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90-11 **STANDARD REFERENCE DATA ACT**

GOVERNMENT

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HEARING
BEFORE THE
COMMITTEE ON COMMERCE
UNITED STATES SENATE
NINETIETH CONGRESS

FIRST SESSION

ON

S. 998


TO PROVIDE FOR THE COLLECTION, COMPILATION,
CRITICAL EVALUATION, PUBLICATION, AND SALE OF
STANDARD REFERENCE DATA

MAY 15, 1967

Serial No. 90-11

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STANDARD REFERENCE DATA ACT

MONDAY, MAY 15, 1967

U.S. SENATE,
COMMITTEE ON COMMERCE,
Washington, D.C.

The committee met at 9:30 a.m., in room 5110, New Senate Office Building, Hon. Daniel B. Brewster, presiding.

Senator BREWSTER. The committee will come to order.

This morning we will have a hearing on S. 998, the Standard Reference Data Act of 1967.

As acting chairman for the sponsor of this measure, the chairman of the committee, Senator Magnuson, I have a brief statement I would like to make.

OPENING STATEMENT OF THE CHAIRMAN

By this time, well into the second half of the 20th century, we have learned many lessons in conservation. We have many valuable and effective programs to protect and preserve our natural resources. Where we have overlooked some problems, as in water and air pollution, we are now trying to recoup our losses. Of course, it always costs more to catch up than it costs to take the proper action in the beginning. And the farther we drop behind, the greater is the cost of catching up.

We have before us today a bill, S. 998, introduced by Senator Warren G. Magnuson, chairman of this committee, aimed at conserving one of the most valuable human resources the country possesses today—our scientists and engineers. The Standard Reference Data Act is aimed at combating one element in what has become known as the "information explosion." This bill is designed to help rescue our scientists and engineers from acting as information clerks—wading through mounds of scientific papers in search of technical data they need to conduct an experiment, to design a company's production line, to develop an important new product.

Numbers are the stock in trade of scientists and engineers. The decisions they make every day in their lives rest on numbers which tell them whether a particular ceramic will withstand heat well enough to function in a space environment, or if a metal is strong enough for a specialized use. And there is no shortage of numbers. Ninety percent of all the scientists in the history of the world are alive and working today. They turn out mountains of data. The information is desperately needed by modern science and technology, but a specific number may be very hard to find in the mountain of research results.

An engineer in search of a number goes to his library. He may not be able to find what he wants in a reasonable amount of time. Or, he

may find that two or more researchers have come up with different results. If he finds just one number, there is a real possibility that the number is wrong.

In the face of these uncertainties, he can use a number and hope for the best. He can determine the number experimentally himself, possibly duplicating work already done by someone else. He can also overdesign his system to take care of all the uncertain numbers.

In this process you can see the multiple waste—a valuable engineer in the library instead of in his laboratory; the duplication of experimental effort; the waste of money in overdesign.

The Standard Reference Data Act—let me say I am also a co-sponsor of this—would give the Secretary of Commerce responsibility for collecting and compiling reference data from the scientific literature. This program shall greatly reduce the amount of material a researcher has to wade through.

The act would provide for critical evaluation of numbers in the literature, by outstanding experts in each field. Its goal is to give the researcher more confidence in the results that he finds. Also, the act provides means for getting evaluated data out to the technical community.

The Standard Reference Data Act is designed to provide a mechanism for meeting a pressing national problem. It would conserve the time of our scientists and engineers for more important duties. Indeed, if this program could save the average scientist just 10 minutes a week, which is a reasonable assumption, the saving to the Nation's research and development programs would be of the order of \$100 million per year.

My confidence in the soundness and potential value of this program is enhanced by the fact that the program would be administered by the National Bureau of Standards. The National Bureau of Standards, which recently moved into magnificent new laboratories in Montgomery County, Md.—in which I have a particular interest—has a long and distinguished record of achievement in science and technology. Thus, responsibility for this vital program would be placed in the most capable hands we have.

I will place a copy of the bill in the record at this point then I would like to call on Dr. Chalmers W. Sherwin, Deputy Assistant Secretary for Science and Technology, Department of Commerce.

(S. 998 follows:)

[S. 998, 90th Cong., first sess.]

A BILL To provide for the collection, compilation, critical evaluation, publication, and sale of standard reference data

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

DECLARATION OF POLICY

SECTION 1. The Congress hereby finds and declares that reliable standardized scientific and technical reference data are of vital importance to the progress of the Nation's science and technology. It is therefore the policy of the Congress to make critically evaluated reference data readily available to scientists, engineers, and the general public. It is the purpose of this Act to strengthen and enhance this policy.

DEFINITIONS

SEC. 2. For the purposes of this Act—

(a) The term "standard reference data" means quantitative information, related to a measurable physical or chemical property of a substance or system of sub-

stances of known composition and structure, which is critically evaluated as to its reliability under section 3 of this Act.

(b) The term "Secretary" means the Secretary of Commerce.

Sec. 3. The Secretary is authorized and directed to provide or arrange for the collection, compilation, critical evaluation, publication, and dissemination of standard reference data. In carrying out this program, the Secretary shall, to the maximum extent practicable, utilize the reference data services and facilities of other agencies and instrumentalities of the Federal Government and of State and local governments, persons, firms, institutions, and associations, with their consent and in such a manner as to avoid duplication of those services and facilities. All agencies and instrumentalities of the Federal Government are encouraged to exercise their duties and functions in such manner as will assist in carrying out the purpose of this Act. This section shall be deemed complementary to existing authority, and nothing herein is intended to repeal, supersede, or diminish existing authority or responsibility of any agency or instrumentality of the Federal Government.

Sec. 4. To provide for more effective integration and coordination of standard reference data activities, the Secretary, in consultation with other interested Federal agencies, shall prescribe and publish in the Federal Register such standards, criteria, and procedures for the preparation and publication of standard reference data as may be necessary to carry out the provisions of this Act.

Sec. 5. Standard reference data conforming to standards established by the Secretary may be made available and sold by the Secretary or by a person or agency designated by him. To the extent practicable and appropriate, the prices established for such data may reflect the cost of collection, compilation, evaluation, publication, and dissemination of the data, including administrative expenses; and the amounts received shall be subject to the Act of March 3, 1901, as amended (15 U.S.C. 271-278e).

Sec. 6. (a) Notwithstanding the limitations contained in section 8 of title 17 of the United States Code, the Secretary may secure copyright and renewal thereof on behalf of the United States as author or proprietor in all or any part of any standard reference data which he prepares or makes available under this Act, and may authorize the reproduction and publication thereof by others.

(b) The publication or republication by the Government under this Act, either separately or in a public document, of any material in which copyright is subsisting shall not be taken to cause any abridgment or annulment of the copyright or to authorize any use or appropriation of such material without the consent of the copyright proprietor.

Sec. 7. There are authorized to be appropriated such amounts as may be needed for the purpose of this Act.

Sec. 8. This Act may be cited as the "Standard Reference Data Act."

Senator BREWSTER. Dr. Sherwin.

Doctor, I see that you have a prepared statement. Please proceed as you wish, and introduce the gentlemen with you.

STATEMENT OF CHALMERS W. SHERWIN, DEPUTY ASSISTANT SECRETARY FOR SCIENCE AND TECHNOLOGY, DEPARTMENT OF COMMERCE; ACCOMPANIED BY DR. A. V. ASTIN, DIRECTOR, NATIONAL BUREAU OF STANDARDS, AND ROBERT ELLERT, OFFICE OF GENERAL COUNSEL, DEPARTMENT OF COMMERCE

Mr. SHERWIN. On my right is Dr. Astin, the Director of the National Bureau of Standards, and on my left, Mr. Robert Ellert, from the General Counsel's Office in the Department of Commerce.

Senator BREWSTER. Please proceed.

Mr. SHERWIN. Mr. Chairman, I appreciate the opportunity to appear here today in support of the Standard Reference Data Act, S. 998. Enactment of this will significantly improve the effectiveness of scientists and engineers in conducting the \$20-billion-a-year research and development activity in this country. In addition to increase effectiveness, the proposed bill would make possible important savings in both time and money.

I would like to describe what reference data are and why they are important, the problems associated with their compilation, evaluation, and dissemination, some background on standard reference data activity, and highlights of the proposed bill.

IMPORTANCE OF REFERENCE DATA

Reference data are the numbers that give the properties of matter and materials such as melting points, electrical resistances, heats of formation, and so on. These numbers, the results of experiments by researchers, are mainly published in the scientific and technical literature.

There are about 1,500,000 scientists and engineers in the United States today. They all use reference data in their everyday work. Let us take one group—the roughly quarter of a million electrical engineers—to illustrate now more specifically how reference data are used. These engineers must use such properties as electrical resistivity, thermal conductivity, magnetic permeability, and melting point in their work. These and other properties enable electrical engineers to design communications devices, such as radios, TV, microwave systems, telephone systems, or electrical components for use in automobiles, in the home, in the factory, or in highly sophisticated space vehicles, where the components have to work reliably under extreme conditions. These engineers also design power transmission systems, in which they must include safety controls—devices that cut off power when an overload or other dangerous possibility occurs.

Other engineers, hundreds of thousands of them, are concerned with transportation—motor vehicles, railroads and subways, airplanes, ships. In their daily work they need to know properties of alloys, metals, rubber, plastics, fuels, and a host of other materials.

In dealing with other great national problems, such as pollution, corrosion, safety, health, or contamination, engineers and scientists depend upon reliable and readily available values for the properties of materials to do their job well. For example, what are the properties of fuels which bear on smog control? What are the properties of detergents, especially how they break down in chemical reactions that render them harmless? Data provide the basis for most of the decision-making process in science and technological industry. The effectiveness of the decisions is directly dependent upon the reliability of the data.

PROBLEM

The problem with existing reference data is twofold.

1. There has been an enormous increase in the volume of scientific and technical literature; 35,000 periodicals publish about 1 million research papers each year. Locating the needed number is exceedingly difficult, and becoming more so. Yet they must be located.

2. Having searched the literature, the scientist or engineer often finds that there are several conflicting values or numbers for a given property. Which one is the best value?

The problem may be clearer if we look at just one property of one substance—the melting point of a given ceramic material, for example. A team of engineers has the assignment of designing a space vehicle that will successfully withstand the exceedingly high temperature

generated by friction as the vehicle reenters the atmosphere from a trip in space. The design of this vehicle must take into account many considerations, among which are: (1) how much heat will friction generate on a given material with specific surface and other characteristics at a given speed in a given atmospheric density, (2) how much heat will the material tolerate before it breaks down or melts, (3) how can this heat be contained, dissipated, or insulated to protect the occupants or instruments in the vehicle? If the necessary data to make these calculations are uncertain or unreliable, or hard to come by within the time available, the engineers are faced with undesirable alternatives:

They can make a new measurement to determine the needed number, thus duplicating work that has already been done, and with no guarantee of greater accuracy, or

They can overdesign the vehicle to assure safety. Thus, if the unevaluated data available show a range of melting points for the particular ceramic material from 1,500° C to 2,000° C, they would use the lowest one to be safe. But if they knew that a higher melting point was a reliable number, they could design accordingly.

The need for readily available, critically evaluated reference data is pressing. In present circumstances, we are experiencing unnecessarily high costs for research and development, waste of scarce technical manpower, duplication of effort, and delay in the industrial application of scientific and technical advances.

Consider just the waste of manpower. If the average scientist or engineer today is saved only 10 minutes a week that he would otherwise have to spend locating and evaluating data, the annual saving to the Nation would be of the order of \$100 million.

BACKGROUND

Compilation of data and preparation of tables is a process by which the voluminous scientific literature is compressed and made much more accessible and useful. The cost of this compression is surprisingly small. The research described in a typical article in a scientific journal costs \$20,000 to \$40,000, according to National Science Foundation estimates of U.S. research projects. Experience shows that for \$100 to \$200 additional—a fraction of 1 percent of the research investment—the contents of such a paper can be analyzed, evaluated, and made part of a reliable, convenient compilation of data. Such a compilation includes the world literature on the subject, since the compilers review foreign journals as well as United States ones. Thus the user may take full advantage of all the research done on his subject, without handicap as to language or availability of foreign journals.

Consider the specific case of a well-known data compilation prepared at the National Bureau of Standards: NBS Circular 500, "Selected Values of Chemical Thermodynamic Properties," was published in 1952 (a revision is now being completed). The authors collected 10,000 references and chose 6,000 for careful evaluation. At an average figure of \$30,000 per paper (present-day costs), the scientific raw material of this effort was worth \$300 million. The work of preparing Circular 500 would cost about \$600,000 at today's figures. Thus, for 0.2 percent additional cost, a mass of valuable but unordered

scientific information was condensed into a systematic, internally consistent, reliable set of tables. NBS Circular 500 has been used as the primary reference source for thermodynamic data in thousands of research and development projects including petroleum refining design, chemical processing, rocket propellant research, metal corrosion studies, and in fact every phase of this country's technology. More than 7,000 copies have been sold, and the ready access which it provides to thermodynamic data has saved many millions of dollars in scientists' time alone.

A revision of the data in Circular 500 is now being made. Since the original publication, many additional articles in the same field have been published, now representing an estimated \$1.2 billion in research. The selection of important papers and evaluation of the data contained therein will be accomplished for somewhat more than \$1 million.

Circular 500 is typical of a substantial body of compilations which have been among the basic tools of scientists and engineers throughout the history of technology. Every scientist and engineer owns—I should say I have never met a scientist or engineer who does not own at least one handbook which contains, among other things, table after table of data on the properties of the substances and systems which he deals with every day.

These compilations were prepared in response to a particular need of the technical community. Some were one-time projects and never updated. Others are continuing projects. Some were sponsored by a mission-oriented agency of the Federal Government; others by private organizations. However, there was no coordination or standardization of format or quality. In some technical areas there has been extensive duplication; in other areas data compilations are nonexistent or inadequate.

When it became apparent some years ago that the total national level of effort on the production of data compilations was not maintaining pace with the needs of scientists and engineers, knowledgeable individuals and groups, both within the National Bureau of Standards and throughout the scientific community, explored various ways of attacking the problem. These studies led to the development of a plan for a decentralized operation, with a small program management office located within NBS, and data centers located throughout the country in laboratories where special competences existed. The plan was brought to the attention of the Federal Council for Science and Technology. This group, which had been concerned about the data situation for some time, endorsed a Federal policy statement establishing a National Standard Reference Data System in order "to provide on a national basis critically evaluated data in the physical sciences." This policy statement called upon the National Bureau of Standards to assume responsibility for the administration of the National Standard Reference Data System, which came into being in 1963.

The responsibilities of NBS are the following: (1) promote compilation of evaluated data, (2) coordinate related work under the auspices of all Government agencies, (3) establish standards of quality for all products of the system, (4) operate a National Standard Reference Data Center at NBS, and (5) establish standards of methodology and such other functions as are required to ensure the compatibility of all units of the National Standard Reference Data System.

Within the National Bureau of Standards the responsibility for administering the National Standard Reference Data System was assigned to the Office of Standard Reference Data. Three major groups of activities within the Office of Standard Reference Data have been initiated: (1) the planning and implementation of a series of data compilation activities organized according to technical scope; (2) an information systems design and research activity; and (3) a variety of specialized information services to be provided to the technical community by the Office of Standard Reference Data.

In developing and operating the data compilation program up to the present time, the Office of Standard Reference Data has established activities in seven broad categories of properties: (1) nuclear properties, (2) atomic and molecular properties, (3) solid state properties, (4) thermodynamic and transport properties, (5) chemical kinetics, (6) colloid and surface properties, and (7) mechanical properties. In each of these, responsibility for developing a comprehensive, coordinated program has been assigned to a program manager. Existing projects of other governmental and nongovernmental agencies are taken into account and project priorities are determined by consultation with specially constituted advisory panels and with groups of specialists from the academic world, Government, and industry.

Some of the projects are conducted within NBS laboratories; others are in university or other Government laboratories; a few are in industry. None are under the direct operational supervision of the Office of Standard Reference Data, which is exclusively for program management. The data evaluation and compilation activity is normally conducted as part of the ongoing program of a productive experimental group, with an established reputation for competence and vigor. Data evaluation can be done adequately only by a specialist in the field, a person of mature experience whose judgment is respected by other experts.

The information system design activity concentrates on the problems of handling data, on communications and connections between data centers, and on the technology (hardware and software) required to make the data storehouse most available to the user in the U.S. technical community.

To place the information systems design into practice, a variety of services are being planned, making use of the storehouse of data in the NBS National Standard Reference Data Center in Washington. This storehouse will eventually contain a complete collection of compilations of critically evaluated data produced throughout the world. The services would include answers to specific inquiries, issuance of a "current awareness" publication, operation of a library of computer tapes and programs, and preparation of special data handbooks as needed by a particular group in the technical community. Other services may be added as the need becomes apparent.

During the 3 years that the National Bureau of Standards has administered the National Standard Reference Data System a good start has been made toward improving the supply of standard reference data to the American technical community. These years of operation have, however, revealed the need for additional authority from Congress in order to increase the effectiveness of the system. The authorities needed are contained in the proposed legislation before you.

In 1966, H.R. 15638 was introduced on behalf of the administration by Representative George P. Miller, Chairman of the Committee on Science and Astronautics. The bill was referred to the Subcommittee on Science, Research, and Development, which held 3 days of hearings on June 28-30, 1966. Witnesses included: Donald F. Hornig, Director, Office of Science and Technology; Dr. J. Herbert Hollomon, Assistant Secretary of Commerce for Science and Technology; Dr. Allen V. Astin, Director, National Bureau of Standards; Dr. Frederick Seitz, president, National Academy of Sciences; Curtis G. Benjamin, chairman of the board, McGraw-Hill Book Co., Inc.; W. Bradford Wiley, president, John Wiley & Sons, publishers; and John F. Haley, staff director, Joint Committee on Printing.

The committee also consulted with the Copyright Office and the General Accounting Office, and communicated with individuals and business, professional and Government groups, asking their opinions on the bill. All supported the overall purpose of the bill, but suggestions were made for improvement. These suggestions were considered and the subcommittee recommended a clean bill, H.R. 16897, which subsequently was approved by the House. The bill before this committee is identical with the one that passed the House at the last session of the Congress.

HIGHLIGHTS OF THE BILL

The proposed bill gives the Secretary of Commerce the following authorizations:

1. To provide for the collection, compilation, critical evaluation, publication, and dissemination of standard reference data.
2. To prescribe standards, criteria, and procedures for the preparation and publication of standard reference data.
3. To sell standard reference data at a price which may defray an appropriate part of the cost of collection, compilation, evaluation, publication, and dissemination of the data.
4. To secure copyright on behalf of the United States in standard reference data compiled and evaluated by the National Bureau of Standards.

The bill provides for a more comprehensive and expanded standard reference data system to meet the Nation's rapidly growing needs. It authorizes funding the program through a combination of appropriations and user charges. Further, it provides the flexibility needed to permit optimum cooperation between private individuals and groups and the Government in the collection, evaluation, and dissemination of reference data. Finally, it clarifies by statute the central responsibility of the Secretary of Commerce with respect to various aspects of standard reference data activities.

Senator BREWSTER. Thank you very much, Dr. Sherwin. Let me ask you a few questions.

Why is it better for the Federal Government to establish this center, or this service, rather than scientists and engineers through some professional society or through a straight commercial venture?

Mr. SHERWIN. Let us speak first to the question of the scientists, engineers, and their professional societies. None of these organizations at the present time has the breadth of technical competence that the Government can provide to coordinate and manage a program of this type.

Second, they have inadequate funding to produce the large amount of effort required in providing critical evaluation. The benefits that are obtained from the work of this type are distributed throughout industry and throughout Government. Consequently, it is difficult for individual organizations or industrial groups to finance and support such an effort, and collect for reimbursement of the effort. It is an expensive operation as books go, and compilations go.

Senator BREWSTER. In your judgment, it would not be a self-supporting commercial venture?

Mr. SHERWIN. No. There is evidence that it cannot be self-supporting, because it is not being done today on a scale anywhere near adequately, either in industry or professional societies.

Senator BREWSTER. As you know, sir, we now have a Clearinghouse for Federal Scientific and Technical Information. We have the Defense Documentation Center and the State Technical Services program. And in each department, agency and bureau in the Federal Government we have some type of reference library and data accumulation activity. Why does it make sense to try to put all these under a central authority at NBS? What will be the relationship between the National Standard Reference Data System and existing systems, some of which I have enumerated? And do we not have some duplication of Federal effort in the whole field here?

Mr. SHERWIN. There is no duplication between the National Standard Reference System and the three systems you mentioned, which are the Clearinghouse, the Defense Documentation Center, and State Technical Services organizations. Those organizations, although they are distributing technical knowledge and distributing reports, are not collecting and evaluating scientific quantitative data. This is the unique function of the Standard Reference Data System. So there is no overlap in this function.

There is a problem, not of overlap, but of maintaining cooperation between the various agencies involved in the Standard Reference Data function. The Atomic Energy Commission, for example, collects and processes reference data, and the Defense Department as well. It is indeed one of the purposes of the bill to provide for coordination of these data collection efforts among all agencies.

Senator BREWSTER. You are convinced that the National Bureau of Standards is the best group to undertake this activity?

Mr. SHERWIN. Without any question. This type of evaluation is a highly technical, specialized activity. It requires critical scientific and engineering judgment in the compilation and evaluation of the data. It is not a clerical or a routine function, except for certain aspects of the collection process. The fundamental effort is really a creative scientific activity and can only be performed, supervised, and coordinated by competent scientists.

Senator BREWSTER. You have mentioned foreign research and that we would review foreign research papers. How will you handle the matter of making available our data to foreign nations and foreign governments? How will you handle the problem of classified material which I assume you will certainly be involved with, and what relationship, if any, will you have with the National Security Agency?

Mr. SHERWIN. The plan of the National Standard Reference Data System does not include any provision for the collection of classified data in this particular system. Such data can be collected and processed by agencies that wish to do so, but not as a part of this system.

The products of the National Standard Reference Data System will therefore be available to foreign organizations by ordinary distribution and sale.

Senator BREWSTER. And the information would be available to foreign agencies of one sort or another?

Mr. SHERWIN. Yes.

Senator BREWSTER. How much will it cost to, one, establish this system, and, two, to carry it on an annual basis?

Mr. SHERWIN. To establish it, it would take several years of carefully building up the capability. The level of ultimate stable operation can be determined from a quite well-known calculation. About 20 percent of the annual publication of scientific and technical papers are primarily concerned with reference data, with specific numbers and measurements of numbers that are important. Therefore if one wishes, in a stable state, to evaluate and process this volume of material, one knows the amount of input that has to be processed, which is certainly several hundred thousand papers a year.

We know the average cost of producing a valuable and competent evaluation of the paper, \$100 or \$200, which I mentioned in my testimony. You multiply this by the number of papers produced in the world and the cost per evaluation, and you come up with \$18 or \$20 million a year for evaluation of the worldwide effort with the present type of quality, which we believe is necessary to provide reliable data.

Senator BREWSTER. This is the figure you would anticipate as your annual budget? Or does that include overhead, housekeeping, and services?

Mr. SHERWIN. That covers the whole operation including overhead, management, and information services.

Senator BREWSTER. As you well know, the Federal budget is very tight right now. Can you in your mind justify this additional expenditure at this time? Or is this one of the programs which can wait until our involvement in Southeast Asia is not so terribly expensive?

Mr. SHERWIN. The very argument made for the importance of the system justifies it at the present time, because it is intended to increase the efficiency of our resources. It saves the time of existing scientists and engineers. We will get back, we believe, the money and time put in many times over. Therefore, in a time of pressure, the efficient use of existing resources, the enormous number of papers produced throughout the world, being collected and made accessible, is, to my mind, of very high priority, and an economy-producing activity.

Senator BREWSTER. Will this result in new capital construction at NBS in Montgomery County?

Mr. SHERWIN. No.

Senator BREWSTER. You have existing housing and facilities or lands there?

Mr. SHERWIN. That is right.

Senator BREWSTER. What percentage of your cost do you think you would recoup from the sale of the information data?

Mr. SHERWIN. We estimate that a maximum of about 25 percent of the cost of the program might be recovered when it is fully developed. This estimate has in it some assumptions regarding the ability to provide specialized services, the sale or distribution of magnetic tapes and other particular materials, as well as publications.

Senator BREWSTER. Dr. Sherwin, I wish to thank you on behalf of the chairman, for an excellent statement, and for the forthright manner in which you have answered the questions.

Mr. SHERWIN. Thank you.

Senator BREWSTER. Now I would like to call Dr. Robert Cairns, vice president for research of Hercules, Inc., Wilmington, Del.

Dr. Cairns, I see you have a prepared statement. Do you have any associates with you?

**STATEMENT OF DR. ROBERT CAIRNS, VICE PRESIDENT, RESEARCH,
HERCULES, INC., WILMINGTON, DEL.**

Dr. CAIRNS. No; I do not.

Senator BREWSTER. You may proceed as you wish.

Dr. CAIRNS. I will not read the prepared statement but I would like to go over its points briefly, and then answer any questions that you care to address to me.

I am well acquainted with the activities of the Office of Standard Research Data. I favor this activity. I think that the current legislation is a very good step in the direction of buttressing this new activity.

It is fairly well developed in planning to cover essential types of data that are used by our scientists and engineers. I think that what they need now is a good basic support over the on-going years.

Science and technology generate data. We know that we are spending in this area at least \$20 billion a year. The data serves as a basis for further research and development work, and also it generates data that are most useful and for practical purposes in engineering. Thus the storehouse of data is the foundation on which science and technology and engineering are based.

The education of a scientist or an engineer is based on principles and relationships that are derived from and verified by this storehouse of data. For example, a chemist, in carrying out the simplest type of chemical reaction where he puts two chemicals together, must start out with knowledge of the properties of the chemicals that he uses, such things as boiling point, melting point, solubility, refractive index, specific gravity, toxicity, stability, infrared and ultraviolet spectra, and many types of thermodynamic properties.

The properties a chemist must seek in the literature are those that he must determine or calculate himself. He needs to know before he carries out a chemical reaction many things.

The American Chemical Society made a study recently which is summarized in the Journal of Chemical Documentation for February of this year, which elucidates the many different types of properties that are essential, that are often sought after in the literature at great expense to the individual.

It was also clear as a result of this study that the current compilations available to a chemist fell very short of meeting his needs. I offer this as an example of the needs of chemists.

I think that the plans of the Office of Standard Reference Data take into account these needs. Actually, this study was made with their cooperation. They have done a very good job of finding out what is really needed.

In addition to the types of data that I have mentioned, chemical engineers need pressure-volume-temperature data—the steam tables

are a prime example which are the basis for designing and running powerplants—at increasingly higher temperatures and pressures; they are concerned with mechanical properties, corrosion data, thermochemical data, azeotropic data, et cetera. Physicists are intimately concerned with atomic and molecular properties—molecular and atomic weights, spectra, decay, and crystallographic data.

In all of these cases this data filters into engineering handbooks and in designing a plant hundreds of pages of data are needed.

These data must be eventually verified, evaluated, and extended by publication before they can take their place in the storehouse of data for ready availability. Previous data that our science and technology have generated are scattered throughout thousands of journals over many years of accumulating literature. Just in the chemical field alone, we abstract and index 10,000 journals, and out of these 10,000 journals annually will come say 200,000 literature abstracts. And each of these abstracts is replete with numerical data. So you can see that a further step is needed in order to bring this data into readily available form.

Data compilation is a task that is broadly shared by individuals, by organizations large and small, which signified its essential character. I believe that data compilations can and should be broadly shared.

To go back about 40 years, there was a very noble effort made under the aegis of the National Research Council to produce what was then called the International Critical Tables. The sheer magnitude of the task of updating this great work has stood in the way until the Federal Council, 3 years ago, recognized the necessity of Federal support and leadership.

In the meantime there have been many special projects on data compilation in the areas where the needs were paramount. For example, the American Petroleum Institute in its various projects has spent over a period of years about \$3 million in order to establish data compilations on hydrocarbons as a basis for the liquid fuel industry. And the Manufacturing Chemists Association carried out somewhat more limited efforts in certain fields of chemistry in an attempt to generate a broad data base.

For many years the National Research Council in its Office of Critical Tables has espoused and collated the work of these many smaller data compilations. However, again I say the magnitude of the task, the difficulty of sharing in the expense and effort, stood in the way of doing anything other than keeping track of what was going on.

I was Chairman of the Division of Chemistry and Chemical Technology in 1962 and this Division had responsibility for the sponsorship of this Office of Critical Tables. I know from this experience of the very large unfulfilled needs of broader compilations of technical data.

During this period we saw the initiation of planning efforts aiming toward a new office. We were as cooperative as we could be in promoting this activity through offering advisory groups of different types.

I think therefore that there is a very significant need that has not been served and that the plans and programs that they have now in progress are well worthwhile.

In addition to the general purposes of this act, provision is made for the Secretary of Commerce to copyright compilations. I believe

that this is a necessary step in order to recover any significant portion of the costs of compilation and distribution. And also I note that the Secretary may authorize the publication of such data by others. I think it is highly desirable to have such a provision so as to facilitate the use of standard reference data by standard publishers of the many media that are used by engineers in the pursuit of their occupation; namely, technical handbooks and the like.

I would be glad to answer any questions, Mr. Chairman.

Senator BREWSTER. Dr. Cairns, does your firm do any governmental research at any level at this time?

Dr. CAIRNS. Yes. We have a fairly significant program in the field of chemical propulsion related to missiles—solid propellants.

Senator BREWSTER. If this system were completely established and the data were available to your people, would it enable you to do this research at any less cost to the Government?

Dr. CAIRNS. I think there is little doubt that the availability of standard reference data in this instance, particularly in the thermochemical field, would have a perceptible influence on efficiency. In other words, the chemist or physicist going to a particular place could ask a question and get an answer in a matter of minutes instead of hours. It is difficult to say what the quantitative effect would be but I should think it would be of the order of a few percent in efficiency overall.

Senator BREWSTER. Does the data that your people compile now get accumulated under present programs by any Government agency?

Dr. CAIRNS. Yes. The reports are compiled and indexed. I don't believe that there is an actual accumulation and compilation of data as such. I think we would look to the standard reference data for them on chemical information relating to many types of chemicals. Now we have to go back to individual articles, to chemical abstracts, or to indices of classified documents, if that happens to be involved.

There is a great deal of the information, however, of a thermochemical nature, which is not classified but which is quite important for the working out of special types of mixtures.

Senator BREWSTER. In your judgment could the National Academy of Sciences, or the American Chemical Society—I understand you are president-elect of that society—could they do this job—either one of them—as well as the National Bureau of Standards?

Dr. CAIRNS. The problem is to find out some means to gain benefits and get them in the form of return, financial return, to offset expenses. It is hard to close the circle because data are so broadly used that it is very difficult to know how to recover these costs without the help of some general system such as taxation.

I regret to say this in a sense because it has held up progress in data collection for 20, 30, 40 years. I think it is well beyond what the American Chemical Society can do. We are already spending for recording chemical literature and indexing and abstracting about \$20 million a year, all of which money comes from either dues or, more importantly, from subscribers. In other words, from the users of chemical information.

To put in an additional step of comparable cost to refine this information and make it readily available would impose again a burden of trying to get this money back. I think because it is so generally used,

not only by scientists but by the engineering profession at large, that this would be a very difficult thing to do. In effect it has not been done. I have not seen any really strong steps taken in that direction.

I would welcome the support and leadership of the Government and at the same time hopefully see them in turn charge for the services provided to get some measure of usefulness in terms of need.

Senator BREWSTER. I gather then in your judgment there is not sufficient demand by the scientific community, by industry, to make this program commercially or professionally self-supporting?

Dr. CAIRNS. I think because of its scale and because of the need for a very broad system, which is very expensive and is available to all people, it has to have an organization of the scope of Government in order to spread the cost.

Senator BREWSTER. Will this governmental activity in this area downgrade the American Chemical Society and like professional societies?

Dr. CAIRNS. Not in any way. Actually they would be using the scientific output that is recorded in the society's journals and abstracts to render them more useful and to render the results more accessible. There is an efficiency factor here which would be very desirable.

Senator BREWSTER. Now let's get around to the matter of copy-righting. This data would be compiled, filed, and indexed at the taxpayers' expense. Why should the compilations be copyrighted? Why should they not be readily available to the public?

Dr. CAIRNS. There are several reasons. For one thing, if you have some return, and if it isn't complete—in other words, if you do charge something—I think you get automatically a measure of usefulness. That is, that people are willing to pay for something that they usually need. If it is given out freely, you have always the uncertainty of how far you should go in developing the system of data and data reference.

If you have a cost factor that you can relate to pricing policy, then I think you have a better control over a long period of time.

The other element is in allowing for specialized distribution systems. Information freely available isn't always the most available. It has to be in many cases repackaged. I mentioned technical handbooks, for example. This particular reference data system, they refer to computers. Computers are very expensive. Again, we must relate the cost to the usefulness through some kind of pricing system.

The technical handbooks can be designed and published through private sources, enabling a return to be made and the copyright will permit this to be done on a reasonable and economical basis. I think through this type of partially recompensed system of costs, you might get more effective, more efficient distribution than if it was just say handed out through the Government Printing Office.

Senator BREWSTER. You don't believe a user-scientist would be hindered in his work by virtue of the copyright provision?

Dr. CAIRNS. No, I don't, not at all.

Senator BREWSTER. You see no basic philosophical conflict in charging the taxpayer for something which he has paid for?

Dr. CAIRNS. I think that if he is to be reasonably assured of the efficiency of the operation, he should have some concern for the willingness of the people, the specific users of the system, to be able to control its use in repackaged forms to a reasonable degree. I think it is

in the interest of the taxpayer, as much as anyone, that this copyright restriction be applied, to provide for a more efficient system.

Senator BREWSTER. Senator Moss?

Senator Moss. I don't think I have any questions at this time, Mr. Chairman. I was late coming in.

I appreciate the testimony. I am just having time to scan it now.

Senator BREWSTER. Dr. Cairns, thank you very much for your most enlightening testimony.

Dr. CAIRNS. Thank you.

Senator BREWSTER. Now we would like to call Mr. William Knox, the vice president of McGraw-Hill, from New York.

Mr. Knox, welcome to the Commerce Committee.

I see you have a prepared statement. You may proceed in any manner in which you would like.

STATEMENT OF WILLIAM KNOX, VICE PRESIDENT, MCGRAW-HILL, INC., NEW YORK, N.Y.

Mr. KNOX. Thank you, Mr. Chairman; Senator Moss.

It certainly gives me great pleasure to testify today on behalf of the standard reference data bill, S. 998.

My contact with standard reference data goes back to the 1930's, when I first used the International Critical Tables to aid my graduate research, and has continued to this day. I have as a researcher and engineer used standard reference data in industrial research. I have also managed a privately financed reference data production activity, carried out as a necessary adjunct to industrial design engineering.

More recently, as a staff member in the Office of Science and Technology, and as Chairman of the Federal Council's Subcommittee on Scientific and Technical Information, I worked closely with the National Bureau of Standards and the Department of Commerce as they struggled to increase the national reference data evaluation effort in response to the Federal Council's suggestion dating back as far as 1963, and even before that, and as the legislation before you was developed.

Finally, I now am concerned with the best methods for getting critical or standard reference data into the hands of those who need it. As you know, I am vice president of McGraw-Hill, Inc., a leading publisher and operator of information services in science, technology, and business. McGraw-Hill, in fact, published the International Critical Tables in 1929. Even today there are demands for this compilation of very essential data.

It is, however, hopelessly obsolete as far as the scientific and technical engineering community of this country are concerned and we definitely need a vigorous and sustained program in this area.

I have given the background on my credentials, so to speak, merely to support what I believe to be the case—that I have been personally experienced in most of the aspects surrounding the production, marketing, and use of standard reference data.

Now as to S. 998, there is no question that a program like this should be strongly supported by the Congress. Measurements are being repeated in research and engineering programs, facilities and equipment are being overdesigned, and capable scientists and engineers are needlessly compiling and evaluating reference data in un-

coordinated and overlapping private programs, all for the lack of a comprehensive, coordinated, and accessible set of standard reference data.

The cost of this vacuum, the lack of a comprehensive and coordinated reference data program to this country, is enormous. I won't attempt to quantify beyond saying that in my opinion its cost is probably more than a hundred times the cost of this proposed program. I am sure that the sponsors of the program and other witnesses—for example, Dr. Cairns—gave and can give illustrative examples.

A central question, it seems to me, as you have already asked, Senator Brewster, is why the Federal Government should take the responsibility for organizing, financing, and monitoring the standard reference data program. My answer is simply there is no other way to get it done. No other organizational mechanism exists outside of Government which can provide the necessary leadership, and the coordination, and the support, all three legs of the stool.

The raw data to be collected are furthermore being generated largely by Federal-aid supported research and the critically evaluated data are of great utility in Federal programs.

Furthermore, the beginnings of an adequate program are already available under the coordination of the Bureau of Standards. It would be wasteful in my opinion to undo what has been done, and attempt to create a completely new organizational structure.

Although I support the objectives of the bill and most of its features, I would like to call your attention to an inadequately defined area, the area of getting the evaluated reference data to the person who wants it.

I have given over the past few years considerable thought and a great deal of my working hours to trying to define the role of the Federal Government and then trying to crystallize an action program within the Federal Government to support that role. I believe that the role of the Federal Government is significantly and appropriately different with respect to the production of reference data on the one hand, and the marketing of these data on the other hand. By production I mean collecting the raw data from the published literature, the compilation of these data, the critical evaluation of them, and the recording of the evaluated data in a basic medium or form.

By marketing I simply mean the process of informing people of the existence of the reference data. A lot of people do have to be told that the data are available; and supplying the data to them in the various forms in which they wish to get it. Some people may want a handbook, some people may want a periodical journal, some people may want a telephone inquiry service, others may want it in computer tape form. There are a variety of forms in which people may wish to get it.

And then I also mean by marketing, continually modifying these products as people's needs and desires change.

I believe in Federal leadership and coordination and support of the production ends, the production of these critically evaluated data. Equally I believe in private sector responsibility for marketing these data.

It seems to me the situation is analogous to Federal leadership in supporting the development of hybrid corn, new fertilizer processes,

and new aerospace technologies, but then relying on the private sector to spread these developments throughout our society.

An even more recent and direct analogy is the Federal leadership and support of the development of new high school courses in the sciences. The National Science Foundation provided the funds for the development of these new curriculums, and then private publishers, individual school systems, and individual teachers used the basic material to serve what they considered to be legitimate market purposes.

The bill as it stands does not make clear the proper roles of the Secretary of Commerce with respect to these two different functions.

As a specific example, in section 4, and I quote—"the Secretary * * * shall prescribe * * * standards, criteria, and procedures for the preparation and publication of standard reference data." Would this mean that the media and format of publication are subject to the Secretary's standards and criteria? Would microfiche be acceptable but roll microfilm not? Would tables of data arranged one way be acceptable, but different arrangements not?

The publishing industry has had decades of experience in marketing reference data—the handbooks, the international critical data themselves for decades. It knows the variety of and ever-changing demands people make regarding the format and media through which they receive their information. It would be almost impossible for a Federal Government agency to respond quickly and easily to changing product requirements at what I would call the retail level.

As another example, in section 5 the Secretary is, in essence, put into the retail marketing business, selling standard reference data with a partial cost recovery. However, the prices suggested "may reflect the cost of collection, compilation, evaluation, publication, and dissemination of the data."

I believe in complete Federal subsidy of the collection, compilation, and evaluation of standard reference data. At those points the data have little or no value to any individual person, and it would be very difficult to devise a mechanism for recovering costs. A somewhat analogous situation is the continuing Federal subsidy for improving our inland and coastal waterways. Until someone uses a deeper harbor, the dredging has had no value. It would be, furthermore, hopeless to take up a collection along the river bank of the various people who would use the river to accomplish the job.

After the standard reference data have been compiled, however, they have more value. Users can understand and appreciate their value and be willing to pay for them. Since individual users need different parts of the total collection of reference data, and need them at different times in different formats and media, the potential users should be offered a choice from among a number of different reference data services. This, I strongly believe, is the appropriate area for which the private sector should take and is willing to take responsibility.

In summary, I strongly support the standard reference data program envisioned in S. 998. It is in the best American tradition whereby the Federal Government undertakes to develop basic collections of data difficult or impossible to achieve through other normal mechanisms of our society. However, strengthening the bill to emphasize the private sector role in the publication and dissemination of stand-

ard reference data would act in the best interests of the user and the Federal Government.

I would be glad to cooperate further with the committee and the Department of Commerce, if they so desire.

Senator BREWSTER. Thank you very much, Mr. Knox.

If the U.S. Government did not initiate this program, did not fund it, do you believe the publishing industry of the United States could do it in any fashion at all, or would?

Mr. KNOX. Mr. Chairman, it is not the role of the publishing industry to actually support the compilation of information. It acts primarily as a marketer of information. It endeavors to find valuable information or information of potential value to put it through what we call the editorial process of formatting it, providing the necessary graphs, illustrations, presenting it in a form that we think a potential market will find it useful. And then, after that editorial process, the publishing industry then tries to market the product.

It is not, never has been, in the business of actually supporting a large, let's say information-generating effort on its own. It instead acts as a middleman between those who generate information or knowledge or entertainment, it acts as a middleman between those creative people and the other people in our society who might find this information of utility and/or entertainment.

Senator BREWSTER. Will you comment generally on the manner of copyrighting information developed at the taxpayers' expense and then more precisely on what effect copyrighting this data compilation would have on your publishing industry?

Mr. KNOX. Let me see if I understand the first question. You would like an expression of my opinion on the effect of copyright generally?

Senator BREWSTER. By the Government.

Mr. KNOX. Normally, I think it would be better for the Government not to obtain copyright to materials which are going to be marketed directly by the Government. In this instance you will notice that I suggested that the proper channel for marketing this information would be through the private sector.

If the Government intended to market this large mass of standard reference data through the private sector, some means of protecting the editorial efforts and expense and marketing efforts and expense of the publishing industry is required. There are very few, perhaps half a dozen, examples where more than one private publisher has been able to market without losing money, material which has already been produced by the Government Printing Office and thereby put in the public domain. Once material is put in the public domain this becomes almost impossible then for anyone in the private sector to put into it the necessary effort to make a merchantable product out of it and then sell it. It practically prohibits it.

I would say if the intent is to use the private sector for the marketing of this, let's say at the retail level anyway, the marketing of the standard reference data, then some protection and copyright protection would appear to be the appropriate mechanism at this point in time.

This copyright mechanism should be in fact granted to the Secretary of Commerce.

That is a long answer to what was a rather direct question. I hope it is satisfactory.

Senator BREWSTER. You would argue then, sir, that so far as marketing this data, there cannot be a mix between the private sector of our economy and the Government, because the Government's publication would preempt the field in a competitive sense, and it should be marketed almost in its entirety through private industry?

Mr. KNOX. I would hope that private industry would be able, as I believe large sectors of it are, able to handle the marketing of this information for the maximum benefit to our economy. The proper role of the National Bureau of Standards might in this case be that of a wholesaler providing the basic data for any number of private publishers or other kinds of firms which are now quite active in this area, supplying them with the evaluated data en masse, leaving it up to the entrepreneurs to select from it those parts that they think actually can be marketed.

The responsibility lodged with the Secretary and in turn delegated to the Bureau of Standards for monitoring the effectiveness of this program would, it seems to me, include—and I hope very directly—the responsibility for insuring that in fact the dissemination, the marketing function, was being adequately carried out by the private sector. It would not mean that they would do it. It would mean that they would insure that it is done.

Senator BREWSTER. Is private industry, a large company like McGraw-Hill, limited to the printed page, or could private industry market this material by way of type, by tape, microfilm, recording, IBM cards, or some other means other than the printed page?

Mr. KNOX. The firm I represent, McGraw-Hill, actually markets right now data banks on computer tape, it markets information in film, 16-millimeter, 35-millimeter film. It is contemplating services in sheet film called microfiche. It actually supplies to schools live animals and fishes. It will do anything that conveys information or knowledge or entertainment and if it serves a useful function in our society.

I believe that you will find a great many other publishers are also moving in this direction, have already moved in this direction. And of course there are in our society any number of capable, aggressive, entrepreneurs who will move into a vacuum if they see one, and there are a number of such who have moved into the area of supplying information through computer services, through microfilm services, through aperture cards, punchcards of all kinds.

It is a very competitive business and we hope it will stay that way.

Senator BREWSTER. Senator Moss?

Senator Moss. Thank you, Mr. Chairman.

By having private industry market this data, do we get into this area of overlap and variation which is one of the problems now? How do we avoid that?

Mr. KNOX. The overlap and the variation today really is in the value to be assigned to, say, the specific heat of a compound. There may be several values of this reported in the literature. Once a reference value has been assigned to this by virtue of the operation of this program, that reference value will be the standard. There will be no variation in that in the various retail marketing operations. The variations will instead be in selecting parts of the total reference data collection for marketing to selected audiences.

For example, if a chemist in Dr. Cairns' firm was almost entirely interested in polymer chemistry, there could be a set of these data that were very specific to the interest of polymer chemists. And it would be the function of the private entrepreneur, I believe, to guess at a potential market for this information and to create a package of standard reference data specifically suited for that group. So there would be no overlapping in the reference data but other competitive firms might think they could do a better job of selecting for these polymer chemists and publish something slightly different.

In that case I would think the polymer chemists would benefit by having an ability to choose between two competitive products, and therefore the research program would be more efficiently carried out.

Senator Moss. The bank of information would be the same across the board, but there would be selected parts marketed?

Mr. KNOX. And different people might think they have a better idea than somebody else on how to select this. Just like we have different automobile companies that think they know how to make a car that appeals to people a little better than one of their competitors.

Senator Moss. And little variations such as you describe are different methods of presenting the same basic data?

Mr. KNOX. That is right.

Senator Moss. Thank you.

Senator BREWSTER. Mr. Knox, thank you very much for an extremely able presentation. I would also like to again thank Dr. Sherwin, and Dr. Cairns, for appearing here this morning.

This concludes our list of witnesses for this morning.

The record of this hearing will remain open until Friday of this week, in the event any of these three witnesses or other parties want to provide the committee with additional material.

Gentlemen, thank you very much.

The hearing stands adjourned.

(Thereupon, at 11 a.m., the committee was adjourned.)

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS,
Washington, D.C., May 19, 1967.

Hon. WARREN G. MAGNUSON,
Chairman, Committee on Commerce,
U.S. Senate, Washington, D.C.

DEAR SENATOR MAGNUSON: The National Society of Professional Engineers has reviewed S. 998, the bill now pending before the Committee to provide for the collection, compilation, critical evaluation, publication, and sale of standard reference data, and submits the following views for your consideration.

We fully support the concept of a National Standard Reference Data System, and, while we understand that such a system has been established in the National Bureau of Standards since 1963, we heartily endorse enactment of the pending legislation if it is felt that separate legislation authorizing establishment of this service is needed.

From the viewpoint of the engineering profession, we feel the overall effect of the pending bill should be good. We do have some reservations, however, about the provision permitting the Government to copyright data collected and compiled by it, and urge that the Committee's report emphasize strongly the limited and restricted purpose for which such copyright authority is granted in this case.

We appreciate this opportunity to express our views, and hope you will call on us if we can assist you in any way.

Sincerely yours,

PAUL H. ROBBINS,
Executive Director.