[illegible] Congress
Session
COMMITTEE PRINT

TECHNICAL RESEARCH ACTIVITIES OF COOPERATIVE ASSOCIATIONS

STUDY OF

THE SUBCOMMITTEE ON PATENTS, TRADEMARKS, AND COPYRIGHTS

OF THE

COMMITTEE ON THE JUDICIARY

UNITED STATES SENATE

EIGHTY-FIFTH CONGRESS, SECOND SESSION

PURSUANT TO

S. Res. 236

STUDY NO. 21

Printed for the use of the Committee on the Judiciary

UNITED STATES
GOVERNMENT PRINTING OFFICE
34347 WASHINGTON : 1959

COMMITTEE ON THE JUDICIARY

JAMES O. EASTLAND, Mississippi, *Chairman*

ESTES KEFAUVER, Tennessee
OLIN D. JOHNSTON, South Carolina
THOMAS C. HENNINGS, JR., Missouri
JOHN L. McCLELLAN, Arkansas
JOSEPH C. O'MAHONEY, Wyoming
SAM J. ERVIN, JR., North Carolina
JOHN A. CARROLL, Colorado

ALEXANDER WILEY, Wisconsin
WILLIAM LANGER, North Dakota
WILLIAM E. JENNER, Indiana
ARTHUR V. WATKINS, Utah
EVERETT McKINLEY DIRKSEN, Illinois
JOHN MARSHALL BUTLER, Maryland
ROMAN L. HRUSKA, Nebraska

SUBCOMMITTEE ON PATENTS, TRADEMARKS, AND COPYRIGHTS

JOSEPH C. O'MAHONEY, Wyoming, *Chairman*

OLIN D. JOHNSTON, South Carolina
ALEXANDER WILEY, Wisconsin

ROBERT L. WRIGHT, *Chief Counsel*
JOHN C. STEDMAN, *Associate Counsel*
STEPHEN G. HAASER, *Chief Clerk*

CONTENTS

APPENDIXES

PUBLICATIONS OF THE SUBCOMMITTEE

Patent Studies

Other Publications

FOREWORD

This study was prepared by the Office of Technical Services (John C. Green, Director) of the U.S. Department of Commerce, in its Trade Association Division and under the supervision of Jay Judkins, head of that Division, for the Subcommittee on Patents, Trademarks, and Copyrights as part of its study of the U.S. patent system, conducted pursuant to Senate Resolutions 55 and 236 of the 85th Congress. It is one of several being prepared under the supervision of John C. Stedman, associate counsel of the subcommittee.

One of the perennial problems, in this age of increasing emphasis upon technical research and its importance, is that of filling the research needs of those business organizations in any given industry that are too small to provide their own research, and of undertaking the useful research which, whatever the reason, no single firm is prepared to undertake by itself. The importance of this subject is attested by the fact that a Government-sponsored 3-day conference on "Technical and Distribution Research for the Benefit of Small Business" was held in Washington in September 1957 to deal with this very subject. Among the solutions frequently suggested is increased aid by the Federal Government. The Small Business Administration Act of 1958 contains provisions designed to assist small business concerns in this important field. Other suggestions include stepped-up aid through universities and greater resort to "contract" research by private and nonprofit research organizations.

One of the more promising ways of dealing with this problem, is cooperative research undertaken and supported on an industrywide basis by the members themselves, and conducted through their trade associations—and with the results accruing to the industry as a whole for the benefit of all. This type of research has long operated quite extensively and successfully in European countries. The extent of its organization and the nature of its operation in the United States, however, is less well known. The present study fills this gap, providing us with up-to-date data on activities in this country and comparing the activities here with those in selected foreign countries. The role of the patent system in this type of research is, of course, likely to be quite different from its role in traditional privately supported research. This aspect also receives appropriate attention.

In publishing this study, it is important to state clearly its relation to the policies and views of this subcommittee. The views expressed by the authors are entirely their own. The subcommittee welcomes the report for consideration, but its publication in no way signifies acceptance by the subcommittee of the statements contained in it. Such publication does, however, testify to the subcommittee's belief that the study represents a valuable contribution to patent and related literature and that the public interest will be served by its publication.

JOSEPH C. O'MAHONEY,
Chairman, Subcommittee on Patents, Trademarks, and Copyrights,
Committee on the Judiciary, United States Senate.

DECEMBER 30, 1958.

TECHNICAL RESEARCH ACTIVITIES OF COOPERATIVE ASSOCIATIONS

By Office of Technical Services (John C. Green, Director)

I. INTRODUCTION

Trade and professional associations have contributed substantially to the progress of technical research in the United States, principally through the promotion of research on the part of their individual members. Their actual participation in research with money and laboratories has been a lesser factor, and is in fact only a small percentage of the national total, as of 1958.

In the United States, industrial research is considered the dynamic factor in competition. Accordingly, alert manufacturing firms reserve the most challenging investigations for their own laboratory or contract efforts. It is this type of research which leads to new products and processes, and the individual companies usually obtain statutory protection by obtaining patents on the results.

The type of research which is carried out cooperatively through a trade association or by joining forces with other companies in a single project normally relates to a broad problem of common interest. The work is considered worthwhile, but is not of such immediate nature as to justify financing and control by a single company. As a natural result, trade associations undertake general investigations and patents are rarely obtained on the results. Cooperative research is a useful supplement to the research a company carries on individually for the strengthening of its competitive position, but it is in no sense a substitute.

It has been estimated that expenditures of trade and professional associations on technical research in 1957 would be about $20 million, only a fraction of the Nation's total research volume which has been estimated at more than $9 billion. Add to this $20 million the research outlay of agricultural and other types of associations, and the 1957 estimate for all cooperative organizations would be only about $26 million.

Such sums are only a fraction of the Nation's total research volume. As estimated by the National Science Foundation in a 1958 bulletin, the total for 1956 was $9 billion. The largest segments were said to be $6.5 billion expended by American industry (about one-half of which was Federal Government financed) and $1.4 billion directly performed by Federal Government agencies. Most of the remaining approximately $1 billion was expended by universities, foundations, associations and other nonprofit institutions (also partially Government financed), according to the NSF "Reviews of Data on Research and Development," May 1958.

It should be noted that of over 4,500 non-Government laboratories in this country, only 50 or so are owned by associations. Further,

these are small laboratories, having fewer than 150 employees each. In fact, only about 10 have as many as 50 staff workers.

The most extensive survey ever made of the volume of technical research supported by all types of cooperative organizations was one undertaken by Battelle Memorial Institute for the National Science Foundation: "Research by Cooperative Organizations, 1953." The results were published in 1956. More than 5,000 organizations were contacted, using the facilities of the U.S. Department of Commerce.

According to the survey, approximately 530 cooperative organizations spent $20.4 million in 1953 on technical research and development. About half of this amount was spent in association laboratories. Of the remainder, most went to universities and nonprofit research institutes, with a lesser amount to commercial and government laboratories and laboratories belonging to members of the associations.

Of the $20.4 million, trade and professional associations spent 72 percent, farm and other cooperatives about 28 percent:

	Percent
Trade associations	61
Professional associations	11
Total	72
Farm cooperatives	14
Other cooperatives	14
Total	28

Eighty-five percent of research financed by professional associations was in basic research. Conversely, trade associations concentrated 75 percent of their research funds on applied research, according to the 1956 publication, "Research by Cooperative Organizations," previously mentioned. For the purpose of this report, basic research is defined as the investigation of fundamental laws and phenomena of nature, and the compilation and interpretation of information on their operation. Applied research is defined as the pursuit of a planned program toward a definite, practical objective—a preconceived end result.

The 80 leading associations in the country accounted for about 80 percent of the $20.4 million. Of these, 30 actually financed over 50 percent of the research. Among all associations, the range of expenditures was from a low of $100 to the $1,700,000 spent by a single agricultural cooperative, the Hawaiian Sugar Planters Association.

As earlier stated, relatively few patents grow out of association-financed research, many associations making the results of their work freely available to the public. According to the Battelle Memorial Institute survey, "the consensus seems to be that the revenue to be derived from royalties is not sufficient to warrant extensive use of the patent system."

While many associations have a strong interest in product research, the larger proportion of association research money is spent in service

areas in which patentable items are not likely to be developed, such as:

1. Research on broad industry problems concerned with raw materials.
2. Testing of products and procedures.
3. General trouble-shooting research.
4. Acting as centers of information on basic and applied research of special interest to the industry.
5. The encouragement of research by every firm in the industry. (This activity is a part of the program of almost every association.)

34847—59——2

II. PATENT ARRANGEMENTS OF TYPICAL ASSOCIATIONS

The largest manufacturing industries in the United States are automobile and aircraft production. Each provides factory employment to as many as 800,000 persons. Both industries have been almost free of patent litigation for decades, due to cross-licensing agreements covering most of the patents in each area.

All manufacturers in these industries have received the benefit of multiple research. The patentees who donate their inventions to the industry-improvements common fund receive the benefits of most of the research carried on by all of the rival manufacturers in the industry.

The automobile industry, in its patent-sharing procedures, utilizes its regular trade association, the Automobile Manufacturers Association, organized in 1900. With a staff of about 100, the AMA, with headquarters in Detroit, carries on a wide range of association services.

In contrast, the manufacturers of airplanes have the Aircraft Industries Association of America, in Washington, D.C., as their national trade association; but have another association, the Manufacturers Aircraft Association in New York City, as a separate agency to administer cross-license agreements between aircraft manufacturers in the United States.

In 1915 all members of the Automobile Manufacturers Association agreed to exchange patent rights for 10 years. The arrangement has been renewed periodically, with certain restrictions. The latest (1952) agreement does not include all recently issued patents. However, it has become the custom of the industry to work out cross-licensing methods without litigation for practically all patent rights, with no, or only nominal, royalty fees.

The Manufacturers Aircraft Association was organized in 1917 to bring an end to patent friction and litigation. During the past 40 years patents of the members have been interchanged, either on a royalty free basis or on a license basis with fees fixed by the association after arbitration proceedings.

Detailed information on cross-licensing agreements is given in most standard works on patents. (See bibliography.) One example of studies published in law journals is "'The Patent System' in Law and Contemporary Problems," School of Law, Duke University, Durham, N.C. (pts. I and II). Because of the scope of the survey, its table of contents is presented in appendix B. Of special interest is the article on "Patents and Competition in the Automobile Industry," by C. A. Welsh.

As brought out on preceding pages, the comparatively few trade associations which operate research laboratories endeavor to avoid the problems which often accompany the management of patent rights. This also applies to those which finance association research in other agencies, such as universities. The patent policies of several associations are given below. They are believed to be typical of the policies of most trade associations.

American Bottlers of Carbonated Beverages.—Royalty free. A few patented products are sold by the association.

American Gas Association.—Royalty free. This trade association has one of the largest research budgets, especially for sponsoring projects in university laboratories.

American Iron and Steel Institute.—Patents are dedicated to the public. Most of this association's research is carried on in the laboratories of its members through specific project committees.

American Meat Institute.—Patents are dedicated to the public.

American Petroleum Institute.—Patents are dedicated to the public. The API has financed research projects at many universities, research institutes, and the National Bureau of Standards.

American Wood Preservers Association.—Small fees are charged for licenses of the few patents owned by AWPA; proceeds go to the research fund.

Douglas Fir Plywood Association, and the allied Plywood Research Foundation.—License fees for the use of association patents are charged to aid association research.

Lithographic Technical Foundation.—Results are normally published. In rare instances patent protection may be sought. Thereafter, any industry member may use royalty free.

National Canners Association.—Patents are dedicated to the public. The NCA has one of the largest association laboratories.

National Coal Association (Bituminous Coal Research, Inc.).—Some patents are licensed on a royalty free basis. Fees are charged for others, with the proceeds used for further research.

National Lumber Manufacturers Association (Timber Engineering Co.).—License fees are charged for some patents, and much of the research funds of TECO are derived from the sale of patent-protected connectors used in fastening timber beams together.

Tanners Council of America.—Small royalties are charged on some of the association patents.

United States Beet Sugar Association.—Patents are licensed on a royalty free basis "to all responsible applicants."

III. DIFFICULTIES OF PATENT MANAGEMENT

The associations contacted for this study stressed their belief that such nonprofit organizations are not, as a rule, able to deal effectively with all the problems of protecting patent rights and other phases of patent management. Associations prefer to avoid legal controversies on patent rights, with the attendant costs and delays in solving real or alleged conflicts. As stated by Dr. Vannevar Bush, former president of the Carnegie Institution of Washington, in his "Endless Horizons" chapter on "The Need for Patent Reforms" (p. 152):

> There are three primary defects in the system as it stands at present, considered in connection with the functions which it is called upon to perform in a modern complex technical world. The first defect arises by reason of the issuance by the Patent Office of an enormous number of patents, many of which should never be issued, chiefly because of an unduly low standard of invention. The second defect has to do with the excessive cost and delay in the litigation of patents, by reason of the present system of appeals. The third results from the difficulty met by the courts in handling scientific or technical questions without competent nonpartisan assistance.

IV. PRESIDENT'S CONFERENCE ON RESEARCH

Associations are fully aware of the problems referred to in the above quotations. The subjects of association research and association desire to avoid patent management problems were among the topics of discussion at a late 1957 national conference on research as it applies to small business.

Approximately 1,000 representatives from business firms and associations, including many experts from universities, met in Washington, D.C., at the President's Conference on Technical and Distribution Research for the Benefit of Small Business, September 23–25. It was the largest conference ever held in this field. Published proceedings are available from the Office of Technical Services, U.S. Department of Commerce. (See appendix B.)

About one-half of the delegates attended the some 15 roundtable discussions which were devoted to technical research. The above-mentioned difficulties of smaller firms in dealing with patent protection of inventions were discussed. Also mentioned was the fact that the federal governments of many other nations give direct financial support to the research activities of trade associations. The objectives in such nations are twofold: to encourage greater technical research by industry; and to strengthen smaller firms, through their associations, in their efforts to lessen the increasing concentration of business in the hands of dominant corporations.

No resolutions on such subjects were adopted, but references were made to two 1957 reports of the Senate Committee on the Judiciary: "Patents, Trademarks, and Copyrights," Senate Report No. 72, 85th Congress, 1st session (1957), and "Distribution of Patents Issued to Corporations (1935–55)," Senate Patent Study No. 3 (1957). The first-named report gives the following statistics, as derived from the second named (at p. 11):

> Thirty-eight corporations each received more than 1,000 patents, and 356 corporations each received between 101 and 1,000 patents. A selected group of 176 largest United States corporations, during the 1939–55 period, obtained 121,708 patents which represented more than 20 percent of the total issued.

Management details of the President's conference were largely in the hands of an advisory committee of businessmen set up by the U.S. Department of Commerce and the Small Business Administration, with the president of Pennsylvania State University as chairman.

The principal conference address on trade association technical research was delivered by T. E. Veltfort, managing director, Copper and Brass Research Association (and former president of the American Society of Association Executives). In his paper on "The Trade Association As a Source of Technical Research and Development Assistance to Small Business," the author stated that the above-

mentioned Battelle-National Science Foundation survey did not reveal all association expenditures and activities in this field:

> It should be pointed out that the Battelle survey somewhat understates the participation of trade associations in technical research * * * They may arrange to exchange technical information among members, organize a group or committee of technical experts from the industry and even undertake a certain amount of outside testing and investigative work, without classifying this as financially "supporting" technical research * * *
>
> While the largest amount of technical research funds were spent in association-owned laboratories, most of the projects were carried on in educational institutions * * *
>
> Generally, such research should be limited to problems of industrywide significance * * *
>
> Endowments and Government or private grants are occasionally available to finance research, but generally these are more likely to be made to technical and professional organizations than to trade associations * * * (pp. 79–84).

Following this important national conference on "Research for the Benefit of Small Business," the following six recommendations for future action were made:

> 1. The Department of Commerce and the Small Business Administration, utilizing their field facilities, should cooperate fully with chambers of commerce, trade associations, development organizations, universities, State and local governments and other appropriate groups in the organization and conduct of similar conferences at the regional, State, or local level.
>
> 2. The Department of Commerce and the Small Business Administration should take steps jointly to promote and facilitate the dissemination of technical and distribution research materials to small business through trade associations, the trade and technical press and larger companies.
>
> 3. The Federal Government should convene a meeting of representatives of colleges, universities and research bureaus to discuss ways of increasing and improving the services which educational institutions provide for small businesses in the fields of technical and distribution research and in business management generally.
>
> 4. The Federal Government should consider calling a second national conference for the benefit of small business, to be organized and conducted at a suitable time in the same manner as the recent conference. Special emphasis should be given in such a conference to the management problems of small business, including, but not confined to, the problems of technical and distribution research.
>
> 5. Federal procurement agencies should be asked to reexamine their policies and procedures with the object of increasing the participation of small companies in research and development contracts.
>
> 6. Federal Government agencies issuing publications dealing with technical and distribution research should be urged to give greater emphasis in the preparation of these publications to readability and to the commercial application of the subject matter (pp. 285–286).

V. CONCENTRATION OF RESEARCH; ASSOCIATIONS AND COMPANIES

In 1958, approximately one-half of the almost 2,000 national trade associations were featuring discussions on technical research at their conventions, sponsoring research conferences or using other means to encourage their members and their industries to be "research-minded" as to new and improved products and production techniques. Several hundred associations were cooperating with universities, Government agencies and research institutions in laboratory investigations—yet it is likely that more than one-half of all research expenditures were by some 30 national associations. The situation was probably somewhat similar to that summarized in the National Science Foundation's previously mentioned "Research by Cooperative Organizations, 1953."

A similar high degree of concentration in a comparatively few companies of the technical research done by individual concerns, is revealed in two Federal Government reports. In 1952, a survey was made for the Department of Defense by the U.S. Department of Labor resulting in a report entitled, "Scientific Research and Development in American Industry" (1953, 120 pp., 50 cents). As stated on page 1:

> Nearly 2,000 concerns, including almost all companies with large research programs, sent in usable questionnaires. These companies employed about 6½ million persons. * * * The study covered most of the industrial research and development work in the United States—probably about 85 percent of the total * * *."

It is stated elsewhere in the report that,

> research employees totaled almost 240,000, of which 96,000 were research engineers and scientists. * * * Approximately half of these were working on federally financed projects * * *. The largest 34 companies had 48 percent of all research employees, and 54 percent of all research expenditures. The largest 129 companies had 72 percent of the employees, and 78 percent of all expenditures on research.

There are at least 50 giant companies with 1,000 or more researchers, each. These are named in appendix A, compiled for this report from the latest (1956) edition of "Industrial Research Laboratories of the United States." This top group in research (and patents) activities have some 3,500,000 employees, including 150,000 technical research specialists.

In 1956, an even more extensive survey was made by the U.S. Department of Labor for the National Science Foundation, resulting in the 1956 NSF report, "Science and Engineering in American Industry" (120 pp., 70 cents). Approximately 20,000 firms were studied. They had some 400,000 employees in research and develop-

ment, of which 157,000 were scientists and engineers. As stated on page 4:

> Research and development activities are centered in large companies. The 400 companies with 5,000 or more employees did over 70 percent of the research and development work. The average ratio of research and development cost to value of sales was 1.7 percent for large- and medium-size companies.
>
> About nine-tenths of the total cost of industrial research development was accounted for by these nine industries: Aircraft, electrical equipment, motor vehicles, chemical, machinery, professional and scientific instruments, petroleum, telecommunications, and fabricated metal products. The first two had two-fifths of the grand total for all industries.

From the above two studies it is seen that an overwhelmingly large proportion of research conducted by American business, with its 4,300,000 enterprises in 1958, is done by a few hundred firms of comparatively giant size. Only through cooperative effort, such as through the medium of trade associations, can most smaller firms financially arrange for direct participation in technical research.

Of all business enterprises, about 95 percent have 20 employees or less—and 4 percent have from 20 to 100 employees. Thus, only 1 percent of all American business have more than 100 full-time workers. Of the more than 300,000 manufacturing firms, only 6 percent have more than 100 employees and 12 percent have more than 50 full-time workers. The great majority of members of the Nation's trade associations are firms of "smaller business" size.

VI. LARGEST FIELDS OF U.S. EMPLOYMENT IN 1957–58

The population of the United States reached 175 million in 1958. This is a 23 million increase since 1950. Decades ago, agriculture was the foremost employer. Now, business fields (marked with asterisks in the table below) are the largest job providers, and include about two-thirds of the 1957 total of 69 million employees, employers, and self-employed. Manufacturing is the leading single field, with about 25 percent; retailing is second; agriculture is third.

Most of the 3 million business employers, and many of the over 1 million no-employee business units, are members of the 2,000 national mutual aid organizations of businessmen. Well-managed associations constantly encourage research and business promotion to insure high levels of employment. Some 30,000 persons serve as staff employees of the 2,000 national associations and their 10,000 local area affiliates.

1957–58 Employment

"Job providing" field	Number	Percent	A typical larger staff association
	Million		
Total	69	100	
Manufacturing*	17	25	Automobile Manufacturers Association.
Retail trade*	9–9½	14	National Retail Merchants Association.
Agriculture	6–7½	10	American Farm Bureau Federation.
Government (local)	5	7	United States Conference of Mayors.
Construction*	4	6	Associated General Contractors of America.
Transportation*	3½	5	Association of American Railroads.
Services (business)	3½	5	American Hotel Association.
Services (professional)*	3	4	National Association of Accountants.
Government (Armed Forces)	3	4	Association of the U.S. Army.
Wholesale trade*	3	4	National Wholesale Hardware Association.
Finance, insurance, real estate*	2½	4	American Bankers Association.
Government (Federal)	2½	4	
All other: Utilities*, mining*, domestic services.	5	7	American Petroleum Institute.

Sources: U.S. Department of Commerce. "Survey of Current Business," February 1958, and "National Associations of the United States" (and supplements).

34347—59——3

VII. THIRTY TYPES OF MUTUAL AID SERVICES OF TRADE ASSOCIATIONS IN THE UNITED STATES

What is the relationship of technical or industrial research by associations to the 30 typical activities of representative nonprofit organizations of businessmen?

Almost one-half of the nearly 2,000 national trade associations of businessmen in the United States are limited in size of staff, having five persons or less, so that a full program of activities cannot be carried on. Most of the some 10,000 local area associations are affiliated with these national groups, according to a U.S. Department of Commerce (Office of Technical Services) publication, "Directory of National Trade Associations: 1956." The number of such organizations has doubled since 1930.

Listed below are the 15 major activities of the average national associations of manufacturers; also, the 15 areas of activity which, in most industries, are of lesser importance. With staff assistance, committees of association members are appointed to study over, and held find solutions to, these specialized problems of the industry. It will be seen that the encouragement of industrial research is usually a continuing service of a majority of the national organizations.

A. FIFTEEN MAJOR OR PRIMARY SERVICES OF TRADE ASSOCIATIONS

(1) Serving as the industry's center of information on business facts and problems affecting the industry's employers, employees, and customers.

(2) Issuing frequent (weekly, etc.) bulletins.

(3) Sponsoring frequent conferences and annual conventions.

(4) Keeping in touch with trade and professional associations in all related industries.

Engaging in:

(5) Government relations and legislative research: Federal and local.

(6) Industrial research: Encouraging members to realize the vital importance of technical research, to find new or improved products or manufacturing techniques. Only a small percent of associations provide financial support to a considerable extent, such as is required to establish an association laboratory.

(7) Commercial research: To find wider and more profitable markets.

(8) Public relations activities: The increase of consumer goodwill.

(9) Sales promotion of the industry's products.

(10) Labor relations in general. (Few regular trade associations, however, go so far in employer-employee services as to act as the industry's collective bargaining agency for employers.)

(11) Statistics: Chiefly, republication of useful data from Government agencies and all other sources on current production, sales, etc., so that each member will have latest information on industry trends. Also economic planning surveys, that is, long-range studies of possible future years' trends as to competition from other industries, raw material supplies, production and distribution improvements, etc.

(12) Uniform cost accounting and industry surveys of costs of production and distribution.

(13) Standardization, simplification, inspection, grading and certification.

(14) Studies of trade practices, unfair competition, and business ethics (false advertising, defamation of competitors, etc.).

(15) Commercial arbitration, between members, or between members and customers, both in domestic and in foreign trade.

B. FIFTEEN MINOR OR SECONDARY SERVICES OF TRADE ASSOCIATIONS

As a general rule, these services are of lesser importance in the program of a trade association of national scope than those listed above.

(1) Foreign trade promotion: This would include surveys of foreign markets, tariffs, regulations, export and import statistics, and so on.

(2) Legal advice on broad industry problems, but not acting as general legal adviser for individual members.

(3) Credit problems: This would also include studies of the industry's financing, credit, collection, cash discount, etc., practices. A small percent of associations operate an industry credit bureau.

(4) Insurance aid; also fire and accident prevention studies.

(5) Traffic problems; also some prepare freight rate books.

(6) Warehousing, packaging, and related problems.

(7) Patents, copyrights, trademarks and designs services.

(8) Field services, and branch office assistance.

(9) Exhibitions of the industry's products at trade shows. Most of the Nation's some 3,000 exhibitions each year are held by, or in cooperation with, trade associations.

(10) Aid in the exchange or resale of excess machinery and equipment.

(11) Operation of an employment placement bureau.

(12) Cooperation with trade associations in Canada, England, etc.

(13) Engineering and inspection assistance.

(14) Specialized services: library, visual aids, management research, conservation.

(15) Cooperative buying and selling. Only a small percent of businessmen's associations are active in cooperative buying or selling (however, these are major services of farmers associations).

A recent textbook on the activities of association management is a 1956 publication of 310 pages, "Trade Association Law and Management" by G. P. Lamb and S. S. Kittelle. (See bibliography.) The part which associations play in the research and other problems of smaller firms is thus summarized (p. 19):

> Trade associations contribute to the preservation of small business by making it possible for the small firms to pool

resources and secure industry information and know-how which would otherwise be available only to large firms.

Macy's, General Motors, and du Pont in their respective fields have financial resources which enable them to collect whatever economic data they may need, and to carry out any scientific or other research they may think valuable.

Smaller firms that compete with these or with lesser industrial giants cannot afford such projects individually. It is perhaps not an exaggeration to say that small business in many fields would all but disappear unless there were some central agency—such as a trade association—to assist them in procuring necessary business information.

VIII. ASSOCIATIONS WITH LARGER RESEARCH EXPENDITURES

A few important associations, such as the American Petroleum Institute and the Sugar Research Foundation, use only the facilities of universities and research institutes. However, the majority of the leaders have their own association-owned laboratories; some also support outside research. Those with the largest number of research employees are named in table A, below, while considerable detail on the current work of representative associations is given later in this report.

TABLE A.—*Some leading associations as to number of employees in association-owned laboratories in recent years*

Association	Headquarters city	Laboratory employees
American Meat Institute Foundation	Chicago, Ill	75 to 125.
Association of American Railroads	Washington, D.C	Do.
Portland Cement Association	Chicago, Ill	Do.
National Canners Association	Washington, D.C	50 to 60.
National Coal Association (Bituminous Coal Research, Inc.)	do	Do.
American Gas Association	New York, N.Y	30 to 40.
National Lumber Manufacturers Association	Washington, D.C	Do.
Structural Clay Products Institute Foundation	Geneva, Ill	Do.
Tanners Council of America	New York, N.Y	Do.
American Institute of Baking	Chicago, Ill	15 to 25.
American Dry Milk Institute	do	Do.
American Institute of Laundering	Joliet, Ill	Do.
American Newspaper Publishers Association	New York, N.Y	Do.
Asphalt Institute	Washington, D.C	Do.
Douglas Fir Plywood Association	Tacoma, Wash	Do.
Lithographic Technical Foundation	New York, N.Y	Do.
National Cotton Council	Memphis, Tenn	Do.
National Institute of Dry Cleaning	Silver Spring, Md	Do.
National Printing Ink Research Institute	Bethlehem, Pa	Do.
Sulphite Pulp Manufacturing Research League	Appleton, Wis	Do.

Source: Trade Association Division, OTS, U.S. Department of Commerce.

The names and addresses of 320 trade and professional associations of national scope which, out of the some 3,000 larger organizations, have been especially active in promoting technical research are given in appendixes E and F. Three short lists below (tables B, C, and D) name some 50 representative associations which at varying times have lead in annual expenditures among the association-owned laboratories.

TABLE B.—*Some associations with $100,000 or more annual research expenditures in recent years*

American Gas Association	420 Lexington Ave., New York, N.Y.
American Iron & Steel Institute	150 East 42d St., New York, N.Y.
American Meat Institute Foundation	939 East 57th St., Chicago, Ill.
American Newspaper Publishers Association	750 3d Ave., New York, N.Y.
American Petroleum Institute	50 West 50th St., New York, N.Y.
Anthracite Institute	237 Old River Rd., Wilkes-Barre, Pa.
Association of American Railroads	Transportation Bldg., Washington, D.C.
Automobile Manufacturers Association	New Center Bldg., Detroit, Mich.
Automotive Safety Foundation	1200 18th St., Washington, D.C.
Bituminous Coal Research, Inc. (affiliate of National Coal Association).	Southern Bldg., Washington, D.C.
Corn Industries Research Foundation	1001 Connecticut Ave., Washington, D.C.
Hawaiian Sugar Planters Association (farmers and sugar refiners).	Honolulu, T.H.
National Canners Association	1133 20th St., Washington, D.C.
National Coal Association. (See Bituminous Coal Research, Inc.)	
National Lumber Manufacturers Association (Timber Engineering Co.).	1319 18th St., Washington, D.C.
National Paint, Varnish & Lacquer Association.	1500 Rhode Island Ave., Washington, D.C.
National Vitamin Foundation	149 East 78th St., New York, N.Y.
Pineapple Research Institute of Hawaii (farmers and canners).	25 Dole St., Honolulu, T.H.
Portland Cement Association	33 West Grand Ave., Chicago, Ill.
Steel Founders Society of America	Terminal Tower, Cleveland, Ohio.
Structural Clay Products Research Foundation.	Geneva, Ill.
Tanners Council of America	411 Fifth Ave., New York, N.Y.

Source: Trade Association Division, OTS, U.S. Department of Commerce.

TABLE C.—*Leading associations, ranked as to technical research expenditures about 25 years ago*

American Gas Association	$200,000
National Canners Association	174,000
Portland Cement Association	125,000
American Petroleum Institute	100,000
National Lumber Manufacturers Association	100,000
National Electric Light Association	100,000
National Paint, Varnish & Lacquer Association	50,000
Tanners Council	40,000
American Refractories Institute	40,000
Glass Container Manufacturers Institute	30,000
Malleable Founders Society	30,000
National Institute of Dry Cleaning	25,000
Biscuit & Cracker Manufacturers Association	25,000
Structural Clay Products Institute	20,000
National Sand & Gravel Association	20,000
American Institute of Steel Construction	20,000
Asphalt Institute	18,000
Evaporated Milk Association	17,000
American Dry Milk Institute	15,000
Gray Iron Founders Society	15,000

Source: "Profitable Practice in Industrial Research," pp. 198–201, 1932. (Edited by Malcolm H. Ross National Research Council.) Harper Bros., New York.

The net number of organizations in tables A and B is 31. The 23 named in table D, below, are among those trade associations (or their affiliated research foundations or institutes) which have been as large in individual years as some of the 31 leaders.

TABLE D.—*Additional associations with appreciable research expenditures*

Aircraft Industries Association	Shoreham Bldg., Washington, D.C.
Alloy Casting Institute	286 Old Country Rd., Mineola, N.Y.
American Bureau of Shipping	45 Broad St., New York, N.Y.
American Dairy Association	20 North Wacker Dr., Chicago, Ill.
American Pharmaceutical Manufacturers Association.	30 Rockefeller Plaza, New York, N.Y.
American Potash Institute	1102 16th St., Washington, D.C.
Association of American Soap & Glycerine Producers.	295 Madison Ave., New York, N.Y.
Electronics Industries Association	1721 De Sales St., Washington, D.C.
Glass Container Manufacturers Institute	99 Park Ave., New York, N.Y.
Manufacturing Chemists Association	1625 I St., Washington, D.C.
National Association of Home Builders	1625 L. St., Washington, D.C.
National Clay Pipe Manufacturers, Inc	1820 N St., Washington, D.C.
National Dairy Council	111 North Canal St., Chicago, Ill.
National Safety Council	425 North Michigan Ave., Chicago, Ill.
Nutrition Foundation	99 Park Ave., New York, N.Y.
Pennsylvania Grade Crude Oil Association	Box 96, Oil City, Pa.
Railway Wheel Association	445 North Sacramento Blvd., Chicago, Ill.
Sugar Research Foundation	52 Wall St., New York, N.Y.
Tile Council of America	800 2d Ave., New York, N.Y.
Tin Research Institute	492 West 6th Ave., Columbus, Ohio
Underwriters Laboratories	207 East Ohio St., Chicago, Ill.
Western Pine Association	510 Yeon Bldg., Portland, Oreg.
Wine Institute	717 Market St., San Francisco, Calif.

The listings on previous pages include most of the trade associations which are comparatively heavy supporters of technical research. Included are a few farm producer-food processor groups, such as the Pineapple Research Institute. Not included are a number of professional organizations which devote appreciable sums to laboratory or other research. Examples of these are listed in table E.

TABLE E.—*Some leaders among professional associations*

American Association of Textile Chemists & Colorists
American Dental Association
American Electroplaters Society
American Institute of Chemical Engineers
American Medical Association
American Oil Chemists Society
American Society of Mechanical Engineers
American Society for Testing Materials
Engineering Foundation

IX. RESEARCH PROGRAMS OF 32 ASSOCIATIONS

American Bakers Association (American Institute of Baking), Chicago, Ill.: Nutrition and food composition, food spoilage, food processing.

American Bottlers of Carbonated Beverages, Washington, D.C.: Soft drink technology, including bottle washing, disinfectants, sugar, water, and etiology of product deviation.

American Dry Milk Institute, Chicago, Ill.: Nonfat dry milk solids, dry whole milk, dry buttermilk solids, dry whey solids, physical and chemical properties, utilization, quality control, standards development.

American Gas Association, New York, N. Y.: Domestic, industrial, and commercial fuel gas utilization, mixing and substituting gases in gas production, and the basic design principles of burners, appliances, and accessories.

American Institute of Laundering, Joliet, Ill.: Commercial laundry procedures, textile laundering qualities.

American Meat Institute (American Meat Institute Foundation), Chicago, Ill.: Bacteriology, histology, composition, and nutritive value of meat and meat products; composition, processing, and utilization of animal fats; radiation and high frequency sterilization, dehydration, and curing; nutritive value of animal protein feeds; toxicity studies of chemicals; antioxidants.

American Newspaper Publishers Association, New York, N.Y.: Chemistry, physics, photography, stereotyping, as applied to graphic arts in newspaper printing.

Anthracite Institute, Wilkes-Barre, Pa.: Development and improvement of equipment for utilization of anthracite; consultant and advisory work for manufacturers in connection with improvement and testing of equipment.

Asphalt Institute, College Park, Md.: Asphalt paving for highways and airports; use of asphalt for water control and prevention of erosion, including revetments, reservoir and canal linings, dam facings, and earth dam core walls; prevention of underground seepage; properties, tests, and specifications for asphalt.

Association of American Railroads, Washington, D.C.: Improvements in design, specification, and use of the elements composing tracks, bridges, and rolling stock; containers for shipping; sanitation.

Association of Manufacturers of Chilled Car Wheels, Chicago, Ill.: Development of metals and designs to produce maximum wear resistance and strength in car wheels. Studies are based on castings produced in an electric melting furnance and cupola and tested in the association's wear, impact, tensile, and hardness-testing machines. Control and basic research; ferrous metallugy in connection with chilled tread cast iron railroad car wheels. (The name of the above was changed to Railway Wheel Association in 1957.)

Douglas Fir Plywood Association, Tacoma, Wash.: Douglas fir plywood quality control and product applications; mechanical and

physical properties; glue bond performance; structural applications; finishing and sealers; plastic overlays and allied products.

Lithographic Technical Foundation, Inc., New York, N.Y.: Chemical, physical, and engineering research for the improvement of materials, methods, and equipment for the lithographic industry.

National Canners Association, Washington, D.C.: Chemistry, bacteriology and technology of foods; sterlization processes of acid and nonacid foods; bacterial spoilage; standards for canned foods; sanitation and waste disposal in canning plants.

National Coal Association (Bituminous Coal Research, Inc.), Washington, D.C.:

At the Pittsburgh laboratory: New equipment and processes for the improved utilization of bituminous coal for industrial, railroad, residential and gasification uses; smoke and fly ash control; coal refuse and waste product utilization; coal preparation; properties of coal; coal for chemical, metallurgical, and process uses; engineering economics.

At the Dunkirk, N.Y., laboratory: Coal-burning gas-turbine locomotives; pressurized combustion of pulverized coal at high rates of heat release; controlled feeding of coal under pressure conditions; cleaning hot pressurized combustion gas.

At the Huntington, W.Va. laboratory: New methods and machinery for continuous mining of bituminous coal; materials handling related to coal mining.

National Crushed Stone Association, Washington, D.C.: Aggregates used in concrete, bituminous concrete, ballast, etc.; flexible pavement design.

National Independent Meat Packers Association, Washington, D.C.: Meat foods and pharmaceuticals; fats and oils; shortening and lard; animal feeds; animal and human nutrition.

National Institute of Drycleaning, Washington, D.C.: Detergency in nonaqueous solvents; purification of dry-cleaning solvents; drying of organic solvents from textiles; testing of products sold to the dry-cleaning industry; methods of handling new fabrics; causes of fabric damage; chemistry of various staining substances.

National Lumber Manufacturers Association (Timber Engineering Co.), Washington, D.C.: All fields of wood, such as physical properties, chemistry, preservation, and commercial utilization of waste products.

National Paint, Varnish & Lacquer Association, Washington, D.C.: Development of testing methods.

National Potato Chip Institute, Cleveland, Ohio: Growing, transporting, storing, and selecting of potatoes best adapted to potato chip processing; improvement of color of potato chips; deterioration of fats and oils at high temperatures; use of antioxidants in delaying rancidity; packaging of chips for longer shelf life.

National Printing Ink Research Institute, Bethlehem, Pa.: General problems of the printing ink industry; standard testing methods; adequate testing instruments; production problems, such as loss due to drying and livering; utilization of new types of raw materials; fundamental studies in printing ink rheology, transfer of fluids and dispersions from one surface to another, and dispersion of pigments in fluids.

34347—59——4

National Sand & Gravel Association, Washington, D.C.: Properties and uses of mineral aggregates, particularly in the construction field; methods of evaluating and improving aggregate performance; properties of concrete and factors affecting quality and methods of improving performance.

Pennsylvania Grade Crude Oil Association, Oil City, Pa.: Recovery of petroleum from depleted reservoirs by water-flooding and air-and gas-drive methods.

Plywood Research Foundation, Tacoma, Wash.: Plywood; wood waste utilization; machine improvement.

Portland Cement Association, Chicago, Ill.: Cement, concrete, and allied materials (in the largest laboratory of any trade or professional association devoted primarily to research).

Quality Bakers of America Cooperative, New York, N. Y.: Control and improvement of ingredients; cooperative experimental work with other research agencies on new developments affecting the baking industry; new bakery products and processes; dough properties.

Structural Clay Products Research Foundation, Geneva, Ill.: Architectural and structural research; industrial engineering; lightweight aggregate research; ceramics; acoustics; fundamental research.

Sulphite Pulp Manufacturers Research League, Appleton, Wis.: Lignin and carbohydrate components of spent sulfite liquor; process and produce development work on torula yeast and furfural from sugars; dispersing, adhesive, foaming and soil-stabilization agents from lignosulfonates; methods of eliminating stream pollution, including evaporation and burning of spent sulfite liquor.

Tanners Council, New York, N. Y.: Product improvement, skin and leather chemistry; tanning technology.

Underwriters Laboratories, Chicago, Ill.: This organization is sometimes classified as an association laboratory, because it was formed by the National Board of Underwriters in 1894. However, it is an independent agency, devoted to testing and allied services rather than to research. Its staff of over 600 persons make investigations and tests of electrical and all other devices, materials, and systems which pertain to fire, life and automotive hazards, and also to theft and accident prevention.

Western Pine Association, Portland, Oreg.: Product improvement and new products; increased utilization of woods and mill wastes; byproducts; industrial engineering assistance to member mills.

X. TRADE ASSOCIATION RESEARCH ABROAD

In Europe, the concept of cooperative research by a number of firms in an industry has become well established. In fact, it is a favorite technique for accomplishing both basic and applied research. One who examines the many facets of research in this country and in Europe is struck with the relative emphasis upon cooperative work abroad.

With few exceptions, no Federal funds are given to associations in the United States to start them in the field of technical research, or to assist them in carrying on research already started. This is in sharp contrast to the situation in many other countries. For example, most of the associations in the United Kingdom first engaged in technical research because of offers from the British Government to aid them financially. In many cases the Government agreed to advance 1 pound for every 2 or 3 pounds raised by industry to carry on research in its field.

It has been argued that the lessened pressures of competition, with a stronger reliance on combined effort within European industry, have been important factors. Equally, it has been said that industrial organizations abroad are not so heavily capitalized and, therefore, find it more necessary to finance the costs of research through joint ventures. In the United Kingdom, where these efforts have had their strongest flowering, the Government has provided "seed" money to give groups of firms the incentive to create their own research associations.

It appears that shortly after World War I there was a realization in England that they must augment their industrial research facilities and programs. This appreciation, coupled with the strong support of a leading British statesman, Lord Haldane, markedly contributed to the research association plan with funds provided through the Department of Scientific and Industrial Research. Over the years this activity has flourished, until there are now 48 research associations in England. It is interesting to note that funds furnished by the British Government have been more than matched by industry's own financing. This is sound evidence of the value of the work to the member firms. Further, it spurs interest in the projects and acceptance of the results.

While research associations or their equivalents are seen in most of the countries of Europe, the pattern varies, depending upon the national economy and the special needs of domestic industry. In Italy, one finds Government domination, but relatively little commercial acceptance as compared with England. In Sweden, ndustry association research is one part of a broad pattern of cooperative activity. Nevertheless, in all countries, leading manufacturing firms carry out their own research in their own laboratories in addition to participating in combined projects. Of course, the results of single company financed work are retained for the individual company's benefit.

It is important to note that cooperative research is normally restricted to problems common to an entire industry. This is natural since it is only on broad problems of concern to a number of companies that one can expect industrywide financial support and application of the findings. The indirect result of this situation is that a cooperative group rarely tackles product research which leads to patents; nor does it look into the most challenging and newest developments facing an industry. Such proposals are normally handled by the individual firms, as they are in this country. Thus, cooperative research at home or abroad is a supplement, a very useful supplement, but in no sense is it a replacement for the firm's own individual effort.

While it is not of major importance at this time, the cooperative research activities of the European Productivity Agency merit attention. EPA, an offshoot of the Organization for European Economic Cooperation, has as one of its committees a multigovernmental group which formulates and administers cooperative research programs. Here they address themselves to research problems of concern to the several countries comprising OEEC. For example, they have an active research program on marine corrosion. Another program relates to exploring the industrial uses of peat. One of their pioneer efforts was work on the low-shaft blast furnace, which promises certain industrial and commercial advantages. In addition to sponsoring research, EPA constitutes a forum for the exchange of research information between the member countries, and thus merits attention as a device for breaking down international barriers.

A recent development in Europe is the creation of affiliates of American research institutes. At this time, four leading United States institutes have in being or under development the creation of European laboratories staffed by Europeans. It is too early to predict how these will fit into the cooperative research pattern in Europe, but it seems fair to say that they will play a part, probably as laboratories accepting contracts from trade associations and like cooperative groups.

To enlarge on the diversity of research association techniques abroad, a few examples will be given. First, is the Shirley Institute in the United Kingdom. This research association was one of the early efforts supported by the Department of Scientific and Industrial Research. Its creation reflected an awareness of the need to modernize the British textile industry.

The steady growth of this organization is reflected in its finances. Starting with an annual expenditure of £4000 in 1920, it rose in 1929 to £51,000, in 1931 to £93,000, and 1955 to £312,000. Some part of this money was derived from public funds through annual grants made by the Department of Scientific and Industrial Research. It is interesting to note that the industry's own recognition of the value of this research has resulted in an agreement for a statutory levy, which presently contributes the sum of £225,000 to the annual income of the institute.

The control of the Shirley Institute is vested in a council of 50, drawn from all the contributing sections of the industry. Although the institute was set up originally to benefit the firms producing cotton fabrics, it now contains a rayon and a silk research section. This recognizes the importance of these synthetics to the welfare of the textile industry at large.

The Shirley Institute, like most of its parallel organizations in British industry, contains a liaison department with the firms it serves. This branch is staffed by practical men drawn from the industry and further trained in research at the Shirley Institute, who pay regular visits to all members. This provides a direct method of distributing the results to those best fitted to put them to use. These visits run over 4,000 a year. It should be noted that this liaison has double benefits since, in addition to bringing the results of new research to the industry, the liaison officers bring back to the laboratory new problems from industry which require scientific attention.

As earlier stated, cooperative research is normally restricted to the consideration of problems of general interest to the industry. This means that all members are entitled to all the research results at the same time. Nevertheless, it is a fact that there are inventive developments which can be best introduced by a single firm being the first in the field. This precedence furnishes a justification for the risks of promotion and introduction of a new development. Those concerned with the Shirley Institute have recognized this problem and have sought to solve it by the creation of a separate association known as Shirley Developments, Ltd. The sole purpose of this association is to exploit the discoveries and inventions of the institute, primarily for the benefit of the British textile industry. The control of the company is vested in a board of seven directors. Further, the company becomes the prime licensee of all the Shirley patents, with authority to grant sublicenses for manufacture and sale on a royalty basis.

Those concerned with the direction of the Shirley Institute state that the 30 years of continuous experience has built up a mass of scientific knowledge which is being more and more used in the solution of current problems. In other words, the institute is becoming as valuable for its stored and recorded information as for its ability to make new discoveries. This points up the fact that many firms, particularly the smaller ones, may think that they need research when their requirement will be satisfied simply by better access to existing pertinent facts.

In France, the wide variety of problems, the considerable financial outlays, and the scarcity of skilled research workers have also led private firms to pool their efforts in research. In that country there are several such research institutes which serve one branch of industry or one group of firms in a given trade. It is interesting to note that these centers are normally financed by the industry benefited, but they have acquired official recognition by an order of the Ministry of Industry. Like British associations, they maintain a close liaison with industry in order to keep their knowledge of industrial problems up to date and to reveal directly to companies, through conferences, their successful findings.

The revenue for these centers may be derived from subscriptions from the branch of industry concerned, by fees for special services rendered, or by subsidy donations and legacies. In the case of the petroleum industry there is a sales tax, i.e., 8 centimes per liter of petrol. In the iron and steel industry the tax is 84 francs per ton of ordinary steel. These are the primary funding sources for the centers; they provide over 90 percent of the total funds available.

The pattern of cooperative research in the Netherlands does not markedly differ from that earlier and generally described. However,

in addition to research institutes serving various sectors of industry there is a large national center of applied research known as the TNO Institute. This large national laboratory combines research for industry at large, with special services for firms through contracts. The "free" research is financed by the Government; the appropriate industry, either individually or through groups of cooperating firms, finances the special studies. In addition, the research institutes which have been formed for the exclusive benefit of a particular industry often develop a working affiliation with the central TNO organization.

As might be expected, cooperative research institutes are well known and highly regarded in Sweden. One of the earliest is the Swedish Iron Masters Association, which dates back to 1747. This association contains a division called the Research Council. This division sponsors substantial research with the actual work usually performed in various steel companies and foundries. There is a coordinating body for the several research commissions under the Royal Academy of Technical Science. In Sweden, there are often formal contracts between the Government and the industry benefited, under which the Government provides buildings and certain services, and in addition pays the salaries for basic research. Industry, on the other hand, accepts the responsibility for providing instruments to cover the normal running expenses and for the applied research staff. These agreements are usually made for 5-year periods. The industrial support is normally provided through the pertinent industrial research association.

In closing, we note that those in Europe charged with spurring productivity clearly recognize the importance of applied research to their objective. Currently, their efforts in individual countries and through the European Productivity Agency give more attention to the stimulation of applied research by individual firms than by cooperative methods. This appears to be a recognition that cooperative research is already making a strong and solid contribution to productivity in Europe, and additional stimulus is little needed. Rather, it is through promotion of research by individual firms, leading to new products or process improvement, that research can now spur productivity in the industrial societies of Europe.

A list of 46 British research associations, together with data on annual expenditures, is presented in appendix G.

XI. DETAILS ON CURRENT RESEARCH OF 10 TRADE ASSOCIATIONS

1. NATIONAL LUMBER MANUFACTURERS ASSOCIATION (TIMBER ENGINEERING CO.)

Testing facilities arranged by the National Lumber Manufacturers Association, the largest association in the wood products industry, have been expanded to include a wide range of conventional and specialized equipment for evaluating the performance qualities of wood products and processes. These facilities range from a 200,000-pound machine, which tests wood roof trusses and glued laminated ship timbers, to instruments for microscopic examination of wood finishes. The association has a technical staff of over 30 persons in its research affiliate, Timber Engineering Co. (TECO,) dedicated to advancing the use of wood as an engineering material, was established in 1933 by the lumber industry as an incorporated affiliate of the NLMA.

In 1943, TECO broadened the scope of its initial objective with the opening of its wood research laboratory in the Nation's Capital. Testifying to the value of the laboratory's services are 4 major expansions of its plant and facilities in 14 years—expansions required to meet the wood industry's research needs and opportunities.

The newly enlarged laboratory, officially opened in November 1956, is more than five times the size of the first building. The TECO Laboratory is well equipped to handle virtually all phases of research and development in wood products and processes, including comprehensive tests and evaluations, and surveys of markets and individual plant operations.

The TECO connector system of construction, introduced to America's designers and builders nearly a quarter of a century ago, broadened the applications of engineering principles to wood, opening the way for new concepts in timber design for light and heavy construction. The TECO system is based on the use of wedgefit split ring connectors and shear plates that spread loads more evenly throughout timber joints, enabling each joint member to apply its full strength. The simplicity of installing TECO connectors and assembling the wood structures without jigs speeds up building schedules, reflecting lower labor costs.

Engineered wood roof trusses, once limited to heavy structures, were introduced into the light construction field by TECO trussed rafters in 1946. Since then, they have been used in nearly 200,000 dwelling units. By eliminating load-bearing partitions, clear-span TECO trussed rafters give architects more freedom of interior planning, and enable builders to speed up completion.

In a new service started in 1956, home builders in key cities were shown how to build wood roof trusses with TECO connectors, and use Trip-L-Grip framing anchors, in full-scale demonstrations by personnel from the laboratory.

Further impetus stems from Timber Engineering's distribution of free technical data and typical designs to practicing and student architects and engineers and informative literature to builders to guide them in making the most efficient use of wood in their structures.

"Timber Design and Construction Handbook" is designed for the convenience of architects and engineers and instructors and students in these professions. It provides a single source of concise, reliable, and essential information needed to design and construct the best, most economical structures in wood.

It was prepared with the cooperation of the National Lumber Manufacturers Association, West Coast Lumbermen's Association, Western Pine Association, Southern Pine Association, American Institute of Timber Construction, American Wood Preservers Institute, and Douglas Fir Plywood Association.

Latest and most significant milestone in the TECO laboratory's growth is its new, fully equipped, and highly flexible pilot plant for the development of wood particle board, newest byproduct of improved utilization practices in the lumber and wood product industries.

As its name implies, particle board can be made of any raw wood material, sizes and shapes unsuitable for traditional lumber or wood products, such as forest thinnings, slabs, edgings, trimmings, shavings, and even sawdust.

Particle board is a valid and versatile material, presently used in furniture and door cores, decorative wall paneling, store and display fixtures, and other products using sheet material.

Consistent citing of research needs by industry leaders has resulted in a steadily rising volume and variety of industry demands for laboratory services.

Wood chemistry, oldest and most prolific field of research in the utilization of forest products, offers unlimited opportunities in the development of new products for increased sales, and new processes for improving wood's performance.

TECO's new, 3,500-board-foot-capacity Moore dry kiln provides added facilities for studies in improved seasoning methods. The kiln will serve as a curing chamber for glued and laminated products, a controlled temperature and humidity room for quality control work, and as a conventional kiln for drying lumber.

The laboratory has long been a leader in the application, testing, and evaluation of new wood adhesives and advanced gluing and laminating techniques.

This affiliate of the National Lumber Manufacturers Association is now self-supporting, with nominal fees for the use of the patented TECO connectors and its revenue from varied laboratory service in wood products for both member and nonmember.

2. PORTLAND CEMENT ASSOCIATION

With a research staff of over 120 persons, the association's $3 million laboratories located 16 miles northwest of Chicago are the largest and most completely equipped in the world devoted exclusively to research on cement and concrete. Dedicated in 1950, they contain more than 98,000 square feet of floor space.

The association also maintains a staff of research scientists at the National Bureau of Standards, U.S. Department of Commerce, in

Washington, D.C. They are working under a cooperative fellowship set up to study basic problems relating to the constitution and properties of portland cement.

The field organization of the association includes more than 350 engineers, architects, and farm specialists working out of 32 district offices, in addition to 200 other staff employees at the laboratories and at the headquarters offices.

A survey conducted by the American Concrete Institute Committee on Research has disclosed that engineering colleges and private and governmental agencies are engaged in more than 350 different research projects involving portland cement and concrete. The Portland Cement Association is actively cooperating in many of these projects.

It is association policy to make all scientific discoveries, new developments, and patentable inventions relating to cement and concrete fully, freely and immediately available to the public.

Since 1916, when the Portland Cement Association established its research laboratories in Chicago, many important contributions have been made to concrete technology.

The water-cement ratio principle of proportioning concrete mixtures was among the earliest and most far-reaching developments of association research. Another important contribution is the development of air-entraining portland cement to resist severe frost action and pavement scaling when certain chemicals are used to melt pavement ice. Pressure-grouting to stabilize railway and highway subgrades and tunnels, and soil-cement for low-cost light-traffic paving on roads, streets and airports are other important developments.

In addition to research conducted in the association's large laboratories near Chicago, numerous field projects are in progress in many widely separated sections of the country, in low and high altitudes, in States with severe winter climate and in semitropical areas.

A far-reaching research project relating to portland cement is the longtime study of the performance of portland cement in concrete, started in 1940. This project is financed by the association and conforms to a program prepared by an advisory committee made up of eight prominent research engineers and scientists outside the cement industry and four directly representing the industry. The basic purpose of the investigation is to determine what factors are responsible where differences in performance are found. More than 24,000 individual containers were required for the cement samples taken. One phase of these studies was the building of two-lane concrete test pavements totaling more than 6 miles. Nearly 400 test sections were built with various materials used in rotation on different sections.

Other phases of the project included the casting and driving of large concrete piles into the waters of Cape Cod, the Hudson River, the Atlantic Ocean near St. Augustine, and the Pacific Ocean near Los Angeles; observation of the durability of a thousand concrete beams exposed to alkali soils near Sacramento, Calif.; testing of concrete at large dams in the high Sierra Nevada and the Rocky Mountains; and the establishment of two experimental test plots in Illinois and Georgia where some 2,000 concrete specimens are exposed to varying weather and soil conditions.

All this involved the making of 9,000 laboratory specimens and 2,800 field specimens before the projects could get underway. The

findings of this study will result in improving the durability and lengthening the service life of concrete structures under the various conditions of exposure.

Each year the headquarters and 32 district offices of the Portland Cement Association receive approximately 300,000 requests for information. To service the great bulk of these requests quickly and adequately, the association has prepared more than 400 different publications covering the various fields in which cement and concrete are used. The publications range from highly technical booklets on the design of reinforced concrete to simple, easily understood folders on how to build concrete tanks or make small improvements around the home. More than 2,500,000 pieces of literature are distributed by the association in an average year.

The association is supported by voluntary financial contributions of its more than 70 member cement companies in the United States and Canada. These member companies, widely spread geographically and operating 152 separate plants, produce a very large proportion of all portland cement used in the United States and Canada.

The founders of the association realized that in order for portland cement to merit and attain widespread use and public confidence, a vast amount of basic research, product development, technical service, education and promotion would be required. If each company were to have undertaken this task independently, a tremendous duplication of effort and expense would have resulted. The Portland Cement Association was therefore organized in the interest of economy and efficiency and to insure a coordinated and sustained attack on the many complex problems of research, development, and expansion of markets.

3. AMERICAN MEAT INSTITUTE FOUNDATION

There are numerous areas of scientific and technical research being undertaken by the American Meat Institute Foundation, which is housed on the campus of the University of Chicago. Among these are nutrition studies, a search for improved methods of handling and processing livestock, a never-ending hunt for better utilization of meat byproducts, and ways of improving the tenderness of meat. The organization's patents are available without charge to all responsible applicants, if "used in the public interest."

The American Meat Institute Foundation was incorporated in 1944 and began operations on a modest scale in 1947. It moved into its present building in 1949 and immediately began broadening its work. It now has over 50 scientists on its staff. Officials say that its staff and research projects will expand as funds and facilities become increasingly available.

The foundation is a nonprofit organization affiliated with and located at the University of Chicago. Supported by meatpackers throughout the country, it is dedicated exclusively to research and education. The physical plant of the foundation represents with its equipment an investment of more than a million dollars. Some members of the foundation staff hold professorial appointments in the university, and graduate candidates for advanced degrees, working with these professorial counselors, may conduct their thesis research studies in the foundation laboratories.

The foundation carries on so many varied research projects that it is not feasible to name all of them. However, a few of them are briefly mentioned below by way of illustrating the type of projects in which the foundation is engaged.

Chemistry of rancidity in fats.—All fats in the course of time take on oxygen from the air and become rancid, developing unpleasant odors and flavors. Information on the chemical reactions involved is useful in devising methods of retarding the spoilage through rancidification of fats and foods made with fats.

Development of antioxidents for animal fats.—Large numbers of compounds are being tested for their effectiveness in retarding rancidity in fats. Two superior antioxidants have been developed by the foundation. Both antioxidants are unique in that they not only protect the fat but also retard development of rancidity in the foods made with fat—crackers, pastries, potato and corn chips. One of the foundation antioxidant formulations, AMIF–72, is sold under the trade name, Tenox II, and was developed in cooperation with the Tennessee Eastman Corp. It is estimated that over 50 percent of federally inspected lard is currently stabilized with these antioxidants or with formulations containing them.

Development of new uses for animal fats.—(Supported by contract with Bureau of Agricultural and Industrial Chemistry, USDA.) These studies are designed to develop new uses for inedible greases and tallows. Foundation research has been responsible, in major degree, for the increasing use of animal fats in poultry and other foods. This has provided an important new outlet for a product in surplus supply.

Greenish discoloration of sausage and cured meats.—These discolorations are usually due to the action of harmless bacteria. Extensive studies have shown that the organisms responsible for surface greening, green rings, and green cores belong to definite groups of bacteria. Practical use of these studies is being made to diagnose the source of product discolorations occurring in plants throughout the country, and to recommend procedures for the elimination of the trouble.

Thermal death time studies of greening bacteria.—These studies show that the organisms responsible for greening at the core are identical in every determinable property to those causing surface greening except that they have a greater heat tolerance. These studies furnish the basis for recommending methods of control in processing. These bacteria and disclorations are nontoxic, but the product so affected is not acceptable as food.

Food poisoning staphylococci.—This project was directed toward the development of dependable, yet simple, laboratory tests that will identify staphylococci that are capable of producing the enterotoxin responsible for most cases of food poisoning. In many laboratories the presence of any staphylococci in a food is considered sufficient to condemn the food. However, these studies have shown that the ability to produce enterotoxin is limited to members of a very well-defined group of staphylococci. These studies have been especially beneficial in providing the means of identifying the food source and cause of food poisoning outbreaks. They indicate that only food items which contain large numbers of this particular type of staphylococcus should be considered potentially dangerous on the basis of laboratory examination.

Histological structure of beef and hog casings.—The structure of beef and hog intestines before cleaning and at different stages of the preparation of casings has been studied. The purpose of these studies is to furnish information useful in improving the methods of preparation of the casings.

Hide and skin.—Improved methods of handling hides and skins in the packing plant is the objective of studies in connection with these products. Initially, the research sought practical methods of cleaning. Current research seeks improvements in curing methods. Ultimately, the foundation hopes to be able to uncover new and better uses for hides, hide substance, and leather.

Nutritional values in meat.—Foundation research is providing a wealth of information on the nutritional content of meat. Data are being made available on the proximate analysis and the mineral, caloric, amino acid, and vitamin content of selected fresh beef, pork, and lamb muscle cuts, organ meats, and processed meats. Improved and more accurate analytical methods are being developed in these connections, especially for determination of folic acid and vitamin B_6. Work also is in progress on the relationship between nutrition and degenerative diseases. Information on the nutritional value of meat is utilized by physicians, nutritionists, and dietitians the world over.

Meat tenderization.—Several research projects are directed toward development of basic information on factors responsible for tenderness in meat and toward discovery of effective new methods for tenderization of meat. This work includes closely coordinated histological, bacteriological, and home economics studies, with some emphasis on accelerated aging and on enzymatic tenderization.

Extension of keeping qualities of fresh and processed meats.—Extensive study is being devoted to the possibilities of increasing the shelf life or keeping quality of both fresh and processed meat products. The potentialities of utilizing atomic fission products for sterilizing fresh meat are being investigated pursuant to contracts with the Quartermaster Food and Container Institute for the Armed Forces, and special attention has been devoted to the chemistry of changes that occur during irradiation. Additional research studies have been conducted on dehydration and rehydration of fresh meat cuts and on new methods for processing canned whole hams and other items in large cans.

4. STRUCTURAL CLAY PRODUCTS RESEARCH FOUNDATION (STRUCTURAL CLAY PRODUCTS INSTITUTE)

Since its inception, the foundation's principal research objective has been "end-use" research, dedicated to seeking means for putting its industry's products "in-the-wall" at a lower total overall cost.

The Structural Clay Products Research Foundation was organized in 1950 by clay brick and tile manufacturers in the United States and Canada to undertake research aimed at improving the competitive position of brick and tile in both present and future markets. Its membership has subsequently increased until today there are 110 U.S. manufacturers participating and 28 from Canada.

This research effort began as an exploratory 5-year program with its future beyond that date to be reviewed at that time. A total of $1¼ million was subscribed by the membership for this exploratory

period. At the end of 3 years, however, the membership had seen sufficient results, and could see sufficient future progress, that it decided to establish the foundation on a permanent basis.

The income of the foundation is approximately $550,000 annually, and it has current liquid assets of nearly $1¼ million. This reserve will permit the foundation to undertake important long-range programs rather than planning its programs on the basis of each year's income only.

It also will make for stability in its technical staff since the size of the annual budget will not necessarily have to be tied exactly to current income. The current operating budget is approximately $500,000.

Three approaches have been taken to implement the objective of end-use research, according to Director Robert B. Taylor:

1. It has critically examined many current wall designs to determine if a simplification of wall design will utilize the strength of its materials more efficiently, or improve the performance of the wall.

2. It has looked into the design of specific clay units for specific markets to determine if changes in unit design could be made to simplify wall construction and reduce overall wall costs.

3. It has critically examined site construction techniques to determine those conditions at the job which should be eliminated or modified to improve both mason and laborer productivity.

In connection with approach No. 1, the "SCR insulated cavity wall" was developed. This wall, incorporating a special low density porous insulation especially developed for it, gives a U–factor of 0.12 with exposed masonry on the interior and exterior surfaces and at the same time performs as a true cavity wall in preventing transfer of moisture from the exterior to the interior.

Other walls also are being studied to determine possible modifications. This is particularly true of masonry walls normally thought of as non-load-bearing elements. Tests to date indicate that many such partitions of relatively slight thickness have very real structural strength and might well be considered as economical load-bearing elements in a structure.

The first result of approach No. 2 (unit design) was the development of "SCR brick," first announced to the construction industry in 1952. This unit was developed for the large percentage of current home building that is one story in height. It provides for a single width wall, normally 6 inches thick, that does not require either masonry or frame structural backup materials. Because only 4½ units need be laid per square foot by the mason, this design radically reduces the number of units he must lay per square foot and increases his wall area production per day by nearly 100 percent. To date, more than 30,000 SCR brick homes have been built.

In regard to approach No. 3 (improved site techniques) the foundation has looked critically at the site problems of both the mason and the laborer. In regard to the mason, it has found that continuously adjustable scaffolds, which keep the mason in an optimum working position with respect to the wall he is building, can markedly improve his productivity without increasing fatigue. In these scaffolds, provision also is made for keeping the mason's supply of brick and mortar at a convenient height and location behind him. These improvements in scaffolding techniques by actual test have demon-

strated that they can increase productivity between 20 and 25 percent.

While new products were originally subordinated to end-use research, they are becoming an increasingly important factor in the foundation's development work. Although SCR brick is primarily a new unit design, it also is a new product in terms of its direct applicability to a specific market. It has demonstrated that it is a profitable item for the manufacturers.

Another new product, designed for a specific market, has been named "SCR re-nu-veneer." This is a ¾-inch-thick clay slab with a Norman brick face size. It has a special shape that permits rapid attachment to existing wood or fiber sheathing, with special metal clips to hold it in place. The joints are filled with mortar, applied through a pressure gun which was developed by the institute. Special L-shaped corner units are employed so that a genuine brick appearance is achieved

Economic studies indicate that it can be applied in place and be directly competitive with many types of re-siding materials on the market. It also has a definite place for interior redecoration of existing buildings, since it will not require the strengthening of walls or floors to carry its weight. If this new product reaches 10 percent of its potential market it will provide a $58 million annual market for the industry in a remodeling field in which it has never had a major foothold

Among other projects are:

1. Prefabricated panelized wall sections for both interior partitions and exterior curtain wall applications.

2. A low-cost pre-stressed partition panel for interior uses, which has been developed.

3. A structural ceramic glazed clay tile unit 4 inches thick that has a sound absorption of 60 percent, and a sound transmission loss of 47 decibels unplastered and 54 decibels plastered on the back side.

4. A process for the production of economical light-weight clay units also has been developed. The foundation believes it will permit a reduction of weight for structural brick and tile units of 40 percent in addition to the weight saved through coring.

5. The foundation has built six test buildings with six different types of masonry wall construction, and one identical building with metal panel walls and another identical building with wood frame walls. Each building is heated and cooled as desired by a custom-built air conditioner and electrical heating device. Hundreds of thermocouples and dozens of heat flow meters are employed, plus a very elaborate control and instrumentation building.

6. Fundamental research into mortars, which has begun to show progress.

7. A large amount of the foundation's work in the past and present involves architectural research studies. For example, facing tile shapes are being analyzed with a view to a simplification of shapes to reduce plant production and inventory problems as well as the design of such walls by the architect.

Research effort in 1950 was begun by employing the technical and industrial research facilities and staff of Armour Research Foundation of Illinois Institute of Technology. This was supplemented by contractural arrangements for architectural research with an architectural firm.

In 1951 the foundation leased laboratory space of its own to supplement the contract work, and began to acquire its own staff and equipment as objectives and programs began to develop and mature.

In 1954, the structural clay products industry authorized the establishment and construction of a new national research center for the industry. It was built on a 15-acre site 40 miles west of Chicago in Geneva, Ill., and was occupied in 1955. Within the engineering section of this building, a full-size, two-story building can be erected to study construction techniques and to develop shortcuts that will result in lower construction costs.

Space also has been provided for the establishment of pilot plant production lines for the automatic packaging machine, and for the pilot production of panelized wall sections in connection with this longer range research. Facilities have been provided for testing full-size wall sections for water permeability and for compressive, transverse, and racking strength.

Complete ceramic research facilities of both a fundamental and production nature have been installed. Engineering and architectural laboratories have been provided.

Sufficient land is available at the site to permit the erection of full-sized prototype structures to test building techniques and materials developed in the laboratory.

For specialized personnel or equipment, or for certain projects of short duration, the Foundation still intends to employ the services of established research organizations.

5. NATIONAL COAL ASSOCIATION (BITUMINOUS COAL RESEARCH, INC.)

In 1955, 470 million tons of coal were mined in 28 States. Vast as the industry is, however, it has been having difficulties due largely to a rapid shifting of its markets. For many decades, for example, the largest principal user of bituminous coal was the railroad industry. In recent years, however, due to dieselization, the railroads have been "small users" of coal, according to industry officials.

This shifting of markets is one reason why great stress has been laid on technical research.

> The coal industry's growing awareness of the importance of research is a significant trend in maintaining coal as America's primary fuel—

a statement by the National Coal Association declares.

> This research is a factor in the mechanization and automation of the mining process. It is developing improved methods of utilization of coal in stokers and boilers. It is uncovering new uses for coal. Work by leading coal and chemical companies and coal-related industries is contributing to the wiser use of our rich coal reserves.

To find new uses for coal, a study of research projects and possibilities was recently made by the U.S. Bureau of Mines, Bituminous Coal Research, Inc., and other representatives of the coal industry, and was published in May 1956. It lists 209 projects which have been or may be undertaken by the Bureau of Mines, independent research organizations, and other groups.

Bituminous Coal Research, Inc., has the support of coal producing companies, railroads, electric utilities, and companies engaged in the manufacture of mining and coal using equipment. Research projects sponsored by the industry, through BCR, pertain to the actual mining of coal, efficient utilization of coal, and to utilization of such byproducts of coal consumption as fly ash.

Headquarters of the industry-sponsored BCR and a bench-scale chemical and process laboratory are maintained at Pittsburgh, Pa. Another laboratory is located at Columbus, Ohio, devoted to the development of equipment and methods for greater efficiency in coal consumption.

One major industry research project, initiated around the close of World War II, has been the development of a coal-fired gas turbine locomotive, on which work has been done by the Locomotive Development Committee of BCR, at Dunkirk, N.Y.

Another significant part of the bituminous industry's research program has been the work of the Mining Development Committee of BCR, which concentrates on studies of ways and means of safer, cheaper, and faster mining of coal. Headquarters for this operation are located at Huntington, W.Va.

Studies have been made and completed on such projects as a commercial automatic coal-fired steam generator; the status, performance, and potential of continuous mining machines; and improved methods and equipment for coal and ash handling. BCR will put production models of automatic steam generators into field trials this year. These units for commercial and small industrial application will be competitively priced. Much general interest has been attracted by the research on the in-plant pneumatic transport of coal; the use of fly ash as a material in construction of concrete bridges, roadways, building blocks, and concrete soil pipes; and the development of a coal-fired heater that quickly and effectively dries wet farm crops.

BCR has been allowed numerous patents on ideas developed in the course of their research work. These patents are available to contributing members at no charge. They may be made available to others at a very nominal charge. This charge is not for the purpose of making a profit, but to exercise certain control over the use of the patents for the best interest of coal.

6. NATIONAL SAND & GRAVEL ASSOCIATION AND NATIONAL READY MIXED CONCRETE ASSOCIATION

The engineering problems of the National Sand & Gravel Association and the National Ready Mixed Concrete Association are so closely allied that, to a very large degree, their research activities are conducted jointly.

These joint research activities fall under six general heads:

(1) Laboratory researches and facilities sponsored at the University of Maryland. In addition to a regular staff, they sponsor research fellowships leading to the degree of master of science.

(2) Publication of papers and reports covering their laboratory work and other information of interest to the industry.

(3) Operation of an engineering consulting service for members of both associations.

(4) Representation of the two industries in the work of many different technical organizations whose activities affect, or are of interest to, members of the associations. Examples are work with the American Society for Testing Materials, the American Concrete Institute, the Highway Research Board, and others.

(5) Conducting at the University of Maryland an annual short course for the instruction of industry technicians.

(6) Miscellaneous assignments in finding solutions to technical problems of member companies.

A single director of engineering serves both associations. He has an associate director and clerical and administrative assistants in the Washington office. At the University of Maryland is a staff of engineers and laboratory technicians working under the general direction of the director and associate director of engineering and under the immediate direction of the laboratory supervisor.

Overall supervision of the laboratory research carried on by the associations is in the hands of a small committee consisting of the university's dean of engineering and the director of engineering of the two associations. Research policy is fixed by a joint research committee consisting of seven members, three representing NSGA, three representing NRMCA, and the director of engineering. The university does not participate in planning or outlining the association's research work. However, it does have an unqualified veto over what may be done. It should be noted that this veto has never been used, and all concerned regard it as extremely unlikely that it would ever be used.

Some of the more important studies undertaken during the past 10 years include: (1) Concrete admixtures; (2) effect of fly ash on characteristics of concrete; (3) truck mixer efficiency; (4) gravel in bituminous mixtures; (5) thermal properties of concrete and their effects on resistance to heating and cooling; (6) effects of curing on the measured compressive strength of concrete; (7) effects of time of mixing on water retention and strength of concrete; (8) effect of concrete content, age of test and air entrainment on flexural strength of concrete; (9) effect of maximum size of coarse aggregate on flexural strength of concrete; (10) effect of specimen size on the level and the reproducibility of flexural strength test; (11) flexural strength producing properties of various cements; (12) difference in flexural strength between molded and sawed specimens; (13) flexural strength producing properties of various coarse aggregates.

The associations give a yearly short course during which they attempt to bring up to date in technical research various engineers and technical personnel of member companies. In addition, local short courses are held in various areas where there is a demand for them.

7. COOLING TOWER INSTITUTE

Adequate supplies of cool, clean, fresh water are vital to the efficient operation of many industrial plants today. Oil refineries, chemical plants, electrical generating plants, and many other process industries are dependent upon uninterrupted supplies of cooling water.

Water-cooling towers are water conservation devices. Each recycling of the circulated water through a cooling tower returns to the plant about 95 percent of the used water for immediate reuse. In

fact, the only loss of water from the system is a small amount evaporated to accomplish the cooling and a lesser amount drained from the system to control hardness concentration.

In an effort to develop reliable and unbiased technical information for industry, users, and the public, the major manufacturers of industrial cooling towers organized the Cooling Tower Institute as a nonprofit institution, with only six member companies.

The technical research program is a continuing study of basic problems. Its principal research activity is divided into three areas: (1) field studies of operating towers, (2) academic studies in technology, and (3) engineering studies to develop standards of design and construction.

The Cooling Tower Institute has eight active technical subcommittees. Their titles are self-descriptive: Acceptance test procedure, performance, wood maintenance, water conservation, engineering standards, business practices, technology, and code tower.

Cooling tower designs are being developed to meet greater needs for colder water at less cost. The quest for new and better materials and methods continues. Studies in the use of laminated redwood, plastics and impregnated woods are in process. Thermostatically adjustable, variable pitch propellers are already in production, and densely packed towers of the film-surface type are a new development on the market.

As of 1956 the total gross sales of cooling towers by institute members totaled approximately $25 million, representing about 90 percent of the industrial tower business and approximately 50 percent of all cooling tower production.

Expenditures by the CTI for research in 1955 were approximately $45,000, with an additional $40,000 paid directly by member companies. Independent member company expenditures for research were approximately $622,000, making an overall research expenditure in 1955 of $707,000—approximately 4.7 percent of industry sales for that year. Corresponding figures for 1956 (not yet available) will be slightly less than for 1955.

The CTI has a full-time office in Palo Alto, Calif., for executive management of the association, and maintains a field engineering service in Houston, Tex.

A technical bulletin on accepted test procedures was the culmination of a 3-year effort to develop a generally acceptable method of determining tower capability for standard installations, fully compatible with the test codes of the various technical and engineering societies.

Efforts have been made to study the effect of the phenomenon known as recirculation. Work continues on this program as well as in the field measurement of propeller-type fan performance and on instrument calibration.

Since 1951 the institute has been accumulating operating information on wood deterioration, wood preserving and water treating. Well over 100 operating towers are inspected annually and complete reports are made available to the tower users, the cooperating trade association, and eventually in bulletin form to the industry at large.

The institute has produced publications on CTI lumber grades and structural design data for distribution to design engineers, architects, consulting engineers and others as recommended procedures for the

design and manufacture of redwood cooling towers. Plans are now in progress to study right-angle gear speed reducer designs, propeller-type fan designs, and other mechanical components of the industrial-type towers. Fire protection, safety devices, and corrosion protection are also under study. All procedures are planned to fit into the American Standards Association program or the codes of the respective technical societies.

8. SCIENTIFIC APPARATUS MAKERS ASSOCIATION

The Scientific Apparatus Makers Association serves the scientific instrument industry. Through its work in establishing standards for instruments which are used in technical research, it exerts much influence on technical research and, of course, is always seeking ways to improve the tools of research so that more accurate results may be obtained in less time.

SAMA reports that through its many technical committees it is able to save users of scientific equipment time and money by reducing production costs, inventory carrying charges, and increasing availability of component parts.

Among the scientific and technical groups with which the Scientific Apparatus Makers maintain close contact are: American Chemical Society, American Institute of Radio Engineers, American Institute of Electrical Engineers, American Society for Testing Materials, American Institute of Physics, American Society of Mechanical Engineers, Instrument Society of America, American Standards Association, National Academy of Science, National Science Teachers Association, electronic weighing groups and others.

The Scientific Apparatus Makers Association exerts great influence in spreading the effects of quality control and technical research. It has cooperated in the establishment of pilot quality control laboratories in nonlaboratory industries—that is, in industries which conventionally do not use such scientific techniques. Once established, the advantages of such laboratories are so obvious that they find wide acceptance.

To get an idea of how this program works, consider an actual pilot plant program set up at a nominal cost for a confectionery company in a Chicago suburb. The following are typical steps:

1. The user's operation was carefully analyzed and job standards were set up for necessary personnel.
2. A job specification was prepared for a graduate chemist to take charge of setting up the new laboratory. A want ad was put in the paper for such a person.
3. Then a proposed series of possible quality control tests was set up. These included many tests for the eight ingredients commonly used in making the user's candy products, many in-process quality control tests, and numerous finished-product quality control tests. Each of the tests was carefully described.
4. A list of the scientific equipment needed and its approximate cost was included.
5. A drawing of a satisfactory laboratory was made.

SAMA sets up various quality control, research and development resource conferences at various universities. In a typical workshop, 500 carefully selected Michigan manufacturers were invited to par-

ticipate in such a program at Michigan State University. The advantages of research and development and quality control are outlined to participants, who also receive suggestions for improving their own operations.

Possibly the most important work of the group is setting up standards of performance and uniform terminology for laboratory equipment. This eliminates a vast amount of confusion and helps research. A typical field covered is thermometers, including bimetallic thermometers, resistance thermometers, filled system thermometers, glass stem industrial thermometers, and thermocouple thermometers (pyrometers). Each of these is covered by standards several pages long. The advantage of this is that each user of such equipment knows what it is, what it will do, and what to expect from it.

9. CLOTHING MANUFACTURERS ASSOCIATION OF THE UNITED STATES OF AMERICA

Study of clothing is particularly difficult, association members say, because the finished product is made from so many components. Therefore, this association has begun an experiment with a new method of obtaining production information from suppliers of its component parts.

The association has worked with experts in each field that supplies the men's clothing industry. These suppliers conduct research and provide information on the items they produce for apparel manufacturers. Research must be conducted on threads, fabrics, buttons, zippers, linings, and labels, as well as machinery.

Production reports have been issued since 1953. Twelve studies on various aspects of the men's clothing industry have been issued to member companies.

Some 850 member companies are involved, and approximately 250 production managers work for these companies. The only cost involved to the association is the printing and distribution of the reports.

Member companies and individuals producing the reports are willing to do so because it gives them a chance to tell manufacturers about their products; and the studies enhance their reputations, clothing manufacturing officials say.

The reports are edited by officers of the parent group to eliminate sales talk. Before the studies are distributed, the findings are checked in the factories of several manufacturers to make sure that the information is correct. The wording of the reports is examined to make certain that it is in clothing manufacturers' language and is not too technical for the average production manager.

10. PACIFIC COAST TALLOW RENDERERS ASSOCIATION

Synthetic detergents caused a severe depression in the soap markets during the year 1951. Facing a growing surplus of tallow and greases, members of this association began looking for ways in which to expand their domestic markets. They decided that new chemical processes based on tallow were the best long-range possibility. However, none of the firms involved felt financially able or technically equipped to do the necessary research or to pay someone else to do it. They settled on cooperative research.

Some 25 companies formed Tallow Research, Inc., a nonprofit organization financed by its members in proportion to their individual production volume. Tallow Research in early 1952 retained Stanford Research Institute to work on its problem. By late 1953 SRI had worked out a process using dilute acids at moderate pressure to oxidize tallow to dibasic acids, usable in synthetic lubricants and plasticizers.

Another contribution of the research effort showed tallow products to be economical additions to poultry and cattle feeds.

Through this cooperative research program, Tallow Research members have been able to finance some $20,000 worth of research each year. They believe they can see concrete possibilities for easing the industrywide squeeze on their markets.

APPENDIXES

Appendix A

Fifty of the Larger Industrial Companies in Technical Research

The following list includes most of the Nation's top-ranking corporations as to expenditures on technical research and development. Most of them own important patent rights as a result of their own employees' studies plus the purchasing of related patent rights of individual inventors. Thousands of firms of small-business size participate in the success of such leaders in research, through varied types of subcontracting arrangements.

Recent studies of the National Science Foundation and cooperating agencies indicate that nearly 20,000 companies were conducting research and development activities in 1953. They employed over 400,000 research workers, of whom 160,000 were scientists and engineers.

Of the total expenditures by all companies ($3.7 billion in 1953 and over $4 billion in 1954), the 400 largest companies carried on 72 percent of the Nation's technical research.

Most of the 50 largest of these "giants in research" (and patents) are named below—based on data compiled from the 1956 "Industrial Research Laboratories of the United States" (560 pages; $10; National Academy of Science-National Research Council, Washington 25, D.C.).

In 1957 these 50 great corporations had a total of 3,500,000 employees, according to Poor's and Moody's directories. In the 1955–57 period, each has had at least 1,000 specialists in technical research projects. In fact, these 50 leaders employ a total of about 150,000 such technicians.

American Bosch Arma Corp., 320 Fulton Ave., Hempstead, N.Y.
American Cyanamid Co., 30 Rockefeller Plaza, New York, N.Y.
American Machine & Foundry Co., 261 Madison Ave., New York, N.Y.
American Telephone & Telegraph Co., 195 Broadway, New York, N.Y.
Avco Manufacturing Corp., 420 Lexington Ave., New York, N.Y.
Bendix Aviation Corp., 1104 Fisher Bldg., Detroit, Mich.
Boeing Airplane Co., 7755 East Marginal Way, Seattle, Wash.
Caterpillar Tractor Co., Peoria, Ill.
Chance Vought Aircraft, Inc., Post Office Box 5907, Dallas, Tex.
Chrysler Corp., 341 Massachusetts Ave., Detroit, Mich.
Collins Radio Co., 855 35th St. N.E., Cedar Rapids, Iowa.
Douglas Aircraft Co., Inc., 3000 Ocean Park Blvd., Santa Monica, Calif.
Dow Chemical Co., Midland, Mich.
E. I. du Pont de Nemours & Co., du Pont Bldg., Wilmington, Del.
Firestone Tire & Rubber Co., 1200 Firestone Parkway, Akron, Ohio.
General Dynamics Corp., 445 Park Ave., New York, N.Y.
General Electric Co., 1 River Rd., Schenectady, N.Y.
General Motors Corp., General Motors Bldg., Detroit, Mich.
General Tire & Rubber Co., 1708 Englewood Ave., Akron, Ohio.
Goodyear Aircraft Corp., 1210 Massillon Rd., Akron, Ohio.
Goodyear Tire & Rubber Co., 1144 East Market St., Akron, Ohio.
Gulf Oil Corp., Gulf Bldg., Pittsburgh, Pa.
Hercules Powder Co., 900 Market St., Wilmington, Del.
Hughes Aircraft Co., Florence & Teale, Culver City, Calif.
International Business Machines Corp., 590 Madison Ave., New York, N.Y.
International Telephone & Telegraph Corp., 67 Broad St., New York, N.Y.
Kearfott Co., Inc., 1150 McBride Ave., Little Falls, N.J.
Martin Co. (Glenn L.), Baltimore, Md.
Merck & Co., Inc., 126 East Lincoln Ave., Rahway, N.J.

Minneapolis-Honeywell Regulator Co., 2747 4th Ave. South, Minneapolis, Minn.
Monsanto Chemical Co., 1700 South 2d St., St. Louis, Mo.
Motorola, Inc., 4545 Augusta Blvd., Chicago, Ill.
North American Aviation, Inc., Municipal Airport, Los Angeles, Calif.
Phillips Petroleum Co., Phillips Bldg., Bartlesville, Okla.
Procter & Gamble Co., 301 East 6th St., Cincinnati, Ohio.
Radio Corp. of America, 30 Rockefeller Plaza, New York, N.Y.
Raytheon Manufacturing Co., Foundry Ave., Waltham, Mass.
Shell Oil Co., 50 West 50th St., New York, N.Y.
Socony Mobil Oil Co., 150 East 42d St., New York, N.Y.
Sperry Rand Corp., 30 Rockefeller Plaza, New York, N.Y.
Standard Oil Co. of California, 225 Bush St., San Francisco, Calif.
Standard Oil Co. (Indiana), 910 Michigan Ave., Chicago, Ill.
Standard Oil Co. (New Jersey), 30 Rockefeller Plaza, New York, N.Y.
Sylvania Electric Products, Inc., 1740 Broadway, New York, N.Y.
Texas Co., 135 East 42d St., New York, N.Y.
Thiokol Chemical Corp., 780 North Clinton Ave., Trenton, N.J.
Union Carbide Corp., 30 East 42d St., New York, N.Y.
United Aircraft Corp., 400 Main St., East Hartford, Conn.
United States Rubber Co., 1230 Avenue of the Americas, New York, N.Y.
United States Steel Corp., 71 Broadway, New York, N.Y.
Westinghouse Electric Corp., 3 Gateway Center, Pittsburgh, Pa.

Appendix B

Books on Technical Research, Inventions, and Patents, 1952–58

Listed in this section are some 80 selected books of the past 5 years, including a few of prior years, covering the more general aspects of technical research. Not included are many standard works on specific fields. There are, for example, 60 separate branches of engineering alone, each represented by a national society of technical experts. These societies are listed in the U.S. Department of Commerce "Directory of National Trade Associations, 1956," covering such fields as aeronautics, chemistry, electronics, metallurgy, and so on.

The Harvard Business Review of May–June 1957, in an article entitled "Looking Around: Guides to Research and Development," includes an analysis of recent literature on this subject. It mentions the fact that the rapid increase in the literature on the economic aspects of research management is an excellent indication of the current and growing interest in the improvement of research and development programs, inventions, patents, and related subjects. It is stated that—

> "The literature contains many books, research reports, and proceedings of conferences. Several hundred articles have been published in various journals during the last few years on the selection of research projects, control of costs, preparation and size of budgets, duplication of effort, and appraisal of a research program. There are only a few general books which discuss all aspects of the research executive's job, such as—
>
> Organization of Industrial Scientific Research (Mees),
> Research in Industry: Its Organization and Management (Furnas),
> Theory and Practice of Industrial Research (Hertz)."

In view of the importance of these three books, the table of contents of each has been included following the listing of publications. Also set forth are the tables of contents of the two following representative studies on patents and related problems, since all students of such matters are assisted by knowing just what subjects are included in standard textbooks:

Inventions and Their Management (Berle de Camp).
The Patent System (Duke University).

A subsequent part of the appendixes (appendix C) is devoted to selected U.S. Government publications. Leading agencies in this field, such as the Office of Technical Services, National Bureau of Standards, Atomic Energy Commission, and many others, are described in a recent publication of the National Science Foundation entitled "Organization of the Federal Government for Scientific Activities" (1956, 350 pp., $1.75).

The two outstanding Federal Government reports on technical research prior to the recent publications of the National Science Foundation listed in appendix C are:

1. *Research, A National Resource,* a 3-volume publication by the National Resources Planning Board in 1941.
2. *Science and Public Policy,* a 5-volume work sometimes known as the Steelman Report, which was issued in 1947.

Both were published by the Government Printing Office, Washington, D.C. Some volumes are out of print, but are available in larger public libraries. The National Resources Planning Board was the predecessor of the National Science Foundation, of which Dr. Vannevar Bush is recognized as the "father."

BOOKS

American Association for the Advancement of Science. *Industrial Science, Present and Future.* Washington, D.C.: 1952, 150 pp., $2.

American Management Association, New York, N.Y.:
Getting the Most from Product Research and Development. 1955, 150 pp., $3.75.
Getting the Most from Research and Engineering. 1954, 60 pp., $1.75.
Organizing the Research Function for Profit. 1956, 50 pp., $1.75.
Strengthening the Research Efforts. 1956, 65 pp., $1.75.

American Society for Engineering Education. *Engineering College Research Review.* New York: Engineering College Research Council, 1957, 440 pp., $2.

Angerman, V. D. *How to Find a Buyer for Your Inventions.* Chicago: Science and Mechanics Publishing Co., 1956, 190 pp., $2.95.

Anthony, R. N. *Management Controls in Industrial Research Organizations.* Cambridge, Mass.: Harvard Business School, 1952, 540 pp., $6.75.

Bachmann, Otto J., and others. *Patents and the Corporation: A Report on Industrial Technology Under Changing Public Policy.* Boston: J. J. Galvin, Soldiers Field Station, 1958, 190 pp., $10.

Barnard, J. D. and L. E. Edwards. *New Basic Science.* New York: Macmillan Co., 1956, 630 pp., $4.20.

Barnett, Otto R. *Patent Property and the Antimonopoly Laws.* Indianapolis, Ind.: Bobbs-Merrill Co., 1943, 620 pp.

Bates, R. S. *Scientific Societies in the United States* (2d ed.). New York: Columbia University Press, 1957, 315 pp., $6.

Berle, A. K. and L. S. deCamp. *Inventions and Their Management.* Princeton, N.J.: Van Nostrand Co., 1954, 790 pp., $9.

Bibliographies. (See end of list.)

Biesterfeld, C. H. *Patent Law.* New York: Wiley & Sons, Inc., 1949, 270 pp., $6.75.

Birr, Kendall. *Pioneering in Industrial Research.* Washington, D.C.: Public Affairs Press, 1957, 250 pp., $4.50.

Burchard, John, editor. *Mid-Century: The Social Implications of Scientific Progress.* New York: Wiley & Sons, Inc., 1950, 550 pp., $7.50.

Burlingame, Roger. *Machines That Built America.* New York: Harcourt, Brace & Co., 1953, 215 pp., $3.50.

Bush, G. P. and L. H. Hattery. *Teamwork in Research.* Washington, D.C.: University Press, 1953, 190 pp., $4.

——— *Scientific Research: Its Administration and Organization.* Washington, D.C.: University Press, 1950, 190 pp., $3.25.

Bush, Vannevar. *Endless Horizons.* Washington, D.C.: Public Affairs Press, 1946, 180 pp., $2.50.

——— *Science, the Endless Frontier.* Washington, D.C.: Government Printing Office, 1945, 185 pp., 30¢.

Calvert, Robert. *Patent Practice and Management: For Inventors and Executives.* New York: Reinhold Corp., 1950, 385 pp., $5.

Carter, Charles F. and Bruce R. Williams. *Industry and Technical Progress. Factors Governing the Speed of Application of Science.* London: Oxford Press, 1957, 245 pp.

Cohn, V. E. *1999: Our Hopeful Future.* Indianapolis, Ind.: Bobbs-Merrill Co., 1956, 200 pp., $3.75.

Costa, J. S. *Law of Inventing in Employment.* New York: Central Book Co., 1953, 325 pp., $7.50.

Cressy, Edward, and J. G. Crowther. *Discoveries and Inventions of the 20th Century* (4th ed.). New York: Dutton & Co., 1955, 430 pp., $6.

Dearborn, D. C. and others. *Spending for Industrial Research, 1951, 1952.* Cambridge, Mass.: Harvard University, 1953, 100 pp., $2.50.

Directories. (See end of list.)
Drews, Gustav. *The Patent Right in the National Economy of the United States.* New York: Central Book Co., 1952, 210 pp., $5.
Duke University. *The Patent System.* Durham, N. C.: Duke University School of Law. "Law and Contemporary Problems" (quarterly); Part I, Vol. 12, Autumn 1947; Part II, Vol. 13, Spring 1948.
Dupree, A. Hunter. *Science in the Federal Government.* Cambridge, Mass.: Harvard University Press, 1957, 460 pp., $7.50.
Forman, Howard I. *Patents, Their Ownership and Administration by the United States Government.* New York: Central Book Co., Inc., 1957, 350 pp., $8.50.
Fortune. *The Mighty Force of Research.* By the Editors of Fortune. New York: McGraw-Hill Book Co., 1956, 320 pp., $4.00.
Freedman, Paul. *Principles of Scientific Research.* Washington, D.C.: Public Affairs Press, 1950, 225 pp., $3.25.
Furnas, C. C., editor. *Research in Industry: Its Organization and Management.* Princeton, N.J.: Van Nostrand Co., 1948, 580 pp., $6.50.
Hertz, D. B., editor. *Research Operations in Industry.* New York: Columbia University Press, 1953, 455 pp., $8.50.
——— *The Theory and Practice of Industrial Research.* New York: McGraw-Hill Book Co., 1950, 385 pp., $7.50.
Jewkes, J. and others. *Sources of Invention.* New York: St. Martins Press, Inc., 1958, 430 pp., $6.75.
Killeffer, D. H. *The Genius of Industrial Research.* New York: Reinhold Corp., 1948, 270 pp., $5.
Leyson, B. W. *Marvels of Industrial Science.* New York: Dutton & Co., 1955, 190 pp., $3.50.
——— *More Modern Wonders and How They Work.* New York: Dutton & Co., 1955, 215 pp., $3.50.
Livingston, R. T. and S. H. Milberg, editors. *Human Relations in Industrial Research Management.* New York: Columbia University Press, 1957, 465 pp., $8.50.
Marvin, P. R. *Top Management and Research.* Dayton, Ohio: Research Press, 1953, 120 pp., $5.
Mees, C. E. K. and J. A. Leermaker. *Organization of Industrial Scientific Research* (2d ed.). New York: McGraw-Hill Book Co., 1950, 385 pp., $6.50.
Meier, R. L. *Science and Economic Development: New Patterns of Living.* New York: Wiley & Sons, Inc., 1956, 270 pp., $6.
Meyer, J. S. *World Book of Great Inventions.* Cleveland, Ohio: World Publishing Co., 1956, 270 pp., $3.95.
National Academy of Sciences-National Research Council, Washington 25, D.C.
Applied Research in the United States. E. W. Scott, Editor. 1952, 90 pp., $1.
Nonprofit Research and Patent Management in the United States. Archie M. Palmer. 1956, 150 pp., $1.
Nonprofit Research and Patent Management Organization. Archie M. Palmer. 1955, 150 pp., $3.
University Patent Policies and Practices. Archie M. Palmer. 1952, 230 pp., $3; 1955 Supplement, 95 pp., $1.50.
(Also see "Directories" at end of list.)
National Manpower Council. *Proceedings of a Conference on the Utilization of Scientific and Professional Manpower.* New York: Columbia University Press, 1954, 200 pp., $3.50.
National Resources Planning Board. *Research, A National Resource.* (3 vols.). Volume II, *Industrial Research.* Washington, D.C.: Government Printing Office, 1941.
National Science Foundation. (See special list in appendix C.)
Organization for European Economic Cooperation (OEEC). *International Guide to European Sources of Technical Information.* Washington, D.C.: Organization for European Economic Cooperation, 1957, 440 pp., $2.50.
——— *Organization of Applied Research in Europe, the United States, and Canada* (3 vols.). 1954, $4.25. Vol. 1, $1; Vol. 2, $2; Vol. 3, $1.25.
——— *Problems of Scientific and Technical Manpower in Western Europe, Canada, and the United States.* 1957, 220 pp., $2.
Paley, P. and H. Gordy. *Move over, Mr. Edison.* New York: Vantage Press, 1955, 100 pp., $2.50.
Palmer, Archie M. See National Academy of Sciences.
Pratt, Fletcher. *Famous Inventors and Their Inventions.* New York: Random House, 1955, 140 pp., $1.95.

Robinson, William C. *The Law of Patents for Useful Inventions* (3 vols.) Boston: Little, Brown & Co., 1890.

Rottenberg, Simon. *Technical Cooperation in Latin America: How United States Business Firms Promote Technological Progress.* Washington, D.C.: National Planning Association, 1957, 140 pp., $1.75, paper back.

Rubenstein, A. H., editor. *Coordination, Control, and Financing of Industrial Research.* New York: Kings Crown Press, 1955, 430 pp., $8.50.

Standard Oil Development Co. *Future of Industrial Research.* New York: Standard Oil Development Co., 1945, 175 pp. Includes chapters by such leaders as C. F. Kettering, Frank B. Jewett, etc.

Steelman, John R. *Science and Public Policy.* Washington, D.C.: Government Printing Office, 1947. A Report to the President by the President's Scientific Research Board in 5 volumes:

I. *A Program for the Nation*
II. *Federal Research Program*
III. *Administration for Research*
IV. *Manpower for Research*
V. *Nation's Medical Research*

Toulmin, H. A., Jr. *Handbook of Patents* (2d ed.). Cincinnati, Ohio: Anderson Co., 1954, 930 pp., $15.

——— *Patents and the Anti-Trust Laws of the United States: Including Trade Marks and Copyrights.* Dayton, Ohio: Research Press, 1957, $25.

Tuska, Clarence D. *Inventors and Inventions.* New York: McGraw-Hill Book Co., 1957, 175 pp., $3.75.

U.S. Department of Commerce. *Proceedings on the President's Conference on Technical and Distribution Research for the Benefit of Small Business.* Washington, D.C.: U.S. Department of Commerce, Office of Technical Services, 1957, 300 pp., $2.50. (Also see "Directories" at end of list.)

U.S. Department of Justice. *Investigation of Government Patent Practices and Policies* (3 vols.). Washington, D.C.: Government Printing Office, 1947, 980 pp.

U.S. Department of Labor. *Scientific Research and Development in American Industry: A Study of Manpower and Costs.* Washington, D. C.: Government Printing Office, 1953, 120 pp., 50¢.

Usher, A. P. *History of Mechanical Inventions.* Cambridge, Mass.: Harvard University Press, 1954, 450 pp., $9.

Vaughan, F. L. *The United States Patent System: Legal and Economic Conflicts in American Patent History.* Norman, Okla.: University of Oklahoma Press, 1956, 370 pp., $8.50.

Walker, Albert H. *Walker on Patents* (4 vols., Deller's edition). New York: Baker, Voorhis & Co., 1937; plus 1955 cumulative supplement.

Wilson, E. B., Jr. *Introduction to Scientific Research.* New York: McGraw-Hill Book Co., 1952, 375 pp., $6.

Wilson, M. A. *American Science and Invention.* New York: Simon & Schuster, Inc., 1954, 440 pp., $10.

Wise, J. K. *Patent Law in the Research Laboratory.* New York: Reinhold Corp., 1955, 150 pp., $2.95.

Wood, Laurence I. *Patents and Antitrust Law.* Chicago, Ill.: Commerce Clearing House, Inc., 1942, 220 pp.

Woodling, G. V. *Inventions and Their Protection* (2d ed.). New York: Bender & Co., 1954, 500 pp., $10.

BIBLIOGRAPHIES AND BIOGRAPHIES

American Men of Science (8th ed., 3 vols.). Jacques Cattell, editor. New York: Bowker Co.

Vol. 1. *The Physical Sciences.* 1955, 2,180 pp., $20.
Vol. 2. *The Biological Sciences.* 1955, 1,275 pp., $20.
Vol. 3. *The Social and Behavioral Sciences.* 1956, 760 pp., $20.

Industrial Research and the Professional Employee: A Bibliographic Review. Edith Arlen. Chicago: University of Chicago, 1955, 140 pp., $5.

Scientific, Medical, and Technical Books Published in the United States of America, 1949–1952. New York: Bowker Co., 1953, $10. (Also see National Science Foundation bibliographies in appendix C.)

DIRECTORIES, ETC.

Directory of Commercial and College Testing Laboratories. Philadelphia, Pa.: American Society for Testing Materials, 1955, 40 pp., $1.

Directory of International Scientific Organizations. New York: Columbia University Press (UNESCO), 1954, 250 pp., $2.50.

Handbook of Scientific and Technical Awards in the United States and Canada, 1900–1952. Margaret A. Firth, Editor. New York: Special Libraries Association, 1956, 490 pp., $10.

Industrial Research Laboratories of the United States (10th ed.). J. F. Mauk. Washington, D.C.: National Academy of Sciences-National Research Council, 1956, 580 pp., $10.

National Associations of the United States. U.S. Department of Commerce. Washington, D.C.: Government Printing Office, 1949, 700 pp., $3.50. 1956 Supplement, *Directory of National Trade Associations*, 57 pp., 40¢.

Scientific and Technical Societies of the United States and Canada (6th ed.). Washington, D.C.: National Academy of Sciences-National Research Council, 1955, 450 pp., $7.50.

ILLUSTRATIVE TABLES OF CONTENTS

Most of this report has been devoted to summarizing the type of helpful assistance which smaller business firms can secure from trade associations, while the preceding list names some 80 recent books on technical research, patents, and related problems.

The tables of contents of six representative studies on patents, inventions, and research are presented below, to indicate the broad scope of subjects which an association must be familiar with if it decides to be the owner of many patents. As stated in the introduction, only a very small percent of trade associations are patent owners.

a. *Getting the Most from Product Research and Development.* American Management Association (1955)

In this American Management Association report of 150 pages, key executives in 13 companies and a Government agency explain how to organize a research program, formulate a sound research policy, select projects and set long-range goals, use outside assistance most effectively, and set up a system of cost controls.

---

b. *Inventions and Their Management.* A. K. Berle and L. S. deCamp (1954)

Contains many special features, including 40 reference cases. The business of invention and commercialism of new products is featured. Also included is an extensive bibliography, a list of patent associations, libraries receiving current patent office publications, and a glossary of words and phrases commonly used in the field.

Contents

c. *Organization of Industrial Scientific Research* (2d ed.). C. E. K. Mees and J. A. Leermaker (1950)

This book presents a detailed account of the history and development of industrial scientific research, the general principles of its conduct, and an analysis of the methods actually used for the organization and operation of industrial research laboratories.

Contents

---

d. *The Patent System.* "Law and Contemporary Problems" (quarterly). School of Law, Duke University, Durham, N.C. Part I, Vol. 12, Autumn 1947; Part II, Vol. 13, Spring 1948.

Contents of Part I

Contents of Part II

e. *Research in Industry: Its Organization and Management.* C. C. Furnas, Editor (1948)

In this book, "the thoughts and experiences of a number of successful executives with long-standing research experience, representing a good cross-section of American industry, are made available to those who may have an interest in the organization and management of industrial research activities. All those having any connections with industrial research laboratories, from laboratory assistant to corporation president, have a potential interest in this activity, which is becoming a dominant part of the American scene" (from the preface).

Contents

---

f. *Theory and Practice of Industrial Research.* D. B. Hertz (1950)

The chapter headings indicate the phases of research "theory and practice" covered by this standard textbook.

Contents

APPENDIX C

PUBLICATIONS OF THE NATIONAL SCIENCE FOUNDATION AND OTHER TECHNICAL RESEARCH CENTERS IN THE FEDERAL GOVERNMENT

1. National Science Foundation (selected reports)

	Pages (approximate)	Price	Year
Advisory and Coordinating Mechanisms for Federal Research Development	30	Free	1957
Annual Report, 1958	245	$1.00	1958
Basic Research: A National Resource	65	.45	1957
Current Research and Development in Scientific Documentation	55	Free	1958
Federal Funds for Science: Fiscal Years 1956–58	60	.35	1957
Federal Support for Science Students in Higher Education	35	.30	1956
Funds for Basic Research in the United States, 1953	5	Free	1957
Government-University Relationships in Federally Sponsored Scientific Research and Development	45	.40	1958
Graduate Student Enrollment and Support in American Universities and Colleges	300	1.50	1957
Grants for Scientific Research	15	Free	1955
Highlights of Conference on Research and Development, and Its Impact on the Economy	5	Free	1958
List of International and Foreign Scientific and Technical Meetings (quarterly)	50	1.00	1957
Non-Conventional Technical Information Systems in Current Use	50	Free	1958
Organization of the Federal Government for Scientific Activities	350	1.75	1956
Publications Resulting From NSF Research Grants	40	.30	1957
Research by Cooperative Organizations	50	.35	1956
A Program for National Information on Scientific and Technical Personnel	70	Free	1958
Research and Development Costs in American Industry, 1956	5	Free	1958
Research and Development by Nonprofit Research Institutes and Commercial Laboratories	85	.50	1956
Research Expenditures of Foundations and Other Nonprofit Institutions, 1953–54	25	Free	1958
Science and Engineering in American Industry (1958 edition in press)	120	.70	1956
Scientific Activities in Six State Governments	60	.40	1958
Scientific Manpower, 1956	70	Free	1957
Scientific Manpower, 1957	50	Free	1958
Scientific Personnel Resources	90	.50	1955
Scientific Research Expenditures by the Larger Private Foundations	25	.25	1955
Scientists and Engineers in Research and Development, 1954	5	Free	1958
Soviet Professional Manpower: Its Education, Training, and Supply	400	1.25	1955
Trends in the Employment and Training of Scientists and Engineers	25	.20	1956
Bibliographies:			
Bibliography for the International Geophysical Year	60	.25	1957
A Selected Bibliography of Research and Development and Its Impact on the Economy	25	Free	1958

Also there are many reports in such series as National Science Studies, Scientific Manpower Reports, Scientific Manpower Bulletins, Science Information Exchange. Among the Foundation's Monthly publications are its *List of International and Foreign Scientific and Technical Meetings.*

2. Office of Technical Services (OTS)

The average smaller firm probably has more technical research contacts with this agency than any other in the Federal Government, since it sells some 200,000 research reports each year.

Created by Congress in 1950 and partially supported by funds from the National Science Foundation, it is an agency within the Department of Commerce. Each month OTS releases to the public from 600 to 800 research reports which have been prepared by units within the Atomic Energy Commission, Department of Defense, and many other Government and non-Government agencies carrying on federal-financed research. Its monthly *U.S. Government Research Reports* totals some 800 pages of bibliographic material each year.

3. Periodicals of other Government agencies

Other research periodicals are named in the *Monthly Catalog of U.S. Government Publications* ($3 a year, Government Printing Office, Washington 25, D.C.). Included are the following:

Agency	Publication	Subscription
Agriculture	Agricultural Research	$1.00
Atomic Energy Commission (AEC)	Nuclear Science Abstracts	6.00
Defense	Armed Forces Medical Journal	5.25
National Advisory Committee for Aeronautics	Technical Reports	10.00
National Bureau of Standards	Journal of Research	4.00
	Technical News Bulletin	1.00
Navy	Bureau of Ships Journal	1.75
Office of Naval Research	Research Reviews	1.50
Patent Office	Official Gazette	30.00
Public Health Service	Public Health Reports	4.25

Appendix D

Recent Magazine Articles: Chiefly 1956–58

Below is a short list of recent articles pertaining to company and association research. They are typical of current data which are available in larger public libraries. As indicated by their titles, such articles should be time-saving and helpful to "small business" firms and association executives.

Accounting for Research and Development Costs. NACA Bulletin, June 1955, Research Series No. 29.

Arnold, Philip M. *Why Not Try Cooperative Research.* Harvard Business Review, v. 32, July–August 1954, pp. 115–122.

Arthur, W. E. *Development Costs in a Company Laboratory.* NACA Bulletin, May 1954, p. 1124.

Bober, W. C. *Thinking Ahead: Population and Technology.* Harvard Business Review, v. 35, July–August 1957, pp. 19 plus.

Bruun, J. H. and J. M. Moran. *Research and Development Costs in the Chemical Industry.* Chemical Engineering News, October 20, 1952, pp. 4365–4367.

Cartwright, E. O. *Industry Research Programs for the Investor to Watch.* Commercial and Financial Chronicle, v. 184, November 22, 1956, pp. 2194–2195.

Currie, William E. *Cooperative Research and the Antitrust Laws.* Journal of the Patent Office Society, v. 36, October 1954, pp. 690–712.

Dollars Don't Tell All: Survey of Research Spending by Trade Associations. Chemical Week, July 21, 1956.

Ewell, Raymond H. *Role of Research in Economic Growth.* Chemical and Engineering News, v. 33, July 18, 1955, pp. 2980–2985.

Fitzgerald, G. R. *Process Improvements Being Developed Through Manufacturing Research.* SAE Journal (Society of Automotive Engineers), v. 65, May 1957, pp. 60–61.

Ganging Up on the Technical Shortage. Iron Age, April 4, 1957, p. 59.

H. Gershinowitz. *Industrial Research Programs and Academic Research.* American Scientist, v. 46, March 1958, pp. 24–32.

Hafstad, L. R. *Industrial Research and Development Today.* Tool Engineer, v. 40, May 1958, pp. 209–211.

Hall, N. I. *Management of Large Research and Development Organizations:* Proceedings of the Institute of Radio Engineers. April 1957, pp. 451–454.

Harris, L. E. *Labs and Institutes: Nonprofit Research Institutes are Now Applied Business Institutions.* Chemical and Engineering News, v. 35, May 6, 1957, p. 30.

C. C. Higgins. *Inside Research and Development: A Guide for Bewildered Business Men.* Management Review, v. 46, April 1957, pp. 75–79.
Holland, M. and M. Ross. *Research: The Radar for Progressive Management.* Duns Review and Modern Industry, v. 69, December 1956, pp. 52 plus.
Holroyd, R. *Importance of the Integration of Research with Other Industrial Functions.* Chemistry and Industry, June 29, 1957, pp. 882–885.
Hoseh, M. *Scientific and Technical Literature of the U.S.S.R.* Journal of Chemical Education, v. 33, May 1957, pp. 397–402.
How Research Directors Get a New Slant on Their Jobs: 8th Annual Meeting on Industrial Research. Chemical Week, v. 80, June 22, 1957, pp. 70–76.
How to Size up the Productive Researcher. Chemical Week, v. 80, May 25, 1957, pp. 50 plus.
Industry Increases Spending for Research. Electronics, v. 29, November 1956, p. 20.
Industry Spends Millions for Research. Steel, v. 140, March 4, 1957, p. 81.
James, J. V. *Helping Top Management Keep on Top of Research.* NACA Bulletin, March 1954, p. 383.
Johnson, Samuel C. and Conrad Jones. *How to Organize for New Products.* Harvard Business Review, v. 35, No. 3, May–June 1957, pp. 49–62.
Judkins, Jay. *Industrial Research by Trade Associations in 1957.* ASAE Journal, v. 9, April 1957, pp. 9–16 (American Society of Association Executives).
Killian, J. R. *Importance of Research Told at New Plant Dedication.* Industrial Laboratories, v. 9, August 1958, p. 82.
Kliever, Waldo H. and R. Z. Bancroft. *Choosing and Evaluating Research Products.* Product Engineering, June 1953, p. 184.
Kline, C. H. *Research on a Limited Budget.* Soap and Chemical Specialties, v. 34, March 1958, pp. 179 plus.
Knight, R. R. *Research Pays Off in Proportion: The Story of Kaiser Aluminum and Chemical Corporation.* Iron Age, v. 179, May 2, 1957, p. 75.
Leedy, H. A. *How Large and Small Firms Can Keep up with Research Costs.* Commercial and Financial Chronicle, v. 185, January 10, 1957, pp. 18–19.
Lum, J. H. *Industry's Stake in Fundamental Research.* Industrial and Engineering Chemistry, v. 49, May 1957.
Lytle, A. R. *Research Management.* Metal Progress, v. 71, March 1957, pp. 72–75.
Managing Research and Development: Some Problems and Pitfalls. Management Review, v. 46, April 1957, pp. 29–31.
Miller, T. T. *Industrial Research: How Top Management Evaluates its Research Program.* Chemical and Engineering News, v. 36, February 24, 1958, pp. 88–92.
National Science Foundation Reveals Research and Development Figures. Electronics, v. 30, March 10, 1957, p. 28.
Orth, C. D. *More Productivity from Engineers: With the Growing Importance of Technical Research and the Desperate Shortage of Technical Personnel, That is the Only Solution.* Harvard Business Review, v. 65, March–April 1957, pp. 54–62.
Ott, E. *Research Requirements.* Oil, Paint, and Drug Reporter, v. 171, February 4, 1957, pp. 4 plus.
Price, G. A. *Most Valuable Dollar Spent is the Research Dollar.* Commercial and Financial Chronicle, v. 185, April 18, 1957, pp. 1810 plus.
Research is Big Business. Steel, v. 140, April 29, 1957, p. 123.
Rubenstein, Albert H. *Looking Around: Guides to Research and Development.* Harvard Business Review, v. 35, May–June 1957, pp. 133–134.
——— *Setting Criteria for Research and Development.* Harvard Business Review, v. 35, January–February 1957, pp. 95–104.
Ryder, F. L. *Explore Personality Factors in Research and Development.* Industrial Laboratories, v. 9, March 1958, pp. 10–13.
Salveson, Melvin E. *High-Speed Operations Research.* Harvard Business Review, v. 35, July–August 1957, pp. 89–99.
Seigle, L. *Coordination in Soviet Education and Research.* Journal of Metals, v. 10, March 1958, pp. 178–179.
Shanin, Dorian. *The Statistically Designed Experiment: A Tool for Process and Product Improvement.* Harvard Business Review, v. 35, July–August 1957, pp. 67–73.
Stedman, John C. *Patents and the Antitrust Laws.* Journal of the Patent Office Society, v. 21, January 1949, pp. 14–32.
Stolz, Robert K. *Planning: Key to Research Success.* Harvard Business Review v. 35, May–June 1957, pp. 82–88.

Suits, C. G. *Plan Ahead to Make Research Effort Pay Dividends.* Iron Age, v. 179, March 7, 1957, pp. 83–85.
They Offer Recipe for Top Research Management. Columbia's 9th Annual Conference on Research and Development. Product Engineering, v. 29, June 23, 1958, p. 22.
Ulin, Robert P. *Thinking Ahead: What Will Research Bring About?* Harvard Business Review, v. 36, January–February 1958, p. 27 plus.
Top Problem for the United States: A General Shortage of Brain Power. Business Week, No. 1443, April 27, 1957, pp. 176–202.
Travis, H. F. *Far-Reaching Effect of Patent Decrees: Role of Research.* Magazine of Wall Street, v. 97, March 3, 1956, pp. 671–673.
Vicek, A., Jr., and L. E. Laux. *Manufacturing Research: A Plan for the Future.* Tool Engineer, v. 39, November 1957, pp. 75–79.
Welsh, C. H. *Patents and Competition in the Automobile Industry.* Law and Contemporary Problems, Duke University, v. 13, No. 2, Spring 1948. (See also "The Patent System," Duke University, in Appendix B.).
What Are Companies Planning in Research. Chemical and Engineering News, v. 35, May 20, 1957, pp. 20–21.
Whitmore, E. *Research Builds Minnesota Mining and Manufacturing Company.* American Business, v. 27, February 1957, pp. 16–18.

Appendix E

175 Trade Associations With a Special Interest in Technical Research

The 175 national trade associations listed below are typical of those especially active in encouraging research in their industries by various means, such as (1) keeping their members abreast of current research in their field (2) holding frequent "clinics" on technical problems; (3) financing research fellowships; and (4) in some cases engaging in actual laboratory work.

Not included are the special-project organizations where a limited number of companies in an industry set up a small research agency to deal with a special problem. Examples are Drilling Research, Inc., and Fractionation Research, Inc.

The names italicized had larger than average staffs in 1956–57. Those marked with an asterisk (*) had staffs of less than 4 persons.

Association	Staff (approximate)	Members (approximate)
Acoustical Materials Association, 335 East 45th St., New York, N. Y	*	30
Aircraft Industries Association of America, Shoreham Bldg., Washington, D.C	80	140
Alloy Casting Institute, 286 Old Country Rd., Mineola, Long Island, N.Y	5	40
Aluminum Smelters Research Institute, 20 North Wacker Dr., Chicago, Ill	5	20
American Bakers Association (and American Institute of Baking), 20 North Wacker Dr., Chicago, Ill	30	2,000
American Bottlers of Carbonated Beverages, 1128 16th St., Washington, D.C	25	3,000
American Butter Institute—National Cheese Institute, 110 North Franklin St., Chicago, Ill	6	200
American Coke and Coal Chemicals Institute, 711 14th St., Washington, D.C	5	30
American Concrete Pipe Association, 228 North La Salle St., Chicago, Ill	12	200
American Cotton Manufacturers Institute, Johnston Bldg., Charlotte, N.C	40	1,000
American Council of Independent Laboratories, National Press Bldg., Washington, D.C	*	70
American Dehydrators Association, Board of Trade Bldg., Kansas City, Mo	*	180
American Drug Manufacturers Association, 1426 G St., Washington, D.C	6	70
American Dry Milk Institute, 221 North La Salle St., Chicago, Ill	40	200
American Gas Association, 420 Lexington Ave., New York, N.Y	320	7,900
American Hotel Association, 221 West 57th St., New York, N.Y	45	6,000
American Gear Manufacturers Association, 1 Thomas Circle, Washington, D.C	5	170
American Institute of Baking (of American Bakers Association), 400 East Ontario St., Chicago, Ill	70	1,500
American Institute of Laundering, South Chicago St., Joliet, Ill	100	4,500
American Institute of Steel Construction, 101 Park Ave., New York, N.Y	55	300
American Iron & Steel Institute, 150 East 42d St., New York, N.Y	75	2,600
American Manganese Producers Association, National Press Bldg., Washington, D.C	*	130

Association	Staff (approximate)	Members (approximate)
American Meat Institute (and AMI Foundation), 59 East Van Buren St., Chicago, Ill	100	640
American Mining Congress, 1200 18th St., Washington, D.C	25	1,000
American Newspaper Publishers Association, 750 3d Ave., New York, N.Y	125	750
American Paper & Pulp Association, 122 East 42d St., New York, N.Y	40	20
American Petroleum Institute, 50 West 50th St., New York, N.Y	350	10,000
American Potash Institute, 1102 16th St., Washington, D.C	30	20
American Poultry & Hatchery Federation, 521 East 63d St., Kansas City Mo.	10	4,300
American Railway Car Institute, 200 East 42d St., New York, N.Y	5	20
American Transit Association, 292 Madison Ave., New York, N.Y	75	750
American Tung Oil Association, Box 73, Poplarville, Miss	*	300
American Zinc Institute, 60 East 42d St., New York, N.Y	15	140
Anthracite Institute, 237 Old River Rd., Wilkes-Barre, Pa	10	20
Appalachian Hardwood Manufacturers, Inc., 414 Walnut St., Cincinnati, Ohio	*	40
Asbestos Cement Products Association, 509 Madison Ave., New York, N.Y.	*	20
Asbestos Textile Institute, care of Philadelphia Textile Institute, Schoolhouse Lane, Philadelphia, Pa	*	20
Asphalt Institute, Asphalt Institute Bldg., University of Maryland, College Park, Md	50	50
Associated Veterinary Laboratories, Inc., Box 87, East St. Louis, Ill	*	20
Association of American Railroads, Transportation Bldg., Washington, D.C	750	400
Association of American Soap & Glycerine Producers, 295 Madison Ave., New York, N.Y	25	180
Association of Edison Illuminating Companies, 51 East 42d St., New York, N.Y	*	60
Association of Roller & Silent Chain Manufacturers, 3343 Central Ave., Indianapolis, Ind	*	20
Automobile Manufacturers Association, New Center Bldg., Detroit, Mich	100	30
Bituminous Coal Research, Inc. (affiliate of the National Coal Association, infra).		
Book Manufacturers Institute, 25 West 43d St., New York, N.Y	*	50
Brass and Bronze Ingot Institute, 308 West Washington St., Chicago, Ill	*	20
Building Waterproofers Association, 60 East 42d St., New York, N.Y	*	50
Burning Oil Distributors Association, 505 North Michigan Ave., Chicago, Ill	*	30
Calcium Chloride Institute, 1200 18th St., Washington, D.C	10	20
California Redwood Association, 576 Sacramento St., San Francisco, Calif	30	20
Canning Industry Research (affiliate of the National Canners Association, infra).		
Cast Iron Pipe Research Association, Prudential Plaza, Chicago, Ill	5	20
Cast Iron Pressure Pipe Institute, 5120 Manning Dr., Bethesda, Md	*	20
Chamber of Commerce of the United States, 1615 H St., Washington, D.C	500+	23,400
Chlorine Institute, 342 Madison Ave., New York, N.Y	*	40
Cigar Manufacturers Association of America, 350 Fifth Ave., New York, N.Y	10	100
Clothing Manufacturers Association of the United States, 220 Fifth Ave., New York, N.Y	10	1,000
Cocoa Merchants Association of America, 82-92 Beaver St., New York, N.Y	*	100
Compressed Gas Association, 11 West 42d St., New York, N.Y	6	250
Concrete Reinforcing Steel Institute, 38 South Dearborn St., Chicago, Ill	*	120
Cooling Tower Institute, 420 Emerson St., Palo Alto, Calif	*	10
Copper & Brass Research Association, 420 Lexington Ave., New York, N.Y	25	50
Corn Industries Research Foundation, 1001 Connecticut Ave., Washington, D.C	10	20
Douglas Fir Plywood Association, 1119 A St., Tacoma, Wash	45	60
Edison Electric Institute, 750 Third Ave., New York, N.Y	90	200
Enameled Utensil Manufacturers Council (and other associations), Keith Bldg., Cleveland, Ohio	10	20
Evaporated Milk Association, 228 North La Salle St., Chicago, Ill	30	40
Farm Underwriters Association, 175 West Jackson Blvd., Chicago, Ill	*	40
Farmers & Manufacturers Beet Sugar Association, Second National Bank Bldg., Saginaw, Mich	15	25
Fibre Box Association, 224 South Michigan Ave., Chicago, Ill	55	160
Folding Paper Box Association of America, 222 West Adams St., Chicago, Ill	30	200
Gray Iron Founders Society, 210 National City-East 6th Bldg., Cleveland, Ohio	12	450
Grinding Wheel Institute, 2130 Keith Bldg., Cleveland, Ohio	*	40
Gypsum Association, 201 North Wells St., Chicago, Ill	10	50
Independent Petroleum Association of America, Post Office Box 1019, Tulsa, Okla	40	11,000
Indiana Limestone Institute, Box 72, Bedford, Ind	12	20
Industrial Fasteners Institute, 1517 Terminal Tower, Cleveland, Ohio	10	70
Institute of Boiler and Radiator Manufacturers, 608 Fifth Ave., New York, N.Y	8	60
Institute of Makers of Explosives, 250 East 43d St., New York, N.Y	5	20
Insulation Board Institute, 111 West Washington St., Chicago, Ill	5	20
Insulating Siding Association, 1201 Waukegan Rd., Glenview, Ill	*	20
Internal Combustion Engine Institute, 201 North Wells St., Chicago, Ill	*	20
Lead Industries Association, 60 East 42d St., New York, N.Y	15	90
Linen Supply Association of America, 22 West Monroe St., Chicago, Ill	10	750
Lithographic Technical Foundation, 131 East 39th St., New York, N.Y	35	1,800
Malleable Founders Society, Union Commerce Bldg., Cleveland, Ohio	10	80
Manufacturing Chemists Association, 1625 I St., Washington, D.C	50	170
Metal Powder Industries, 130 West 42d St., New York, N.Y	*	70
Metal Treating Institute, 271 North Ave., New Rochelle, N.Y	*	80

Association	Staff (approximate)	Members (approximate)
Milk Industry Foundation, 1145 19th St., Washington, D C	15	1,500
Millers National Federation, 309 West Jackson Blvd., Chicago, Ill	35	200
Motion Picture Research Council, 1421 North Western Ave., Hollywood, Calif.	10	20
National Association of Automotive Mutual Insurance Companies, 20 North Wacker Dr., Chicao, Ill	5	40
National Association of Cotton Manufacturers, 80 Federal St., Boston, Mass	10	400
National Association of Ice Industries, 810 18th St., Washington, D.C	10	1,500
National Association of Manufacturers, 2 East 48th St., New York, N.Y	500	20,400
National Association of Photo-Lithographers, 317 West 45th St., New York, N.Y	6	825
National Association of Wool Manufacturers, 386 4th Ave., New York, N.Y	15	375
National Board of Fire Underwriters, 85 John St., New York, N.Y NOTE.—In 1894 the NBFU formed the Underwriters Laboratories, which, with a staff of over 800, is the Nation's largest testing and inspection agency in the association field.	380	225
National Canners Association (and Canning Industry Research, Inc.), 1133 20th St., Washington, D.C	120	900
National Clay Pipe Manufacturers, 1820 N St., Washington 6, D.C	15	60
National Coal Association (and Bituminous Coal Research, Inc.), Southern Bldg., Washington, D.C	55	750
National Concrete Masonry Association, 38 South Dearborn St., Chicago, Ill	15	800
National Confectioners Association, 221 North La Salle St., Chicago, Ill	15	500
National Cotton Compress & Cotton Warehouse Association, Post Office Box 23, Memphis, Tenn	*	6
National Cotton Council of America (farmers associations and companies), 1918 North Parkway, Memphis, Tenn	80	*
National Cottonseed Pvoducts Association, Post Office Box 5736, Crosstown Station, Memphis, Tenn	20	600
National Crushed Stone Association, 1415 Elliot Pl., Washington, D.C	15	200
National Dairy Council (farmers and companies) 111 North Canal St., Chicago, Ill	80	2,500
National Electrical Manufacturers Association, 155 East 44th St., New York, N.Y	100	600
National Federation of Textiles (became a part of American Cotton Manufacturers Institute in 1958).		
National Independent Meat Packers Association, 740 11th St., Washington, D.C	5	700
National Institute of Diaper Services, 67 West 44th St., New York, N.Y	8	80
National Institute of Dry Cleaning, 909 Burlington Ave., Silver Spring, Md	80	8,500
National Lime Association, 925 15th St., Washington, D.C	8	60
National Live Stock and Meat Board (farmers and companies), 407 South Dearborn St., Chicago, Ill	50	20
National Lubricating Grease Institute, 4638 J. C. Nichols Parkway, Kansas City 2, Mo	5	150
National Lumber Manufacturers Association (and Timber Engineering Co.), 1319 18th St., Washington, D.C	100	16
National Macaroni Manufacturers Association, 139 North Ashland Ave., Palatine, Ill	*	130
National Mineral Feeds Association, Equitable Bldg., Des Moines, Iowa	*	100
National Mineral Wool Association, 1270 Sixth Ave., New York, N.Y	5	30
National Paperboard Association, 80 East Jackson Blvd., Chicago, Ill	30	120
National Paint, Varnish & Lacquer Association, 1500 Rhode Island Ave., Washington, D.C	55	1,250
National Petroleum Association, Munsey Bldg., Washington, D.C	15	80
National Plant Food Institute, 1700 K St., Washington, D.C	25	260
National Potato Chip Institute, International Hanna Building, Cleveland, Ohio	6	250
National Printing Ink Research Institute, care of Lehigh University Institute of Research, Chemistry Building, Bethlehem, Pa	18	80
National Renderers Association, 30 North La Salle St., Chicago, Ill	*	200
National Retail Hardware Association, 964 North Pennsylvania St., Indianapolis, Ind	65	23,000
National Sand & Gravel Association (and National Ready Mixed Concrete Association), 1329 E Street, Washington, D.C	18	250
National Sanitary Supply Association, 159 North Dearborn St., Chicago, Ill	10	1,100
National Slag Association, Perpetual Bldg., 1111 E St., Washington, D.C	5	30
National Slate Association, 455 West 23d St., New York, N.Y	*	90
National Warm Air Heating & Air Conditioning Association, Engineers Bldg., Cleveland, Ohio	15	500
National Wooden Box Association, Barr Bldg., 910 17th St., Washington, D.C	6	300
Natural Gasoline Association of America, Kennedy Bldg., Tulsa, Okla	*	50
Nutrition Foundation, 99 Park Ave., New York, N.Y	*	70
Oil Heat Institute of America, 500 5th Ave., New York, N.Y	12	3,200
Oxychloride Cement Association, care of Food Machinery & Chemical Corp., 161 East 42d St., New York, N.Y	*	20 20
Pennsylvania Grade Crude Oil Association, Post Office Box 96, Oil City, Pa	15	750
Perlite Institute, 45 West 45th St., New York, N.Y	5	60
Plywood Research Foundation, 620 East 26th St., Tacoma, Wash	6	90
Porcelain Enamel Institute, 1145 19th St., Washington, D.C	10	150
Portland Cement Association, 33 West Grand Ave., Chicago, Ill	600	70
Pressed Metal Institute, 3673 Lee Rd., Cleveland, Ohio	8	300
Printing Industry of America (and Technical Association of the Graphic Arts), 5728 Connecticut Ave., Washington, D.C	30	5,000
Proprietary Association of America, 810 18th St., Washington, D.C	10	300

Association	Staff (approximate)	Members (approximate)
Quality Bakers of America Cooperative, 120 West 42d St., New York, N.Y	50	130
Rail Steel Bar Association, 38 South Dearborn St., Chicago, Ill	5	20
Railway Wheel Association, 445 North Sacramento Blvd., Chicago, Ill	40	20
Refractories Institute, First National Bank Bldg., Pittsburgh, Pa	*	60
Research and Development Associates, Food and Container Institute, 1819 West Pershing Rd., Chicago, Ill	*	500
Roll Manufacturers Institute, Farmers Bank Bldg., Pittsburgh, Pa	*	20
Scientific Apparatus Makers Association of America, 20 North Wacker Drive, Chicago, Ill	15	220
Society of the Plastics Industry, 250 Park Ave., New York, N.Y	25	3,000
Southern Furniture Manufacturers Association, 209 South Main St., High Point, N.C	6	350
Southern Pine Association, National Bank of Commerce Bldg., New Orleans, La	35	200
Steel Founders Society of America, Terminal Tower Bldg., Cleveland, Ohio	15	150
Steel Joist Institute, Dupont Circle Bldg., Washington, D.C	*	20
Steel Shipping Container Institute, 600 5th Ave., New York, N.Y	*	30
Sterling Silversmiths Guild of America, 551 5th Ave., New York, N.Y	5	20
Stoker Manufacturers Association, 307 North Michigan Ave., Chicago, Ill	*	50
Structural Clay Products Institute (and SCPR Foundation), 1520 18th St., Washington, D.C	80	170
Sugar Research Foundation, 52 Wall St., New York, N.Y	10	120
Sulphite Pulp Manufacturers Research League, 1101 East South River St., Appleton, Wis	20	20
Tanners Council of America (and Tanners Council Research Foundation), 411 5th Ave., New York, N.Y	25	300
Technical Association of the Graphic Arts (affiliate of Printing Industry of America, supra).		
Technical Association of the Pulp & Paper Industry, 155 East 44th St., New York, N.Y	10	8,700
Tile Council of America, 800 2d Ave., New York, N.Y	10	30
Timber Engineering Co. (See National Lumber Manufacturers Association, supra.)		
Tin Research Institute, 492 West 6th Ave., Columbus, Ohio	6	20
Tufted Textile Manufacturers Association, Post Office Box 81, Dalton, Ga	8	300
Underwriters Laboratories, Inc. (formed by the National Board of Fire Underwriters), 207 East Ohio St., Chicago, Ill	800	200
Wallpaper Wholesalers Association, 1400 Chestnut St., Philadelphia, Pa	*	100
Water Conditioning Association, International, 325 West Wesley St., Wheaton, Ill	4	600
Waxed Paper Institute, 38 South Dearborn St., Chicago, Ill	8	30
West Coast Lumbermen's Association, 1410 S. W. Morrison St., Portland, Oreg	200	550
Western Pine Association, Yeon Bldg., Portland, Oreg	80	350

Appendix F

145 Professional Associations With a Special Interest in Technical Research

The membership of most professional associations and technical societies consists of persons with specialized educational training whose primary interest is in research. Consequently, each of the organizations listed below is an important factor in national, and often international, research in its particular field. Professional associations as a general rule have a periodically published journal in which basic and applied research is reviewed. They also have a large number of local chapters which hold monthly or quarterly meetings.

The associations italicized below had larger than average staffs in 1957–58 Those marked with an asterisk (*) had staffs of less than 4 persons.

	Year organized	Staff (approximate)	Members (approximate)
Acoustical Society of America, 335 East 45th St., New York, N.Y	1929	*	2,100
Agricultural Research Institute (NRC), 2101 Constitution Ave., Washington, D.C	1951	8	150
Air Pollution Control Association, 4400 5th Ave., Pittsburgh, Pa	1907	8	1,250
American Association for the Advancement of Science, 1515 Massachusetts Ave., Washington, D.C	1848	45	53,000
American Association of Cereal Chemists, care of Merck & Co., Inc., Rahway, N.J	1915	5	1,100
American Association of Engineers, 8 South Michigan Ave., Chicago, Ill	1915	20	5,500
American Association of Petroleum Geologists, Box 979, Tulsa, Okla	1917	20	13,000
American Association of Textile Chemists & Colorists, Lowell Technological Institute, Lowell, Mass	1921	*	7,500

	Year organized	Staff (approximate)	Members (approximate)
American Association for Textile Technology, 100 West 55th St., New York, N.Y	1934	5	1,000
American Ceramic Society, 4055 North High St., Columbus, Ohio	1899	20	5,700
American Chemical Society, 1155 16th St., Washington, D.C	1876	325	80,000
American Bureau of Shipping, 45 Broad St., New York, N.Y	1862	340	350
American Concrete Institute, 18263 West McNichols Road, Detroit, Mich	1905	15	8,500
American Dairy Science Association, 32 Ridgeway Circle, White Plains, N.Y	1906	*	2,200
American Electroplaters Society, 445 Broad St., Newark, N.J	1909	10	8,000
American Foundrymen's Society, Golf and Wolf Rds., Des Plaines, Ill	1896	40	13,000
American Helicopter Society, 2 East 64th St., New York, N.Y	1943	*	1,400
American Institute of Architects, 1735 New York Ave., Washington, D.C	1857	40	12,000
American Institute of Biological Sciences, 2000 P St., Washington, D.C	1948	15	38,000
American Institute of Chemical Engineers, 25 West 45th St., New York, N.Y	1908	45	17,000
American Institute of Chemists, 60 East 42d St., New York, N.Y	1923	*	3,000
American Institute of Consulting Engineers, 33 West 39th St., New York, N.Y	1910	*	225
American Institute of Electrical Engineers, 33 West 39th St., New York, N.Y	1884	50	50,000
American Institute of Industrial Engineers, 145 North High St., Columbus, Ohio	1948	5	5,300
American Institute of Mining, Metallurgical and Petroleum Engineers, 29 West 39th St., New York, N.Y	1871	50	27,000
American Institute of Physics, 333 East 45th St., New York, N.Y	1931	55	19,000
American Institute of Plant Engineers, Post Office Box 185, Barrington, Ill	1954	*	1,600
American Leather Chemists Association, University of Cincinnati, Cincinnati, Ohio	1903	*	800
American Mathematical Society, 190 Hope St., Providence, R.I	1888	20	5,200
American Meteorological Society, 3 Joy St., Boston, Mass	1919	35	6,500
American Patent Law Association, National Press Bldg., Washington, D.C	1897	*	2,000
American Public Works Association, 1313 East 60th St., Chicago, Ill	1894	6	3,000
American Pulp & Paper Mill Superintendents Association, 327 South La Salle St., Chicago, Ill	1919	5	1,800
American Rocket Society, 500 5th Ave., New York, N.Y	1930	15	12,000
American Railway Engineering Association, 59 East Van Buren St., Chicago, Ill	1899	8	3,500
American Society of Agricultural Engineers, 420 Main St., St. Joseph, Mich	1907	10	4,700
American Society of Agronomy, 2702 Monroe St., Madison, Wis	1907	5	3,200
American Society of Bakery Engineers, 121 West Wacker Dr., Chicago, Ill	1924	5	2,800
American Society of Body Engineers, 100 Farnsworth Ave., Detroit, Mich	1945	*	400
American Society of Civil Engineers, 33 West 39th St., New York, N.Y	1852	75	40,000
American Society for Engineering Education, University of Illinois, Urbana, Ill	1893	6	8,000
American Society of Heating and Air Conditioning Engineers, 62 Worth St., New York, N.Y	1894	25	11,500
American Society of Lubrication Engineers, 84 East Randolph St., Chicago, Ill	1944	5	2,800
American Society of Mechanical Engineers, 29 West 39th St., New York, N.Y	1880	130	43,000
American Society for Metals, 7301 Euclid Ave., Cleveland, Ohio	1913	60	26,000
American Society of Naval Engineers, 1012 14th St., Washington, D.C	1888	*	3,100
American Society for Quality Control, 161 West Wisconsin Ave., Milwaukee, Wis	1946	10	9,000
American Society of Refrigerating Engineers, 234 5th Ave., New York, N.Y	1904	25	7,000
American Society of Safety Engineers, 425 North Michigan Ave., Chicago, Ill	1915	8	7,000
American Society of Sanitary Engineering, 4716 Ewing Ave. South, Minneapolis, Minn	1906	*	2,000
American Society for Testing Materials, 1916 Race St., Philadelphia, Pa	1898	70	13,000
American Society of Tool Engineers, 10700 Puritan Ave., Detroit, Mich	1932	65	38,000
American Specification Institute, 134 North La Salle St., Chicago, Ill	1921	*	275
American Standards Association, 70 East 45th St., New York, N.Y	1918	70	2,500
American Statistical Association, 1757 K St., Washington, D.C	1939	5	5,700
American Welding Society, 33 West 39th St., New York, N.Y	1919	25	12,800
Association for Applied Solar Energy, 3424 North Central Ave., Phoenix, Ariz	1954	5	35
Association for Computing Machinery, 2 East 63d St., New York, N.Y	1947	*	3,100
Association of Consulting Chemists & Chemical Engineers, 50 East 41st St., New York, N.Y	1928	*	125
Association of Consulting Management Engineers, 347 Madison Ave., New York, N.Y	1929	6	45
Association of Federal Communications Consulting Engineers, 1302 18th St., Washington, D.C	1948	*	40
Association of Mutual Fire Insurance Engineers, 429 North Pennsylvania, Indianapolis, Ind	1932	*	150

	Year organized	Staff (approximate)	Members (approximate)
Association of Iron & Steel Engineers, 1010 Empire Bldg, Pittsburgh, Pa	1907	12	7,500
Association of Official Agricultural Chemists, Box 540, Franklin Station, Washington, D.C	1884	*	2,500
Atomic Industrial Forum, 3 East 54th St., New York, N.Y	1953	25	1,500
Audio Engineering Society, 135 West 14th St., New York, N.Y	1948	*	2,000
Building Research Advisory Board (NRC), 2101 Constitution Ave., Washington, D.C	1949	8	30
Building Research Institute (NRC), 2101 Constitution Ave., Washington, D.C	1951	10	1,100
Bureau of Highway Traffic, Strathcona Hall, Yale University, New Haven, Conn	1926	6	(1)
Carnegie Institution of Washington, 1530 P St., Washington, D.C	1902	250	(2)
Conference of Municipal Public Health Engineers, St. Louis County Health Department, Clayton, Mo	1939	*	220
Conference of State Sanitary Engineers, New Jersey State Department of Health, Trenton, N.J	1920	*	200
Conference of Utility Commission Engineers, National Bureau of Standards, Washington, D.C	1923	*	65
Coordinating Research Council (of the petroleum industry), 30 Rockefeller Plaza, New York, N.Y	1942	20	700
Council for Technological Advancement, 1200 18th St., Washington, D.C	1952	----------	----------
(Chief activity is economic research; is in the office of the Machinery and Allied Products Institute at the above address. Has no separate staff or membership.)			
Crop Protection Institute, 229 Quackenbos St., Washington, D.C	1920	8	50
Electrochemical Society, 1860 Broadway, New York, N.Y	1902	8	2,500
Engineering College Research Council (part of the American Society for Engineering Education), New York University, University Heights, New York, N.Y	1948	----------	----------
Engineering Foundation (see also United Engineering Trustees, infra), 29 West 39th St., New York, N.Y	1914	*	4
(Organized by the 4 national societies of civil, electrical, mechanical, and mining engineers, to promote engineering research.)			
Engineers Council for Professional Development, 29 West 39th St., New York, N.Y	1932	*	8
(A conference group of 8 engineering societies; the 4 in the Engineering Foundation (civil, electrical, mechanical, mining), plus the American Institute of Chemical Engineers, American Society for Engineering Education, National Council for State Boards of Engineering Examiners, and the Engineering Institute of Canada.)			
Engineers Joint Council, 29 West 39th St., New York, N.Y	1941	8	
(A coordinating agency for some activities of the national societies of civil, electrical, mechanical, and mining engineers; also, the American Institute of Chemical Engineers, American Society for Engineering Education, American Water Works Association, and the Society of Naval Architects and Marine Engineers.)			
Federation of American Scientists (was Federation of Atomic Scientists), 1805 H St., Washington, D.C	1946	*	2,200
Federation of Paint and Varnish Production Clubs, 121 South Broad St., Philadelphia, Pa	1922	5	3,800
Food and Nutrition Board (part of National Academy of Sciences—NRC), 2101 Constitution Ave., Washington, D.C	1940	----------	20
Forest Products Research Society, Box 2010, University Station, Madison, Wis	1947	8	3,500
Foundry Educational Foundation, Terminal Tower, Cleveland, Ohio	1947	5	475
Future Scientists of America Foundation. (See National Education Association, infra.)			
Geological Society of America, 419 West 117th St., New York, N.Y	1888	25	4,700
Highway Research Board (part of National Academy of Sciences–NRC), 2101 Constitution Ave., Washington, D.C	1920	----------	50
Illuminating Engineering Society, 1860 Broadway, New York, N.Y	1906	20	9,000
Industrial Research Institute, 100 Park Ave., New York, N.Y	1938	5	145
Institute of Aeronautical Sciences, 2 East 64th St., New York, N.Y	1932	50	17,000
Institute of Food Technologists, 176 West Adams St., Chicago, Ill	1939	6	4,500
Institute of Radio Engineers, 1 East 79th St., New York, N.Y	1912	135	58,200
Institute of Traffic Engineers, 2029 K St., Washington, D.C	1930	5	1,000
Instrument Society of America, 313 6th Ave., Pittsburgh, Pa	1939	15	8,500
Insulated Power Cable Engineers Association, 283 Valley Rd., Montclair, N.J	1925	*	75
International Association of Printing House Craftsmen, 411 Oak St., Cincinnati, Ohio	1919	*	14,000
International Acetylene Association, 30 East 42d St., New York, N.Y	1898	5	200
Lithographic Technical Foundation, 131 East 39th St., New York, N.Y	1924	35	2,000
Malt Research Institute, Box 2039, Madison, Wis	1939	*	8
Manufacturers Standardization Society of the Valve and Fittings Industry, 420 Lexington Ave., New York, N.Y	1908	*	60
Mining and Metallurgical Society of America, 11 Broadway, New York, N.Y	1908	*	450

[1] Not given.
[2] Foundation.

	Year organized	Staff (approximate)	Members (approximate)
National Academy of Sciences-National Research Council (semigovernmental), 2101 Constitution Ave., Washington, D.C	1863	650	110
National Aeronautic Association, 1025 Connecticut Ave., Washington, D.C	1922	10	15,000
National Association of Corrosion Engineers, M. & M. Bldg., Houston, Tex	1943	25	5,400
National Association of Power Engineers, 176 West Adams St., Chicago, Ill	1882	10	15,000
National Association of Practical Refrigerating Engineers, 435 North Waller Ave., Chicago, Ill	1910	*	3,000
National Council of Patent Law Associations, National Press Bldg., Washington, D.C	1926	*	15
National Council for Stream Improvement, 271 Madison Ave., New York, N.Y	1943	15	250
National Education Association (NEA), 1201 16th St., Washington, D.C	1857	700	700,000
This association includes about 60 affiliated associations, commissions, departments, etc.—including the Future Scientists of America Foundation, and the National Science Teachers Association.			
National Institute of Ceramic Engineers, 4055 North High St., Columbus, Ohio	1938	*	750
National Patent Council, 1434 West 11th St., Gary, Ind	1945	5	1,500
National Research Council (part of National Academy of Sciences, supra), 2101 Constitution Ave., Washington, D.C	1916	----------	----------
National Science Foundation (a U.S. Government agency), 1951 Constitution Ave., Washington, D.C	1947	----------	----------
National Science Teachers' Association (part of National Education Association, supra).			
National Society of Professional Engineers, 2029 K St., Washington, D.C	1934	25	40,000
Natural Resources Council of America, Wire Bldg., Washington, D.C. (in office of Wild Life Management Institute)	1946	30	40
Radiation Research Society, Box 10901, Pittsburgh, Pa	1951	*	600
Railway Fuel & Traveling Engineers Association, 139 West Van Buren St., Chicago, Ill	1895	*	700
Refrigeration Service Engineers Society, 435 North Waller Ave., Chicago, Ill	1933	5	9,000
Research and Engineering Council of the Graphic Arts Industry (part of the Printing Industry of America, supra), 5728 Connecticut Ave., Washington, D.C	1947	----------	----------
Science Clubs of America, 1719 N St., Washington, D.C	1941	8	350,000
Science Service, 1719 N St., Washington, D C	1921	60	60,000
Society of the American Bacteriologists, Mount Royal and Guilford Ave., Baltimore, Md	1899	5	5,700
Society of American Military Engineers, Mills Bldg., Washington, D.C	1920	15	26,000
Society of Aeronautical Weight Engineers, Hughes Aircraft Co., Culver City, Calif	1939	*	250
Society of Automotive Engineers, 485 Lexington Ave., New York, N.Y	1905	100	23,000
Society for Experimental Stress Analysis, Box 168, Cambridge, Mass	1943	5	1,800
Society of Fire Protection Engineers, 60 Batterymarch St., Boston, Mass	1950	*	1,000
Society of Industrial Packaging and Material Handling Engineers, 14 East Jackson Blvd., Chicago, Ill	1945	*	1,800
Society for Industrial and Applied Mathematics, 100 West 10th St., Wilmington, Del	1952	*	1,225
Society for Motion Picture and Television Engineers, 55 West 42d St., New York, N.Y	1916	15	5,700
Society of Naval Architects and Marine Engineers, 74 Trinity Pl., New York, N.Y	1893	10	6,900
Society for Non-Destructive Testing, 1109 Hinman Ave., Evanston, Ill	1941	*	2,500
Society of Photographic Scientists and Engineers, Post Office Box 1609, Washington, D.C	1947	10	800
Society of Plastics Engineers, 34 East Putnam Ave., Greenwich, Conn	1941	8	5,000
Society of Soft Drink Technologists, 1128 16th St., Washington, D.C	1953	*	150
Society of Women Engineers, 4 Washington Sq. North, New York, N.Y	1952	*	650
Southern Association of Science and Industry, 3846 Hillcrest Ave., Atlanta, Ga	1941	*	1,000
Standards Engineers Society, Box 281, Camden, N.J	1948	*	400
Sugar Research Foundation, 52 Wall St., New York, N.Y	1943	6	110
Systems & Procedures Association of America, Penobscot Bldg., Detroit, Mich.	1944	*	2,000
Technical Association of the Pulp & Paper Industry, 155 East 44th St., New York, N.Y.	1915	10	8,700
Textile Research Institute, Box 625, Princeton, N.J	1930	75	740
United Engineering Trustees, 29 West 39th St., New York, N.Y	1904	50	4
(Consists of 2 departments: the Engineering Foundation, and the Engineering Societies Library which has over 180,000 volumes.)			

Appendix G

British Research Associations in 1956

(Compiled from data in "Combining for Research," issued by the Department of Scientific and Industrial Research, London, 1956)

The 41 associations listed below, ranked by size of income, had a total of 15,000 members and a revenue of about $13 million (at $2.80 to the pound). The 10 largest expended almost two-thirds of the total annual revenue. The associations in the two largest fields, and their functions, were:

British Iron & Steel Research Association.—Carries on research in the "transportation and beneficiation of ores; production of pig iron and steel; furnace design; steel-working; surface finishing; protection against corrosion."

British Cotton Industry Research Association.—Carries on research in "comprehensive studies of utilization of cotton fiber, natural silk, and man-made fibers, from evaluation of raw materials, preparing, spinning, weaving, to dyeing and finishing, and from fundamental properties of cellulose to design of machinery."

Research association	1954 income (in pounds)	Year formed
British Iron & Steel Research Association	516,000	1945
British Cotton Industry Research Association	396,000	1919
British Electrical & Allied Industries Research Association	327,000	1920
British Coal Utilization Research Association	308,000	1938
British Rayon Research Association	298,000	1946
Top 5=39 percent.		
Parsons & Marine Engineering Turbine Research and Development Association	291,000	1945
British Shipbuilding Research Association	244,000	1944
Wool Industries Research Association	227,000	1918
British Ceramic Research Association	170,000	1948
Motor Industry Research Association	146,000	1946
Top 10=64 percent.		
British Non-Ferrous Metals Research Association	140,000	1919
Production Engineering Research Association of Great Britain (machine tools, pressed metals, etc.)	131,000	1946
British Cast Iron Research Association	115,000	1921
British Welding Research Association	113,000	1946
Coal Tar Research Association	90,000	1949
Printing, Packaging, & Allied Trades Research Association	83,000	1930
British Coke Research Association	80,000	1944
Linen Industry Research Association	70,000	1919
Research Association of British Rubber Manufacturers	70,000	1919
British Scientific Instrument Research Association	70,000	1918
British Boot, Shoe, & Allied Trades Research Association	68,000	1919
British Paper & Board Industry Research Association	68,000	1945
British Steel Castings Research Association	65,000	1953
Research Association of British Paint, Colour and Varnish Manufacturers	63,000	1926
Hosiery & Allied Trades Research Association	58,000	1949
British Leather Manufacturers Research Association	57,000	1920
British Internal Combustion Engine Research Association	56,000	1943
British Food Manufacturing Industries Research Association	55,000	1946
Research Association of British Flour-Millers	53,000	1923
British Hydromechanics Research Association (Pumps, Valves, etc.)	53,000	1947
British Baking Industries Research Association	44,000	1946
British Launderers Research Association	40,000	1920
British Jute Trade Research Association	39,000	1946
Fruit & Vegetable Canning & Quick Freezing Research Association	22,000	1952
British Gelatine & Glue Research Association	21,000	1948
Research Committee of the Furniture Development Council	20,000	1950
Lace Research Association	18,000	1946
British Hat & Allied Feltmakers Research Association	18,000	1947
British Whiting Federation Research Council (Chalk)	17,000	1948
Coil Spring Federation Research Organization	15,000	1946
Cutlery Research Council	7,000	1952

NOTE.—The above list covers the 41 associations for which income figures are given for 1954. Five others were formed in 1954–55, covering the industries of files, glass, heating and ventilating, lime, and timber

Bibliography on trade association research abroad

Title	Author	Published by—
Administration and Organization of Scientific Research and Technical Development (1955).	Department of Scientific and Industrial Research, United Kingdom Government.	H. M. Stationery Office, London.
Combining for Research (1956)	do	Do.
Europeans Pool Metals Research	A. I. Nussbaum	Industrial Laboratories, November 1956, Chicago.
Industrial Research in England 1956–57 (1957).	Erwin Clarke	Todd Publishing Group, Ltd., London.
Industrial Research in Europe (1955)	W. W. Eaton	Research and Engineering, October–November 1955, New York.
The Organization of Applied Research in Europe, the United States, and Canada. Vols. I and II.	European Productivity Agency.	Organization for European Economic Cooperation, Paris.
The Organization of Applied Research in Europe.	Proceedings of the conference held at Nancy, Oct. 11–13, 1954.	Do.

Additional copies available from
Superintendent of Documents
Government Printing Office
Washington, D. C. Price 20¢