory role is its low ranking in the federal pecking order (Cabinet officers outrank Stever). Lacking the implicit power of a White House office, NSF is viewed as less able to coordinate federal research programs and restrain the self-serving proclivities of larger agencies. Hornig, for instance, recalls the massive fish-kills along the Mississippi in the 1960's. They were ultimately traced to agricultural insecticides, but not before the old OST stepped into an argument between the Agriculture and Interior departments and brought its own expert opinions to bear. Hornig said he found it "hard to believe" that a science adviser outside the Executive Office would carry much weight in these circumstances.

Stever disagrees. When disagreements arise, he says, "We'll try mainly to shed more light on issues. Have we got all the facts? Are all the judgments in? There are cases when we should bring up the other side of issues."

Stever says that he has taken steps to strengthen the old Federal Council on Science and Technology (composed of R & D leaders in the agencies) so that it can deal with internecine problems. What the NSF's two policy units lack in political muscle among the agencies they hope to make up by a reputation for impartiality.

"So far we haven't come to a head-to-head crash," Stever says, "although on occasions agreement has been less than perfect."

Steering Clear of Weapons

Among the issues that the OEP and STPO have dealt with are relations between military and civilian weather satellite programs; the balance of nuclear versus coal research; and space programs in the post–space shuttle era.

For the most part, NSF officials believe that federal agencies are much better able to direct their own research programs today than they were a decade ago. With help from the science foundation, they say, OMB should be able to balance research priorities as well as it ever has, if not more adeptly.

In keeping with the view that agency research programs are now more self-sufficient than formerly, the NSF has waived the science adviser's role in a controversial area—the weapons systems—that traditionally occupied nearly half the old OST's time and effort. "We've chosen not to get involved in weapons," Drew says. "The Defense Department and the National Security Council are capable of assessing these things themselves. Review procedures have greatly changed and the NSC has new muscle."

The Killian panel disagreed, saying that even a strengthened technical staff in the NSC is "likely to be inadequate."

Stever said his communications with the Defense Department have mainly taken the form of an occasional letter to Malcolm R. Currie, the director of research and engineering, drawing attention to gaps in Currie's basic research programs. "That's one of my most important roles," he says. "Selling the agencies on stronger basic research roles."

One might easily conclude that the President's new science adviser is adopting a somewhat passive posture, but he insists it isn't true. "I can take the initiative when I get my ducks lined up," Stever says, and cites as a case in point a study of food supply problems undertaken jointly by Drew's policy office and the National Academy of Sciences.

Overall, Stever acknowledges that an office at 1600 Pennsylvania "might be a better address than 1800 G Street"—the NSF's location, a few blocks away. But the organization of the Executive Office is up to the President. "You can legislate away, but he can ignore it. The White House is his . . . and it's my job to get as much science and technology into the government with the structure we have."

—ROBERT GILLETTE

Law of the Sea: Fisheries Plight Poses Dilemma for United States

The third Law of the Sea conference, now in session in Caracas, Venezuela, finds the United States in a genuine dilemma where the regulation of fisheries is concerned. In the U.S. view, the tendency of some nations to act on their own to control fishing within a wide area off their coasts is a haphazard process inconsistent with a sound world order. The U.S. position is that fishery regulations should be established only pursuant to international agreement. Yet overfishing by foreign fleets has so reduced many fish stocks in waters adjacent to the United States that the U.S. government may have to take unilateral action to save the fish from commercial extinction. The fishing industry along the Atlantic Coast and in the Northwest is solidly behind legislation that would extend the U.S. jurisdiction over fisheries to 200 miles offshore.

The dilemma is heightened by the fact that the domestic tuna and shrimp industries, based largely in California and the Gulf states, fish off foreign coasts. And, while those fishing interests who are in favor of the 200-mile limit want very badly to stop or severely restrict foreign fishing off the U.S. coasts, they are leary of any legislative proposals that would make themselves subject to strong federal regulation and enforcement.

The fisheries problem being considered at the Law of the Sea conference is an extremely difficult one because it raises two diametrically opposed principles. On the one hand, there is the traditional principle that, outside such narrow territorial waters as coastal states may properly claim, fish of the high seas may be harvested by any vessel, regardless of its na-