The Times They Were a Changin'

Raemer Schreiber (left) joined the Laboratory in 1943. In the '50s he was the Leader of the Weapons and the Nuclear Propulsion divisions and then, in 1961, was appointed Technical Associate Director. He remained in that position after Agnew became Director until "Harold, in 1972, decided I was really Deputy Director, so he changed my title." Robert Thorn (right), currently the Deputy Director, first joined the Laboratory's Theoretical Division in 1953. His numerous administrative positions included Theoretical Design Division Leader, Associate Director for Weapons, and, from March to July, 1979, Acting Director of the Laboratory.

SCIENCE: *Schreib, you were Technical Associate Director from 1962 to 1972 and as such were part of the transition between the Bradbury and Agnew eras. What do you feel was Agnew's vision of the Laboratory when he became Director?*

SCHREIBER: Only Harold can answer that question definitively. I do know he was always intensely proud of the capabilities of the Laboratory and did not feel that its expertise needed to be confined to nuclear physics. He was willing to tackle any scientific or technological problem worth solving. Generally he took the attitude, "If we don't have the experts, we can get them." You should remember that at this time reactor work was shifting over to commercial utilities, and the AEC was clamping down on new reactor concepts. Harold saw that the future of the Laboratory might well be in other directions than just pure nuclear physics.

SCIENCE: *Bob, you were the Theoretical Design Division Leader and then later Agnew's Associate Director for Weapons during the '70s. What do you feel he hoped to accomplish when he became Director?*

THORN: I think Harold felt we needed to regain the initiative in weapons development that we'd lost to Livermore. In 1970 this Laboratory was still largely a weapons lab, but Livermore was doing a better, more aggressive selling job and was pushing for the enhanced radiation weapons and all the strategic weapons—the nuclear warheads for Minuteman and Polaris. Their reputation was better than ours, or at least perceived to be so by some people. Harold's vision was to restore the luster that Los Alamos had lost. It's true that he thought the Laboratory was premier in all fields and he would undertake anything, but above all he wanted to be first in our principal mission of weapons development.

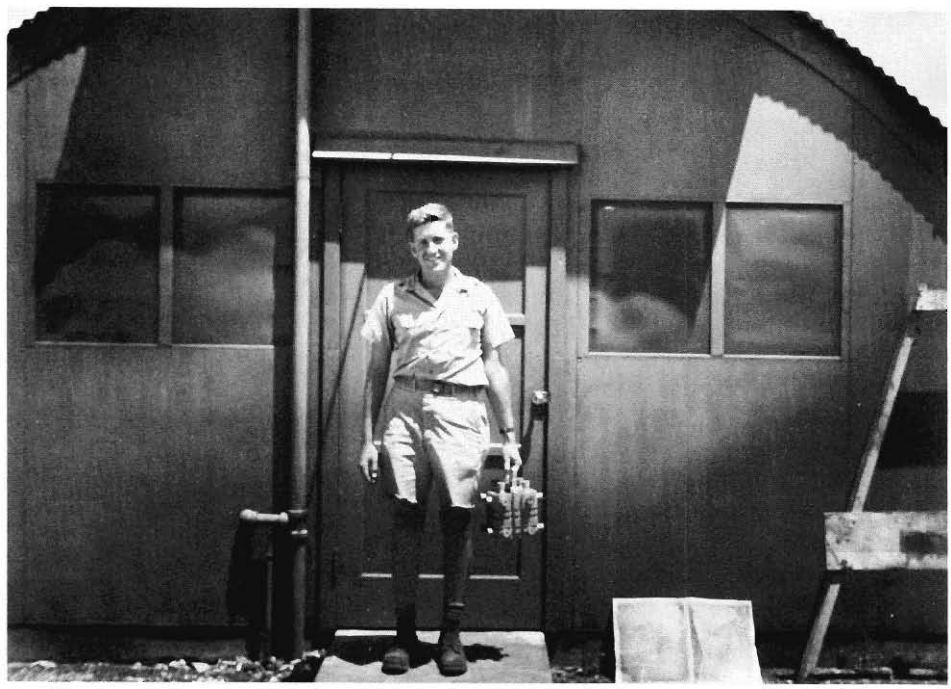
SCHREIBER: There's another aspect to the Bradbury-Agnew transition that I feel is also important to recognize. At the end of World War II, when Norris became Director, a lot of people who had served during the war years on Laboratory advisory boards simply disappeared. Norris really didn't have an existing management structure to work with, so he was able to start with a clean slate. Twenty-five years later the Laboratory was firmly established, and Norris was working with a senior staff of people he'd worked with for years. He knew what they could do and what they were interested in doing, so he was able to take a low profile and run a fairly relaxed ship. But many of these people were also approaching retirement. Norris knew and they knew that major changes would have to be made in a few years. However, Norris did not want to make changes that would obligate the incoming director. When Harold took over he had the chance to assert his leadership at once. It was an appropriate time to reshuffle personnel and his reorganization took place over the first couple of years.

THORN: I agree. Both Oppenheimer and Bradbury operated with small staffs and were able to stay close to all aspects of the effort because there were only a very few major programs. For example, I think when

Harold took over there was the Weapons program, the Space Nuclear Reactor program, and the Fusion program. By the end of Agnew's directorate there were 600 programs! Harold realized that things were getting more complicated and set up two associate directors, one for weapons and one for research, to handle the technical programs. He inherited a Technical Board from Norris made up of the director's immediate staff, division leaders, and department heads, but as time went on this function was largely replaced by the associate directors working with their divisions.

SCHREIBER: In fact, Norris and Harold had different personalities, different approaches to management, and the Tech Board meetings show some of these differences. All major policy decisions under both directors were discussed or announced at these meetings. Norris' favorite technique was to state the question, perhaps offer some possible answers, and then sit back with his feet on the table and let people talk. He might pose some questions from time to time, but generally he let everyone have his say. Quite often a consensus would be reached, in which case he'd simply say, "OK, let's do it that way." Or there might be times when violent differences of opinion would emerge. Then he'd either rule one way or another or suggest that we adjourn and think it over some more. Harold preferred to research the subject first, make up his mind in advance, then announce his decision at a Tech Board meeting. He would listen to contrary arguments to see if anyone really couldn't live with the decision. As a result, he might modify his stand, but he did not encourage prolonged debate.

Harold could be fairly hard-nosed when it came to the shuffling of senior personnel. Perhaps he had to be since he was dealing with entrenched incumbents, but he also believed that the future of the Laboratory depended on bringing in fresh people with new ideas and on rotating responsibilities to provide management training. This was a deliberate stirring of the Laboratory by



Agnew at Tinian in 1945.

Harold, and he put his priorities for the Laboratory above the feelings of those displaced. On the other hand, he was quite compassionate in dealing with hardship cases anywhere in the Laboratory.

One thing was the same under both directors: it was implicit that management get their jobs done without formal directives or instructions. The general attitude was, "If I have to tell you how to do it, you shouldn't be holding down that office."

SCIENCE: *How did management change from the beginning to the end of the Agnew era?*

SCHREIBER: It got more complex. Because of the small number of major programs, interdivisional coordination under Bradbury was handled by steering committees or working groups usually chaired by one of the division leaders. As a result, program direction was quite decentralized and the Director's staff was small. But then the AEC discovered "program direction," which is a polite way of saying that it was building its staff to participate more directly in calling the shots out at its laboratories. Moreover, it was subdividing its budget and personnel to enforce compliance with its directives. This process has continued through the ERDA and DOE regimes and is largely responsible for the large growth in administrative positions in the laboratories themselves.

For example, the Budget Office under Bradbury had two men and a secretary. Harold had to set up the Financial Management Office which grew to about fifteen to eighteen people. Periodic reports and what were called Form 189's were required for every project. This resulted in an enormous amount of bookkeeping, so the accounting office had to grow. There were a number of requirements from Washington that Harold at first just flatly refused to comply with. He won some of these, but lost others.

THORN: In fact, by the end of Harold's tenure it was obvious to many, including

Harold and Norris about the time of the transition between the two directors in 1970.

Harold, that substantial management changes had to be made. The changes were largely necessary because of the increase in programs, program direction from Washington, and accountability. As a manager, you had to control and review the yearly proposals to make sure that they went to Washington in the proper form and that they were the kind of thing the Laboratory wanted to do. In addition you had divisions over which you had to exercise line management. So you were both program manager and line manager. And then you presumably were supposed to remain technically competent. It was just too much to do—too much for a director and two technical associate directors to do. Harold wisely held reorganization in abeyance and allowed his successor, Don Kerr, to implement his own management system.

SCIENCE: *Bob, getting back to Agnew's desire to regain the initiative in weapons development, what were the major accomplishments in the Weapons program in the '70s?*

THORN: When Harold took over, Livermore was responsible for the development of all the strategic missile warheads, which were the big prestige items in the eyes of the public and the Defense Department. But Harold fought vigorously to acquire new warhead responsibilities.

SCHREIBER: Harold was a very aggressive salesman.

Thorn: Yes. He started the Weapons Program Office and the Weapons Planning Office. These were supposed to be part of what you might say was our marketing group. By backing up this group with the technical people in the design and engineering divisions, we could be more aggressive about going out and getting these weapons systems. He also tried to reinvigorate the Weapons program here by splitting the old Theoretical Division—the design part away from the theoretical physics part—so as to provide more emphasis to weapons design. As a result of these efforts, we were awarded responsibility during his tenure for the W76 used in the Trident warhead, the W78/Mark 12A used in the Minuteman III warhead, and the W80 used in the air-launched cruise missile warhead. Also, the Laboratory introduced the first enhanced radiation bomb into the stockpile and developed new versions of the air-carried B61, a general purpose bomb and warhead for short-range attack missiles. One of the weapons developments that Harold felt most proud about was the introduction of insensitive high explosive that makes the stockpiled weapons containing it much safer to handle. An accidental detonation that scatters radioactive plutonium becomes highly unlikely.

SCHREIBER: Another point is that Harold took over at the time when the national emphasis was shifting from aircraft to ballistic missiles, so the major weapon developments were aimed at matching the bomb to these new carriers. Microelectronics and the ability to communicate or to install elaborate instructions in missiles opened a new era in the mating of warhead to delivery system. Ideas such as smart missiles that could track a target or the concept of multiple independent re-entry vehicles (MIRVs) were growing. These ideas required new weapons, but not in the sense of changing the basic physics of the innards of the device. Rather they were new weapons in the sense of changing the configuration to match size, weight, and shape requirements of the missile warhead or in changing how the weapon was told to behave to match the safing, arming, and fuzing requirements of the delivery systems. These requirements led to significant and detailed changes involving highly intricate engineering of the warheads. Also changes were made to improve yield-to-weight ratios and to extend the useful stockpile lifetimes of the warheads. Because of the necessarily close relationship between warhead and delivery system, this period was one of very intensive collaboration with the

Defense Department.

THORN: The collaboration was revitalizing. Originally I think Los Alamos slipped because many of the people here had been in the business since the beginning—twenty-five years—and some of them had grown tired of the arms race. Their attention shifted to diversifying into other fields. As a result, the Laboratory was not putting the kind of attention into weapons development that a weapons lab should be putting into it. After all, we're not here to argue for arms control, we're here to design weapons. But in this period we started to participate more actively with the Defense Department, both by designing to meet their stated weapons needs and by developing our own ideas and trying to sell them.

SCIENCE: *The diversification into nonweapons programs, then, did not start with Agnew?*

SCHREIBER: In one sense, yes. There was a strong effort under Bradbury to diversify into nonweapons applications of nuclear energy, but this was generally limited to nuclear reactors and nuclear fusion. In the '60s there was considerable encouragement by the AEC to try out all sorts of ideas for building reactors, and Los Alamos had projects in nuclear rocket propulsion, the thermionic reactor for generating electricity directly, the graphite-based, ultra-high-temperature reactor, reactors in which the fuel was molten at operating temperatures, and so forth. It was a time when anybody who had an idea that would stand up under peer scrutiny could try it out. But, as I said earlier, about the time of the Bradbury-Agnew transition there was a budget squeeze, and the AEC curtailed support of new reactor work to concentrate on the commercial development of the light-water reactor and on research and development of the liquid-sodium-cooled breeder reactor. This created an immediate need at Los Alamos to find other activities for many of the people who had been in the field of reactor development.

Harold with Edward Teller in 1973.

Part of the need was satisfied by a push into energy programs. For example, the potential of lasers to do isotope separation and to initiate fusion reactions was brought to Harold's attention, and he authorized an immediate expansion of this work. A bit later the oil crisis of '73 and '74 stimulated interest in alternative energy sources, and that led to substantial programs in solar energy, hydrogen as a fuel, and hot dry rock geothermal systems. Other energy programs included synthetic fuels, fuel cells, and superconducting transmission lines. Our large computer facility made possible demographic and socio-economic studies of energy resources and energy distribution.

THORN: In fact, the push into the energy programs during the '70s was so vigorous that the Laboratory, rather than shrinking, almost doubled in size. Harold had correctly recognized that times were changing. He responded by infusing the Laboratory with a spirit of experimentation based on the expertise we'd acquired over the years dealing with multidisciplinary problems in weapons research. It was a period of excitement and challenge.

It was also true that many of the programs were unrelated to our principal mission, and the Laboratory lost a great deal of the cohesive spirit that bound it in its first twenty-five years. What happened was that in response to the energy crisis the AEC had its charter broadened: it could look into other energy programs besides nuclear. The government thought the way to solve the energy problem was with an influx of money, and the fastest way to get started was at the level of the national laboratory. Of course, they found some eager people here quite willing to work on these problems. But as far as having any overall coherent plan—that was missing! The result at the Laboratory was a multitude of programs. When everyone had been paid from the same source—the weapons program—you could

Harold spearheaded the drive for the Laboratory's National Security and Resources Study Center, shown here under construction in 1976.

walk up to somebody, ask him to do something, and he'd get it done. Today you ask, and he'll say, "I can't do that. I'm working on another program, and my sponsor won't allow me to work on yours unless you give me some money." That's an example of what I mean by a loss in the spirit of cohesiveness.

SCIENCE: *What were some of the outstanding nonweapons programs under Agnew?*

SCHREIBER: Well, as I mentioned before, laser fusion and laser isotope separation were initiated by Agnew. A great deal of excellent research has come out of those programs. There's LAMPF—the Los Alamos Meson Physics Facility—which was conceived in the Bradbury years, then realized in the Agnew years. LAMPF, of course, is a story in itself.

We have the new plutonium facility, which is the finest plutonium research and development facility in the country, perhaps in the world. That such a facility was necessary had been recognized at Los Alamos for years, but Harold was the one who convinced the AEC. The old DP site had been built in a hurry as a temporary facility and was being kept in a safe operable condition at considerable maintenance cost. So first the AEC had to be made aware that something should be done. If they were just going to shut the old site down, what then? There were two other reasons the decision was held up: environmental requirements had been changing so that it was hard to pin things down, and it was going to be a very expensive bit of construction because of the need for safeguards and protection against everything from a laboratory fire to an airplane crashing into the building. In essence the AEC was committing itself to having all plutonium research done at the new facility wherever it was built. Much of the selling was to point out the expertise in plutonium research that already existed here at Los Alamos. Construction of the new facility finally started in 1974.

The hot dry rock geothermal concept was an outstanding program under Agnew. Morton Smith should be given credit for initiating and selling this one—he probably made two thousand speeches on the subject. As I recall, preliminary exploratory work had been authorized by Bradbury, but a full-scale effort was not mounted until later when manpower, including chemists and materials fabrication people, became available when the Rover (space nuclear reactor) and UHTREX (ultra-high-temperature reactor) programs were halted.

In a similar vein, work on reactor safety analysis was a natural spin-off from the various experimental reactors that had been designed and built here. People who had been in the UHTREX and LAMPRE (molten plutonium reactor) programs and who were familiar with the safety requirements of reactors moved into that field.

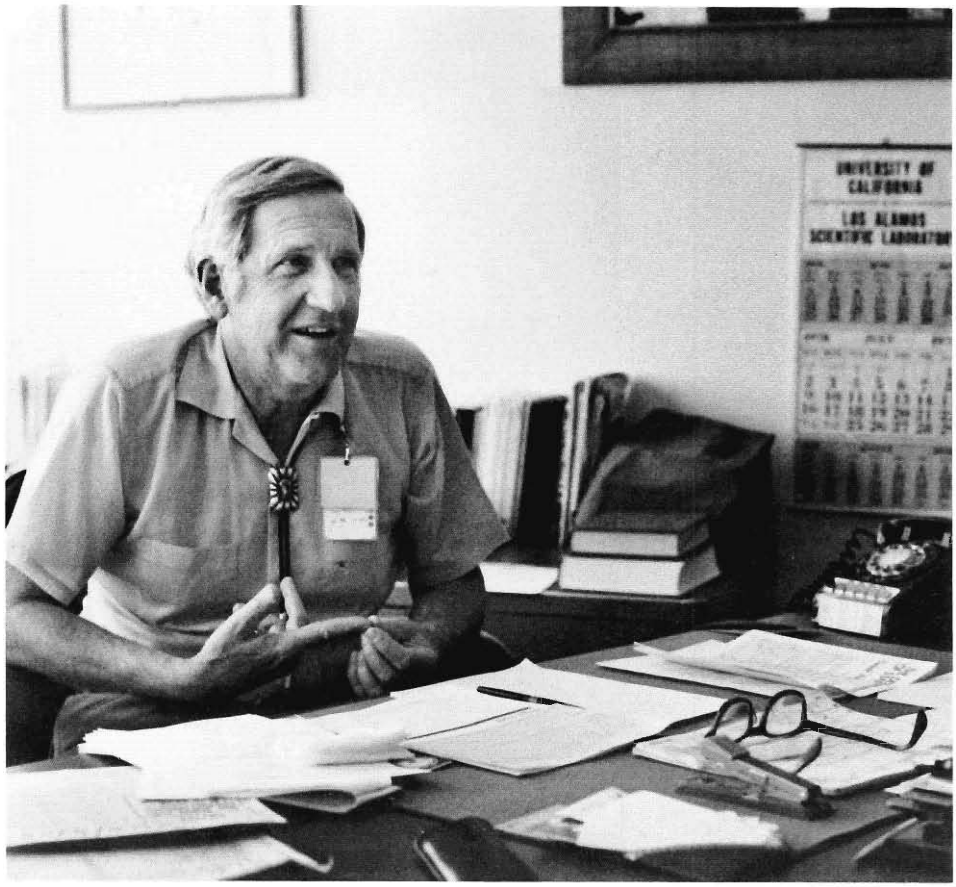
THORN: I agree, Schreib, except I would attribute the reactor safety program more to Kaye Lathrop and other theoreticians who were using large computer codes for weapons simulation and started developing similar codes for reactor safety analysis. They expanded weapons transport codes by adding the appropriate equations of state, accounting for two-phase flow of water and steam, and so forth. But more important, they brought with them the experience of using large codes to model complex problems.

In contrast to many of the other nonweapons programs, the nuclear energy programs at Los Alamos have always complemented the weapons effort. Much of the work involves transport codes used in weapons calculations or involves the plutonium facility or provides useful neutronics data. In that sense, these programs have been cohesive, not divisive.

SCHREIBER: Nuclear Material Safeguards was another outstanding program; it was well under way toward the end of Bradbury's stewardship, then was expanded under Agnew. I was directly involved in its development but can take little credit since Bob Keepin was the founder and chief salesman. He badgered me into authorizing a small initial program, then parlayed that into a major effort by selling it to key officials in the AEC. He acquired equipment and laboratory area from defunct reactor programs using the "camel in the tent" approach. This approach comes from the old Arab story in which the camel outside the tent says his nose is freezing, so the owner tells him he can stick his nose in, then the camel says his ears are freezing, and so on. Bob used a lot of the equipment from the defunct UHTREX, including a building adjacent to it that had been built for reactor experiments. But the real success was the fact that he recognized a very real need—accountability and safeguards for fissionable materials—and then did something about it.

SCIENCE: *What about the theoretical effort?*

THORN: Well, Harold, although he was an experimentalist, respected theoretical physics, and he wanted a first-class theoretical research effort in the Laboratory. Peter Carruthers was hired by Harold and given that charter, which Pete was largely able to fulfill. Also, Harold started the Laboratory Fellows program to help bring eminent external scientists to the Laboratory. Early Fellows were Herbert Anderson, Richard Garwin, Gian-Carlo Rota, Bernd Matthias, and Anthony Turkevich. This program has been continued and expanded under Kerr, who has also instituted a Fellows program composed of outstanding scientists within the Laboratory. And there was a major expansion in computing under Harold, including purchase of the first Cray computers.

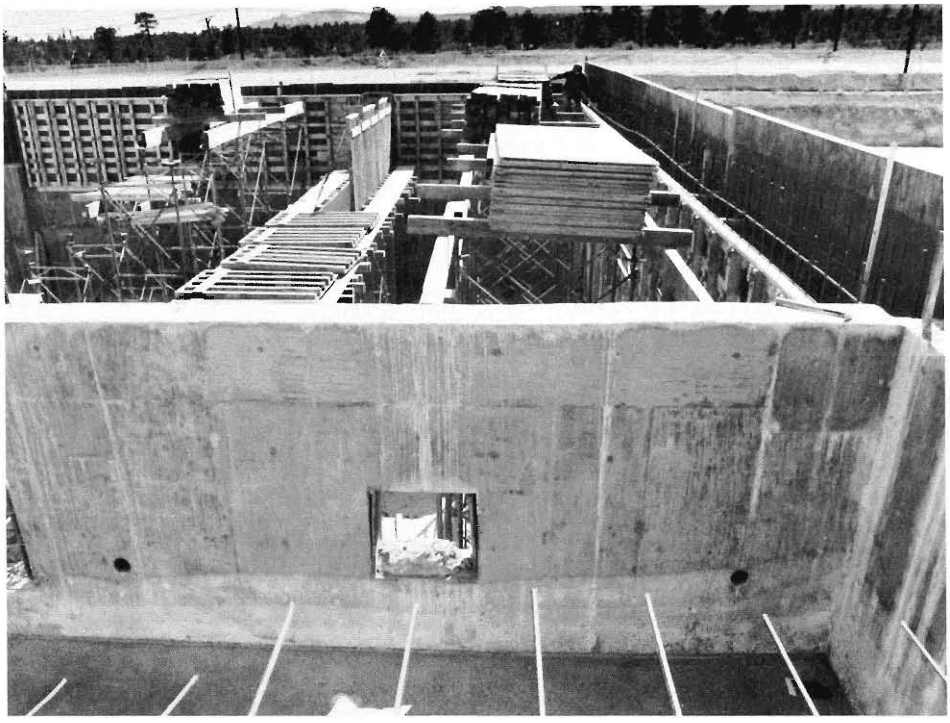


SCHREIBER: One of Harold's objectives was to find ways to finance the growth of basic research, including the theoretical efforts, up to a level of perhaps ten percent of the total Laboratory effort.

SCIENCE: *How did the funding sources and amounts change during this period?*

SCHREIBER: As we've already indicated, budgeting was not a major problem for most of Bradbury's tenure because the money came in a few large chunks accompanied only by general directives. However, the AEC eventually began to exert its muscle in program direction, and then the Laboratory had its first budget crisis in the early '70s with the cancellation of the UHTREX, LAMPRE, and Rover programs.

THORN: Essentially the entire experimental reactor program was wiped out, then Rover, plus there were cuts in the weapons program. The first thing that Harold did was to say, "Let's do reimbursables. Besides the AEC we'll work for the Defense Department, we'll work for any other federal agency." Harold was never just negative about a situation; he always had a solution or two. The idea of reimbursables was an important solution that not only helped the Laboratory survive a crisis, but opened new doors such as



Harold helped convince the AEC of the absolute necessity for a new plutonium research and development facility. Construction started in 1974.

The Helios facility was constructed during the mid '70s to further explore the use of the CO_2 laser as a driver for inertial confinement fusion. Helios is an eight-beam system with an output of 10 kilojoules in 1 nanosecond.

developing productive ties with industry.

SCHREIBER: The Laboratory had already done a limited amount of reimbursable work, but mostly at the initiative of the sponsor of the work. With the AEC cutbacks, active solicitation of reimbursable work was started and a full-time employee was assigned to sell the ideas. In the early period, this was encouraged by the AEC. However, when reimbursable work grew above ten percent of the AEC budget to the Laboratory, worries were expressed about possible wholesale layoffs if, for any reason, reimbursable work stopped. Most of the contracts were for a period of one or two years, so the worry was real, both to the AEC and to Laboratory management. An informal compromise was reached with the agreement that reimbursables would be held approximately to the ten-percent level.

As matters turned out later in the '70s, the AEC budgets grew and the Laboratory continued to expand. However, it was not all that easy. Each year's budget was a cliff-hanger, but Harold was an excellent salesman and knew how to bargain successfully.

THORN: He was indefatigable. He understood that good public relations were becoming necessary. He was good at it, but he needed to be. He traveled extensively, addressed groups, served on committees, and maintained contacts with Congressional delegations.

SCHREIBER: Considering the wholesale cuts at the beginning of the '70s, the Laboratory definitely needed that kind of effort.

THORN: Harold never stopped believing in or selling the expertise and the potential that exists in this Laboratory and its people. ■