

Reel 4-A (First Retype, October 27, 1965)  
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At the end of the last reel, I was talking about the problem of keeping in condition in Washington during the war, and this reminds me of an incident which I thought I ought to put down. One of the troubles was that air-conditioning raised the very devil with anyone who had to move about the city. I had offices in the Joint Chiefs' building, and in the CIW building; I was often in the Pentagon, sometimes up on the Hill; and OSRD was spread through several buildings -- with the result that I was likely to be all over the city. When I was, I was in and out of air-conditioning -- out into 110 degree heat in a car, and in to 70, and it was very trying indeed. I don't think enough attention is paid to this. It seems to me it puts quite a strain on the system to make that kind of

1) HEALTH & AIR  
CONDITIONING IN  
WASHINGTON

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abrupt transition a dozen times a day.

1) AIR-CONDITIONING  
AND FDR

One day I was due at the White House, and I got so busy that I didn't realize, until it was too late, that I had thoroughly sweated through the summer suit I had on. It was a queer white thing -- I've forgotten what they call them -- but one of these wrinkled summer suits. By the time I started for the White House, I suddenly realized that I'd sweated the thing through. But I went right ahead, and when I went in to see FDR, he took a good look at me, and got a great laugh out of the fact that I was thoroughly soaked. He said, "Well, Van, (ital.) how do you like the temperature in here now." The remarkable thing about this is that FDR, with all that he had on his mind at that time, could remember how he handled his visitors enough to change the temperature

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in his quarters. He always was a kindly sort of individual, as we know, but that, I thought, was very remarkable indeed.

(Question 40 was answered on Reel 1)

Question 41: The difference between basic science and applied science.  
The difference between applied science and technology.  
Technologist vs. engineer.

- 1) BASIC SCIENCE
- 2) THE KILGORE COMMITTEE

Question 41 is all about the definition of scientists and engineers and so on. Now in the first place, why do we speak of basic science? We used to call it fundamental science, or pure science. I think I introduced the term; at least, if I didn't, some of the crowd with me did. It came into use at the time when the Science Foundation bill was working its way through Congress, and particularly through Senator Kilgore's committee. Kilgore and his committee originally had the idea that the science foundation was going to be some kind of thing to help our poor inventors and the like. Also, Kilgore's

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staff had some ulterior motives. There was one chap named Schimell (SP.? I think this is correct. It will be in some of my correspondence with Irvin Stewart) who spent a great deal of time trying to get something on me during the war, and his snooping around OSRD was at times a bit troublesome. Incidentally, he later went onto the UN staff, and was later one of the group that got thrown out of there on the grounds that they had too much association with Communists. (Stewart wrote Kilgore when this occurred, and asked if he was the same one -- which he certainly was--but had no reply.)

Kilgore and his committee had no idea of what pure science was. So we coined the term basic science, as being a little more descriptive, and we gave them quite a story about the way in which basic science had been built up and had been very necessary for the development of the A-bomb. That's where basic science came from, I'm

- 1) THE KILGORE  
COMMITTEE
- 2) SCHIMELL

pretty sure. Basic science, of course, is the kind of science carried on merely for the acquisition of new knowledge without any intent of applying it and with no applications in mind.

- 1) EXPLANATION OF TERM "BASIC SCIENCE"
- 2) APPLIED SCIENCE SEEKS APPLICATION AND IS EXPLORATORY

We can take an example from microbiology. Down at Cold Spring Harbor, Dr. Alfred<sup>D.</sup><sub>A</sub> Hershey is working on such things as the way in which viruses multiply within a bacterium. He has no applications in his mind; he's simply trying to find out the facts of life. On the other hand, a microbiologist at Merck & Company may be working on a variety of organisms to see which of them develop possibly useful antibiotics. This second affair is applied science. At the applied science level, there is very little ~~thought~~ ~~of~~ economics involved. ~~XXXXXX~~ The work that is being done is exploratory; results are being sought, all right, but they're not being tied into the costs of production and the likes.

(VB: Re applied science: the sense here  
is scrambled, will you please unscramble)

Next we have the engineer. The engineer is the man who stands between science and its applications. Taking the facts of science, he applies them in an economic manner and for useful purposes. His job is, on the one hand, to know science well enough to be able to utilize it, and to know economics and business well enough, on the other hand, to be able to fit the two together. The engineer, therefore, cannot be expected to be fully an economist, or fully a scientist. He is an intermediary, and a very useful one, a very necessary one.

In addition we have a man who's called the technologist. This term differs in its application between England and the United States, for example, but it also differs within the U.S. The technologist is usually the man who's aiding the engineer or the applied scientist. He knows a great deal about application; he may be very skilled; but he's not the professional man. The engineer, for

- 1) ENGINEER IS  
INTERMEDIARY  
BETWEEN SCIENCE  
AND BUSINESS
- 2) TECHNOLOGIST  
ASSIST ENGINEER  
OR APPLIED  
SCIENTIST BUT NOT  
PROFESSIONAL MAN

example, developing some sort of an electronic affair, may have a technologist who's highly skilled at connecting transistors into a useful circuit, but he's not any more than that. He's not the man who can see on the one hand where the thing is going to lead in business and its applications, nor on the other hand can he look back to see what's new in the field of semiconductors that might lead him to a particular application. That's the technologist. In some ways he's similar in medicine. In medicine we have the physician, the research physician, the nurses, and finally the technologist. The technologists here are the ones who carry out the tests under instruction.

I said something a while ago about why, in OSRD, we referred to our personnel primarily as scientists. This was because the word "engineer" had gotten improper meanings among the military personnel. It's for the same reason that we spoke of the Office of Scientific Research and Development. (X-REF FORWARD TO PAGE 322) We needed to emphasize science in order to be accepted. The important thing

1) TECHNOLOGIST --  
ASSISTS ENGINEER  
OR APPLIED  
SCIENTIST BUT NOT  
PROFESSIONAL MAN

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about that title, however, is that it also has "development" in it. There was a good deal of danger that the military services might bar us from applications to such an extent that we would simply be working on the fringes. We'd come up with things, which they could then use or not, as they saw fit, and all matters of use would be in their hands. That would not have been the way to win the war. (I should at some time compare with Britain where the civilians had no independent funds of their own -- or nearly none.)

We managed to develop OSRD into a situation where it had a collaborated program -- the military personnel sitting down with scientists, in the same section, and discussing things jointly. Thus, we reached over into the application and actually into the field, as you know. It was essential to get that word "development" into our outfit so that it would be very clear

1) WHY THE NAME  
OFFICE OF  
SCIENTIFIC  
RESEARCH AND  
DEVELOPMENT

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that we were not only going to research on scientific matters that might be of military use, we were going to develop the gadgets; we were going to develop them to the point where they could be put into production.

1) FRAGMENTATION  
OF ORGANIZATION  
OF SCIENCE IN  
THIS COUNTRY

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Question 42: Science in the central government

This is Question 42, all about the National Academy of Sciences, and so on. Now of course, both British and Americans tend to make all of their scientific organizations complicated. They've always done so and probably always will. It's a part of the American trait that when three men get together, there'll soon emerge a president, a treasurer and a secretary. At any rate, the organization of science in the country is fragmented into about 1000 pieces, with professional societies on all sorts of detailed phases of science. Way

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back at the time of the Civil War, the National Academy of Sciences was formed to advise government, and so it did. But its very form was bound to develop it almost entirely into some sort of mutual admiration society. Election to the Academy was much sought after, and was guarded by all sorts of procedures, for the aim was to honor the outstanding scientists of the country. On the whole it doesn't do too badly, though of course it makes lots of mistakes. Since in general it elects rather old men, and since it brings together men of such widely different disciplines that they could hardly understand one another, it was bound to be moribund when it came to actual action. It becomes active only when it has a vigorous president, such as Detlev Bronk, who breathed life into it to an extent that I would hardly have thought possible.

1) FLASHBACK --  
CIVIL WAR,  
FORMATION OF  
NATIONAL ACADEMY  
OF SCIENCES

Hence, during the war, while the OSRD worked with the Academy and with the National Research Council, it was a matter of collaboration only; the Academy and Council could never have done the job themselves.

The Council was set up during the First World War to supplement the Academy, since it certainly needs supplementing. It's divided into sections on various broad affairs -- for example it has a section on engineering. There is a strange thing about this because scientists who are brought into the National Research Council are asked to work in an organization subordinate to the National Academy of Science. The scientists thus brought in are asked to do a lot of work, but are not admitted to the central organization. This is a good deal to ask of any scientist -- that he come around to a lot of work under the Academy, yet not be made a member of it. The NRC has worked far better than one might expect with such a handicap. Its section on medicine has done a lot of very good work, and did do a lot of very good work during

- 1) FRAGMENTATION OF  
SCIENTIFIC  
ORGANIZATION (cont)
- 2) NRC -- SET UP IN  
WW I TO SUPPLEMENT  
NAC

the war. In fact, we hardly could have operated the Committee on Medical Research during the war as a part of OSRD if we had not had the collaboration of the Research Council.

Around this hangs quite a story involved with Dr. Weed, which I'll probably recite somewhere but which we probably won't want to put in any records.

(ital) In recent years we've had quite a development: first, in the appointment of a scientific adviser to the President, with Jim Killian as the first. Fortunately this was set up in a way that was reasonable; that is, we had not merely an adviser, we had a Science Advisory Committee. The difference is fundamental. During the war, Churchill had Cherwell as his scientific adviser, but Cherwell gave his personal advice. (X-REF AHEAD TO PAGES 426, 452B AND 724 AND BACK TO 176) He didn't have a means, or he didn't utilize a means, by which he could be sure that the advice he gave

- 1) ADVENT OF  
SCIENTIFIC  
ADVISORY COMMITTEE
- 2) ROLE OF CHERWELL  
VS. ROLE OF  
CHAIRMAN OF  
SCIENCE ADVISORY  
COMMITTEE

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was the advice of the best scientists that could be gathered on a particular subject. Personal advice, not tempered by consultation with thoroughly qualified professional men, is a dangerous thing to have, and also a very annoying thing. But here we have the President's Science Advisory Committee, with some strong men on it, and the chairman of this committee, as the President's scientific adviser, is bound to consult with them before he gives any important advice. This makes a lot of sense. And I think it's worked very well. Wiesner has gotten himself into some difficulties, but I think on the whole he's handled the thing with reason. He's been accused of being an empire-builder or something of the sort, but I don't think this is just.

1) ROLE OF CHERWELL  
VS. ROLE OF  
CHAIRMAN OF  
SCIENCE ADVISORY  
COMMITTEE

2) WIESNER

We have, in addition, a Federal Council on Science and Technology. As I understand it, this group which has no authority, is a coordinating group where men from the departments which have bureaus that are scientific in nature, gather to consult on their joint programs, to try to prevent a lot of useless overlap and the like. I haven't had anything to do with this organization so that I can't say from my own experience how well it operates -- probably as well as any such coordinating body in government ever operates.

1) FEDERAL COUNCIL  
ON SCIENCE AND  
TECHNOLOGY TO  
TRY AND PREVENT  
OVERLAP

Question 43: Congressional Committees concerned with Science and Technology

Question 43 reminds me of an episode before a Congressional committee, which I may have recited elsewhere, but I know you don't mind a bit of duplication. One time I was before a House committee, and they were asking me about a Navy program. Of course this was

always embarrassing to me, because I didn't like to talk about a Navy program unless I'd studied it thoroughly, and usually when a Committee brought such a thing up, I didn't have an opportunity to, and it came as a surprise. (X-REF BACK TO PAGES 148,149)

At any rate, it was a highly technical matter, and after a little questioning, one of the Congressmen said to me, "How do you expect us to become sufficiently acquainted with this subject, this highly technical subject, to understand it sufficiently so that we can appropriately pass judgment on it?" and I replied, "I don't." The committee looked rather surprised, and the Congressman said, "What do you expect us to do?" I said, "I expect you to do what you usually do under such circumstances. You listen to a lot of witnesses; you sort out those that seem to you to make sense, and seem to be trying to clarify the matter

1) REPEAT OF CON-  
GRESSIONAL  
TESTIMONY ANECDOTE  
TOLD EARLIER

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appropriately and so on, and then you go along with them in your judgment."

And I said, "Fortunately, you gentlemen are all good judges of human nature, or you wouldn't be here." The committee liked this because, of course, that was exactly what they do.

Now we have many committees in Congress; for example, Science and Technology, and that's the way they go about it, of course. I rather think, for example, that the Senate's Joint Committee on Atomic Energy has handled its affairs pretty well. I don't think they've interfered unduly with the AEC. Moreover, some of that Committee, without any doubt, now have a pretty good understanding of the atomic energy development. This doesn't mean that they know nuclear science; they don't need to. But it

1) CONGRESSIONAL  
COMMITTEES CON-  
CERNED WITH  
SCIENCE AND  
TECHNOLOGY

does mean that they may have a very good judgment as to the costs of power developed in nuclear plants as compared to the power developed from fossil fuels. They have a pretty good idea, no doubt, of what the promise is for breeder piles; what the questions are on stocks of uranium and plutonium, and how these may possibly be replenished. At any rate, my experience with the Congress, and before its committees, is that in the House, in general, the men I've met have been trying very hard to get a good grasp of what their witnesses were talking about. I believe that an intelligent man, no matter what field or training he may have had, if he spends hour after hour with the opportunity to question scientists who really know their subject and can express themselves, will end up with a pretty good understanding, which will be

1) CONGRESSIONAL  
COMMITTEES CON-  
CERNED WITH  
SCIENCE AND  
TECHNOLOGY

all that he will need for judgment on the broad aspects of a program.

1) NEED FOR  
SCIENTIFIC  
ADVISERS IN  
COURT

This is parallel in some ways to what we find in the courts. The court has a judge with a legal background only; he gets into a technical subject, and witnesses come before him who testify -- experts so-called -- and are cross-examined.

(ital) This can be a farce, because sometimes the experts talk in terms that the judge can't possibly understand, and he simply sits there and gets bored. Nevertheless, he's called upon to exercise his judgment, and the legal profession is such that he doesn't hesitate to assume the responsibility although the judgment may be based on faulty understanding. The thing that would cure this -- and it is available, as far as that's concerned, in many courts -- would be for the judge to have a scientific adviser himself; a man with whom he could sit down

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(not in the courtroom but in chambers)  
and ask questions: get him to clarify all  
sorts of things. (EH TO VB: But see page 208)  
The litigants or their lawyers usually are  
afraid of this because they think the adviser  
might be prejudiced and that he'd have  
altogether too much influence. But I  
don't know why they should fear this.  
This is exactly the same as being afraid  
that the judge may have prejudice. However,  
it's not used in this country, and it would  
be a great help.

Early in my career, I had plenty of  
opportunity to become an "expert" in court  
testimony, and I did a little bit of it  
-- not very much. Fortunately I came to the  
conclusion early that if I did this, I  
probably wouldn't do much else, and it was  
not a career I found attractive. (EH TO VB:  
Examples? VB TO EH: In cases involved with  
the Spencer Thermostat , for example)

1) NEED FOR SCIENTIFIC  
ADVISERS IN COURT  
(CONTINUED)

The only reason I toyed with it at all, when I was young, was that I was broke, and the pay of an expert was excellent. I did a bit of it, and then I quit, and I'm glad I did, of course. I remember all sorts of things about it, but they're hardly worth telling.

One thing might illustrate the fact that the so-called expert is not at the mercy of the lawyer who's cross-examining him, no matter how rugged that lawyer may be. I remember one time when I was testifying in an interference case under the patent statutes, and the opposing lawyer was from the General Electric Company. One of their scientists was sitting beside him and feeding him questions. All I had to do when he asked a question which was at all embarrassing was to say, "Now before I answer that, I want to know exactly what you mean by such-and-such a term. I can't answer it properly because the term is ambiguous; if you'll just define it, I'll answer it." This

1) NEED FOR SCIENTIFIC  
ADVISERS IN COURT  
(CONTINUED)

would leave the lawyer completely up in the air, because he wouldn't have the slightest idea what the term meant. He didn't dare turn to his expert and ask him to explain it, so he'd fuddle it up somewhere, and go on to something else.

1) BACK TO CONGRESSIONAL COMMITTEES CONCERNED WITH SCIENCE AND TECHNOLOGY

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[SMALL CUT OF MATERIAL REPEATED ELSEWHERE]

In the Congress, these committees get a chance to learn because they get the scientific men from the agencies before them. They can have them in executive session, or the affair can be quite informal. They can query witnesses to their hearts' content. They do, and I think this works very well.

Now often it is suggested that the committees of Congress having to do with scientific matters should have a staff of scientific men of their own. I'm inclined to disagree with this, because I'm afraid that if this were done, they would get second-string men only. (EH TO VB: You seem to be contradicting here, what you said back on Page 206) (VB TO EH: I don't think there's

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a contradiction. The staffs of Congressional committees have, some of them, been excellent. But the general run has not. If the Library of Congress (which has excellent people on its staff) were called on to provide scientific advise<sup>c</sup> as needed, it would be different.) I don't think that men of really great capabilities would want to put themselves into the post of being the scientific adviser and member of the staff of a committee of Congress. For one reason, the head of that committee would undoubtedly be a lawyer, they'd be a sort of second-string affair, it would not be a post of any real dignity, or any great usefulness.

I think that the committees of Congress, when they need to learn something scientific, have ample opportunity to do so, because they can get before them the witnesses they need for the purpose, and they can query them all they please. I've been queried that way a good many times, and I've found, in general

1) BACK TO CONGRESSIONAL COMMITTEES CONCERNED WITH SCIENCE & TECHNOLOGY

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certainly in the House and not so much in the Senate, the members of the committee are genuinely anxious to learn something, and not merely playing a game. (EH TO VB: What accounts for the difference?

VB TO EH: House members are a far less cocky crew. The difference may be merely that House members are likely to be younger and less experienced. Whatever the cause, I certainly sensed a difference in atmosphere. Of course there were chaps in the House that were playing a game or trying to get a headline. Also men with fixed ideas who had ceased to seek for light. But I found less of this in the House than in the Senate. When I had become well acquainted with Cannon and several members of his House Appropriations Committee they sometimes called me to meet with them in executive session with no clerk present.

1) HOUSE MEMBERS  
MORE ANXIOUS  
TO LEARN

This would not be a formal meeting of the full committee. Just a few of the influential members. It was done so that the press did not know it occurred. At these sessions they did not stick to OSRD matters, and some such sessions occurred after the war. They would quiz me about all sorts of things. As an example, at one they asked my opinion of the Navy program on large carriers. I gave them my judgment that, in general, the advent of the A-bomb called for a mosquito fleet, just as it called for dispersion on land (you remember I discussed this latter with Montgomery in France.) But I added that an individual opinion such as mine should not be given great weight. I told them that, if I were in their position, I would not appropriate for my military program unless it had been reviewed favorably by a disinterested professional group competent to examine all phases of it. They did not, of course, adopt this procedure, but it would have helped if they had. The Joint

1) HOUSE MEMBERS  
MORE ANXIOUS TO  
LEARN

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Chiefs organization was supposed, under the Unification Act, to do this sort of thing, but did not. I don't think its equivalent appeared until McNamara forced it. This sort of informal delving never occurred in my experience in the Senate.)

Question 44: VB's recommendation of Science Advisory Board. Did NSF grow out of this? Did NIH grow out of OSRD-Medical Division?

- 1) WW II
- 2) EASE OF APPROVING PROJECTS IN WARTIME

I don't know just when the name National Science Foundation was concocted, but undoubtedly it flowed out of that recommendation of the Science Advisory Board. The whole story of the creation of the Science Foundation will come later, no doubt. (SEE NSF CARD. THERE IS NO ONE PLACE WHERE ENTIRE STORY IS TOLD) The fact that government-subsidized research gathered great momentum during the war accounted for a great many things. During the war, the process of government support of a war research program was greatly streamlined, as you know. It was quite possible for a section of OSRD to

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approve a project, a program, one day, have the NDRC endorse it inside of a week, and have the go-ahead within ten days of the time the thing was first considered. Red tape was cut right and left. This was possible, of course, because the way in which OSRD was set up put all the authority in the hands of the Director; there were very few checks on his actions such as accumulate in an old bureau over the years. (X-REF FORWARD TO PAGE 402)

In regard to the National Institutes of Health program, this was undoubtedly one of a number of things which just went on after the war because people had seen the possibility of government-supported research in the public interest. The National Institutes of Health program of setting up its own great research laboratories was a different thing, of course

- 1) WW II
- 2) EASE OF APPROVING PROJECTS IN WARTIME
- 3) OSRD CHIEF OMNIPOTENT
- 4) GOV'T SUPPORTED RESEARCH CONTINUES BECAUSE IT WORKS

but the program of support, by grants, of medical research throughout the war simply followed as an inevitable result of the OSRD-National Research Council-Medical [X-REF FORWARD TO P. 505] Division program. In the same way, the Navy at the end of the war set up the Office of Naval Research, which incidentally I encouraged and helped get started. This was merely to carry on after the war one thing that had been discovered during the war in regard to civilian research, namely that fund-granted research, collaborating with the military, was a thing that could be made to work.

- 1) POST WW II
- 2) GOV'T SUPPORTED RESEARCH CONTINUES AFTER WAR BECAUSE IT WORKS
- 3) OFFICE OF NAVAL RESEARCH

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Question 45: How did various organizations group after OSRD was disbanded?

Of course the NSF evolved into quite a different form from what was considered at the time when the recommendations went in to

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FDR. At that time, there were a good many men in the medical field, (who of course wrote their own part of SEF) who had found out during the war that a great deal of medical research could be conducted to advantage under government support, that this could be done without regimenting them and so on. They naturally wished it to continue after the war, and it did. It continued in a number of ways. But the Science Foundation itself of course gradually evolved into the form in which it's in at present. You'll find that in the legislation that established the Science Foundation, there are quite a few differences, both from the formulation that was outlined in the Science Frontier paper, and the way in which the Foundation now operates.

1) DEVELOPMENT OF  
NSF

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[CY NOTES: THE VARIOUS PROPOSED BILLS DRAFTED PRIOR TO THE ENACTMENT OF THE NSF BILL IN 1950 APPEAR IN THE "NSF" FILE IN THE BUSH PAPERS. THE PRINCIPAL CHANGES AMONG THE BILLS ARE OUTLINED IN CHART FORM IN THIS FILE. THE CHAIN OF AUTHORITY FROM THE PRESIDENT AND/OR THE NSF BOARD TO THE DIRECTOR WAS A MUCH-DEBATED POINT.]

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Question 46: What about Science Advisor to Secretary of State in Eisenhower Administration?

Now here's a thing on which I won't be able to give you all the details, although I think most of it's in my file in one way or another. There was a good deal of talk, for a long time, about scientific advisers in the State Department, particularly in connection with our embassies, to facilitate the exchange of scientific information between allies after the war and so on. The man who started the whole show was Lloyd Berkner.

Lloyd was in the CIW. He might have succeeded Fleming as the Director of the Department of Terrestrial Magnetism, which Tuve now heads, but Tuve was chosen, and while Lloyd served loyally under him for a while, he pulled out later. He became head of the show on Long Island, Brookhaven,

- 1) SCIENCE ADVISER  
TO THE SECRETARY  
OF STATE
- 2) LLOYD BERKNER

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and I guess gave the trustees of that outfit a good deal of difficulty. He's now running a scientific program down in Texas. He had the idea, as I remember it, that it would be of great help to our embassies, and also help in the exchange of scientific information, if a scientist was installed in each one of the important embassies. This was really set up and started going, but it after a while got lost in the complexity of the State Department, which is of course a real quagmire. So the idea petered out. I won't attempt to give the entire history; there were several men who headed it. There were some very strong men who went to embassies, particularly in England, but the whole thing was a bit foreign to the thinking of the State Department and it never really got top-line support.

1) SCIENTISTS IN  
EMBASSIES

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Question 47: Who gets credit for Geophysical  
Year of 1957-58

I really didn't have much to do with the setting up of the Geophysical Year in 1957-58. Lloyd Berkner again was the sparkplug. Lloyd is a really great promoter of this sort of thing. For example, recently he has been the prime mover in bringing the American Institute of Electrical Engineers and Institute of Radio Engineers together in a single organization. A lot of people were involved in this, but Lloyd was the fellow who really made it spark, and was, as far as I know, the chap who put the I.G.Y. across. Again, many people were involved, but he was the fellow that gave it the drive.

Lloyd Berkner's a swell fellow; I had excellent relations with him. He sometimes gets on people's nerves just simply by reason of his drive. I can give you one incident that'll show what kind of a chap

- 1) GEOPHYSICAL YEAR
- 2) LLOYD BERKNER

he really is. When Fleming retired as head of the Department of Terrestrial Magnetism of CIW, there were four men in the department any one of whom would have made a good successor. The two principal ones were Tuve and Lloyd Berkner. Each one of them came to me to say independently that if the other man was chosen to head the department he would serve under him loyally. They both meant it. Merle was chosen, and Lloyd did serve under him well. But Lloyd was too high-powered a fellow to remain as just a scientist in the Department of Terrestrial Magnetism. He was doing some interesting work, and he was fascinated by it. He did quite a lot on the business of transmission of radio signals over a long distance by reflection from ionized regions. But he was primarily a scientific promoter, and a good one;

1) BERKNER & TUVE  
AND DEPT. OF  
TERRESTRIAL  
MAGNETISM AT CIW

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hence he soon got into all sorts of executive posts.

1) LLOYD BERKNER

He's very highly regarded, and, I think, a type of man we need in this country, a man who knows how to organize and finance things that might not get going if it wasn't for him. I think Lloyd also is a little difficult to work with from the standpoint of the people over him. I never had any trouble with him -- neither did Merle Tuve. But I know that the trustees (or directors or whatever they are) at the Brookhaven Laboratories had all kinds of difficulty, because they couldn't quite tell where Lloyd was or where he was heading. This was just because he put a lot of pressure on to get things done. The trustees were a little slow on the uptake, and he started doing things without their knowledge and consent. Some of them were quite annoyed, but I always felt that there were two sides to this question, and certainly Lloyd has accomplished enough in the world to prove his case.

Question 48: Peaceful uses of atomic energy

I'm not quite sure what you have in mind here. "Peaceful uses of atomic energy" of course means primarily the use of atomic energy to generate electric power. There are other possible uses, such as making a new Panama Canal, but right straight along, the peaceful uses of atomic energy is centered around replacement of fossil fuels by atomic fuels. During the war, there wasn't any doubt that Churchill thought, that, come the end of the war, the atomic energy would solve Britain's power problems of dwindling coal supply, costing more and more man-hours per ton. Churchill knew this, and I think he was very keen to get going on it after the war. I think he was guided into this point of view by some of the people in British industry, notably in ICI. It was this that led to the great controversy we had over giving information on atomic energy to the British. This story will undoubtedly

- 1) PEACEFUL USES  
OF ATOMIC ENERGY
- 2) CHURCHILL & USE  
OF ATOMIC  
ENERGY FOR COAL  
AFTER WAR
- 3) CRISIS OVER TRANS-  
MISSION OF  
INFORMATION TO  
BRITAIN

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Page 215A

come up later, for it was the subject of my rather vigorous conference with Churchill at the time when there was a crisis over this matter of interchange. (X-REF FORWARD TO PAGES 270, 274, 432) (Now told in Atlantic Monthly -- copy in office)

\* \* \*

Question 49: Why did Truman veto NSF legislation?

- 1) POST WW II
- 2) TRUMAN VETOED  
FIRST NSF BILL

I never really got to the bottom of why Truman vetoed the NSF legislation the first time it came on his desk. I had quite a talk with Jim Webb about it at the time, when he was head of the Bureau of the Budget, but I didn't find out from him, either. I think it was because Truman wanted to keep in his own hands full control of the organization. Specifically,

(ital) he wanted to appoint the board and the director,  
and he wanted to have the director directly  
responsible to him, not responsible to a  
board. Now I think, but I couldn't prove  
this at all, that some of the men in Senator  
Kilgore's office thought that if the bill  
went through as they'd first prepared it,  
one of them was going to be made the direc-  
tor; this may have been behind the whole  
business. I'm not sure and I don't think  
it's ever been uncovered.

But Truman did veto the NSF bill  
the first time. (X-REF FORWARD TO PAGE 702)  
I tried to get Webb to dissuade him but  
Webb simply took the point of view that  
he followed the boss's orders and that was  
that.

The second time the bill came up,  
I had a conference with Truman about it,  
and managed to persuade him not to veto it.  
(X-REF FORWARD TO PAGE 339 AND 702) When  
I first sat down with him, he lit on me  
in his characteristic way, and said the bill

- 1) POST WW II
- 2) TRUMAN VETOED  
FIRST NSF BILL
- 3) JIM WEBB
- 4) VB CONVINCED  
TRUMAN

Reel 4-A  
Page 216A

was still no good. I said to him, "Mr. President, you don't understand that what we're doing is to try to protect you. If you have the director of this outfit reporting to you directly, so that he's completely under your control, then every congressman will have some grant that he wants made to a university out in Podunk, and you'll have no protection whatever. What you need is a buffer to protect you from this sort of thing, and we've got that buffer set up. It's set up in a way that won't embarrass you, and it's set up purposely to protect you." Some of this sort of argument went over with Truman; later he signed the bill without any qualms.

1) VB CONVINCED  
TRUMAN TO SIGN  
2ND NSF BILL

\* \* \*

Question 50: Financial limitation on NSF funds

Now this is an interesting affair. Congress passed the bill and Truman signed it, setting up the NSF, and then came the question of the initial appropriation. I appeared before the House Appropriations Committee on this, and I urged them not to appropriate too much money at once. I told them the NSF had to learn how to handle its affairs and had to get organized. It would take them a year to get their house in order and to get their programs reasonably sorted out; they couldn't at the same time appropriate large amounts of money and do it wisely. I told them, "If you start them slowly, and then increase their funds if they're successful, you'll have a much better show than if you appropriate too much money at first and then get mixed up with it." This was one of the times when a Congressman said to me

1) NSF APPROPRIATIONS

2) BUSH TESTIFIES

Reel 4-A  
Page 218

that I was the only man that ever came up on the Hill and urged them not to spend money. I thought it made sense, and while they put on a limitation at first -- they did it in their authorization act, I think, they took it off before it was really embarrassing.

1) NSF AND MONEY

The Science Foundation today is spending a very large amount of money indeed, and I feel sure that if they'd started in with great funds, they would have gotten all balled up, because everybody and his uncle would have been after grants. They couldn't have organized to handle it reasonably; they would have made mistakes, and having made mistakes, they'd have lost Congress's support. Some of the people in the Science Foundation I know griped that I'd told Congress not to give them too much money at first, but Alan Waterman, who did a fine job of heading the NSF for years, I think was entirely in agreement

Reel 4-A  
Page 218A

with me, and much preferred to get going  
on a modest basis.

\* \* \*

Question 51: Full story of OSRD; Prewar  
climate made OSRD possible,  
how OSRD beat its swords into  
plowshares

- 1) WW II
- 2) OSRD & SECRECY

As far as secrecy is concerned, we had  
no case of disloyalty during the war among  
the organization of OSRD, in the staff, or  
the scientists, or anywhere else, and as far  
as I know, none in connection with the con-  
tractors who were working for OSRD. We had  
only one case of gross carelessness that I  
remember. A professor that I've known very  
well for years left a briefcase on a train.  
I hopped on his neck, and that was all there  
was to that one. The record is entirely clear  
as far as I know. (X-REF FORWARD TO PAGES 277,  
687)

Reel 4-A  
Page 219

On secrecy, let me say in passing that every year Secretary Stimson and I talked with the principal men in both houses of Congress about the appropriations on atomic energy. (X-REF BACK TO 143-144 AND FORWARD TO 418) This would include the Chairman of the Appropriations Committee, the senior minority member and so on. We told them the whole works; Stimson said very little, and I outlined what the program was; what it was costing; where it was located; where the Germans stood; everything that might be of interest. Out of that came no leak whatever that I know of. The old story that you can't trust Congress with a secret just isn't so in time of war. That was all right.

Of course Phinney Baxter told quite a bit of the story, and it appears in all sorts of volumes. (QUERY TO JK) The great set of volumes that the Radiation Laboratory got out is one of the finest jobs along that line. I don't think we plan to tell the whole story of OSRD; it would be impossible. I

1) WWII

2) REPEAT OF CONGRESS  
CAN KEEP SECRETS

Reel 4-A  
Page 219A

think our point is this: that some of the most interesting things have never been told. Other things have been told incompletely or incorrectly. I think we try to touch on the points that ought to be touched in that way. (N.B.) [and QUERY]

\* \* \*

Question 52: Full employment, automation,  
and the GNP

- 1) PRE-WW II
- 2) NDRC MONEY

Part of this question reminds me of the first meeting of NDRC after we'd got authorization to go ahead, where we discussed how much money we ought to ask for. We were going to get our money, if we got it at all, out of the President's funds for the Executive Office. We had a discussion around the table; somebody mentioned five million dollars, and Frank Jewett

thought that we couldn't properly spend that reasonably and economically in the first year. I've forgotten what we did spend in the first year, but we went considerably beyond five million dollars. At the first in NDRC, we regarded ourselves as just going to be working on the outskirts, on the things that the Army and Navy themselves were not working on but which we thought were worthwhile. It was quite a while before we got the idea that we were really taking over on war research pretty completely.

In regard to the gross national product, I remember one instance where I was at a meeting, and Truman had just said that he expected the GNP would get up to 300 billion. Upon which I remarked that I'd be glad to see it go there provided it wasn't placed there by simply inflating the dollar. Well, they've inflated the dollar, all right; just about halved its value, but we have

- 1) PRE WW II
- 2) NDRC MONEY  
AND AREAS OF  
RESPONSIBILITY
- 3) TRUMAN AND THE  
300 BILLION GNP

Reel 4-A  
Page 221

gone in our gross national product over  
twice what Truman was talking about.

\* \* \*

All this talk about automation -- I  
think we've got a great deal of it backwards.  
We've had automation ever since the invention  
of the spinning jenny. It may be going  
on faster today than it used to, but we've  
always had it, and it's not the thing that  
puts people out of work.

1) AUTOMATION

There are a good many reasons why we  
have trouble with employment today, even  
though our number employed is greater than  
it's ever been in history and still growing.  
One of the reasons, of course, is that the  
introduction of automatic machinery replaces  
unskilled labor with skilled labor (X-REF  
FORWARD TO PAGE 549) Of course you can't  
afford to automate unless you're going to  
save money. If the cost of installing your  
automatic machinery and maintaining it is

is greater than the labor cost that you save, it doesn't make any sense whatever. But, when the balance is in the right direction, you proceed to automate. When you do, you replace a man who is simply sitting down and putting in screws somewhere by a hand screwdriver, with an automatic machine. The result is that the unskilled fellow's likely to be out of work. On the other hand, someone's got to build that automatic machinery, and somebody's got to adjust it, and somebody's got to maintain it. It calls for skilled labor. This is one of the troubles of course.

1) AUTOMATION

Another reason is that right in the middle of large unemployment, we have increased the minimum wage. I believe this means that there are many people in this country who

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Page 222

just cannot earn the minimum wage and who are hence unemployed because nobody can afford to pay them more than they're worth.

That we have such men is no doubt true. They live on Social Security, of course, on Employment Compensation, and so on.

The difference between what they can get in those ways and what they can earn is not large, if they're paid what they're worth. Nevertheless, I think that nine out of ten of these people would rather be earning a moderate wage than sitting around collecting some sort of benefit.

I believe that minimum wage laws are just in the wrong direction, at the present time at least.

I suspect that in our relations with labor in this country, we're going to gradually work toward a system where the men at the bench are on salary rather than on wages. In other words they're paid by the year or the month, and they're paid whether they work or not. I think we're headed in that direction, and certainly

1) EMPLOYMENT AND  
THE INCREASED  
MINIMUM WAGE

that would take care of one thing that has troubled me all my life. In a little town somewhere is a factory; it employs the men of the town and is their only support -- they're utterly dependent on it. One man who happens to own control of that plant can shut it down or move it to another place, and nobody else has any recourse. I just don't like that, and I don't like anything that puts men at the disadvantage where they feel they have to kowtow or else they will be imposed upon or lose their livelihood.

I don't know what the trends will bring about. Today, we're headed toward more fringe benefits, more vacations, all that sort of thing; we're learning to produce all that we need with fewer man-hours. It seems to me to make a lot of sense. The only trouble is, I hope we don't do it so fast that we throw the machine out of gear. If we proceed as

1) FUTURE CHANGES  
IN EMPLOYMENT

Reel 4-A  
Page 223A

we are without going to excess, men in the next generation are going to earn an adequate living -- a luxurious living, from the standpoint of their grandfathers -- and do so with much less labor than we have today, and much more leisure. That's reasonable, and that will help to keep unemployment from growing. But if we go too fast in that direction, we'll break up the machine that makes the whole thing possible, namely, the industrial system of the country. This we musn't do. Now of course, I'm not saying what men will do with their leisure if they get it. Maybe it's not going to be salutary. Many of the people who get leisure just won't know what to do with it. But I suspect that the American people have enough sense to learn how to have a good time if they've got a bit more leisure. Everything points in that direction that I've seen thus far.

1) FUTURE CHANGES  
IN EMPLOYMENT

\* \* \*

When the end of the war came, there wasn't any doubt whatever that the great splurge in scientific research and development which occurred during the war was bound to continue into the peace. It was also evident that the spirit of research had gone so far that industry, universities, government all were going to further research to improve our economic well-being and of course, our competition with Russia. The main point, I think, of the whole thinking that went into SEF was that in the postwar world, there must be greatly increased research throughout the American scene; second, that this simply could not be supported adequately from private funds. The object was to steer the government support of research, regarded as inevitable, into safe channels, into channels where the support would be forthcoming but where the evils that might be

- 1) POST WW II
- 2) SCIENTIFIC RESEARCH  
AND DEVELOPMENT  
CONTINUE INTO  
PEACE

feared would be minimized. The principal evil, of course, was that there might be a bureaucratic control of research.

I can pause here to give another point. I said to you after the end of the war that it would be many years before Russia would compete with us on scientific research. I said this because I knew that the Russian laboratories would be politically dominated -- dominated by commissars who would dictate the program, and who would steer the thing in accordance with the great political machine of Russia, for Russia's imagined ends, and that the scientists themselves would have little freedom. I think that was the case at the time, and I also think that if it had continued indefinitely, Russia indeed would have been behind us, not only in fundamental science, but also in the applications of science.

1) POST WW II

2) CHANGE IN  
RUSSIA'S ATTITUDE  
TOWARD SCIENTIFIC  
RESEARCH IN HER  
OWN COUNTRY

Reel 4A  
Page 225A

But then Russia did a very important thing. She realized the situation as well as we did, apparently, and she took the commissars out of the laboratories.

(X-REF FORWARD TO PAGE 296) Visitors to Russia just a bit later found great laboratories with about the same freedom as in this country: the scientists picking their own program; the programs of a great laboratory determined by consensus among the scientists working in that laboratory. So Russia did make progress, in science and in the applications of science, notably in Sputnik.

Turning back to the situation that was to obtain after the war: we had had, during the war, a situation where scientists had ready access to groups of other scientists whenever they had an idea. (You will remember that whenever I say "scientists" all through this thing, I mean scientists and engineers.) The chap who thought he had

1) POST WW II

2) CHANGE IN  
RUSSIA'S ATTITUDE  
TOWARD SCIENTIFIC  
RESEARCH IN THEIR  
OWN COUNTRY

an idea for a way to combat the submarines could sit down with a section of men who were studying it deeply, his own peers in science, and military men as well. If his idea was thought to be sound by that group, it could go ahead. The judgment of peers on a program was something new. There are dangers here, of course; the research in a particular area may get into the hands of a clique who hands out grants only to their own colleagues and doesn't listen attentively to a man coming in from the outside. But those dangers are small compared to the bureaucratic control of research. A very important point was that in looking to the postwar world research, we hoped very much that that system would be continued in one way or another.

One other point as an aside: the people who came before these sections were men of established standing, who thought

- 1) WW II
- 2) COOPERATION  
AMONG SCIENTISTS
- 3) BUREAUCRATIC  
CONTROL OF  
RESEARCH

clearly, and they met with a group who knew the conditions for success. In the submarine field, to take that as an example, the men sitting around the table and listening to this chap knew the conditions of anti-submarine warfare at the time. They knew the techniques, they knew the course of success with various instrumentalities, they knew other things. They could judge whether an idea made sense or not.

During the war we had an Inventors' Council. In fact at the time when the NDRC was set up, the Inventor's Council was also proposed, and there was considerable danger that what became NDRC would be saddled with the Inventors' Council as well. Here is where it was important that Harry Hopkins and I spoke the same language, for he readily understood that these two things should not be merged,

1) WW II

2) INVENTORS' COUNCIL

Reel 4-A  
Page 227A

that they involved entirely different kinds of effort. I took over the job of getting NDRC on its feet while he placed the Inventors' Council, which had some strong advocates, within his own organization

(X-REF AHEAD TO PAGE 398) (HOPKINS'

ORGANIZATION WAS THEN DEPARTMENT OF COMMERCE)

[CY NOTES: YES, IN 1940 H. HOPKINS WAS SECTY. OF COMMERCE] and there it continued. The people in the

Inventors' Council reviewed hundreds of thousands I guess, of inventions, suggestions, ways to win the war, from any number of people . Out of this great mass of stuff came, as far as I know, not a single invention of importance toward the winning of the war. (X-REF AHEAD TO PAGE 398) The reason is perfectly clear: the men who made the suggestions had no idea of the course of the war, the technical needs, the success and failure of various instrumentalities, and they were hence working entirely in the dark; the great bulk of them just chaps

- 1) WW II
- 2) INVENTORS' COUNCIL
- 3) HARRY HOPKINS

out in the woods somewhere. That system will not work in this country or anywhere else. The British had quite a lot of trouble with it. They had important advisory committees burdened with it.

1) WW II

2) VB ON INVENTIONS

(VB ASIDE: This brings up a discussion I had yesterday with Eli Shapiro at the Harvard Business School. General attorneys, and judges, often miss the real justification for a patent system. This is illustrated by the talk I had with Elihu Root Senior when MIT adopted its patent policy, which I think I have recited somewhere. Some inventions not many today, result from flashes of invention by an individual. Spencer and his snapping disc gives an excellent example. Others may arise when an individual reviews a field and discovers a point that has been missed because of the human tendency to stay in a groove. I think my hydraulic stuff illustrates this well. So did my work on external combustion engines, which never

came to anything, but should have.

Most inventions arise, however, because of the advance of techniques, and a need which can then be met. When this is the case, the invention is likely to be made independently and nearly simultaneously in a number of places, usually in laboratories where the need is appreciated and the group is well ahead of the pack on techniques. This occurred at the Radiation Lab and elsewhere during the war. An excellent example is the appearance of the Gee system and Loran, in Britain and the U.S. almost simultaneously. This is one case where the British told me about it, but asked that I hold the knowledge of it to a very small group (as I remember it Compton and Loomis only) since wider knowledge could not contribute, and danger of Nazis finding out about it was serious. This was adhered to. Then Loran appeared independently

1) VB ON INVENTIONS

2) LORAN

Reel 4A  
Page 228B

We explained this to the British and they readily understood. When nearly simultaneous invention appears in a number of places, it is still desirable from a public standpoint that a valid patent be given to one inventor, with of course care to pick the first one. The patent system was not set up just to reward invention, and thus stimulate invention by individuals, although this was one early reason, now not so important.

Its real value lies in two matters. First, it enables the lone inventor, or the small group, to attract venture capital, and be thus able to bring new things into public use, which would never get there without such help. Second, it justifies large research expenditures by industry. The pharmaceutical industry, for example, could not afford to spend three hundred million a year on research, if it could not recoup on new products with high margins. The patent system has been greatly weakened by the rising cost of litigation, and the failure

1) VB ON INVENTIONS,  
THE PATENT SYSTEM

of courts to grasp its real nature.)

Now don't misunderstand me. Many of the men who made suggestions to the Inventors' Council were very earnest individuals. I got very little of this, but I can tell you of one or two things. There was one time when a chap who had an idea followed me all over Washington. The men over at my office, had told him to go to the Inventors Council, but he wouldn't. He wanted to get hold of me personally, and of course my office kept that sort of chap from getting in my way. So he followed me. If I went into an office, he'd sit down outside or stand outside till I came out. This finally became so noticeable that I talked to -- I guess I talked to -- the Secret Service people and asked them if the thing was dangerous. Somebody interviewed him, and told me that he was

1) WW II

2) INVENTORS' COUNCIL

just a simple-minded fellow, so I gave him a ten-minute interview and listened to his idea, which didn't make any sense, after which he went home. The point is, he was just earnest -- and he thought he knew how to win the war.

I had one other that was interesting. Sam Calloway told me one day that a chap had been trying to see me for quite a while who had an idea, and he wished I'd talk to him. Sam very seldom said this, so I knew there was something in it. I called the chap in, and he sat down and told me that he'd driven four or five hundred miles in his old Ford, to place his idea before the proper authorities in Washington. He thought he knew how to win the war. So I let him talk, and what he said of course again made no sense. I kept my face straight, and simply sat and listened till he got through. Then I said to him, "Now look.

1) WW II

2) PERSISTENT  
INVENTORS

Reel 4A  
Page 229A

You must understand the situation in which I'm placed. If this idea was already in the hands of the military, if it was worked on intensively, it would be made very secret, so that the enemy wouldn't learn anything about it. I couldn't tell you anything about what's going on, because of the regulations on secrecy. I'm not saying that this is the case; I'm merely saying that if it was the case, I couldn't tell you about it. I've got one more thing to say to you. You ought to keep this very secret yourself, because there are enemy agents about, and we wouldn't want them to hear about it." With that, he left, entirely happy, and got into his Ford and drove back home.

This was a chap who was very honest, very loyal, very patriotic, who honestly thought he was trying to help win the war. When he came back to Tennessee or wherever he came from, he went back with the conviction that he'd done his full duty.

1) WW II

2) PERSISTENT  
INVENTORS AND THE  
INVENTORS COUNCIL

Reel 4A  
Page 230

The men who had these ideas were a nuisance at times, but among them were devoted, patriotic chaps, who shouldn't have been mistreated, and who weren't. The Inventors' Council served a very useful purpose in giving them a place to tell their story. This is all quite a digression, but the point is that we had a system whereby men who had standing experience and scientific skills could sit down with a group who knew the conditions of warfare at the time, and who, while they didn't tell the incoming fellow any secrets, could judge whether he had something that was worth putting on the program. And this worked.

[ONE PAGE OF MATERIAL CUT HERE...REPETITION OF MATERIAL APPEARING EARLIER IN REEL #4 ON GOVERNMENT SUBSIDY OF RESEARCH, JUDGMENT BY COMMITTEE, & SCIENCE FOUNDATION BILL & TRUMAN.]

1) WW II

2) PERSISTENT INVENTORS AND THE INVENTORS' COUNCIL

Reel 4A  
Page 231

Question 53: Every major advance in technology tends to raise problems which only the Federal Government can decide.

1) CENTRALIZED  
GOVERNMENT

Now this is not very responsive to your Question 53, but I think it bears on it directly, and I can now go on to what your real point is. There isn't any doubt that as civilization becomes more and more complicated, governments must of necessity become more and more centralized to cope with the situation. This is inevitable; it must occur. And I do not oppose its occurrence. I merely take the point of view that it must be done in an orderly manner and it must not be overdone. (EH TO VB: When are you coming to grips with what you mean by "an orderly manner.")

VB TO EH: Right here I evidently mean in accordance with constitutional processes)

Let me first say what I mean by "an orderly manner." The greatest piece of legislation in regard to civil rights was

Reel 4A  
Page 232

not enacted by the Congress of the U.S., but by the Supreme Court. It was undoubtedly, in my opinion, contrary to the Constitution. It was not really an interpretation of the Constitution; it was new law, made by judges. This is not only incorrect, this is highly dangerous. The greatest danger is that, proceeding down this path, the Supreme Court will discredit itself, and the Supreme Court needs to maintain the respect of the people in order to function properly. (MORE ON THE SUPREME COURT ON PAGE 682)

(This subject is, of course, not well expressed here. This also applies on page 241. Much of the problem lies in the difference between reinterpret and remodel. My point is that the Courts have been rewriting the Constitution and making new law, not reinterpreting it in the light of modern conditions. You ought to read constitutional lawyers on this, and also Arthur Krock. The best treatment I know of occurs in an article by Kurland, University

- 1) CENTRALIZED GOVERNMENT
- 2) THE SUPREME COURT'S ROLE

Reel 4A  
Page 232A

of Chicago Law School, Harvard Law Review, November 1964. I'll send it to you, if you wish. It's the old story. The Court and the Constitution are being endangered in generally good causes.

To be specific on "orderly manner". The body of law is built up over the years by general adherence to precedent. Citizens can have sure guidance only when such a structure exists, modified only gradually and consistently. The primary criticism of the present Court by Elihu Root, Jr. is that they have departed from precedent unduly and unnecessarily, and have thus thrown the system into confusion. We have this in connection with the Anti-Trust Acts. These were necessary and salutary. Yet, after many years, we still do not have a consistent pattern by which a business can determine whether a proposed action is legal or not. Just recently the Court ordered a bank, which had merged

1) CENTRALIZED  
GOVERNMENT

2) THE SUPREME  
COURT'S ROLE

Reel 4A  
Page 232B

with another several years ago to unscramble  
itself, although the merger had been approved  
by government banking control agencies. It  
is the job of the courts to create order, not  
confusion.) [END INSERT]

1) CENTRALIZED  
GOVERNMENT

2) THE SUPREME  
COURT ROLE

I think also that a large amount of the  
expansion of federal power over the states,  
which has been found constitutional by the  
Supreme Court, and which depends upon the  
interstate commerce clause is quite absurd.  
We have a barber down in Atlanta, who refuses  
to take a Negro customer, and the law is going  
to say that he must take that customer if  
he's going to stay in business. Well, all  
right, if that was based on an amendment  
to the Constitution that really gave that  
federal power into the hands of the federal  
government, well and good, but it is not thus  
based. It's based on a decision by the  
Supreme Court, or will be shortly, that this  
law is constitutional, and it will be

Reel 4A  
Page 233

dependent on two things: first, the 14th amendment, but more strongly, upon the interstate commerce clause. This barber buys some soap which is made in Minneapolis, and hence the federal government can regulate his business. It's this kind of hokum that I object to very strongly.

Now we seem to be pretty nearly at the end of this reel, so I'll turn it over on the other side.

1) CENTRAL GOVERNMENT  
CONTROL

END REEL 4-A

Reel 4-B (beginning)  
Page 234

The other side of this coin is that I object strongly when extension of the federal power goes too far. The founding fathers had some very fine ideas, and one of them was that states should maintain their own integrity, their own freedom as far as possible, and be interfered with by the federal government as little as possible. Hence we can have states trying out all sorts of systems, and if one of them went bad and caused a debacle, it would not interfere with the strong growth of the country as a whole. Whereas if the federal government, with full control, went sour on something, the fat would be in the fire. This was only one of the reasons. We've whittled away at it in every way possible until we've come to the point where our state governments today are pretty feeble and I object to this. Part of this has been

- 1) CENTRAL GOVERNMENT CONTROL  
(continued)
- 2) THE SUPREME COURT  
(continued)

Reel 4-B  
Page 234A

due to unnecessary and overextensive interference by the federal government. (EH TO VB: A pretty small part, I'd think. Also you're dodging my question. VB TO EH: The hell I am)

- 1) THE SUPREME COURT
- 2) ONE MAN-ONE VOTE  
ISSUE

We've just had an excellent example of this. The Supreme Court has ruled that both houses of state legislatures must be chosen in accordance with the principle of one man, one vote. Now there certainly is no basis for this in the Constitution; in fact the Constitution asserts exactly a different principle. (X-REF FORWARD TO PAGE 682) In the federal government the legislature is divided into two branches, and the House of Representatives is on the basis of one man, one vote or at least approximately so, whereas the U.S. Senate is not set up that way at all. It was set up as it is as the result of a compromise, but a compromise that was intended to protect the interests of minorities, namely the interests of the small colonies against the large ones.

Reel 4-B  
Page 235

In the same way, it is entirely proper for a state to have two houses, one of which is elected on a popular basis of one man, one vote, and a second one, so designed as to protect the interests of minorities to a considerable extent. For example, in the state of Colorado, they have a state senate in which the very sparsely inhabited regions have more than their share of representation in their senate. This was adopted for the purpose of protecting these groups against the majorities in the cities. Interestingly enough, the system was approved 2 to 1 by a state referendum. Nevertheless, the Supreme Court of the U.S. knocks this out, and says that this state senate must be elected on a one man, one vote basis. They don't find a basis for this in the Constitution; they disagree -- or at least a majority of them do -- with the ideals of the founding fathers of the system that was then set up and embedded in the Constitution, and they propose to

- 1) SUPREME COURT
- 2) ONE MAN-ONE VOTE  
ISSUE

reestablish their ideas instead of the ones embedded. They propose to do this without recourse to the usual system of amending the Constitution, provided in that document.

I think this is the most striking, and the worst example of federal interference with the state that we've seen. I think it is the case of carrying the federal power altogether too far, and incidentally, in my mind, in complete defiance of the Constitution.

We have to have greater centralization of government under modern conditions, true. We have to regulate centrally all sorts of things affecting the public health and safety, and so on. But we ought to do it as little as is consistent with getting the result done appropriately, and we ought to maintain in local hands, just as much as we possibly can, the local affairs. This was the idea on which our government was founded. We depart from it at our peril, and we are departing from it very rapidly today. (EH TO VB: Well, I feel

- 1) CENTRAL GOVERNMENT CONTROL
- 2) SUPREME COURT
- 3) ONE MAN-ONE VOTE ISSUE

as if I'd gotten the Congressional Committee  
treatment on that question -- no answer at all!)  
[VB to EH: O.K., WHY DON'T YOU WRITE SOMETHING?]

Question 54: On Justice Brandeis' famous remark, "I hate bigness"  
And Henry James berating his native land for "contempt for the past."  
1) HENRY JAMES

Well in answer to your Question 54, I never was an admirer of Henry James. I thought a great deal of William James in many ways, and I've read and reread him, and I still get a great deal out of him. But every time I read Henry James, I get just so far, and quit, so Henry James' remark doesn't strike me too strongly. Let's say a word, however, about "contempt for the past." Instead of having it in this form, let's say that there is such a thing as over-dependence on the past, and I think we have that illustrated. We have it illustrated of course in military matters, when the military tend to fight each war with the weapons of the previous one; we had it to some extent in the last war, although it was overcome.

Reel 4-B  
Page 237A

For example, the Navy, when the war started, felt that it had the submarine menace under full control and didn't need any help. It had a new weapon developed between the wars that it was going to lean on, and it didn't need anymore than this. (EH TO VB: I guess I should have quoted Santayana" "He who does not know the past will be condemned to repeat it." VB TO EH: Quite right! But we can also say that he who knows the past, but does not realize how conditions have been altered will be tempted to correct his attitudes and program falsely.)

(I read quite a lot of history, although you probably have seldom seen any evidence of this.

(Since 1945 I've talked to many who have said in effect: we have always had great wars. Human nature being what it is we must accept that man will have World War III, with hydrogen bombs and all.

1) WW II

2) DEPENDENCE ON PAST

(The danger is certainly present. But in analyzing it, one should realize that some of the causes of war have been removed or rendered less important, and that other causes can be removed. Also the analogy of the two scorpions in a box, which I presented long ago, has certainly not been shown to be without significance. We will have more chance of avoiding a great war if we study history, and study also how the situation has altered.

1) NEED TO STUDY  
HISTORY

(Another illustration is on naval warfare. I have read Mahan, The Influence of Sea Power on History, several times. It certainly was a masterly analysis. And his precepts still applied, in somewhat altered form, when we nearly lost both WWI and WWII because of insufficient realization of the submarine menace. But, in my opinion, when we built a great fleet of great carriers in the post war world, instead of a greater fleet of small carriers, and a mosquito fleet of antisubmarine ships, we just failed to judge how command of the seas could be maintained, in the days of A-bombs, accurate guided missiles, and fast submarines. Mahan's lessons from history

Reel 4-B  
Page 237C

still apply to a large degree. But they need to be interpreted under modern conditions.)

The same thing can be true on organizational matters, and I met it myself. When we were talking about setting up NDRC, there was a good deal of talk about going back to study the experience of WW I and picking out the good parts and so on. We did turn back to WW I, but we turned back only because we found there a law that hadn't been repealed that enabled us to set up NDRC under a National Council which never met. (X-REF BACK TO PAGE 108 AND FORWARD TO 368, 398) This was merely a sort of subterfuge for enabling a new organization to draw on the funds of the Executive Department without any check and balance and so forth by the Congress. (EH TO VB: Sounds exactly like what you were inveighing against in another context -- back on pages 234-236. VB TO EH: In war one should take emergency actions. Note that, when peace came, we promptly dissolved OSRD) If we had turned

- 1) WW II
- 2) DEPENDENCE ON PAST
- 3) ORGANIZING NDRC

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Page 238

back to try to follow the experience of  
WW I, we would have made a serious mistake.  
It was much better to throw it out the window  
and start fresh.

Also there is a good deal of thinking  
today which I think leans on history too  
much. One thing is the fear that wars  
are bound to occur, that we are bound  
to have a great atomic war and that it  
may end civilization. (This illustrates my  
point on page 237. Know the past, but  
don't lean on it blindly). I don't think so.  
I think the situation has so completely  
changed that the causes of great wars in  
the past have been largely abolished. There  
are new factors which make it far more likely  
that war will be avoided. Now I'm not talking  
about brush-fire wars like the one down in  
Viet Nam, where both sides knew perfectly  
well that that sort of a skirmish is not  
going to lead into an overall war unless  
one side or the other boosts it into that

- 1) DEPENDENCE ON PAST
- 2) CAUSES OF WAR

category, and neither side will do so.

I'm not thinking about that, I'm thinking about the allout World War III. I don't think it will occur.

In the first place, we've lost many of the reasons that created wars in the past, and one of the few remaining is the pressure of population. This may be overcome very fast right now, because the rate of growth of population in the world is such that it is bound to bring pressures to bear. But the times have changed with this. The time was, when a particular area got over-populated, and then men in that area could arm themselves with shields and spears and whatnot, and proceed to take over the territory of a neighboring part. This is no longer the case. Very importantly, the over-populated country, the country where it's barely possible to keep the population alive

- 1) THE CAUSES OF WAR
- 2) POPULATION  
EXPLOSION

Reel 4-B  
Page 239A

1) CAUSES OF WAR

by getting them enough to eat, will not be able to create the war system, or the intricate and expensive mechanisms which depend for their production upon a great economic-industrial complex; will not be able thus to arm itself with a sword and a shield and a spear and proceed to sail into its neighbors. So we can't take history with a grain of salt. (EH TO VB: Foggy; bad transcript? VB TO EH: No transcript all right, dictation foggy. This is a hard thing to state. I'll try it again sometime. The trouble is one deals with difference of degree throughout \*\* not with absolutes.) [See Note Attached]

Of course we have also the next point: that wars have been caused in the past by the ambition of ruthless men -- well, Kaiser Wilhelm and Adolf Hitler, and Mussolini, for that matter. One thing

Attachment to Page 239A

Note from VB to EH:

In some ways we are following a pretty rough process. Questions, dictated answers, then criticism with the cold type present. It would be far more normal to revise the type before the criticism. I don't mind, provided we get to a result in the end. But, in reviewing this stuff I'm not in general happy with what appears after I talk to a machine. Perhaps, after all, this talking to a machine is not such a hot caper.

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Page 240

is sure today: any man who thus started such a war would know for one fact that however it came out, he personally would not survive it. He would either be killed by the enemy, or by his own people. People don't start wars where they know they're going to get killed, are sure of it. Is it possible for such an individual to start, and in spite of his entourage? Can he start it alone? Hardly, because the entourage also knows that they are doomed if it starts. No man, no one man, can control the mechanism of a country far enough and completely enough to do this in spite of those in his palace guard. So the conditions for war have changed mightily.

1) CHANGING CONDI-  
TIONS OF WAR

Now I don't say that atomic war might not occur, by accident, or by desperation. I don't say that when we get many countries armed with atomic bombs, there's not a danger that some one of them somewhere may shoot off one of the gadgets. There are still great perils.

Reel 4-B  
Page 241

What I'm really saying is that when we analyze the present situation, it's well to look back on the past, true, but it's also well to be sure not to overemphasize it. But your question has got something about Mr. Justice Brandeis. He said a good many things that were foolish, in my opinion, although he was a great judge, and his presence on the court was salutary. One of the most foolish things he ever said, in my opinion, is just along the lines of what I was talking about in my last question -- along the lines that the Constitution is what the judges say it is, and that it's up to the Supreme Court to remodel (EH TO VB: "Reinterpret" would be a fairer word; VB TO EH: And drawing the line between them is difficult indeed) the Constitution in accordance with modern conditions. I don't know his exact words, but that was the sense. That's the thing that's

1) JUSTICE BRANDEIS

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[EH to VB: IN THESE PAGES WE HAVE CERTAINLY FOUND AREAS WHERE OUR THOUGHTS AND FEELINGS ARE NOT AT ALL IN ACCORD. MAYBE WE SHOULD MAKE THE MOST OF IT!]  
[VB to EH: IT WOULD HELP IF I KNEW WHERE WE DIFFER.]

Reel 4-B  
Page 241A

about as dangerous as anything that I know of.

His statement that "I hate bigness" is, I think, equally foolish. In the first place, a judge on the Supreme Court should not say that he hates anything in the American system. (EH TO VB: I'm pretty sure Brandeis said this long before he was on the bench. VB TO EH: Very likely. I don't know) He's not supposed to be judging the social consequences of various things, or the ways in which laws will actually work in an economic system. He's supposed to find out whether these laws are being enforced properly, and whether they are in accordance with the Constitution. When he's doing that, he'd better keep his mouth shut about whether he thinks they're wise in the light of economic conditions and so on.

This statement that he hates bigness is absurd. In the modern, complex world, we have to have bigness. The American

1) JUSTICE BRANDEIS

2) THE ROLE OF A  
SUPREME COURT  
JUDGE

Reel 4-B  
Page 242

Telephone and Telegraph Company is big.  
We have no monopoly of telephone activity in this country, because the General Telephone Company is also big. But at least we don't have two telephone systems competing in the same region. To say that the bigness in a telephone company is undesirable is absurd. It's only a big telephone company that can do the job. In the same way, bigness is necessary in many another field and I won't go into it. But to hate bigness is absurd, and I fear that a great deal of anti-trust legislation has been based on just that. (EH TO VB: For legislation you mean enforcement I guess. VB TO EH: Right)

1) ON BIGNESS IN  
THE U.S.

There was a time in our history, of course, when bigness was being made artificial by the development of holding companies in the hands of Insull, and all that sort of thing; and when great industrial organizations were buying legisla-

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Page 242A

tures. Theodore Roosevelt's attack on these was needed. The enactment of the antitrust laws was one of the wisest things this country ever did. Its proper implementation and enforcement is necessary in this kind of a country, and if well carried out would be very salutary. Unfortunately, of course, the antitrust enforcement has often been motivated by political things, and also it's been motivated by Justice Brandeis' idea that bigness is undesirable per se. (EH: And I fear that this takes little account of the kind, quality and actions which called for the Sherman and Clayton Acts) We have had better experience under our antitrust laws than England and the continent have had under their system of cartels. I think today in this country it is well accepted that the antitrust laws are necessary, that they should be enforced, and that the principles of

- 1) ON BIGNESS IN  
THE U.S.
- 2) THEODORE  
ROOSEVELT'S  
ANTI-TRUST  
LEGISLATION

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Page 243

their enforcement must be divorced as far as possible from political motivation. I don't think we've done too badly on it, on the whole. (VB: Remember that my early business experience was largely devoted to bucking the big outfits)

\* \* \*

Question 55: DDT in Naples.  
Upsetting the balance of Nature.

1) DDT IN NAPLES

I remember very well having heard the story of the use of DDT in Naples from an officer who was present there, and it was quite funny. They drew a ring of troops around the city, and moved it in gradually, going through every house as they went. The people could escape the circle only by going through a place where they were shot full of DDT. The military took a squirt gun and shot it up their sleeves, and in their pants legs and so on, and down the back of their necks.

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Page 243A

And of course they shot every house that they inspected. Having done this, they eradicated typhus in one blow. Then then forced the Italians to clean up the place. When I went to Naples a good many years afterwards, it was still fairly clean for an Italian city. It hadn't slipped back even then.

1) RACHEL CARSON'S  
THE SILENT SPRING

Now the trouble with Rachel Carson's Silent Spring is that the poor girl got over-emotional, and hence she presented a completely one-sided story. If she'd done a balanced story; if she'd raised the devil with everybody that used insecticides carelessly; if she'd pointed out the damage this was doing; and then if she'd turned around and told about the constructive side of it, she would have gotten in this country, a great surge of support for the constructive side. The constructive side, of course, is the great work that's going on -- the

intense work, all over the country -- to develop insecticides that are fatal to insects but harmless to mammals, birds and fish; and also the development of counter-biological methods.

One of the most striking jobs that's been done is the elimination of the screwfly, I think he's called. What they did was to breed a large number of males, sterilize them, and release them. Thus the female coming out to be mated would have in that particular area, a very much greater chance of mating with an impotent male than with one that could produce offspring. Having done this for some generations, they eliminated the insect quite completely.

The important part about this is that the series -- the numbers plotted against the years -- goes down to zero. It does not just go down and come into equilibrium at a very small value. When

- 1) CONSTRUCTIVE USE  
OF INSECTICIDES
- 2) ELIMINATION OF  
SCREWFLY

one attempts to control an insect by introducing a predator, the predator reduces the numbers of the insect to low values, but then the predator itself begins to starve. One has to be careful of course that the predator is one that will feast only on that particular insect; otherwise he'll turn to other things. If he feasts only on that insect, he will go down at the same time that his prey goes down, to low values, and the two will come into equilibrium at some low value where the balance is attained because of probabilities of one meeting the other. On the other hand, a method that depends on sterilization of males goes down to flat zero. The particular insect is wiped out.

There's also some excellent work being done on the problem of insecticides, along the lines of getting the insect to take the insecticide in a form such that it will not be taken by anything else. I think there's a

1) METHODS OF  
CONTROLLING  
INSECTS

2) INSECTICIDES

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Page 245A

good deal of hope that we will have insecticides that will be innocuous in reasonable dosages to birds and fish and mammals. We haven't got there yet. But my point is that if Rachel Carson had painted a balanced picture, she would not only have been helping some of those who are struggling hard, and who felt insulted by being classed with everyone else, and who are trying to produce safe methods. She would not only have brought them support and encouragement, but she would have made her argument very much stronger. (VB: The title jarred me. My spring isn't silent, it is raucous. But the noise is made by starlings, crows, jays, english sparrows, etc., not by the birds I wish I saw about.)

1) THE SILENT SPRING

The thing that is upsetting the balance of nature, and that's going to upset it a whole lot more, is the great increase in

population in the world. It's not only going to upset the balance of nature, it's going to offset any possible attempts that could be made to raise the standard of living in backward countries. We pour in funds, the population pours in babies, and the two things pretty well offset. Now there are new methods of population control, contraceptives, that are exceedingly attractive. At the present time, the anti-ovulatory pills are fairly expensive. They don't mean anything in expense to a woman who is well-off, of course -- I think it only amounts to 2 or 3 dollars a month. But they are too expensive to be used with mass application to great bodies of the population.

During the war, I used to have an experience once in a while when some of the medical people in the Committee on Medical Research would tell me with great enthusiasm how they had found out how to counteract some oriental disease.

1) THE "BALANCE OF NATURE", AND THE POPULATION EXPLOSION

Reel 4-B  
Page 247

I always told them that I thought that was interesting, but that on the other hand they were probably making the problem of the world so much worse in the postwar years. If they wanted to do something to really excite my enthusiasm, I'd like to have them develop a contraceptive that could be sprinkled from an airplane, that would reduce the birth rate in the population without the knowledge of the inhabitants.

Of course we're a long way from anything like that. But without doubt, anti-ovulatory hormones will be made cheaper. There's now a competition in this country on the subject, and just the competition will bring the price down. Also, the cost of any new product, the cost of making any new product, always comes down over the years as the chemical engineering techniques get refined in its production. So we will

1) THE POPULATION  
EXPLOSION &  
CONTRACEPTIVES

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Page 247A

see them come down. (VB: There are new promising methods)

1) THE POPULATION  
EXPLOSION &  
CONTRACEPTIVES

I rather think that we see on the horizon an end to the resistance of the Catholic Church to the use of contraceptives. I hope it will come soon. (EH TO VB: As of March 1965 it seems to have arrived at last -- more or less. VB TO EH: It all depends upon what the Pope says next). I'm almost sure that it will come ultimately. This of course only affects one part of the population, but it does affect that in a way that is entirely [VB NOTE ON THIS SENTENCE: "WOULD BE IF EFFECTIVE"] unwise at the present time. We all know that in spite of the preaching of the Church, statistics show that Catholics in this country apparently use contraceptives to just about the same extent as any other part of the population. It's the population growth that upsets the balance of nature, that threatens the extinction of the species, that's wiping out the wild places of the earth gradually.

2) THE STAND OF THE  
CATHOLIC CHURCH

Of course this increase in population is accompanied by an increase in mobility. Methods of transportation, the automobile in particular, have enabled men to get farther out into the woods, and they've opened up places that were previously closed. Even if the population did not increase, we would still be up against the fact that man's increasing mobility, and his building of roads, his draining of marshes, his making of dams and so forth, is upsetting the entire balance of nature. Now it's not a question of whether the balance of nature is going to be upset or not: It's bound to be upset. The question is whether we can control the thing, so that the upset makes some sense. When we manage, by some nice trick biological scheme, to wipe out an insect species, we are upsetting the balance of nature in that case. There are plenty of species of insects, so that we don't miss one; it isn't like

1) MAN'S MOBILITY  
AND TAMPERING  
WITH NATURE

Reel 4-B  
Page 249

wiping out a species of birds. But we are upsetting the balance of nature when we wipe out the species of insect. If we do it wisely, we are upsetting the balance of nature in a favorable manner. This is possible, and it does occur. If, for example, we found ways of eliminating the sharks from the oceans without eliminating any other species, that would be upsetting the balance of nature, but doing it in a favorable manner.

As I look at the thing, the upset is inevitable; it's bound to happen. It may be slowed down a bit if we learn to control populations, and I think we will in time. Certainly we will in this country, and hopefully we will in the backward countries at some time. If we do slow down the population growth, then I think there's a reasonable chance that we may have the sense to upset the balance of nature which still remains because of our increasing building of roads,

1) UPSETTING THE  
BALANCE OF NATURE  
FAVORABLY

Reel 4-B  
Page 249A

dams and what have you, but to do it in a way that doesn't really harm nature as a whole. (VB: This is hardly an adequate treatment of a very complex problem.)

\* \* \*

Question 56: The VB squirrel-proof bird house. Similar ingenuities.

1) VB'S INVENTIONS  
SERIOUS AND FOR  
THE FUN OF IT

Of course I've built all sorts of foolish gadgets over the years, and made a lot of inventions, if you want to call them that, for the fun of it. Oh, I made a birdhouse that the pigeons couldn't bother and eat up all the grub, simply by having the perches supported on springs, so that when a little bird landed, he could step in and get his food, but if a pigeon landed it dumped him back end-over-end. I've made a number of such gadgets for the joy of making them. In fact, I'm working on one right now that doesn't amount to anything whatever, but which is kind of fun because the techniques involved are intriguing.

(EH: Not enough about VB the inventor for-the-

fun-of-it)

1) VB ON INVENTIONS

(ital)

(I rather think a lot of invention appears merely because of curiosity and with little thought at the time of possible utility. I've made a number of inventions that I've never followed up, and some of them could have been followed up, I think. But the fun was in exploring, not in the hazardous and somewhat repelling job of trying to promote them.

(The first invention I made was on a surveying machine when I was at Tufts. I built one, it worked, I patented it, it still exists. I think even today, it would be useful. No such gadget exists as far as I know in commercial form. Have I ever told about it?

(I suppose I could dig up quite a few others. Once I worked out a solar-powered pumping rig for irrigation. I still think it would work. I did some work on an air conditioning scheme that I think I could put into commercial form. Yesterday I signed

Reel 4-B  
Page 250A

an application on hydrofoil craft, which may come 1) VB ON HIS  
[fruition?] INVENTIONS  
to function<sup>^</sup>some time. You know I think of my  
justifying typewrit~~er~~ experience, and present  
machines for composition.

(If you want a nice simple one, here is one  
on which I'm rather sure a small business could  
be set up. I don't know whether I invented this,  
or Warren Mead, it came out of one of our many  
conversations while we were playing billiards.  
Nurserymen in this part of the country can trans-  
plant shrubs only in the spring and fall, but  
the demand continues in the summer, especially  
at summer homes. Take an open-ended tin can  
of proper size, or section of stove pipe.  
In the nursery, when shrubs are being trans-  
planted as they are to get correct growth, put  
each of them into one of these cans, which is  
buried with its top at ground level. To move  
the shrub, pick a dry time. One can then lift  
the can, and the shrub and earth will come

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Page 250B

with it, without disturbing roots at all.  
Truck it to the place it is to grow. Plant  
it can and all. Water thoroughly. The can  
will now glide out without disturbing the  
earth. Much better than ball and burlap, and  
less expensive.

(If I hadn't worked in two wars, been  
interested in more consequential things such  
as analyzing machines, I might have gone  
into the nursery supply business.)

I think any man who has a bit of  
ingenuity in his soul gets quite a lot  
of fun out of fooling around with things  
that don't amount to anything, for the reason  
that when he does that, he has no pressure.  
If he's working on a thing that's really  
important, then he's got pressure. He's  
got to get the thing done; he's got to  
get it working right.

1) VB ON HIS  
INVENTIONS

Reel 4-B  
Page 250C

This is true, for example, when I'm working today on a new line of hydraulic devices to operate at high pressure and high speed. I very much want this to succeed, and I work hard on it, for one thing because a lot of good engineers have been working with me at one time or another, and I don't want to let them down. Even if I was never to make a nickel out of it, I'd do it intensely because of the associations and so on.

But, I'm working in a different way on a hydrofoil boat of a new type, and I think it's the way to do it. I may be kidding myself, but I think I've got a set of controls which is simpler and cheaper than the ones ordinarily used; I believe this may make the submerged-hydrofoil craft practical, and that the submerged hydrofoil craft is much better for many things than the surface-piercing type.

- 1) VB INVENTIONS
- 2) HYDROFOIL BOAT

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Page 251

So I'm working away at it. (EH TO VB:  
Maybe this word should be submersible,  
to convey the idea that your foils are  
not unalterably fixed in relationship  
to hull? VB TO EH: No, they run fully  
submerged) But I'm not taking it too  
seriously, because if it never gets any-  
where, why nobody's going to get hurt.  
So I'm just having a lot of fun out of  
doing it.

- 1) BUSH INVENTIONS
- 2) HYDROFOIL BOAT
- 3) ORVILLE WRIGHT

\* \* \*

One time I was out in Dayton, Ohio,  
and I was going to have dinner that night  
with Colonel Deeds, who was getting a  
group together, but there was sickness in  
his family, and he cancelled the dinner,  
with the result that I dined with Orville  
Wright at his house -- just the two of us  
together. During the course of the evening,  
we got to talking about inventions we'd

Reel 4-B  
Page 251A

made that never amounted to anything.  
(EH TO VB: Would like more details on  
such. VB TO EH: Don't remember much in  
detail) He took me up in the attic, and  
he showed me models of inventions he'd  
made that never came through. I don't  
believe he ever did that with anyone  
else. We had a lot of fun that evening,  
enjoyed it thoroughly, and we were both  
in the spirit of the thing. We told  
about the gadgets we'd dug into and  
tried to build just for the joy of  
trying to do it. He had just as much fun  
out of it as I did, I'm sure.

1) VB ON INVENTIONS

2) ORVILLE WRIGHT

\* \* \*

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Page 252

Question 57: What comments on three tons of insects for every ton of animal life.

1) ON CONTROLLING  
INSECTS  
SELECTIVELY

We now have Question 57, and I don't know whether this statement about the tonnage of insects is true or not. Even if it is true, we can conclude one thing certainly: if we could suddenly wipe out all the insects on the earth, we'd be in one heck of a fix, because some of them are needed. I don't think anyone would care to take the chance of wiping out everything. The job of the people that are controlling insects is highly selective. There's another point here: there's a balance between insects in an area. If you wipe out an insect which is attacking crops, you destroy that balance, and it may merely mean that some other insect, perhaps a worse one, takes over. So destruction has to be done with great care. I'd like to study this subject deeply if I could: I think it's fascinating. [EH to VB:  
LO! A BBJ THEME!] [VB to EH: NIX]

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Page 252-A

(VB: It's interesting all right. But a lot has been written about it, by people who know far more about it than I do. It would take a lot of study to make an intelligible and correct article on it.

1) SELF-LIMITATION  
OF POPULATIONS

(A while ago there was a hell of an interesting article in Science on the tendency of population to set up means for self-limitation. The argument was that this came about in evolution, since the population which merely multiplied until stopped by its food supply, became vulnerable, as supply varied, compared to a population which limited before malnutrition set it. Examples from birds and mammals. When the rabbit population in the north drops, foxes have smaller litters, apparently before they lack food. The author thinks human groups had this when in the hunting stage, but have now lost it. I just looked for the article and I fear that my copy of Science has gone to its reward. But I could get it again, of course.)

Of course we're fortunate that Nature built insects with a sharply limited respiration system which relies principally on diffusion through short, very fine tubes. This being the case, the insect can't grow beyond a certain size, because as you multiply the dimensions, the volume of the insect goes up as the cube, and the surface area only as the square of the dimensions. This means that you soon get to a volume which cannot be supplied with oxygen through the surface by the mechanism insects use. So insects have an upper limit on their size. If it were not for this, we'd have bumblebees three feet long, and there'd be hell to pay.

Nature got around this limitation, of course, when it put gills on fish and lungs on man; in the mammal the area of the lung can go up at a much greater rate than the area of the surface of the animal as bulk increases. But still there's a limit. There are two limits on the size of

1) NATURE'S CONTROL  
ON SIZE OF  
CREATURES

mammals, of course; this constitutes one. Otherwise when we made a very big animal, we'd find his entire internal volume taken up by lung. The big animals' ordinarily move slowly, and they can get away with less oxygen supply.

1) NATURE'S CONTROL  
ON SIZE OF  
CREATURES

The other limit to the size of a mammal of course comes about from structural reasons; the legs just can't support the bulk. I don't think there's been too good a study of this, taking the old mastadons, for example. They were enormous; but I have a feeling that the ones that were really big spent most of their time supported by water at least partially.

\* \* \*

Question 58: What remarks elicited by  
Mesquite bush

Of course the mistake that the Texas ranchers made was that when they killed off the mesquite they didn't put in something else that the cattle would like better. Apparently there's a beautiful balance

on water supply in the desert. You'll find that bushes are spread at certain distances; they can't go any closer together because they can't get the water to do it, each one occupies an area. If you remove the mesquite, it should be for the purpose of making it possible for other things to use the water that's available, and to make growth that will be beneficial.

When I was with the CIW, we did a lot of work out at the research laboratories on the Pacific Coast on the development of grasses which would grow properly in various difficult areas, including areas where the rainfall is very light. It's hard to get far with this; it takes an enormous amount of work to do the selection and testing and so forth. We developed hundreds of grasses, and quite a few of them were tried out in various ways. But the real point is that there wasn't enough organized push behind the idea among the ranchers themselves to make

- 1) BALANCE OF WATER  
SUPPLY IN DESERT
- 2) CIW - ADAPTING  
GRASSES TO  
RAINFALL

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the thing really go. Government can't do much unless it gets full cooperation, and I don't think it ever got any.

1) DESERT SAND ·  
DETERGENTS &  
WATER RETENTION

There was another phase of this that I worked on personally at one time, which is one of the things that never came to anything. The trouble with these desert areas, of course, is that usually when they get water, it comes so fast that very little of it soaks into the ground; most of it runs off, makes great gullies and adds to erosion. It occurred to me that if one sprinkled a bit of detergent over the ground -- not very much, and using a cheap detergent -- that the upper levels of the sand would become wetter. When sand is very dry, it's hard for water to wet, and that's the reason that you get the enormous runoff. If there was a bit of detergent in the first inch of soil, I think that the water would penetrate, and that you wouldn't have so much loss. I

Reel 4-B  
Page 255A

suggested this to various people; I don't know whether it was ever tried, or whether it was economically unfeasible, or what. At any rate I haven't heard from it since.

1) DESERT SAND,  
DETERGENTS AND  
WATER RETENTION

(EH TO VB: Van, No wonder I suggested the Balance of Nature as a BBJ topic: these last pages have been fascinating. Also: your detergent suggestion -- I wish I knew what had become of it. Irony: deserts need detergents per page 255, but where water is plentiful the excess-detergent backup problem is making potable waters froth like beer! Here's a chemical engineering problem on a grand scale: how to move a super-nuisance to places where it's needed, and therefore neither surplus nor nuisance. There's a Bonneville-Grand Coulee analogy here. Why not make it?)  
(VB TO EH: Soon the law will bar detergents that are not soon disintegrated by bacteria and such are now available.)

\* \* \*

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Question 59: Paths which lead eventually  
to reality of NSF

1) CIVILIAN  
ORGANIZATIONS &  
MILITARY  
DEVELOPMENT IN  
PEACETIME

2) NASA

This is Question 59, and it opens a very interesting line of thought. I don't think that in time of peace the OSRD concept would work. There've been various efforts to construct one -- that is, an independent civilian organization working on military development, rather generally, in time of peace. (X-REF FORWARD TO PAGE 703) Of course we do have NASA which is working on the peacetime aspects of space vehicles; I have a great deal of doubt as to their program, as you know. But in general, in peacetime all of the military research is being done by the military themselves, or by contractors they engage for a particular development, and which they supervise. There is no such thing as OSRD in peacetime. As I say I don't think it would work.

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There are several reasons why I don't think it would work. In the first place, you can't engage the group we had during the war voluntarily on such a thing in time of peace. In the second place, OSRD worked because it reported to the President, because it had his full backing, and because, for this reason, the military did not dare to resist, as they would in peacetime, the entry of civilians into some of their intimate affairs -- particularly civilians whom they did not control completely. This opposition would be among a few officers -- those who think none too highly of civilians anyway -- and it would also be the kind of resistance that would be subtle. You can't develop military weapons well unless you have the full and hearty collaboration of the military, because it takes both military and scientific judgment to know what is worth developing, and to get it going. When you come to the time of testing in the field,

1) CIVILIAN ORGANIZATIONS & MILITARY DEVELOPMENT IN PEACETIME

the test has to be done by the military. We had opposition during the war but the opposition was scant. Not very many officers wanted to put rocks in the road, and the ones who did were usually fairly easily circumvented. On the other hand we had a lot of officers who were enthusiastic about civilian work, and helped it in every way they could. I remember Jake Devers; I remember Tony McAuliffie.

If it hadn't been for Jake Devers we never would have got the Dukew<sup>w</sup> in shape for use. (X-REF FORWARD TO PAGES 457 AND 763) He tested it because he was training a motorized division, and he tested it on his own grounds of that division. He may have violated an order in doing it; I don't know, but he did it. And those tests were critical and essential. With Tony McAuliffie the story was a little different. Whenever he was in Washington, he was likely to spend an evening with some of the civilian scientific group, discussing things. (X-REF FORWARD TO PAGE 471) His help was great,

- 1) CIVILIAN ORGANIZATIONS AND MILITARY DEVELOPMENT IN PEACETIME
- 2) JAKE DEVERS AND THE DUKW
- 3) TONY McAULIFFE

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but his inspiration was greater yet, because he was a swell fellow in every way, and he really put fire into the people he talked to. He loved to talk to the young men as well. There were many other officers who took this point of view, but I think of these two particularly.

1) WHAT MADE NACA  
WORK

Now of course, you say that NACA for many years conducted basic research. It did have collaboration between the military and the civilian -- it was because it did have that it worked. This was the reason why the governing board of NACA, which selected its own research director, was made up both of civilians and military personnel, good officers from the Air Force in particular. The civilians were not all heads of bureaus or heads of the Smithsonian or something like that; there were independent civilians. They sat around

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Page 258A

the table and discussed things, and they got together; that's the reason the NACA worked.

- 1) WHAT MADE NACA WORK
- 2) THE ORGANIZATIONAL CHANGE IN NASA

When NASA was formed (X-REF TO PAGE 70) I felt strongly that it ought to keep this same situation. If it had, I don't think we would have had quite so much struggle between military and civilian people on all the space aspects, and who knows, the outfit might not have gone quite so wild. On the other hand, perhaps I was wrong, although I expressed myself forcibly at the time that NASA was formed. [EH to VB: I THINK THIS SUBJECT COULD TAKE A LOT OF EXPANSION.] [Jim Killian was steering the affair to a considerable extent. He was aided by Charlie Coolidge who put a lot of time on it. Coolidge consulted me, but I was not brought into the discussions except that one contact. This was a bit strange, since I had been chairman of NACA. I doubt if Hunsaker was consulted more than I was.

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Page 258B

[At present I feel about like this.

1) NASA

Probably if the agency is to spend five billion a year, the present form of NASA with its intimate contact with Congress, and its performance as a part of the President's political program, is correct. But spending five billion a year makes no sense whatever. Not when one thinks of what can be done with billions in impoverished areas, in education, in water supplies, in ending pollution, and so on.]

You know that NASA succeeded NACA, and in fact it was a continuation of the same organization. But it was changed so that the director was solely responsible. He had only advisory boards, and he reported to the President. Jim Webb is a fellow who will take any order from the President and carry it out no matter what he thinks. Perhaps I was wrong because the enormous amount of money handled by NASA -- which I think is altogether too much -- probably

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Page 259

couldn't have been handled as well under the somewhat loose organization that we had in NACA. (X-REF FORWARD TO PAGES 357 AND 310) (EH TO VB: Will you expand here?) (VB TO EH: I've attacked the moon shot a few times. But now is not the time for another crack at it)

I undoubtedly still had this fine relationship of NACA in mind when I spoke of a similar relationship after the war in some research organization. As things have turned out, we haven't got that at all, but we're not doing so badly. The military not only support military research; they also support a lot of research which has very little to do with military objectives indeed. This brings them in touch with a large group of civilians, and I think perhaps we're getting along as well as we would have if we had tried to carry out the kind of thing I had in mind when SEF was put together.

- 1). POST WW II
- 2) COOPERATION  
BETWEEN MILITARY  
& CIVILIANS ON  
RESEARCH

For one thing, in the postwar world we have a group of military officers who can have no doubt in their minds whatever about the value of civilian research and development. The number of people in the military service who think this is all a lot of tripe is so small today as to be practically negligible. So the gulf that existed before the war between military men and civilian scientists and engineers doesn't exist today the way it did then.

\* \* \*

Question 60: VB as President of NACA

Well, I don't have the dates when I was chairman of NACA in my mind either. (1939-1941) I know I finished in 1940. As soon as things got hot at NDRC, I proceeded to drop out of NACA, because it

- 1) WW II
- 2) COOPERATION BETWEEN  
MILITARY &  
CIVILIANS ON  
RESEARCH

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was quite evident that I couldn't carry both things at the same time. I don't know when I started in NACA, and I don't know when I became chairman. It's undoubtedly on record somewhere in my correspondence and so on.

- 1) FLASHBACK PRE  
   WW II
- 2) BEGINNINGS OF  
   NACA
- 3) AMES & VICTORY

The reason why I became chairman was a very interesting one. NACA was formed, as you know, way back in the dark ages, and the fellow who really fathered it and made it go was Ames of Johns Hopkins.

VB to EH: THE EARLY 20's I THINK]  
(X-REF PAGE 71) (QUERY: the 1920s?) ^ He

really did quite a job. He was backed up by John Victory, who had political sense. The two of them built quite an organization -- of moderate size at first, but beginning to be quite a show. Then Ames got old, and began to slip; he had some kind of an illness which affected his mind, and yet he didn't want to get out. The people who were then most influential in NACA, particularly the military people, finally persuaded him to resign. It happened suddenly, and

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Page 261

they elected me undoubtedly because I was the only person around the place who was entirely independent and that they thought they could use. (They really should have turned to Hunsaker) I always told them that the reason they elected me chairman of the National Advisory Committee for Aeronautics was because I didn't know anything about aeronautics. I went along with it, and rather enjoyed it. I learned a good deal, and I think it's probably well that I did, about operating and organization in the center of government; (X-REF BACK TO PAGE 71) that is, the political relations involved, those with the Civil Service Commission, the General Accounting Office, the Bureau of the Budget and about a half a dozen others, which is quite a complicated thing to do. John Victory coached me on this; without him I would have been in a serious state.

1) FLASHBACK --  
PRE WW II

2) BUSH AND NACA

Reel 4-A  
Page 261A

When I first started in, I made an inspection of the laboratories, and I studied in them. I was a bit horrified at first because I thought these laboratories were in general pretty inefficient. The trouble was, I was making the wrong comparison -- I was comparing them with academic laboratories and with laboratories in industry. (X-REF AHEAD TO PAGE 331)

When I began to compare with other governmental laboratories, I felt better. That is, I didn't feel I was responsible for the general fact that governmental laboratories are not on their toes the way private laboratories are. When I made that comparison I relaxed a bit, and I wasn't nearly as disturbed in my mind.

Lewis, who was head of research of NACA, I think did a very good job on the whole, with the conditions under which he had to work, with the Civil Service and what have you. I went ahead and operated

- 1) FLASHBACK  
PRE WW II
- 2) BUSH AND NACA
- 3) LEARNING TO  
DEAL WITH  
GOVERNMENT
- 4) LEWIS

without trying to make any great changes.  
I can tell you an interesting story about  
how we picked the site for a new laboratory

\*if you'd like to hear it sometime. This  
was one of the places where I learned a little  
bit about how to make a show go under the  
auspices of government.

( Briefly, we set up a committee to  
examine sites. They examined 50 and ate  
50 chicken dinners with Chambers of Commerce.  
This took so long that we didn't get around  
to picking the site until Congress adjourned  
-- whereupon there was no explosion when we  
picked Cleveland.

(At the NACA meeting where the decision  
was made, the committee made a lengthy report,  
recommended Cleveland, and gave its reasons  
in detail. The matter was ready for final  
vote, when Orville Wright made a plea for  
putting the lab at Dayton, somewhat emotional,  
and with no comparative data on costs, etc.

- 1) FLASHBACK - PRE  
WW II
- 2) SELECTING A SITE  
FOR NACA LAB

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\* [EH to VB: YES, PLEASE, I WOULD LIKE TO.] [VB to EH:  
WE NEED TO PICK UP A LOT OF POINTS LIKE THIS.]  
[INSERT HERE.]

I was in the chair. Hunsaker promptly moved that we install at Dayton. This nearly bowled me over, but I soon tumbled. So, I said that if we were to overturn our committee I must insist they have full opportunity to be heard. Clerks came in with a stack of files five feet high. The committee chairman started an analysis which was evidently going to continue for hours. After a while, Wright said that he hadn't realized how thorough a job must have been done. Then Wright withdrew his motion. He had of course made it so that we could withdraw it. Then we voted for Cleveland.

(This reminds me of some queer things that happened in the Smithsonian. Notably the time when we retired the secretary (who is still alive), also my relations with Delano, uncle of FDR. He went to the hospital, and told me not to let FDR know he was there, which put

- 1) FLASHBACK - PRE  
WW II
- 2) SELECTING A  
SITE FOR NACA  
LAB

Reel 4-B  
Page 262B

me on the spot. Also the time I made a remark to Delano about chaps who collect stamps. Also how I got off the Regents soon after Warren became Chancellor. Also how Carmichael happened to go to Washington.)

(QUERY: What about these stories?)

(VB: How many darned books are we supposed to write?)]

I could also tell you about the first time I appeared before a Congressional committee, which was in connection with NACA where I did a very bad job indeed, and I nearly got thrown out. (X-REF AHEAD TO PAGES 631, 697 AND BACK TO PAGE 71) But out of it I learned something, which was fortunate. I could also tell you about why Victory became exceedingly loyal to me, and how I had a joke with an Admiral who tried to jump on his neck. But all these can come later if you <sup>want</sup> yarns of that sort. (QUERY: Yes we do)

1) STORIES VB  
SHOULD TELL

\* \* \*

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Question 61: On the Differential Analyzer,  
the antecedence and so forth

1) DIFFERENTIAL  
ANALYZER

There really were three differential analyzers. The first one was just a breadboard machine. That is, it was just made out of pieces of wood and anything that was handy, and the object of it was just to see if the idea was sound. The second one, as you say, was a mechanical machine. (X-REF BACK TO PAGE 59) The thing about it that was a little unusual was that the integrators were made to be pretty fairly precise. It was not easy. The integrator was simply a disk revolving at a constant speed, and a roller that rolled on it, which could be moved different distances from the center. The job was to keep the roller from slipping. If it carried any appreciable load, it would slip, and then the integrator would be highly inaccurate. We overcame this by putting on what's called a torque amplifier, but this itself was mechanical. We finally made integrators that had a precision of about one part in 1000, which was pretty good.

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Page 263

This machine was the one that the press talked about. It was the one of which we made a duplicate for the Army, for their station down where they computed a lot of trajectories. It was the one that was pretty largely copied by Hartry in Manchester, England. We did quite a lot of work on it. The difficulty with it, of course, was that it took quite a little time to change from one problem to another; and of course it did not have the scope that was necessary for many equations. Probably the first time I attracted any attention anywhere was when that machine got talked about. In fact, I was elected to the National Academy of Sciences at a rather young age; I think there were others that were elected younger than I, but I was in the lower bracket, certainly. And this probably was due to the differential analyzer.

1) SECOND DIFFERENTIAL ANALYZER

2) FLASHBACK -  
ELECTION TO NAS

Reel 4-B  
Page 264

Finally came the third machine which we got into use just before the war. This one was wholly electrical, except that the integrators were still mechanical. (X-REF BACK TO PAGE 60) This machine had a very large number of thermionic tubes, was quite hard to keep cool and occupied a big space. It did some work that was some good during the war. After the war, when the digital machines began to come along, it was rapidly made obsolete, and we finally tore it down.

There are now made and sold many Differential Analyzers of the electrical type. There are companies who make them, (EH TO VB: E.G.? Who? VB TO EH: Philbrick Researchers, Inc., Dedham Massachusetts on Route 128) and there are lots of engineers who use them. They are not highly precise, but they change easily from one problem to another, they give qualitative results very rapidly, and they're

1) 3rd BUSH DIF-  
FERENTIAL  
ANALYZER

very useful gadgetry. They supplement the digital machine. If you want precision on a problem, you go to the digital. But if you want to explore, if you want to see what happens to the solution of an equation when you change constants, as you often do when you're designing something, the present-day Differential Analyzers are very convenient indeed. They're made in units that can be plugged together by cables, and they're very versatile. (They also would make great teaching machines if not so expensive.)

Now the antecedents are interesting. Pascal (1623-62) is the first man who really did anything on computing machinery. In fact, he built a computer. And he wrote about computers quite a bit. He had most of the ideas involved in the ordinary desk-type adding and multiplying machine. He was a pioneer of a very strange type, because of course he was primarily a theoretical physicist and mathematician.

- 1) ELECTRICAL DIFFERENTIAL ANALYZERS
- 2) ANTECEDENCE OF PASCAL

Charles Babbage was the fellow who took these ideas, and some of his own, and started to make a really comprehensive machine to do all sorts of things. That would be a fore-runner of the digital machine to the present day, but the trouble with Babbage was that he bit off more than he could chew. (X-REF BACK TO PAGE 59) At the time he was working mechanical devices could not be turned out cheaply or made reliable. The advent of reliable complexity is an exceedingly important phase of modern development. (EH TO VB: This is a favorite theme of yours. I wish you'd expand on it. VB TO EH: <sup>Easy to do.</sup> The modern computer, or telephone system, could not function if the units out of which it is built were not exceedingly reliable.

(It is easy to see why. Suppose there are 1,000,000 units involved. Assume the functioning of all of them is essential to performance. Let us assume they are quite reliable: looking at any one the chances of its failing in the next year is only one in a thousand. Still this means we must expect about three failures

- 1) ANTECEDENCE OF CHARLES BABBAGE
- 2) RELIABLE COMPLEXITY

of the system per day which is intolerable.

1) RELIABLE  
COMPLEXITY

(There are ways of reducing the grief.

In automatic routing of calls of the telephone system, if one path is busy or defective the machine automatically picks another.

In the big computers, if a unit is faulty, the machine won't use it, and will report it.

Also the big computer has very ingenious ways of checking itself to catch mistakes.

(The nature of reliability is shown by the way ball bearings are sold. The companies do not guarantee a certain life. Rather they will present data which shows that, of many of a given design and rating and under specified speed and load, ten percent may be expected to fail in 5000 hours of use, or the like. It is always a statistical matter.

(We come to the superlative in reliability when the telephone company puts a cable across the Atlantic, with a complicated amplifier every

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Page 265B

forty miles, imbedded in the mud at the bottom of the ocean, and expects it to operate without a failure for twenty years.

1) RELIABLE  
COMPLEXITY

(Present-day reliability of components has come about by gradual improvement of design and materials on condensers, resistors, coils, relays, thermionic tubes, transistors. This has largely been due to keen competition. In a socialistic economy, it probably wouldn't happen.

(I can buy a relay and expect it to operate for billions of cycles without fail. Also important, if I am a large customer, I can buy it for very little money. This has allowed many things, automation for example, to go forward rapidly.

(Consider the automobile. When I drove fifty miles forty years ago, I fully expected something to quit. Now I gripe if something goes wrong after 10,000 miles.

Reel 4-B  
Page 265C

And I am right -- for the automobile companies press their suppliers so hard on prices that they don't get the best. On an automobile selling for \$4,000 they will cut the cost of the thermostate for the choke from twelve cents to eleven cents, and the \$4,000 car goes poof. A plague on all their houses.)

Babbage didn't have any of this (reliable complexity) available. Moreover, he was much too ambitious; instead of making a moderately complex machine which would work, and give results (and that would attract attention) he started right in to make a machine that would be comprehensive indeed. And of course he never finished it. Babbage added some of his own ideas to those of Pascal, but primarily, he was building rather than inventing. His conception of what he was trying to do fell short of the ideal by a great deal.

Another interesting precedent was this: after I had the second machine in use, I found in an appendix to a book by Kelvin and Tate on (Q: CY)

- 1) RELIABLE COMPLEXITY
- 2) CHARLES BABBAGE  
(CONTINUED)

3/15/66

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Page 266

theoretical mechanics, a little article by Tate proposing a differential analyzer which had practically all of the basic ideas that were involved in my machine. Of course I hadn't seen this when I built mine, but the ideas were quite parallel; that is, the idea of connecting together some integrators to solve a differential equation. (X-REF BACK TO PAGE 55) Tate never built anything along these lines; he merely had the idea. Of course, if one had been built in accordance with his descriptions, the machine wouldn't have worked, because his integrators, or any integrators that could have been built at that time, would have failed to carry the load, would have slipped, and the accuracy would have been so low as to be utterly useless. However, as far as the idea of the differential analyzer is concerned, he preceded me.

1) TATE'S DIFFERENTIAL  
ANALYZER

(EH to VB: THIS IS THE 1st TIME YOU LET ME IN ON THE IDEA OF CONNECTING TOGETHER SOME INTEGRATORS; ON p 263, etc., YOU JUST SPEAK OF AN INTEGRATOR. CAN WE HAVE MORE DEATIL?) (VB to EH: SURE, AGAIN EASY TO DO:

(The idea of the integrator was old. A watt-hour meter, which gives the basis for your electric bills is an integrator. A mechanical form was found in the planimeter for measuring areas. This entered a variable factor as it integrated. The gadget I made at Tufts for drawing profiles of a line on land had an integrator in it.

(Connecting integrators together, with other units to add, multiply and so on, made a differential analyzer.

(One can make differentiators and connect them the same way and get the same result. But differentiators are notably erratic things.

(Babbage intended to integrate by merely adding terms. That's the way a digital machine works.

(Present-day differential analyzers do their integration electrically. A capacitance integrates the varying current that flows into it, and presents the result as a potential difference. This is far from precise. But it is easy to connect such units together.

1) INTEGRATORS and  
ANALYZERS

[I've said that the digital machine does its work by using arithmetic and a memory. It also uses logical units. That is, it can have a unit, with two inputs, which will operate when either is actuated, or only when both are operated, and so on. In connections of such units we then have the equivalent of "and", "or", "and/or" and so on. This is really what gives it its great power.

[In addition to analogue machines (differential analyzers) and digital machines (which operate in accordance with binary arithmetic) we also have special purpose machines which are neither, but still are analytical. We also have data handling machines. The old Hollorith punched card affair was in this last class.]

Now there's one more thing: there was a man by the name of Hannibal Ford [Q to CY; AB: WHAT WAS FORD'S VINTAGE?] [CY to Q: CANNOT FIND HANNIBAL FORD IN BUSH PAPERS.], who had worked with the Navy on machines for controlling the big guns of a battleship, which computed the speed of the target, compensated for the speed, computed all sorts of things for corrections on the guns, and controlled the guns in such a way that when they were fired, the shell and the target would arrive at the same point at the same time. He did some

- 1) INTEGRATORS and ANALYZERS
- 2) HANNIBAL FORD

[ital] exceedingly ingenious work. I knew a little about it because one time, after the first war, when I was a lieutenant commander in the Naval Reserve, I went aboard the battleship Texas with some other men to run some tests on antiaircraft fire control. There was no such thing, of course, and we were going to confer on it. We were going to examine the equipment for controlling the big guns, and go on from there to see what we could do about controlling antiaircraft guns. Now as a matter of fact, we never did look at the equipment for controlling the big guns, because we were going to do antiaircraft fire with the Shenandoah, [ital] and the Shenandoah never showed up. She went off to some county fair for a celebration, and we were left sitting on the battleship with nothing to do. We didn't have the conferences either. We didn't do anything for several days, till they were about to leave and go home. So, I didn't know of Hannibal Ford's work until many years later, and neither did anyone else, of course, because it was kept very secret by the Navy.

Hannibal Ford, however, made an integrator of a type which is still made and used today, which is a very clever peice of design; so good, in fact, that it

- 1) HANNIBAL FORD  
(Cont'd)
- 2) FLASHBACK -- POST  
WWI  
THE CONFERENCE THAT  
"WASN'T" ON THE TEXAS

had reasonable precision without the use of a torque amplifier. Had I known of Hannibal Ford's work, I could have made much better integrators at the time I was working on the Differential Analyzer. But I did not.

1) HANNIBAL' FORD  
(Cont'd)

I always liked Hannibal Ford, although I only met him once or twice. He was a strange individual. He died many years ago. One of the most ingenious chaps I ever heard of. His house [EH to VB: WHERE?] [VB to EH: DON'T KNOW] which I never visited, was all full of gadgetries, so that when he had a visitor, he barked out an order and up came a cable through the floor and all that sort of thing. [EH to VB: MORE DETAIL WOULD BE VERY INTERESTING.] [VB to EH: FEAR I HAVEN'T ANY.] Hannibal Ford was one of the real geniuses. If he had ever had the idea of the Differential Analyzer, and if he had the backing that he had from the Navy when he made his fire control apparatus, he would have made a beautiful Differential Analyzer, without any doubt. As it happened, his interests were elsewhere, and his stuff was kept secret.

\* \* \*

Question 62: Secrecy and free scientific information exchange.

- 1) WW II
- 2) SECRECY OF ATOMIC ENERGY INFORMATION
- 3) GENERAL GROVES
- 4) THE SMYTH BOOK

This is really quite a question. If I try to cover it fully, I'll be talking for quite a long while. However, we can get started at least. During the war, General Groves had a counterintelligence section in his own Manhattan District, (X-REF AHEAD TO P. 419) which was set up to prevent atomic energy information from getting into the wrong place. I think you'll find something about it in Groves' book. Incidentally in passing, [EH: N.B.] Groves' book is in my opinion quite an accurate record. I have no doubt, from some of the things he told us about this, that there were leaks to the Russians which have not been uncovered -- that is, not publicly -- in addition to the Klaus Fuchs stuff and all the rest of it. So I have no doubt in my own mind that when Truman told Stalin about the atomic bomb just before it went off, at the Potsdam Conference, Stalin already knew all about it -- enough about it so that he was not surprised, certainly.

Now at the end of the war of course we had a mania for secrecy. A lot of it was very foolish. One incident that I remember very well: we got Henry Smyth, of Princeton, who had been working on the atomic energy project, to write a book. His instructions were, to put in it the things that would be helpful to scientists of the United States for further development

of atomic energy, postwar. We also said that he must be careful that everything that he put in there was something known to the Russians already. Well, I didn't follow the making of that book, but I know that General Groves, who was very meticulous about all such matters, was closely in contact with Smyth. Nothing went into that account that was not already known to the Russians, although a great deal went in there that was not known to the American public, or American scientists. [X-REF FORWARD TO 462] Hence it was of great help in getting scientists in this country really moving after the war -- those who hadn't been in the atomic energy project.

Now you realize also that our rule in OSRD was that any man who was working on a project was entitled to all of the secret information necessary for him to carry on his work appropriately and effectively. [X-REF AHEAD TO P. 430] But he was not entitled to secret work that had nothing to do with his project. After the war, both Conant and I were cursed in various circles because we had preserved this rule, and hence kept a whole lot of men from knowing about things that they just wanted to know about. Actually, of course, we said that our job was to fight the war, that we were not interested in postwar things until the war was over, and so on.

- 1) POST WW II
- 2) MANIA FOR SECRECY
- 3) THE SMYTH BOOK
- 4) SECRECY IN OSRD  
BUSH-CONANT RULE

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This was the basis, as you know, of the affair I had with Churchill, which I'll recite to you in the appropriate place. [X-REF FORWARD TO P. 274, 432 AND BACK TO P. 215]

- 1) POST WW II
- 2) THE RELEASE OF THE SMYTH BOOK
- 3) LEAHY'S DISSENT AND TRUMAN'S ASSENT

In the White House, we had a session on the question of releasing the Smyth Report. [X-REF FORWARD TO P. 461B] Harry Truman sat at his desk, and the rest of us gathered around -- Groves, Conant, myself, Admiral Leahy, Smyth, and a few others. After a bit of discussion, Truman went around the room, and said, "I want each one of you to state fully your opinion and the reasons for it." Then he sat back as one after another of us spoke up. Leahy of course made quite a speech, (LEAHY & SMYTH REPORT: X-REF TO 823] saying that we had a great deal of secret stuff, and the Smyth book would give this all to the Russians. This was quite typical of Leahy. He didn't hesitate to be dogmatic about all sorts of things that he knew nothing whatever about. He had no basis for knowing what was in that book, or whether it was known to the Russians, and in fact 9/10ths of the book was stuff he couldn't understand anyway. But he made his speech.

Groves and Conant and I all asserted that the book would do some good to American scientific effort, and that it wouldn't help the Russians a bit.

Finally Truman sat back when we'd all spoken. There was a long silence; he looked at the ceiling. Then he said something to the effect that he wished he wasn't in a position where he had to make decisions like this, or words to that effect. There was another long pause. Then he looked up and said, "You will release the book, and the meeting is adjourned." I went out of there walking on air, because I thought we at last had a President [EH to VB: IF THERE'S AN INFERENCE HERE THAT FDR WAS NOT THAT SORT OF PRESIDENT IT WOULD BE VERY INTERESTING TO EXPAND HERE.] [VB to EH: NO SUCH INFERENCE INTENDED.] who could make a decision, a tough decision, stick to it, and make it in such a way that no one could possibly misunderstand him.

I don't know about Compton's statement -- in fact, I haven't heard him make it. [In Q. 62 THAT IT WOULD TAKE THE RUSSIANS NINE YEARS TO CATCH UP WITH US IF WE GAVE THEM THE OAK RIDGE SHOP DRAWINGS] I was before a Senate committee after the war, in which I made an estimate of how long it would take the Russians to get the atomic bomb. As I remember it, what I said was this: that if they did it in secret, and without importing anything they needed, without importing the machinery, the special equipment, the special materials that would be necessary, so that they would keep the

- 1) POST WW II
- 2) THE RELEASE OF THE SMYTH BOOK
- 3) TRUMAN'S ASSENT
- 4) BUSH'S ESTIMATE OF TIME FOR USSR TO DEVELOP BOMB

thing entirely dark and do it with their own resources, then I thought that it would take them ten to fifteen years. On the other hand, if they freely brought in stuff from outside, got other people to make stuff for them and so on, I thought they could do it in four or five years. (I don't remember the exact times I used, but these were approximately the ones.)

Shortly after that, of course, they took over Czechoslovakia, and having Czechoslovakia, they had access to a very large fraction of the stuff that I had in mind, for Czechoslovakia was very advanced, as we know, from a technical-mechanical standpoint. They got their machinery and equipment and materials and so forth in that way, without much doubt, and the time that they took was just about what I'd guessed. They did not have to hunt around for secrets to do this -- they already had all the knowledge they needed of the primary facts of the situation. I have no doubt about that.

It's very natural for the American people to think they're miles ahead of the world on everything. And it's also a very characteristic thing to put great emphasis on secrecy. We've done that right along; we did it after the first war on things that didn't count for much. We did it after the second war plenty. Of course it made it very difficult for us to do all sorts

- 1) BUSH'S ESTIMATE OF TIME FOR USSR TO DEVELOP BOMB
- 2) AMERICAN PREDISPOSITION TO SECRECY

of things. We were working hard to keep Russian spies from getting into our plants and finding out all sorts of secrets about atomic energy. They didn't do it in that way. They did it because they had channels through scientists who were loyal to Russia and were over here, and who talked with other scientists who didn't realize that they were not good loyal Americans. [EH to VB: IS THIS THE POINT, OR IS IT THAT SOME SCIENTISTS, INTENDING NO DISLOYALTY, WERE HIPPED ON THE WORLD BROTHERHOOD OF SCIENTISTS IDEA?] [VB to EH: THIS TOO NO DOUBT. AND SOME SCIENTISTS WHO JUST COULDN'T HELP TALKING. HAVE I EVER TOLD ABOUT UREY'S CLEARANCE? IT SHOULDN'T BE TOLD IN PRINT CERTAINLY.] Enough filtered through this way so that the Russian scientists without doubt knew what they wanted to know.

On the other hand, of course, the Congress after the war was very hot and bothered on this thing. This has some pertinence in regard to the show I had with Churchill, because if I'd done what Churchill wanted me to do, in regard to our system of secrecy, we would have told the British a great deal that they did not need to know in the prosecution of the war, but that they might wish to know for purposes after the war was over -- purposes of developing power to

- 1) SECRECY
- 2) HOW RUSSIANS GOT SECRETS
- 3) CHURCHILL

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2 take the place of their dwindling fossil fuel supplies.  
If I had done that under Roosevelt's orders, and the  
Congress had found out about it, there would have been  
quite a show. But as you know this was not done.

1) SECRECY

2) CHURCHILL

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