

# NATIONAL INFORMATION CENTER

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## HEARINGS

BEFORE THE

AD HOC SUBCOMMITTEE ON A NATIONAL  
RESEARCH DATA PROCESSING AND INFOR-  
MATION RETRIEVAL CENTER

OF THE

COMMITTEE ON EDUCATION AND LABOR  
HOUSE OF REPRESENTATIVES

EIGHTY-EIGHTH CONGRESS

FIRST SESSION

ON

**H.R. 1946**

A BILL TO AMEND TITLE IX OF THE NATIONAL DEFENSE  
EDUCATION ACT OF 1958 TO PROVIDE FOR A SCIENCE  
INFORMATION DATA PROCESSING CENTER TO BE LO-  
CATED AT ONE PLACE IN CHICAGO, ILLINOIS

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### PART 2

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HEARINGS HELD IN WASHINGTON, D.C.,  
JULY 18 AND 19, 1963

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## STATEMENT OF DR. EUGENE GARFIELD, DIRECTOR, INSTITUTE FOR SCIENTIFIC INFORMATION, PHILADELPHIA

Dr. GARFIELD. It is a pleasure to be here.

Mr. PUCINSKI. You may proceed in any manner you wish. Perhaps Mr. Bell and I agree we will perhaps interrupt you as you go along whenever a question arises so that we can keep the record running smoothly. So, will you be good enough, Doctor, to give us your views on the subject matter before this committee.

Dr. GARFIELD. I have prepared a short statement which I shall not read but submit for the record. I was away when your invitation to appear arrived. At a later date I will be glad to provide any pertinent supporting documentation.

Mr. PUCINSKI. Very good, Doctor.

(Dr. Garfield's prepared statement follows:)

### PREPARED STATEMENT BY DR. EUGENE GARFIELD

We all take the telephone for granted. When we have to wait more than a few seconds for a dial tone, we grow impatient and frustrated. When we call information—seconds seem like hours. We also take for granted the telephone directory—that innocuous book which methodically lists names and numbers in alphabetic order. Imagine the chaos in the telephone company information centers if one day every other page in everyone's phone books were missing. Imagine your frustration if most telephone numbers were "unlisted"—if a special, prolonged, and elaborate effort was necessary each time you made a call.

Contemplate the chaos in your city if there were hundreds of different phone books—some arranged by people's national origins, others by occupations, by district or by name—yet none of them complete. Each time you needed a phone number you would have to know whether your friend was Irish, or a janitor, or whether he lived in the north side of town. Suppose that in each city the system was different—each used a different terminology or system of spelling—a janitor might be a superintendent or a maintenance engineer.

Suppose each of these phone books, large and small, is only half complete and at least a year old when it arrives. Suppose that phone books were not free but cost so much that only libraries could purchase them. Imagine your frustration if you had to go to the library each time you wanted to make a phone call.

Now what has all this to do with the so-called information crisis? The situation I have just hypothesized is a fairly accurate description of scientific communication today. There are some obvious exaggerations. On the other hand, there are even more chaotic aspects difficult to convey by simply analogy. We all use the yellow pages, the classified directory, and frequently find it difficult to locate a number because of peculiarities in our language. Gas stations are listed under service stations and sell gasoline; gas companies may be listed under power companies and sell gas. In science, terminology is constantly changing—faster than the lexicographers or dictionary publishers can cope with. Every scientific dictionary is obsolete long before it is published.

In science communication we not only call local numbers—we are constantly trying to place long-distance transoceanic calls because science is international. Our telephone operators, the information scientists and librarians, must be able to handle dozens of languages including Japanese, Russian, and other exotic tongues.

However, this is only the beginning of the difficulties. After painfully identifying the telephone number of the scientific document he needs, the scientist can't simply dial the number. He must first identify the telephone exchange that handles this number. He may be lucky and find that it is a local exchange. Quite frequently he will find that he must call a Washington exchange or some other remote city. But scientists are stubbornly persevering, and having learned the proper exchange, put through the call only to find that the line is busy. In fact, the average waiting time is a few weeks—and by then—if that hasn't discouraged him—he may find that he called the wrong exchange, the number is out of order, or disconnected, temporarily or permanently. It is not surprising that by the time his call does get through he has sometimes forgotten why he called in the first place.

The working scientist places hundreds and thousands of such calls each year. He would call more often if he did not anticipate, consciously or intuitively, delay and frustration. The net result is that he gives up and only makes a call when he is absolutely desperate. If he can afford the luxury he will turn the job over to someone else—an assistant or a librarian.

Today's system of scientific communication is absolutely chaotic. That we are able to operate with it at all is a tribute to human perseverance. Science communication is still in the pony express era.

At the recent dedication of the new John Crerar Library in Chicago, Dr. J. R. Pierce, of the Bell Telephone Laboratories, discussed "fanatics" who have irresponsibly painted a fanciful picture of the computer in library work. He stated that a "computer which understands spoken English and the relations between words, and translates languages with the facility and economy of humans" is still in the future. I fully agree. The fanatics who have oversold the computer as the electronic brain have correspondingly underestimated the mechanical or nonintellectual aspects of scientific information work. These problems, however, are enormous—and can be solved by existing technology.

The average scientific report represents thousands of dollars of taxpayer money. The cost of making this information readily accessible is infinitesimal compared to its original cost, which is increasing simply because an insufficient percentage of budgeting is devoted to science information and communication. However, as with any other problem, once the problem is identified one must then consider the cost of the solution, if a solution is available, and who will pay for it.

The immediate goal of a National Science Information Center, I believe, should be the compilation, both retrospective and current, of the international "telephone book" of science. This does not mean a telephone directory of scientists, which is also an important need in science communication, but rather it is a true inventory of scientific publication that will enable the scientist to identify and locate documents quickly, with minimum effort, and once identified enabled him, also through a national center or its branches, to obtain needed documents promptly.

If there is any doubt about the chaotic conditions I described above I should like to offer the following suggestion. Let each scientist advise his Congressman of a particular Government report, scientific article, or other publication that he needs during the next year. Let the staff of each Congressman attempt to satisfy each of these document requests within 48 hours. Within a short time the Halls of Congress might reverberate with the howls of anguish, both from Congressmen and from the agencies trying to satisfy the demands of congressional constituents.

Obviously, scientists have not generally made such an attempt to focus attention on the science information problem in this fashion. It might be a salutary development. However, scientists have not always assumed their full responsibilities and obligations concerning scientific documentation in the past. That is why the so-called Weinberg report of the President's Science Advisory Committee is so refreshing, though it doesn't go far enough.

You may hear a great deal said about the changed methods of communicating scientific information. Television, radio, scientific meetings, seminars, etc., are touted as possibly more efficient means of communicating scientific information.

This is somewhat misleading and confuses the problem of educating scientists with the problem of communication of recorded knowledge between scientists. Thousands of scientific meetings are held each year. The cost of these meetings is staggering—as much as \$100 to \$500 million per year. A fraction of these expenditures devoted to the systematic indexing of recorded scientific knowledge would accomplish, I believe, much more. We have lost our respect for the written record, which is not only valuable currently, but also for posterity. Many of the scientific meetings have taken over the proper functions of universities, merely providing postgraduate education. Meetings are only rarely a forum for the exchange of ideas between experts.

Of course, as long as the communication network of science is chaotic individual scientists have no choice. They attend meetings to hear the latest developments. However, the meetings must be organized so far in advance that the research is many months old when it is reported. The multiplicity of specialties with their interdisciplinary overlaps means the same information will be partially repeated at several meetings. Large volumes of proceedings eventually turn up—rarely indexed, frequently passed off as books, simply because they are in hard covers, and so the vicious circle continues.

Much of the redundancy and chaos in science communication could be avoided by an acceleration of the processes involved in science communication, especially the publication of the learned journals. It is not coincidental that the establishment of VINITI, the All Union Institute for Scientific Information in Moscow, came at the same time that Soviet scientists were complaining about inexcusable delays in publication of their research. Among others, an editorial appeared in *Meditsinskiy Rabotnik* on October 18, 1955, which complained bitterly that articles published in 1955 had been contributed in 1952.

Traditionally the professional societies in this country have controlled most learned scientific journals. Lacking the motivations and incentives of free enterprise they have frequently underestimated the gravity of the science information problem. In addition they are jealous of any direct efforts by the Government or private enterprise to solve the problem. They discourage the founding of new journals by entrepreneurs, by withholding the prestige of their moral support, and withhold recognition from reports literature in a similar fashion. Some professional societies are amongst the largest publishers in the world and members sometimes wonder what their true function is. The role of the professional society should be to stimulate the development of needed information services. They should only perform services when other sectors of the economy cannot or will not provide them. Government agencies have tended to identify the scientific community with the professional society—a grave mistake. It is easier to negotiate with the official representatives of these organizations, but they do not necessarily reflect current opinion amongst scientists.

I bring up these issues because you will encounter considerable resistance on the part of these groups to the idea of a national center. However, regardless of the functions of national centers, these groups may justifiably ask—who is going to pay for their services? Shall the Government foot the bill or will it be pay as you go? Just as the present system of communicating scientific information is chaotic, so is the method of its financial support. The inconsistencies are legion. Some scientific journals are supported by advertising, others by subscription, others by page charges to authors, others by Government subsidy, and most by a combination of these factors. Distribution of reprints is variously paid by institutions where the authors work, and these costs inevitably come out of research grant or contract funds. However, if an academic or industrial scientist or engineer wants a research report published by the Government he must frequently pay outrageous prices, even though some other scientist can obtain the same report free of charge because he has a Government contract. Individual Government agencies are inconsistent in their policies. The Public Health Service distributes Cancer Chemotherapy Abstracts free of charge but sells the Journal of the National Cancer Institute by subscription. The National Library of Medicine issues the Index Medicus by subscription but provides free photocopying services to other medical libraries. Subscription prices by indirect subsidies, such as preferential postal rates, research funds, and abstracting charges to authors.

It is my opinion that the individual scientist should make the final decision about such expenditures. As the consumer of scientific information he is best able to judge the services he receives. However, the factors which normally



affect product costs for consumers are complicated by the inconsistencies mentioned above. Several years ago I made the suggestion that the Government would actually save money by providing each scientist with a yearly stipend for the purchase of scientific information services. (See Chemical and Engineering News, May 11, 1959, p. 85.) I would augment that suggestion by adding a stipulation that 5 to 10 percent of each Government grant or contract for research should be a line item for this purpose. Ultimately this would mean that over \$1 billion would be available to scientists for the purpose of scientific communication. The national centers would be able to be self-sustaining or profitable in a reasonable amount of time. The Government might provide initial financing by subsidy or it could be financed in a fashion similar to the satellite communications system.

You should keep in mind that any national document or information center cannot operate effectively until the problems of copyrights are resolved. I suggested a solution to this problem, however, at the same time I discussed the problem of subsidies to subscribers to scientific journals. (See Copyright, Contents Pages, Cooperation, Conscience \* \* \* necessary ingredients for the effective dissemination of scientific information, the Percolator July-August 1959, v. 35, No. 1, pp. 19-23 or Chemical and Engineering News article cited above.) I repeated this suggestion recently at the American University seminar on copyright problems. Librarians and scientists should not have to deal with hundreds of different publishers for photocopying privileges. An organization comparable to ASCAP could be formed to issue royalty coupons which would be used with each photocopy request. However, the problem is not quite so simple as we would like and I suspect that ultimately the Government will have to stipulate that any publication, once it has received author page charges, and especially if the research is Government supported in some manner, should be freely available for research purposes.

In addition to providing scientists with the funds to purchase science information services, we must educate them in their use. This brings up the question of education—not only for professional information scientists, but also for the growing number of laboratory scientists who are devoting a greater percentage of their time to published information. It has been suggested that an annual award be established for the most creative contribution to the field of information science. This is an excellent idea and would create a great deal of interest in the field of information science. Prizes and awards are fine. They give scientific research a great deal of prestige. However, Nobel awards and other prizes are too remote from the young aspiring scientist. Prizes can stimulate or direct his choice of professional field, but there must also be other more direct incentives. Several years ago I tried to interest the Council on Library Resources in a plan that would draw qualified scientists into the field of information science. The council's resources, however, are far from adequate for this type of educational subsidy. We need full-time postgraduate fellowships and undergraduate and graduate scholarships. The fellowships are needed for outstanding scientists who would be paid their regular salaries while attending a 1-year program on information science. Some of these scientists might go on for doctorates in information science. Scholarships are also needed for young people who are making a decision about the special branch of science they will enter.

Finally, fellowships and scholarships are great, but where will the new students of information science receive their training? There are only two institutions that have a program that even begins to approach the curriculum needed for information scientists. Both of them are in Philadelphia. The University of Pennsylvania School of Electrical Engineering has a computer and information sciences curriculum which emphasizes the theoretical side of computer and information sciences. The Drexel Institute of Technology has recently inaugurated a 1-year program in information science, closely associated with the graduate library school—and emphasizes the applied aspects of information science. These programs and others that are developing at Georgia Institute of Technology, are a good start, but most programs are associated with established library schools. Succinctly stated, each major university must establish an information science program which unites all the interdisciplinary facets of the problem—computers, linguistics, philosophy and mathematics, library science, communications, sociology, etc.

None of these problems can be resolved overnight, but I would hope to show in my testimony that there are many practical problems that can be solved now, at a reasonable cost, with a minimum of effort. Whether we accept the challenge of scientific information has far greater implications for the future

security of America, economic and otherwise, than any single scientific program in space, medicine, or atomic energy. In fact the key to the success of all these programs is an integrated, systematic approach to scientific information.

Dr. GARFIELD. The number of areas that I could discuss are legion. Let me begin by discussing the magnitude of the general problem of scientific information. Many of these ideas have been expressed by cliches in the press and scientific journals. However, it is important to mention the exponential growth of the scientific literature. There can be no question about it. Experts may disagree on the slope of the growth curve. However, even if the rate of growth falls off, the absolute growth will continue.

Concomitant with that growth there has been a tremendous growth in the waste, in the lack of utilization of this information. I don't think it is a cliché to repeat that. One could document, separately numerous examples of duplicated research, or rather unknown or unwitting duplication. There are frequently times, in scientific research, when you want duplication but it is a tragedy when you don't know about it.

These duplications affect such things as manpower productivity. I was shown a statement by Dr. Kelsey, which was discussed this morning. I would only disagree with Dr. Kelsey's statement that with better science communication, our productivity might double. I would use a larger multiplier. I have seen some very dramatic examples of how published information can improve research productivity.

Colonel Glenn had a very important point this morning. In spite of the growth of the literature we still need even more information. Sometimes you want some information and you can't find it; you have the darnedest feeling that it is there; it is extremely frustrating not to be able to get at it. So we have these two contradictory facts running in parallel. The fact that we have this wealth of information we are generating and the fact there are thousands of times when we can't find the information that we want—or that it doesn't exist and its nonexistence is difficult to determine quickly.

It has been said by so many people that solutions may be buried in the literature. We sometimes like to talk about it as buried treasure.

Concomitant with all this, we have witnessed in the last 10 years, the growth of a new industry—information technology. While one is justified in talking about an "information crisis," I like to take a little more positive attitude toward the situation. In spite of all the problems, we now are in the "information boom" and we are going through the information revolution.

We have had a number of revolutions in the history of science and this is the new one. An indication of that boom, if I could put it that way, and its relation to overall national knowledge production, is provided by a recent study at Princeton by Professor Machlup which indicated that 25 percent of the gross national product goes into knowledge production. That is an enormous amount of money and effort. And that figure might be low. He had many substantiating statements for that estimate. The percentage which is scientific knowledge production is difficult to single out, but it is a large slice.

Mr. PUOINSKI. You might be interested, Doctor, we had an estimate of scientific development research represent approximately 4 percent of our gross national product, which in itself is a fantastically large figure but it is going to grow even further.

As I stated this morning, it is estimated by the end of this decade, by 1970 we will be spending some \$28 billion in this country on scientific technology and scientific research. This figure becomes particularly staggering when you recall that only 23 years ago in 1940, which is only yesterday, the total Federal budget of the United States was only \$7 billion and that included WPA and a lot of other things. So within 30 years, 1940 to 1970, the expenditures for scientific research will be almost four times as much as the whole Federal budget was. I give you these figures merely to attempt to put into proper perspective the immensity of the problem that we are dealing with.

Dr. GARFIELD. To add to that, there is also evidence that the percentage of those figures that you gave, which contributes to scientific information, is not going to remain and has not been remaining proportional. In other words, if you said we had several million dollars worth of research in 1940, and 1 percent of that was in the scientific information effort, today it is anywhere from 4 to 15 percent, and there is no doubt, in my mind, by 1970, it will be close to 25 percent.

This information revolution is related to the whole changing pattern of scientific research. Scientific information generation is increasingly a larger segment of the total research effort. This has very serious effects on the whole character of conducting research and the type of scientist who performs it. When you talk about a scientist today you are not talking about the same man that you were talking about 10 years ago. As I was telling Congressman Bell, we have large numbers of scientists whom I would personally classify as information scientists. They are not in the laboratory any more. They spend literally 50 to 100 percent of their time doing nothing but processing published information. I distinguish these men from professional information scientists.

Mr. PUCINSKI. As a sidelight I am sure that Congressman Bell and the rest of my committee and our full committee will be particularly interested in this, on the information scientist, because this is a great need, there is a great need in America for information scientists and I have been seriously considering proposing to our committee at the appropriate time that we reflect this need in the National Defense Education Act. Although now, under the present act information scientists, of course, are eligible for loans and assistance. I thought that somewhere along the line in the act we might reemphasize the need for this new category of scientist, the information scientist. You are right, these are the people who now have to be disciplined into translating what is happening in the scientific community for a greater distribution. I presume that is what you mean by information scientist.

Dr. GARFIELD. I fully agree with you about the need for professional information scientists. I am submitting an editorial I wrote last year in which I discussed the changing pattern of the information scientist. What I am trying to say is that the man we ordinarily think of as the pure scientist is becoming an information scientist. At the same time we have people who perform functions not previously identified with the actual laboratory research—librarians, information officers, technical editors, and so forth—who are also coming into the new community of professional information scientists. The

need for those people is as urgent as the need to train pure scientists in the new techniques of information handling.

(The following reprint was submitted by Dr. Garfield:)

[Reprinted from Current Contents, Aug. 14, 1962]

#### THE INFORMATORIUM

Several years ago a colleague commented that very shortly there would only be two kinds of scientists—the laboratory scientist and the information scientist. I don't know whether there is fundamentally much difference between this classification and the older classification of the theoretical and the practical scientist. I believe there is now only one kind of scientist—the information scientist. I also believe there are two types of information scientists—the one who calls himself a laboratory man or a theoretician, and the other who calls himself a professional information scientist.

In many cases, the information scientist may be known by a variety of titles—editors, research directors, or literature scientist. All are quickly coming to the realization, however, that they are intimately concerned with information handling at one or more points in the information processing cycle. Every scientist is a creator, disseminator, consumer, evaluator, retriever, storer, or collector of scientific information. Now that science is creating more information in one decade than it did previously in a century, the consequences of this information explosion are only now slowly being felt. To be an effective and efficient scientist today means, ipso facto, to be an efficient information handler or, at least, an ardent consumer of information in all its forms, published or otherwise.

Occasionally a reader write that he has had it; science information—Current Contents and anything else for that matter—is too much for him. He has decided to throw in the sponge; he has now decided to isolate himself in the quicksand of a few selected journals which he thinks he can at least finish reading. The vast majority fortunately recognize, however, that there is no perfect solution, that each new solution breeds new problems, and each new problem will generate more solutions. There are very few professional information scientists who can operate efficiently without Current Content or its equivalent. If the laboratory scientist will regard himself as a fulltime information scientist, he too will recognize that he cannot operate efficiently without modern information facilities.

EUGENE GARFIELD.

Mr. BELL. Doctor Garfield, at that point is it not true that if we were to develop a more effective mechanism through data processing and other types of machines that we would be gradually eliminating some of the information scientists, would we not? Would that not be a result of the impact of automated type of effort toward gathering information? Of course, there would be plenty of them available but you would be losing some of them on this account because you would be moving them over into the area of discovery and research, would you not?

Dr. GARFIELD. That is right. I think unfortunately, because of what I would call a chaotic condition that exists in the information picture, whatever people we have spend too much of their time on unproductive processing—a sort of semiclerical, routine, or machinable type of activity. This does not permit these people to spend as much time as they ought to on the intellectual or evaluative function of the information production cycle. I could not agree with you more.

It has been my own personal experience that the following inevitably happens. You bring in a person who is supposed to be an evaluator. However, they finally wind up spending 90 percent of their time going through the routine motions of trying to find pieces of information.

Mr. BELL. Doctor, you said in one part of your statement that you want duplication in many cases. I understand that you might go along



with some duplication but could you elaborate on that point? In some cases you said you actually would want duplication, it would be helpful in your effort.

Dr. GARFIELD. I think there has been too much duplication in what I would call the processing end. I think there is justifiable duplication in the evaluation end. Two scientists look at a document and they see something different there and that is a very important part of the scientific research process. So that kind of redundancy, I think you always will have and will need to have. But we do not properly exploit this duplication at present.

Mr. BELL. Doctor Garfield, are you going to make a further statement or do you intend for us to ask questions now?

Dr. GARFIELD. Whenever you wish is all right with me. I just had a few points I thought you might be interested in.

Mr. BELL. I was highly interested in your VINITI lecture. Are you going to be getting into that?

Dr. GARFIELD. Yes, I thought I would mention briefly my experiences in the Soviet Union. I was very glad that you pointed out, Congressman Pucinski, that there are advantages and disadvantages in the way VINITI operates, but the most important point is that the Russians have made up their minds that scientific information is an important area. The great advantage under which VINITI operates is that VINITI has, at its beck and call, as it were, one of the most powerful bodies of the Soviet Union: the Academy of Sciences of the U.S.S.R.

Professor Mikhailov, director of VINITI, is directly in contact with the leadership of the Academy of Science. As such he is representing one of the most powerful groups in the Soviet Union. This means that the highest authorities in the Soviet Government have given top priority to the scientific information problem.

Regardless of what they may or may not be doing now, they definitely are catching up. Unless we do something more drastic than what has been done up to now, they could possibly excel us, and I think that would be dangerous. I felt that way in 1955 and I made public comments to that effect, which I am submitting to you for the record.

Their rate of growth, I think, appears to be greater than ours, particularly in the area of abstracting and certainly even possibly in the total production of scientific information.

Mr. PUCINSKI. I think certainly it should be a source of great concern to the whole scientific community and the whole country that our American scientists frequently have to look to the Soviet abstracts to see what is happening not only in this country in the way of research, but what is happening around the world.

It seems to me this should be our concern. We have had testimony here that would tend to minimize the value of their activity. Since you have been there, Doctor, and you have seen it, I would like to hear your views on this.

Dr. GARFIELD. Certainly it is not the ultimate system but there is no question about it—when you are producing three-quarters of a million abstracts a year you are turning out a tremendous amount of useful information. I don't care what form it is in. We may not agree with

their particular methodologies, it may not be the most up to date, it might be improved in many respects, but it is an enormous amount of information. Anybody can go to the Library of Congress and go through the whole series of reference. You can't help but be impressed. There is no point in carping about the details of how they do it or whether it is indexed or not. The fact is that it is an enormous effort. It is done in spite of the fact, I found, that it frequently took four people over there to do a job that it usually takes one over here, but they are putting people on the job.

Mr. BELL. Is this Viniti in Russia under the control, so far as you can tell of the military or scientific group or civilian group? What is actually the controlling feature of Viniti in Russia?

Dr. GARFIELD. As I said, the control is from the Academy of Sciences of the U.S.S.R.

Mr. BELL. So far as you know this has no particular connection with the military?

Dr. GARFIELD. I have no evidence that the military is directly involved, but I have little doubt that just as many of our scientists advise the military, so do theirs.

Mr. BELL. You do not know, of course, whether or not the military has such an organization of their own separate from Viniti?

Dr. GARFIELD. Well, if we could draw any conclusions about the amount of intelligence work they do you might.

Mr. BELL. I want to ask you one other question. Do you feel that there was some competition in other areas of the Soviet Union with Viniti, itself, or where there was a buildup of other types of organizations doing the same kind of work in other parts of the Soviet Union?

Dr. GARFIELD. There is no question that this is an important point, that Viniti is not the only scientific information activity by a long shot. There are literally hundreds of other specialized centers just as we have in this country, but to my knowledge there is no other comparable organization of such large interdisciplinary scope. Every individual research institute and industry, for example, has a certain amount of scientific information activities going on, particularly in applied research.

Mr. BELL. You don't know whether or not there was any attempt to coordinate the efforts of any of these other groups into Viniti or through Viniti?

Dr. GARFIELD. I know there have appeared criticisms in the Soviet press of a failure to coordinate a lot of their activities. For example, the abstracting work in medical science is still done by the Academy of Medical Sciences. But there have been complaints by Soviet scientists about this fragmentation. So, you see, as big as they get they too have some problems.

Mr. BELL. You did not feel at any time that they were trying to withhold information from you, they were fairly frank about anything you wanted to know? Is that true?

Dr. GARFIELD. Yes.

Mr. BELL. Did you get a feeling there was an attempt to keep information away from you?

Dr. GARFIELD. No, I was not under that impression. They took me through their so-called electro modeling laboratory and various



offices where work was being conducted. But I had no basis for knowing what they did not show me. Many Soviet scientists are reluctant to show you things just because they are not in a finished condition. That may account for reluctance to talk, on some occasions. I did not feel that anything important was being withheld.

MR. PUCINSKI. It is my understanding, Doctor, that the Soviet Institute, VINITI, is supported in the flow of information by some 80 universities in the Soviet Union, some 240 technical institutes, and then some 16,000 various sources of information. I am told that every traveler who leaves the Soviet Union, every Government official, has instructions that as he travels around the world, wherever he happens to go, if he comes across material in a publication, newspaper, convention, speeches, seminars, lectures, that he is to send a copy of that material into the Soviet Institute where the material then is translated, codified, digested, and added to any other material they may have on a given subject? Is my understanding correct as to this tremendous network that is feeding into VINITI?

DR. GARFIELD. Well, I think that up until the present time VINITI has had such a large problem in catching up with the abstracting of the already published literature, that this kind of activity may tend to be exaggerated. Now, that does not mean that other branches of the Government do not do this sort of thing, but I have no basis for speaking on that. It sounds more like an intelligence activity. They do have certain express translation services that are performed at VINITI. A visiting scientist comes back and says he saw a paper by an American that was extremely pertinent to something that they are very vitally interested in. In that case the article would be immediately translated and put into what they call a long digest, something like the Reader's Digest, and that goes into their express service. That is the extent of my knowledge about this. Beyond that, I can't say. There is just so much published literature that I am sure they have enough difficulty keeping up with abstracting. But as far as the universities, that is true.

In Moscow University and in Leningrad, several people told me that they participated in the abstracting work of VINITI.

MR. PUCINSKI. You made an interesting statement here that it took the Soviets all this time, this VINITI Institute was established in 1952, it took them all this time and they are still catching up with the published works that have been published over the last few decades. Do you feel that there is a need, for us to attempt a similar centralization of all this material made available? On the basis of your experience at VINITI, what you have seen there, do you think this country would be wise in setting up a similar operation?

DR. GARFIELD. I would like to answer the question by saying that, regardless of what the Russians do, I have always believed this. I believed in it years ago, and this is why I am very happy to learn of the work of this committee. There is no doubt in my mind that we have to have some kind of centralized coordination and large-scale operation. For this reason I am submitting for the record an item which appeared in Chemical Engineering News 7 years ago.

(The above mentioned item follows:)

[Reprinted from Chemical Engineering News, Jan. 30, 1956, p. 514]

**NEEDED: A DOCUMENTATION CENTER—ORGANIZING THE VOLUMINOUS SCIENTIFIC INFORMATION IN THE UNITED STATES CAN PRODUCE NEW AND VITAL DATA**

"It's ironical that we support establishment of national documentation centers in countries like India and Mexico, yet ignore our own national documentation needs," says Eugene Garfield, documentation consultant. Even the Soviets have an equivalent organization, he stated at a recent American Association for the Advancement of Science meeting.

"We must recognize our own needs—a National Science Intelligence and Documentation Center," asserted Garfield. The National Science Foundation does perform a few functions of such a center, but it is essentially a Government counterpart of other philanthropic foundations that encourage and support scientific research. NSF has no centralized documentation apparatus, he said.

"Beyond this important question of establishing the center, there are specific problems it can attack," says Garfield. These include:

- Coordinating existing indexing and abstracting services and filling gaps left by fragmentary speciality documentation.

- Issuing comprehensive indexes, encyclopedias, handbooks, and other compendiums to span artificial boundaries of specialization.

- Applied research in science linguistics, terminology, and nomenclature.

- Basic research in new documentation techniques—mechanical and otherwise.

- Promoting establishment of a graduate curriculum in science documentation.

**Problems.**—"To the layman and to the average scientist 'documentation' still denotes the usually unpleasant task of providing bibliographical sources," says Garfield. But a conscientious author, having past benefits of effective documentation, will provide an exhaustive bibliography. He knows poor documentation will limit his work's value, so he is conscious of his momentary role as a documentalist.

"Yet documentation now means more than just preparing a bibliography; it covers anything involved in creating and use of documents," points out Garfield. Writing and publishing a paper, analyzing, indexing, storing, copying, retrieving the paper, and using and evaluating data contained in the paper are all part of documentation. Thus, a name should mean all these things.

Furthermore, documentation has something to do with library science, but no one knows exactly the relationship. Documentation, like librarianship, suffers from its own poor public relations work. Very few of those who stand to gain most from documentation know what it can do or has done. Until those people appreciate documentation's potential, financial support for its development will obviously be lacking.

"In a highly competitive world, the quality of documentation available to industrial managers, scholars, and scientists," continues Garfield, "can make the difference between success or failure." Science depends as much as business management upon rapid retrieval of complete data to achieve expected results in time. Thus, documentation is the forerunner of intelligence—a word while receiving wide acceptance, connotes cloak-and-dagger work. In actual practice, 90 percent of Government intelligence work consists of painstaking collection, organization, and analysis of masses of old and new information—most of it originally available to anyone.

**Spies lack Ph. D.**—This point was borne out by recently concluded reviews of foreign scientific progress. Samuel A. Goudsmit, chairman of the physics department at Brookhaven National Laboratory, investigated why the Germans did not achieve the atomic bomb during World War II. Comments Goudsmit: "There are no Mata Haris with doctors' degrees in physics or chemistry. Scientific knowledge cannot be transmitted via laymen."

"The purpose of scientific intelligence is to estimate whether a country's scientists and laboratories will make a significant contribution in case of war. Such an evaluation requires an insight not merely in science, but in economic,

political, and historical questions. It can be achieved only through the cooperation of many competent specialists. The sources of information are usually openly available but visible only to those who are aware of the intelligence problems.

"The evaluation of technical and scientific progress is rather straightforward. More difficult and at least equally important is to reach an opinion about the mutual influence between scientists and governments. Under Hitler and Peron and from time to time in the U.S.S.R., pseudoscientists were the principal advisers to the authorities which of course had detrimental effects upon progress."

*We must start.*—"Our own Government in creating the Central Intelligence Agency took a step whose counterpart must be found for science," says Garfield. The CIA's scope is totality of information pertinent to the Nation's safety and progress. The time has come for an analogous scientific body.

Problems of financial support and manpower are considerable, but they are by no means insoluble. He pointed to the existence of chemical abstracts, excerpta medica, biological abstracts, and many others which prove that money and manpower are not insuperable obstacles. Inertia and intellect are the real problems.

But some positive signs appear that documentation activities are increasing. There is a growing acceptance among scientists that benefits derive from good documentation, and that the literature is more than something used for general inspiration—it is a tool to obtain information just as one performs experiments. Administrators also recognize these activities as being as valuable as lab work.

"Now," concludes Garfield, "a concerted effort is needed to gain maximum benefit from increased documentation activities." Methodology which elevated science to its present status must be applied to documentation. The way to do this is with a coordinating organization—the documentation center.

Mr. PUCINSKI. Yesterday we had testimony from one of the gentlemen who is probably in as important a spot as anybody in this country in this whole problem of assembling information. Admiral Martell. He is Chairman of the Committee on Scientific Information, Federal Council on Science and Technology. That is a most responsible position. Yet Admiral Martell said we could go with index cards and he is perfectly satisfied to think in terms of resolving the whole problem of codifying and coordinating this gigantic flow of scientific information in terms of index cards. I believe I am quoting him correctly, when I recall that he said yesterday that he thought they could do this index cards pretty much.

Mr. BRADEMAS. I am always reluctant to say yes or no when I can't see the context of a statement, Mr. Chairman. But press ahead with your point anyway.

Mr. PUCINSKI. The record will speak for itself. This is why I want to get your reaction and your appraisal of the job ahead. You say that you have been for a central system for some time.

To what extent do the Soviets use hardware computers, mechanization, in their Viniti operation? You were there in 1955.

Dr. GARFIELD. 1961.

Mr. PUCINSKI. That is very recent.

Dr. GARFIELD. There are several areas where you can discuss the use of hardware. One is in the general preparation and organization, printing, what have you, of the various abstracts that are prepared. The Soviet Union is very much interested in mechanized methods of preparing printed publications just as we are. On the other hand there is the problem of mechanized search which is another aspect of the information problem. They have a large scale research activity on the potential use of computers and other types of electronic devices for retrieval.

When I was there maybe there were things they did not show me, but they did show me experimental equipment for searching chemical compounds by various logical devices. Whether they have them now or not, I don't think really matters too much, because they are going to have them very soon, if they don't have them now.

Mr. PUCINSKI. I asked that question merely to bring you to an evaluation of our own problems. Do you feel that we are going to have to develop the hardware here? I am sure you are aware of the work that is now being done to develop equipment capable of doing the job that you describe. Would you give us the evaluation of where do you think we are at this point in the hardware problem?

Dr. GARFIELD. I think that we should never underestimate the power of the index card because you can provide a tremendous service by so-called conventional means. However, those of us who have been trying to push for machine methods for many years feel that the potential of these devices just has not been exploited mainly because the money was not there to do it. The technology is. There already exists a tremendous capability in this field. I am sure that with the proper support more special purpose devices will be forthcoming. So there is little doubt in my mind that computers can be used. We are using them right now.

Mr. PUCINSKI. I have nothing against index cards either. I think I make wide use of them and I think we all do. The Library of Congress, for instance, has a magnificent referral service based on index cards. The Library is trying to mechanize that operation. So that this is not a vendetta against index cards. But I wonder if you could perhaps give our committee a little better idea of the limitations that are being experienced now in this field of processing and retrieval within the scope of our present methods and our present equipment.

Dr. GARFIELD. If I interpret the question properly, it is mainly lack of financial support to apply what we already know. Given financial support there is a great deal that can be done with existing equipment. Obviously there are many new devices that have to be developed to make a marriage, so to speak, of the old methods with the new. The capabilities are enormous. We just are not using them. Have I answered your question?

Mr. PUCINSKI. Yes.

Thank you.

Dr. GARFIELD. There is no question about it. In fact, because of this new information revolution, we are capable today of generating new scientific information, by using new devices and systems, hardware and software, that will enable the modern scientist to make fantastic advances on his own. An individual scientist is capable today of making advances that would have taken scientists in previous generations 20 or 30 years. This is why I refer to the changing character of scientific research.

Since this centralized facility is not available, a tremendous amount of frustration exists amongst many scientists. They throw their hands up and they say, "I am just not going to use the literature." This inevitably leads to waste of scientific talent because of the inevitable duplication.

Mr. PUCINSKI. Doctor, at the outset of our hearings last month Dr. Adkinson from the Office of Scientific Information Services, an

agency that was created by the National Defense Education Act, and there is a proposal before this committee to broaden that agency's scope—but Dr. Adkinson testified they are now publishing a tremendous amount of coordinated information in terms of abstracts and titles, which he thought was doing a reasonably good job.

Would you care to venture an evaluation of that particular aspect and do you have any recommendations on how that could be improved if improvement is needed in order?

Dr. GARFIELD. I don't think I will comment directly on Dr. Adkinson's remarks since I did not read them. He is an old colleague of mine. I think the situation may be described this way. There are in this country many useful information services. There are many useful publications, no question about it. We still produce a very substantial percentage of the world output of scientific information. In a certain sense we are spoiled by that. But there is considerable chaos which results from an overabundance of overlapping, conflicting services, which leads to the frustration I described. People begin to throw their hands up. There are too many of these services and it seems hopeless to some.

If the coordination exists it is not apparent to me.

Mr. PUCINSKI. Proceed, Doctor.

Dr. GARFIELD. We are now getting to the crux of this problem. To me it is not only the physical realization of a national science information center which we have to discuss, but also the concept, because the concept is related to the change in the character of scientific research—to the problem of the multidisciplinary and interdisciplinary nature of research. There is not a scientist that I know today who does not find himself using dozens of different sources of information, channels of information, if you will, in order to satisfy his information requirements. It is this problem, interdisciplinary research, in which I am especially interested because this research covers the well springs, the future of man.

Any specific area in technology, while it is very important, is not of greatest concern to me; but rather the man who is working in the interdisciplinary field will produce the idea that leads to a transistor, a polio vaccine, et cetera. That is why we need a highly coordinated, centralized approach. It is not merely a question of doing a good job for chemistry, physics, biology, or engineering.

Mr. PUCINSKI. That is exactly the point I would like to see you develop and expand on. The proposal which has been made here, and we discussed this backward and forward, and the heart of the proposal for a national retrieval center, is not one that would bring under one roof all the scientists all over America and all of the information scientists and all the translators and all these people.

As I have said repeatedly it would be absolutely impossible to be able to attract that kind of talent to one community for various reasons, either because of climatic conditions, some people like to live in the deserts of Phoenix, Ariz., some in the mild climate of California, other in the wintery and windy climate of Chicago.

So we have said repeatedly we are not attempting to try to put under one tent this fantastic scientific capability. But what we do want is to develop a system, and I think Doctor Touloukian mentioned this yesterday, a national system that is going to have a nerve



center, a command post, through which will flow the exchange of all of this information to see how, for instance, discoveries made in the biochemical field might apply conceivably to the thermophysical field. I don't know that they do, I am not a scientist, but it would seem to me from testimony before this committee that there is a direct relationship in the scientific field that today is being generated in these various research centers.

Yesterday, for instance, Doctor Touloukian told us about the work of the thermal physical properties research center at Purdue University. They are undoubtedly doing a great job, Doctor, at least I was impressed with his testimony. I would like to have the information he developed down there for the specific field of thermal physics; let them continue in their particular field, but make that information also available through this Center to all the other scientists who are probing various other aspects of the scientific community.

Now, I wonder, I think you have really put your finger on this. I wonder if this is a concept which in your judgment would serve the best interest of America.

Dr. GARFIELD. I am surprised that anybody discusses any more whether science is interdisciplinary. If you want I will be glad to submit for the record literally dozens of examples. I can demonstrate the relationship between dairy science and the work of Albert Einstein. This may be incredible, but we encounter this type of relationship every day. That is why I use the expression "it is a truism" when talking about the interdisciplinary nature of research. It is a constant source of amazement that people dispute this.

Mr. BRADEMAS. Allow me to say, first of all, Doctor Garfield, I am very sorry to have been delayed in coming but when constituents call, every Congressman is his own data processing and information retrieval center, and he cannot turn to any electronic system for help.

You said a moment ago, in response to Mr. Pucinski's question, that you find it difficult to understand why there is any necessity of discussing the value of interdisciplinary research and that its value is a truism. But we in Congress deal with truisms. It ought to be obvious to everybody, for example, there are too many people dropping out of high school, and that they ought to stay in high school longer and that if they don't get a good education they will be out of work. In spite of that truism there will be millions of young people who leave high school and go out without an adequate education, and their names will be added to the unemployment rolls in the country. Yet here in Washington we have a very hard time passing legislation to do anything about it, truism or no truism.

So, while I appreciate what you as a scientist have said, let me assure you that nothing that you have said, or seems obvious to you, is irrelevant to the kind of problem that we are tackling. I don't think you quarrel with that proposition.

I was very much interested in what the chairman just said in referring to the use of the word "system" by Doctor Touloukian of Purdue during our testimony yesterday, because that phrase "system" seems to me to be on all fours with the phrase you used here just a minute ago, namely, concept. I think you made the point that it was not so much the question of the physical embodiment of the data center, let us say, but rather the concept of being able to bring together infor-



mation that is the result of research in many disciplines. I think you went on to use the words, "what we need is the right approach, we need a coordinated centralized approach." Mr. Pucinski also made the point that we are not at all seeking to bring together scientists and other researchers under one roof. Yesterday Doctor Touloukian expressed a certain amount of concern in that regard because he made the point that as an operating scientist he felt it important that the operating scientists do some of their own data processing and information retrieval and that their lives should not be lived apart from the documentary scientists.

I am having a hard time, in view of all of these comments from the various experts, I am having a little difficulty in understanding exactly what it is we are hoping to come up with here in the final analysis. Is it a physical embodiment? Is it a somewhat different kind of system, concept, approach? Having said all that, let me ask if you would spell out as clearly as you can, and I am sure it will be very clearly, exactly what it is you think we need to do to meet the problem.

I think what has to be done is manifold. I like to think that one can begin modestly and aspire to great things. But let me give you an example of a situation which I consider to be appalling. I happen to have the pleasure of being associated with Dr. Harold Urey. Recently I was doing some bibliographic research work for him. It was distressing to me that there is no single source, to which anyone could turn, so that in any reasonable length of time, one could determine the publications authored by this man in his lifetime.

Now, I think it is a disgrace, that it should have to be literally a work of fantastic labor by trained librarians, to turn up merely—not some other more complex information I could mention—but merely a list of the publications of our Nobel Prize winners.

MR. BRADEMA'S. Let me interrupt at that point to ask an uninformed layman's question.

Why is it a Member of Congress could not write over to the Legislative Reference Service of the Library of Congress and say, please send me a list of all the publications by Dr. Harold C. Urey.

DR. GARFIELD. You could, and the work could be accomplished with a reasonable, but never with a complete degree of certainty, because, particularly in his case, Dr. Urey has published in so many interdisciplinary areas as for example "The Origin of Life on Earth." I did not say it is a job that can't be done, with a reasonable degree of assurance, but it is extremely expensive. The people at the Library of Congress would have to go through literally dozens and dozens of sources to find out what has been published and never be quite certain of the result. I am acutely conscious of this kind of thing. Many scientists know about certain reference files which we maintain in our organization. I frequently get emergency calls. And this is just the simplest level of bibliographic problem, what I would call the problem of maintaining an international inventory of scientific publications. It just does not exist. And I don't just mean a list of scientific journals.

If you do not even have the raw guts of an inventory control for your business, you just don't have a business. And we are not in business, as far as I am concerned, until we have a basic inventory of

scientific publications. We don't even know all the scientific journals, no less the individual articles that are published. We hear all kinds of unsubstantiated statements about the magnitude, the number of journals, the number of articles.

I have worked on this problem most of my professional life. There have been many studies but we still don't have any definite answers because there is a lack of an integrated interdisciplinary approach. Even the studies lack this approach.

MR. BRADEMAs. Let me, if I may, bring our conversation back to the original question on which you were commenting. What is it that we need to do? You were saying, I believe, and gave this as one example, that we need to attack it in several ways. Is that correct?

DR. GARFIELD. Well, I was trying to say that we should establish a definite objective, among others, to obtain a complete inventory of scientific publications throughout the world. That is a very pressing problem. I mentioned the case of the author index. It sounds trivial, but it is an important thing because in science an author is a subject. Similarly, we ought to have a minimum of subject indexing by conventional and/or automatic methods. For example, as a starting point, I could give you a list of a thousand publications which certainly produce 50 to 90 percent of the really germinal ideas in science. We don't even have a complete cataloging of this basic list of journals.

MR. BRADEMAs. How do you envisage that we could achieve these goals?

DR. GARFIELD. If the Government makes up its mind that it is the Government's responsibility to get this done, numerous mechanisms within the Government or outside will get this accomplished. To perform this task is not inherently difficult, if we make up our minds to do it—to spend the money. The people are available.

MR. BRADEMAs. Let me press you a little bit further if you don't mind. Let us say we get the money, then what would you do?

You see, the reason I press you on this, I feel that to some extent we have been playing with cotton candy in our hearings. It is a little bit difficult for me, we are talking about a center or system or a concept or approach and we have to write a bill that calls for the expenditure of public moneys. I would like to know what it is we are being asked to spend the money on. I would like to know what you would urge that we spend the money on.

DR. GARFIELD. It is a little difficult for me to comment on this. A number of years ago, after crying in the wilderness about this problem, we decided to stop complaining—and we decided, at the Institute of Scientific Information, let's try to do this ourselves. Our publications and projects reflect this. I would hope that the Government would take on the responsibility to do the job with much greater scope than we have been able to do. How do you do it? The job is not that difficult to do. That is what I was trying to say before. The mechanisms are available, the techniques are available. I can spell out for you, if you want, the kind of services that could be done. For example, we are engaged right now in certain studies which will help identify the gaps in abstracting in this country. All these things can be done. To maintain an inventory you have to have people who take the inventory. That means, in this business, cata-

logers, information scientists, and others working full time in acquiring the publications and processing them. Then the information can be put on so-called common language tapes for use by all sorts of agencies in the Government and outside the Government.

There is no central source, today, for example, where tapes are produced that can be used by all who desire them, for the simple job of bibliographic citation.

Mr. BRADEMAs. To be more specific we need more trained manpower who are experts in this particular field who are information scientists and technicians. That would be one thing, I take it.

Now, what I am trying to get at is whether or not you think we would need to establish a center someplace that would be the main receiving center for such information, or if you are suggesting that if we have the manpower we need to funnel them out across the country. I am just trying to get some picture of what you are advocating in somewhat more specific language. You have used the word coordination. The chairman has spoken eloquently of coordination as a key word in our discussions. Will you spell that out a little bit more? I am sorry to press you so specifically.

Mr. BELL. Would you also spell out specifically in what areas we are able to proceed in a mechanized fashion and what area we are not. Are you thinking primarily mechanically, manually or are you thinking of the substantial amount of use of computers and so on?

Dr. GARFIELD. Yes; I think ultimately much of it can be mechanical. You know it is difficult for me to say how fast you would push ahead. I can also make a very specific statement. In every leading city in this country there ought to be a complete, single collection or depository of every leading scientific publication. It just does not exist. I could give you countless experiences of frustration on this problem. Even in the city of Washington you can't easily find in a single library, every leading scientific publication in the world, no less any publication. Some are at the Library of Congress, others at Agriculture, others at HEW, and so forth.

Mr. BRADEMAs. Aren't there very sensible reasons that that is the case, one of these reasons being money?

Dr. GARFIELD. No, sir.

Mr. BRADEMAs. I know that a lot of universities find that the cost of keeping up with scientific publications that come out in such abundance is a very grave problem.

Dr. GARFIELD. I can't agree with you there, although certainly there are specific cases of universities I could name where that would be true. But I think it gets back to this interdisciplinary concept. There are a lot of universities which have a departmental, fragment approach, and wind up not having a complete collection of scientific publications covering the complete spectrum of science. Similarly, in the public libraries in big cities and Government libraries, nobody has the specific responsibility for maintaining a single collection where a scientist can turn to find any particular scientific document he needs—promptly. Timing is quite crucial. People in Government only understand timeliness when they get a call from the Hill.

Mr. BRADEMAS. What you say astonishes me. It astonishes me not so much that you make the point that these collections don't exist but rather, to be quite candid, that you should suggest that they should be in all the major cities of the country. I would hope, maybe we are not really disagreeing here, that such complete collections of scientific literature would be available in university communities, and in most of the major cities I suppose we do have great universities. But I am impressed by the fact that in the southern part of the United States for example, they have been so concerned about the prohibitive cost of each university trying to maintain a complete library that—I think it is the Southern Regional Education Board, or some such group of southern universities—has banded together to try to figure out which university can specialize in what field and which university can specialize in another, so that none of the universities has to be burdened with maintaining a complete collection. I thought it was in the field of sciences that they found the burden most onerous.

Dr. GARFIELD. That surprises me because I would have agreed with you 100 percent on the problem of maintaining collections in the social sciences and humanities, because you are dealing there primarily with monographic book material. In the sciences you are dealing primarily, but not exclusively, with the scientific journals. It is not out of reach of the budgets of a large university to maintain a complete collection, for example, of the thousand publications I mentioned;

When I started my testimony I said that the scientific information problem is an enormous problem. At the same time, I would point out, there are an awful lot of people who, in many respects, tend to exaggerate the problem. If you start out with a simple objective, you can provide a tremendous service for scientists. By saying, this is where we will begin—and from this day forward you can promptly obtain locally any copy of any publication on this list, which represents 75 to 90 percent of the significant publications in science, the remainder can be obtained, equally fast from a national center.

This coordinating center can see to it that every major research center has the basic corpus. The rarely called for items are then maintained elsewhere—preferably in one or a few key centers. This is the so-called core library philosophy.

Mr. BRADEMAS. You are the expert in this field, I certainly am not. I can't quarrel with you on those facts.

Mr. PUCINSKI. My colleague from Indiana has raised a point that we are going to have to face up to sooner or later. Dr. Kelsey spoke yesterday about the tremendous cost of abstracting services to get a complete picture. I believe he used the figure \$60 million. Now, I think our concept of a university library as we have grown up to understand it, is very rapidly going to be completely obsolete. I don't think there is an institution in the world, I don't know of any university, that could possibly afford to maintain a complete library of scientific information that may or may not be of value to its scholars. It is for this reason that H.R. 1946, House Resolution 1946, the bill before this committee, envisages the establishment of a National

Data Processing and Information Retrieval Center which would be connected by facsimile, teletype machine, perhaps even closed-circuit TV, and which would be available to every university, every industry, whoever is pursuing research scientific pursuits.

So that from this Center the individual and this library could get the world's knowledge on any given subjects. That does not necessarily mean that the Center itself would possess this information but the Center would know where this information is and it is entirely possible that Dr. Touloukian down at Purdue University may have a tremendous wealth of research data on terminal physical qualities. Dr. Jones at Michigan University has a problem. By going through the clearinghouse that we are talking about here, a National Center, Dr. Jones could have made available to him very quickly the information that Dr. Touloukian has at Purdue, the information he may have at Hopkins, the information he may have at MIT, because all of this would be tied together by computers at this National Center. Isn't this what we are talking about, Doctor? In your judgment is this concept practical? Practical or is it desirable?

Dr. GARFIELD. I have been discussing the simple problem of document identification and location—document retrieval. This is sometimes easily confused with the problem of getting information—information retrieval. The concept of an information center which goes beyond providing documents and gets into the area of information retrieval would be in the next stage. I am not saying that this ought not to be done. I am simply saying you could not possibly do it until you lick all these other problems of document storage and retrieval and inventory.

I should also bring up the question of the facsimile transmission. You have to also educate scientists, among others, to be willing to pay for the cost of facsimile transmission.

Mr. PUCINSKI. That is right. And Dr. Touloukian mentioned that yesterday. Mr. Davis, the editor of Science News, lamented the fact that there are scientists dealing with these very serious problems who will apparently not pick up the telephone and call for information but will use a letter when it will take 2 or 3 days for a letter to get through. What I want to find out from you is in line with the questions raised by Mr. Brademas, so that we understand what we are talking about, Mr. Brademas asked if you could volunteer some suggestions on what is it we are talking about, what is it we want to do? I think what we would like to get clearly established here is your appraisal of the proposal to establish a Data Processing and Information Retrieval Center which would really serve as the nerve center, command post, which would be the place from which would stem the system of coordinating the collection of information so that we would have in one place in this country an opportunity to get answers to questions that today people apparently can't get. This is what I would like to find out from you, Doctor, if on the basis of your judgment this is a practical approach.

Dr. GARFIELD. I have said that I think we need a national center. I have indicated certain practical problems associated with not having the center. I will be glad to submit ways and means that certain specific task could be accomplished. I don't want to get into details of how you compile this inventory, how you see to it that the publications are available, whether by facsimile or otherwise.



Mr. PUCINSKI. I might add here, Doctor, and I would like to get your view on this, I recently proposed that we establish an annual award similar to the Enrico Fermi Award, to be known as the Vannevar Bush Award, the National Science Foundation, to make an award of \$50,000 annually to the scientist, institution, or agency or whoever makes the most significant contribution for that year in the whole retrieval process.

Now, the reason for that suggestion is because I am aware that at this state of the art there are still vast limitations in this whole field of data processing and information retrieval and I would like you, if you would be good enough, to comment on whether or not there are limitations. Am I correct in assuming that there are limitations? But the fact that there are limitations does not mean that we have to sit back and wait until all the limitations have been removed, as Dr. Kelsey very properly pointed out yesterday. What are your views on this?

Dr. GARFIELD. There is no question about it. You don't have to have all the answers in order to begin work on a solution. I certainly don't know all the answers and I don't think anybody does. The nature of the information problem is such that each new set of solutions generates a new set of problems. Information is a kind of vicious circle where each added degree of sophistication introduces a new problem—a new challenge if you will—because human knowledge feeds on what has gone before.

The fact is that the scientist today, with the simultaneous plethora and dearth of information available to him, present a situation which requires new approaches. I don't think they necessarily will be hardware. The breakthroughs may be in systems—software. We need new solutions but we have many approaches which can be used right now if we adopt this basic interdisciplinary concept. Unconsciously many scientists and other people have objected to approaching science in a big way. They identify big science with denial of their freedom. For some it is the protection of vested interests.

Mr. PUCINSKI. I have been trying to figure out why, as you say, yourself, this whole thing is a truism, there should not be debate, yet there is debate obviously. The testimony we have had before this committee indicates that perhaps we are not ready yet to adopt the concept incorporated in H.R. 1946. So I am trying to determine why would there be any opposition to this concept? And I am wondering, would you care to venture a guess? If there is any opposition, could this opposition be based on the fear of various people who have various segments of this whole problem today, a fear that they might be put out of existence, that they might be driven out of business. For instance, I recently received a query from the people who operate Documentation, Inc., over here in Bethesda. I think you are familiar with it. They asked me was it my thought that the private sector could not do this job, that it would have to be done by the Government. From that inquiry I gathered a concern that if H.R. 1946 were adopted that perhaps they might be put out of business. Of course, I would say that such a fear is completely unfounded. I am sure that Documentation, Inc., is going to be doing some specific work for NASA in the space program. NASA happens to feel that Documentation, Inc., is the best way of retrieving all the



information related to the space program and if this is NASA's judgment it is a perfectly sound judgment.

What I am trying to do with H.R. 1946 is to take the information, incidentally, all unclassified, that Documentation, Inc., develops and forward it to its client, NASA, of course, but also make that information available to the National Retrieval Center so that the Center can then tie in this information with the whole spectrum of the scientific community.

So we are trying to assure these people, Johns Hopkins University right now gets a big grant to translate Soviet technical journals and so there may be a fear among some people at Johns Hopkins that if H.R. 1946 is adopted we are going to lose this work, we are going to lose this grant, we are going to lose these linguists. I think that is a fear unfounded. What we want, if Hopkins can do this work better than anybody else, we want it to stay there, obviously. But with reference to the finished product, I don't know now what they do with it. What we would like Hopkins to do with it is to give a copy of the finished product to the National Retrieval Center so that it can be fed into the nationwide system of information dissemination. This is what we are talking about. Don't you think that this opposition stems from a natural desire for survival, of fear of destruction? Would there be any merit to that?

Dr. GARFIELD. I think that any new proposal will have some opposition because of that kind of fear. The centralized approach of the Library of Congress in dealing with the cataloging problem was feared by many librarians. Yet this has been a great boon to library practice. During the last 30 or 40 years small libraries have prospered as a result. A lot of people do have subconscious fears, but they are certainly unfounded fears. The National Center would actually foster and promote the increased prosperity of the other individual operations in the information industry.

Mr. PUCINSKI. That is exactly what I said yesterday in my opening statement that actually this National Retrieval Center would be a boon to the individual efforts throughout the country because the finished product of their effort would find someplace to go. I am trying to stress as strongly as I know how that H.R. 1946 is designed to complement their activity, not to substitute for their activity. Do you feel that if we did have this National Center, as you and I have discussed it today, and the rest of the members, that we would indeed be able to set up a network of information exchange?

Dr. GARFIELD. There is no doubt about it. The way in which you describe it may not be exactly the same. I could visualize the National Center dishing out to NASA rather than the reverse, but I don't think that matters now.

Mr. PUCINSKI. On that point, of course, it is a two-way street.

Dr. GARFIELD. Right.

Mr. PUCINSKI. Johns Hopkins feeds the Center but conversely the Center may make the material available to Documentation, Inc., material that Documentation, Inc., does not readily have. I agree with your statement, you made it at the very outset here, I just seem to feel that we can't delay this effort any longer. We are far behind now. Your observations on VINITI are particularly interesting.

Mr. BRADEMAN. On the matter of VINITI, you have been there and lectured there, I understand. Just a few quick questions. How many people do they employ at that Center?

Dr. GARFIELD. When I was there I was led to believe there were 2,000 full-time employees and anywhere from 10,000 to 20,000 people in the universities and industry who participated in the abstracting work on a part-time basis. But there were only several hundred people in evidence at my lecture.

Mr. BRADEMAN. I have been told by someone who visited VINITI that he was surprised to find as much manual effort went into the operation as it did. He had anticipated a good deal more emphasis on electronic equipment there. Do you have any comment on that?

Dr. GARFIELD. I think it ties in with the question of their catching up. They had to start from scratch. They have so to speak crawled a little, now they are learning to walk. They are bound to soon learn to run. The concept again is the important thing. It is not the particular mechanic which you use to carry it out. It does not matter whether you use an army of clerks with file cards or whether you use a couple of programmers and a computer. You can achieve the same objective.

In the Soviet Union people are apparently very easy to obtain. They have four or five people doing the job of one. So it was interesting, but not entirely surprising, to find that they had so many people doing this kind of work. But they are using the computers for more sophisticated types of activity. When you talk about machine methods in this business there is a lot of confusion. For example, printing is usually a very integral part of any abstracting center's work. Mechanical and automatic methods of photocomposition are frequently the "mechanized" activities that we really are talking about when we talk about computers in documentation.

Now, the digital computer is gradually merging with and playing its role in that automatic printing process. I think again there is frequently confusion of terminology. Of course, the Soviet Union is one of the largest producers of publications in the world. They certainly are not strangers to photocomposition methods. They were vitally interested, for example, in the systems presently being used by the National Library of Medicine here, and asked all kinds of questions about the system I had designed for NLM as a consultant. It was obvious that they had intentions of approaching the same problem in a similar way. They asked very sophisticated questions. That is the clue. There was not a paper in the American documentation journals that I would refer to, except those that were only a few months old, that their documentation people did not know about. That is one thing I can say. They are thoroughly checked out on the American documentation literature.

Mr. BRADEMAN. This is true in the field of scientific and technical literature, I take it. I remember when some of us were in Russia a couple of years ago, when we sat down with the deans of the University of Kiev and asked if they had American journals in the libraries, they said, of course. I said, do you have our most famous national newspaper, the New York Times? This is the fourth, I think, largest university in the Soviet Union. They said they were sure they had the

New York Times. I said, "Let us go see." We went over to the library and they went through the stacks in a great hurry. They came out with, as I recall, the proceedings of the American Physical Society and some late issues of our chemical abstracts, as I recall, and several other scientific journals, but not a single issue of the powerful New York Times was to be found. So while the Russians were very strong in seeking to glean from us what they could on the scientific and technical side, they had no publications of any significance on what had to do with our political or economic or social values. I cite this anecdote only as an indication of the great emphasis the Russians give to science and scientific information.

Mr. PUCINSKI. You will remember, this morning Colonel Glenn pointed out the fact he thinks this Information Retrieval Center ought to not only confine itself to the scientific community but also the humanities. I was very happy to hear him say that. Apropos to what you are saying here, I think perhaps one of the strongest arguments that will be made for the establishment of a scientific data processing information retrieval center is so that this center is going to perform the scientific role of this country, not the Library of Congress. I think it is going to be one of the greatest tragedies in history if we become so obsessed with the scientific efforts of America that we burden the Library of Congress, which today is the world's greatest storehouse of knowledge in the humanities, with responsibilities in serving the scientific community to the extent that they start phasing out the interest in humanities. I think the same tragedy will happen as happens in an American university if we impose on them the burden of serving the scientific community to the extent that the humanities are neglected. A democracy cannot survive. Certainly they can go ahead and have a scientifically oriented community in the Soviet Union because there is always the deemphasis of the humanities, but I don't think in a democratic atmosphere such as we have in this country that we can ever sublimate the humanities to a secondary role and put all of our emphasis on the scientific community. I think that very thing is happening in America. I had had professors at the University of Chicago indicate a very serious situation developed simply because some of the professors there began to feel very strongly that there was too much emphasis being placed on scientific aspects and not enough on humanities.

I think you are seeing this in universities all over America today. For that reason I was very happy to hear Mr. Brademas make the observation about the Soviet Union. I want us to excel in science but I want us to excel in science not at the cost of excelling in humanities. Would you care to comment on that?

Dr. GARFIELD. I would say that we at the Institute for Scientific Information have always felt, and I personally have always felt, that there cannot be a separation of the behavioral or the social sciences and the physical and applied sciences. Our first effort was in this area, social sciences, and it was distressing to us to discontinue that service last year because it lacked support.

Scientists themselves, interestingly enough, recognize that the behavioral sciences is a new, untouched, so to speak, area for the application of the scientific method, if you will. There is an increasing amount of interdisciplinary research which involves the behavioral

sciences. Information science has also increased the need for studies in psychology, communication, linguistics, and sociology. So your comments are extremely well taken. I think that this national center would have to include many leading publications in the social and behavioral sciences—no question about it. The Library of Congress might stress the history and sociology of science.

Mr. PUCINSKI. Doctor, I think you have a pretty good idea of some of the questions that are of interest and concern to the committee. I am hoping that as we proceed with these hearings we will get some of these questions answered, but I am looking forward to the supplemental material which you are going to present to the committee which I hope will perhaps reflect your views on some of the questions that have been asked of the committee. I am extremely grateful to you for taking the time to present your statement.

I think you have made a great contribution to this committee. Certainly as an information scientist you have a right to express yourself here in the record. Your background certainly reflects that you are qualified to make observations in this field and it is this kind of information that I hope is going to help this committee make a right decision.

We do hope you will send us the supplemental material as quickly as possibly. I would like to call the committee's attention to the fact that we are very privileged to have in the audience Dr. Ralph Lapp, who is a former member of the Atomic Energy Commission. Of course, Dr. Lapp is recognized as one of the foremost physicists in the country. I don't know whether Dr. Lapp has any desire to make any suggestions at this time, but perhaps at some later date we may have the privilege of inviting him to appear before the committee and get his views on this subject.

So, Doctor, we will conclude our hearings today unless there is something you want to add. Is there something you wish to add?

Dr. GARFIELD. I have answered all your questions.

Mr. PUCINSKI. You have, and I think you have given us a pretty good idea.

If it is agreeable with the committee, we have discussed during these hearings the Crawford report and reference has been made to them both by Admiral Martell yesterday and myself. I would like to include at the conclusion of this phase of hearings the Crawford report. We also have some excellent material on Viniti, which I think would be of assistance to the committee.

We also have considerable other material that Dr. Kiron has been assembling on this whole subject. If it is agreeable to the committee, I would like to include in the appendix of our hearings so that the record will be complete and will afford everybody an opportunity to study the discussions and information on the subject which has been developed by this committee.

We had intended to hold hearings on Monday. Unfortunately our witness that we had planned for Monday is in Europe and will not be back. So we are going to now stand adjourned subject to the call of the Chair.

Thank you very much.

(Whereupon, at 3:45 p.m., the hearing in the above-entitled matter was adjourned, to reconvene subject to the call of the Chair.)