posed of three principal frequencies called formants. The precise shape of the formants in each sound is influenced by those of the preceding sound. Thus if the word "not" were excised from the phrase "He was not involved," the formants of the "i" sound of "involved" would still indicate that the "i" had actually been preceded by a "t", not an "s."

Could a counterfeiter evade all these methods of detection? "In overview it looks rather impossible," Blesser says. "But given enough time and equipment and expertise you could make your editing undetectable." There are probably no more than a hundred people in the country who are even aware of all the technical issues. Only if the White House had access to the National Security Agency or the CIA could they get a perfect editing job done, Blesser believes. Other experts feel that detection of a well-edited tape is far from certain. "You can't guarantee that you can detect very professionally done alterations," says Amar G. Bose, professor of electrical engineering at MIT and chairman of Bose Electronics.

Besides testing the authenticity of the tapes, Sirica's panel will also try to restore the conversation in the erased 18 minutes and in any other gaps that may come to light. The 20 July tape is already undergoing tests in the laboratories of the Federal Scientific Corporation in New York. A member of the Sirica panel, Mark R. Weiss, is the corporation's vice-president for acoustic research. At this stage, it seems that, in order to resurrect the erased portions of the 20 July tape, it will be necessary to subtract the hums apparently made by the electric typewriter and tensor lamp in the office of the President's secretary. With the hum removed, the hiss that remains can undergo signal enhancement analogous to that used to process the video pictures sent back by spacecraft. This kind of processing is apparently a standard technique in the intelligence community; without it, the low-grade recordings obtained from the bugging of embassies and the like would be virtually useless. Certain of the panel members have access to the intelligence agencies or their contractors who have the necessary expertise.

A simpler way of restoring the lost portion may be available if the heads of Miss Woods's tape recorder, as is often the case with amateur's machines, were not absolutely clean. Pieces of gunk accumulating on the erase head can sometimes lift the tape away from the erasing signal and leave a thin strip of unerased material on the tape. The strip can be visualized simply by painting the tape with a solution of carbonyl iron particles, which settle only on the strip of tape that has remained magnetized. Also, tape recordings grow stronger with age as the magnetic pattern recruits new particles that are more resistant to erasure. The tape of 20 July, 1972, erased on 1 October 1973, may be just old enough to show this effect. Third, if the erase head were misaligned, it may have left an unerased fringe.

Many of the tests for tampering described by Blesser and other experts are statistical in nature, which means that, unless some particularly crude forgery has been perpetrated, the panel may only be able to give probabilistic conclusions. And exhaustive tests of all seven reels of tape could take a long time—5 man-years according to one estimate. One way or another, Sirica's court will be lucky if it receives any quick or definitive answers from its panel.—NICHOLAS WADE

Cancer: Select Committee Calls Virus Program a Closed Shop

The last few weeks have not been all that one might hope for the nation's premier biomedical research enterprise —the war to conquer cancer. First, assistant secretary for health Charles C. Edwards declared the whole operation an "administrative mistake." Then, a special committee of the National Cancer Advisory Board turned in a review of the multimillion dollar Virus Cancer Program (VCP) that was not exactly complimentary.

Edwards's remark won him as many friends as it did adversaries. Right from the start, many, many scientists opposed the administrative scheme that set the National Cancer Institute (NCI), which is running the war, apart from the rest of the National Institutes of Health. But the National Cancer Act of 1971 was passed just the same, and the question of whether that ever should have happened became submerged as controversies arose over details about how the cancer crusade should be staged. So, a lot of people, including some members of the cancer board itself, were happy to see Edwards resurrect what they consider still to be the basic issue.

The catch is that, were Edwards to have his way by withdrawing the NCI's special status within NIH and cutting it down to size, it does not necessarily follow that future decisions about the level and style of support of cancer research would revert to the scientific community. Nor does it logically follow that less money for cancer would mean more for anyone else. What does follow is that scientific decision-making would become even more centralized within the Administration than it is now (*Science*, 2 November).

The strongest exception to Edwards's charge that the cancer program is an administrative mistake has come from investment banker Benno C. Schmidt, who is President Nixon's principal adviser on the cancer crusade. "Despite expressions to the contrary by the assistant secretary for health, it is my opinion that the National Cancer Act of 1971 is a sound piece of legislation that has worked extremely well," he told a crowd of physicians attending the National Conference on Virology and Immunology in Human Cancer, held recently in New York. The mistakes that have been made, in his opinion, should be blamed on the Administration, not the cancer legislation. Schmidt thinks it was a mistake for the Administration to cut research training grants and to reduce funds for other areas of research at a time when progress in cancer depends upon progress in other areas as well. "At the time we were urging on Congress and the Administration a greater effort in cancer, we were very explicit in the position that the increased cancer effort should not be at the expense of other biomedical research. I must confess that I, for one, did not believe that

would happen." Now, Schmidt admits that he was wrong.

In light of these fundamental questions about the way biomedical research in this country is going, a controversy over the NCI's Virus Cancer Program [formerly the Special Virus Cancer Program (SVCP)] seems trivial. Nevertheless, it is central to questions that are being raised about the ways in which big league, targeted efforts are being run. The answer, in this case, anyway, seems to be not very well.

Virus Program Criticized

For one reason or another, the Virus Cancer Program has provoked controversy ever since it began in 1964 as an organized, coordinated effort to determine whether viruses cause human cancer, and, if so, to do something about it. The VCP is operated with research contracts, rather than grants, and, according to its defenders, supports a large scientific corps for the money—1000 researchers and 1000 technical and secretarial personnel. Within the VCP, several groups have contracts for $300,000 or more. Some top $1 million. Today, the VCP gets 12 percent of the total budget for the war on cancer and is one of the largest contract programs within NIH.

It is not very surprising that there are a lot of people whose feelings about the VCP are anything but generous. And, although unofficial, those feelings have been well chronicled in an article by Nicholas Wade (*Science*, 24 December 1971). Last March, the cancer advisory board decided that it was time to take an official look at the virus program, and it agreed that a committee would be appointed to do so.

Appointing the committee turned out to be rather tricky when initial efforts to find cancer virus scientists without ties to the VCP, or known feelings about it, were unrewarding. In the end, the committee consisted primarily of men who are not working directly in cancer virus research.* Norton Zinder of Rockefeller University is chairman.

The so-called Zinder report, which probably will not be released for several months, was presented to the cancer board in closed session at its recent meeting. Members of the committee, the board, and the VCP were present.

The report begins by stating that the committee fully accepts the probability that viruses cause at least some human cancers and that it believes studies in virology can lead to a basic understanding of a tumor cell. It concludes that the VCP is, therefore, a perfectly sensible kind of program to have and states quite explicitly that it should be continued. Just the same, the report, in the committee's own judgment, has a decidedly "negative tone."

"Should this single funding instrument [the VCP] *as it currently operates* have so large a fraction of the resources that support cancer virology at its disposal? It is the view of this ad hoc committee that the answer to this question is 'No.' " Among other quarrels it has with the VCP, the Zinder committee challenges the assumption that the time is, or was, ripe for the program's goals to be attained. "It is now 10 years and a quarter of a billion dollars later, and the same two objectives remain. It was the assumptions that were wrong. There did not, nor does there, exist sufficient knowledge to mount such a narrowly targeted program," said the committee, which then proceeded to take issue with specific ways in which the VCP functions.

Its main bone of contention is that the Virus Cancer Program is a closed shop. Too few scientists participate. Too few people, all on friendly terms with each other, are in charge of handing out large sums of money to each other. It's too exclusive, too incestuous.

It was only natural that when the SVCP was formed a small group of investigators was involved—an "in group." It now represents a somewhat larger "in group" of investigators. Administratively its procedures lack vigor, are apparently attuned to the benefit of staff personnel, and are full of conflicts of interest. Because the direct targets have become fuzzy since 1964, although available funds for the program continued to grow, the program seems to have become an end in itself, its existence justifying further existence.

Virtually everyone, including NCI director Frank J. Rauscher, Jr., and John Moloney, who heads the VCP, acknowledge that there is room for improvement. Moloney told *Science* that he thinks the idea of opening the program up to more scientists is well taken, within limits. "They have a point. We could open up. But you have to remember, this is a targeted program with specific goals, not a general granting agency." In addition to opening the shop to more scientists, by advertising contracts more widely, for example, Moloney says he was already planning to include more outside researchers on VCP review groups and that he is preparing to assemble a group of outside scientists to constitute an advisory body to his office. They will give general advice on the program and be available to advise specifically any of the various VCP divisions, or segments, as necessary. Whether such moves will quell criticism or satisfy the complaints of the Zinder committee is uncertain.

Another major issue raised in the Zinder report is the matter of contracts versus grants as a mechanism for funding science. Last June, the committee held a meeting in New York at which many persons associated with the VCP

* James Darnell, Vittorio Defendi, Robert A. Good, Keith Porter, James Price, Wallace Rowe, Aaron Shatkin, Chandler Stetson, Richard Tjalma, Norton Zinder, and Maurice Guss, executive secretary.

Sea Law Conference Opens

The Third United Nations Conference on the Law of the Sea opened in New York on 3 December, with 150 nations participating. The 2-week organizing session will not negotiate substantive issues, but will decide on rules, procedures, and officers for the conference, which will reconvene on 20 June for 10 weeks, in Caracas, Venezuela. Later, Vienna may be the site of yet another session.

The Law of the Sea Conference, which follows similar meetings held in 1958 and 1960, will affect the course of oceanographic and geologic research, pollution control, energy policy, and mineral resource development. It will also affect national defense policies and ordinary commercial shipping and fishing activities. Although the meeting was first scheduled for Santiago, Chile, next summer, that country withdrew its invitation in the aftermath of the coup which toppled the government of former President Salvador Allende.

The positions of the various nations on the Law of the Sea have been put forth and debated during six preliminary negotiating sessions since 1971. Thus the New York meeting will be limited to matters of procedure. It is expected to elect Hamilton S. Amerasinghe of Sri Lanka, Ceylon, who presided over the preliminary negotiations, as conference president.—D.S.

testified. Several of them were asked for their views about doing research by contract rather than by grant. In addition, the committee apparently considered the issue repeatedly as it evaluated the VCP through various routes during the course of its investigation. Most of the members of the committee do research by grant, rather than by contract, and their feeling that this is the right way to conduct research is apparent. One gets the impression that the committee is sympathetic to the use of contracts to procure specific services or materials. It makes sense, for instance, to contract with someone to produce viruses, run certain standardized tests, obtain human biopsy material, and so forth. But scientists supported by VCP contracts are also doing a large amount of what can only be called basic research in the strictest sense.

The Zinder committee seems to have two objections to this. One is simply that such studies *should* be done by grant. The other is that because the review of contracts is, in its view, not as rigorous as the review of grant applications by NIH study sections, a lot of mediocre contract work is being supported at what may be the expense of grant research.

There really are two issues. Should all basic research be done exclusively by grants? It is a question the biomedical community has been fixated on for quite a while. Some people say yes. Others, emphatically no. It is not apparent why there has to be an either-or answer, but there are very few people who really *believe* that there is room for both. Most of those who do are scientists who used to work on grants and now have contract support.

Should mediocre work, work that would be turned down as a grant application, be supported, sometimes virtually indefinitely, by contract? Obviously not, and here some of the recommendations of the Zinder committee surely have a place. Scientists should not, for example, sit in the room when their own contracts come up for approval. Nor, for that matter, should members of one review group have control over the contracts of another member. (VCP scientists say this procedure will be avoided under *newly* instituted regulations.) The clincher, which may be legally impossible for the NCI to implement, even were it to want to, is a recommendation to clean house and start all over again. "All contractors should be notified that their contracts will be terminated over the next 3 years."

According to Rauscher, who was responsible for closing the portion of the board meeting at which the Zinder report was discussed, the board gave it mixed reviews. (Among the members of the board, it should be noted, are persons funded by the VCP, persons known to be antipathetic toward it, and persons in between.) There was some feeling, he says, that the report focused too much on the contract versus grant issue. Others felt it failed to recognize some of the very real achievements of VCP scientists, achievement which they believe can be attributed to the fact that the resources of the program and the collaboration it fosters among groups offer something grant research does not. Others felt the report was fine.

Zinder prefers not to comment in detail because he feels obligated to maintain the confidentiality of the board and the NCI, although he says he would have been willing to present the report in open session. He will say, however, that he and the committee stand behind the report and that it was issued without a single minority opinion.

Technically, the cancer board has not yet officially received the report and may not do so until its next meeting in March. Meanwhile, discussion of details of the report will continue through a committee of the board, a committee of the Zinder committee, and a committee of the VCP staff.

Whatever finally happens to the VCP, there are members of the board who say that the Zinder committee report must not simply be accepted and then shelved. Their intention is to see that it is not, which is particularly important at a time when the Administration is putting pressure on the scientific community to do more research by contract, not less.—BARBARA J. CULLITON

Nuclear Safeguards: Holes in the Fence

Stealing a warm silvery lump of plutonium and fashioning it into a makeshift weapon is a scenario of high-technology terrorism that has fired the imagination lately of nuclear critics and Hollywood scriptwriters alike. The Atomic Energy Commission (AEC) acknowledges that skilled technicians could assemble a crude weapon from stolen plutonium or highly enriched uranium. But is it really plausible to suggest that a thief could penetrate the security imposed by the AEC on "special nuclear materials," as it calls the fissionable metals, and could he make off with a critical mass or two?

If a new investigative report by the General Accounting Office (GAO) is any indication, the short answer is Yes. The AEC readily agrees that incentives exist for stealing fissionable material, and that losses have occurred (*Science*, 9 April 1971), but it steadfastly maintains that it is unaware of any actual theft. If the AEC's record really is unblemished though, the GAO's report suggests it may be more by virtue of luck than vigilance.

The GAO's investigation began in the summer of 1972 and centered on 3 of nearly 100 organizations that possess nuclear materials of "high strategic importance" under contracts or licenses granted by the AEC. None of the three companies is identified in the report, although it was learned that at least one processes highly enriched uranium near Oak Ridge, Tennessee.

At each of the three plants, investigators found fissionable material stored in portable containers about the size of small coffee cans. The containers were kept in sheet-steel or cinder-block storage sheds surrounded by fences, wired with alarms, watched by guards, and protected by locks.

Nevertheless, the GAO found that at two of the plants—described only as "Licensee A" and "Licensee B"—one man equipped with an adjustable pocket wrench and a strong arm could breach these barriers and lay his hands, undetected, on the portable containers in a matter of minutes. Locks were found unlocked, seals were broken, alarms