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A Pioneer Among Industrial Research Institutes: Battelle Memorial Institute

By James G. Black, Director
International Programme Development

There is today a widening awareness that research not only can help mankind to a better life, but can be international in its application. Battelle Memorial Institute has been a pioneer in achieving both these goals.

The Institute was founded in 1923 through the will of Gordon Battelle, a North American industrialist. Under the terms of his will, the Institute was established for "encouragement of creative research . . . the making of discoveries and inventions . . . the better education of men", and "the discovery, licence, and disposal" of new technology. Implicit throughout was the belief that both science and industry serve mankind.

In practice, the Institute was established as a "not-for-profit" corporation operated by a self-perpetuating Board of Trustees. The expression "not for profit" means that any income is to be used exclusively for furthering the purposes of the Institute.

The Institute's investigations range from advanced scientific research in virtually every field of physical science to providing knowledgeable economic projections pertinent to any industrial, business or governmental entity. Most of its research is conducted under contract on behalf of industrial firms or governmental agencies which provide the financial support for specific studies. At Battelle, those organizations are known as "sponsors".

Columbus laboratories

The original laboratories were opened in 1929 in Columbus, Ohio, with a staff of twenty-five. Today the Columbus laboratories have a staff of more than 2 700 scientists, engineers, economists and supporting personnel. With its other major research centres at Frankfurt, Germany; Geneva, Switzerland; and Richland, Washington (United States), the total Institute staff exceeds 6 000. The 1965 research volume for the four centres:

Columbus laboratories	\$ 33 150 740
Frankfurt laboratories	6 255 609
Geneva laboratories	3 484 083
Pacific Northwest laboratories	43 017 900
Total	\$ 85 908 332

Battelle-Columbus has been a pioneer in materials technology and development. Titanium, in particular, has been developed for service at the extremes of temperature and pressure, typical of space-age applications. The Columbus

laboratories have also opened new roads in the application of economics to industrial research in the physical sciences.

Forward-looking research on contemporary problems facing industry and society includes socio-economic research, exploration of new technological concepts for groups of interested industrial sponsors, ocean engineering, systems engineering, information systems, transportation research and life sciences—to mention just a few.

Research studies at Columbus—as at other Battelle centres—may be oriented toward the development of a new product, material or process; the conservation or utilization of natural resources; improvement of public health; or the development of new scientific knowledge. D. C. Minton, Jr., is the Director of the Columbus laboratories.

Establishment in Europe—Switzerland and Germany

Until the 1950's Battelle's operations were based entirely in the United States. At the end of World War II, although studies had been conducted on behalf of industrial organizations in other countries, our evaluations indicated that European industry would support contract industrial research.

Initially, steps were taken to register a branch of the Battelle Memorial Institute in Switzerland, and property was acquired for a laboratory site. At the same time, strong inducements were offered to Battelle to establish itself in Germany. These included a land grant for a laboratory site and the use of facilities: water, gas, and electricity. The Institute also was granted the right to use blocked marks for its projects. With this very substantial assistance the decision was made to build a laboratory at Frankfurt/Main.

Similarly, the Swiss authorities co-operated to the fullest in enabling this very unusual type of corporate entity to become a reality. The tax-exempt status accorded to Battelle was felt to be very tangible evidence of their approval. The Frankfurt laboratories opened their doors in 1953, and the Geneva laboratories in 1954.

During those first years the Institute furnished much of the necessary financial support to these laboratories. Today, however, they are self-supporting. Of course, numerous experienced staff members from Columbus were sent to aid in the initial phase of their operation, but by early 1958 there were no American staff residents in Europe. Each today has a high degree of autonomy under

a European director, who reports directly to Dr. B. D. Thomas, President of Battelle Memorial Institute.

The original building at Battelle-Frankfurt contained 160 000 sq. ft. of floor space with nineteen staff members. In its first year the research budget was under \$US 5 000. During the initial phase of its operations, activities were restricted to firms in the Federal Republic of Germany. Shortly thereafter, its services were extended to organizations in other western European countries—primarily the United Kingdom, Norway, Sweden, Denmark, Holland and Austria.

At the beginning of its contract research operations, Battelle-Frankfurt was primarily oriented toward the physical and engineering sciences. An industrial economics division was added in 1955, and since 1960 much of its capability has been directed toward the problems of developing countries, mainly in the field of industrial planning and engineering. Its industrial, mechanical and agricultural engineers, sociologists, economists and geologists are particularly active in this work.

Currently, Battelle-Frankfurt has a staff of more than 800 German scientists and technologists housed in laboratories containing over 421 000 sq. ft. They are grouped

in nine research departments operating under Drs. Max Barnick and Walter Ottmar, co-directors, and possess diverse research capability, particularly in the following fields:

acoustics	metal sciences
applied mathematics and systems analysis	metallurgical process engineering
applied physics	microbiology
biochemistry	navigation and communications
ceramics	optics
electrical engineering	physics engineering
electronics	physiology, toxicology, pharmacology
engine research and automotive engineering	planning of industrial structures
experimental chemistry	plastics technology
feasibility studies	process development
high temperature materials	radioisotopes and nuclear engineering
industrial engineering and planning	regional planning
interfaces research	spectroscopy and analytical chemistry
market research	structure of matter
mechanical engineering	

Figure 1. An example of international co-operation on a broad fundamental study is a comprehensive research effort in chemical vapour deposition being undertaken at Geneva, Frankfurt and Columbus, Ohio, for an international group of sponsoring organizations.

Like other Battelle laboratories, Battelle-Frankfurt was established to serve both large and small industry, as well as governments.

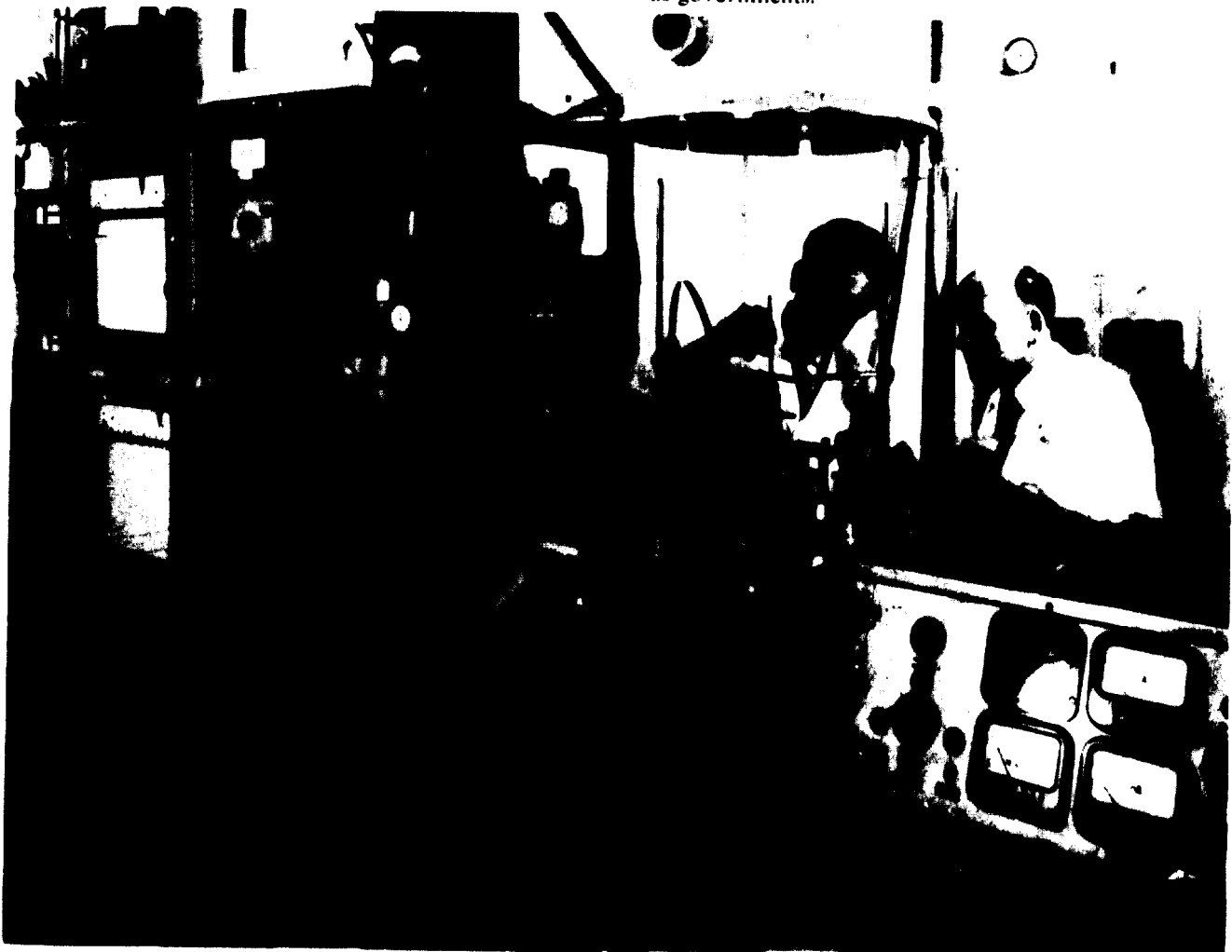
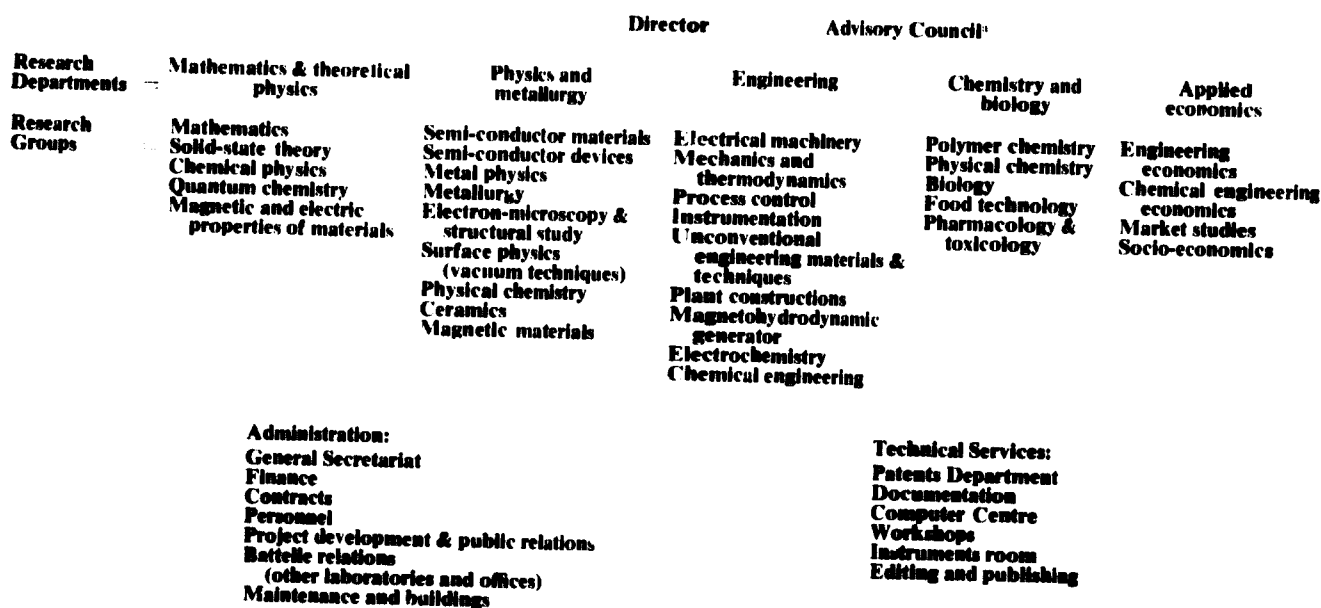


Chart I. Battelle-Geneva Organization Chart



* The Advisory Council is composed of the Research Department chiefs, the General Secretary, and the heads of Finance, Contracts, Personnel, and Project Development and Public Relations, under the chairmanship of the Director.

Internal administrative structures

Each of the laboratories has developed recognized strength in science and technology based on the needs and interests of the countries it serves. Their internal administrative structures differ somewhat in response to the traditions and practices of these countries, but a basic premise is that an environment conducive to creativity and objectivity be maintained.

Chart I illustrates the structure under which Battelle-Geneva conducts its research. There are thirty-two research groups, each of which specializes in various scientific disciplines and experimental techniques. These groups are assembled under five research departments; the department heads report to the director. Supporting administrative and technical services are provided as shown. Matters of general concern to the director of the laboratories are examined by an advisory council composed of the department chiefs, the general secretary, and the heads of finance, contracts, personnel, and project development and public relations.

For each research project, a project leader, whose technical qualifications are best suited to the project, is nominated from the group. He becomes responsible for the fulfilment of all technical tasks pertaining to that project and may solicit contributions from other groups in any department. He is given considerable freedom in planning and executing the project within the limits of the assigned budget, and has direct contact with the sponsor organization. Supervision and guidance by group leaders and department chiefs, though a necessary function, is not meant to deprive the project leader of any part of his over-all control. It is rather a means of strengthening his leadership and giving him the necessary assurance of support.

Within such an administrative structure, Battelle-Geneva has conducted research ranging from electrical engineering and electronics through metallurgy and mechanical engineering to chemistry and food technology. The area served primarily by Battelle-Geneva includes Switzerland, France, Italy and Belgium. The United Kingdom is served by both Geneva and Frankfurt by co-ordination through the Institute's London offices. Dr. Hugo Thiemann, Director of the Geneva laboratories, heads a scientific staff of diverse nationalities.

Pacific Northwest laboratories

The Pacific Northwest laboratories of Battelle Memorial Institute, located in the State of Washington (United States), constitute Battelle's newest research centre. Although they began operations in 1965 as an independent research facility, they have a long and distinguished history of service in nuclear science.

These laboratories, formerly known as the Hanford laboratory, were most recently operated by the General Electric Company under contract to the United States Atomic Energy Commission. While continuing to give particular attention to the peaceful application of atomic energy, they are expanding research in other areas of science and technology, ranging from chemistry and metallurgy to the earth and life sciences. Dr. Sherwood L. Fawcett is the Director of Battelle-Northwest.

Figure II. (right) Special laboratories for the study of exotic materials at Battelle-Columbus house diverse apparatus, such as this electron-beam melting furnace. It is capable of producing experimental castings from bottom size 18 inches long. The high-vacuum environment in the furnace permits the preparation of high-purity materials that are prone to oxidation under atmospheric conditions.

Examples of research activity

Of the literally hundreds of studies being pursued in Battelle laboratories at any given time, a very few examples are cited below:

Methods have been devised by Battelle Geneva for the analysis of pesticide residual deposits on fruits and vegetables; the metabolism of pesticides in plants and animal organisms is studied by means of radioisotope tracers.

A generator has been developed by Battelle-Columbus that can be operated on almost any common solid fuel, indigenous to a particular area, to provide electric power in remote geographical regions. Such generators could be used, for example, for charging radio batteries to help maintain contacts among isolated villages.

In a study of the problems of biological degradation of sewage conducted by Battelle-Frankfurt, emphasis was placed on modern synthetic industrial products that are difficult to degrade both in water and soil, and on waste materials that have a toxic effect in sewage treatment plants and receiving waters. The development of special analytical methods has enabled the gathering of conclusive information on degradation of industrial wastes.

Ecological studies oriented towards the uptake and transfer of radionuclides have been undertaken at Battelle-Northwest. Study environments have ranged from a selected spot of sage-brush, where soil and plants constitute the system, to a major segment of northwest Alaska, where the radioecology includes flora, fauna and man.

In co-operation with four major European industrial firms, Battelle-Geneva has developed a high-tonnage articulated dumper with exceptional performance characteristics. Known as the TX-40, it has a progressive power transmission, climbs a 50 per cent grade under load, maintains a speed of up to 72 km./hr. and has outstanding suspension and drive features.

Development of equipment for packaging textiles, food-stuffs sensitive to touch and perishable food-stuffs are among projects under study. This Battelle-Frankfurt work includes the development of simple devices and complete automatic machines or production chains.

The processing, uses and possible Mediterranean area markets for Syrian phosphates were studied in a joint effort involving Battelle economists in Europe and technologists in the United States.

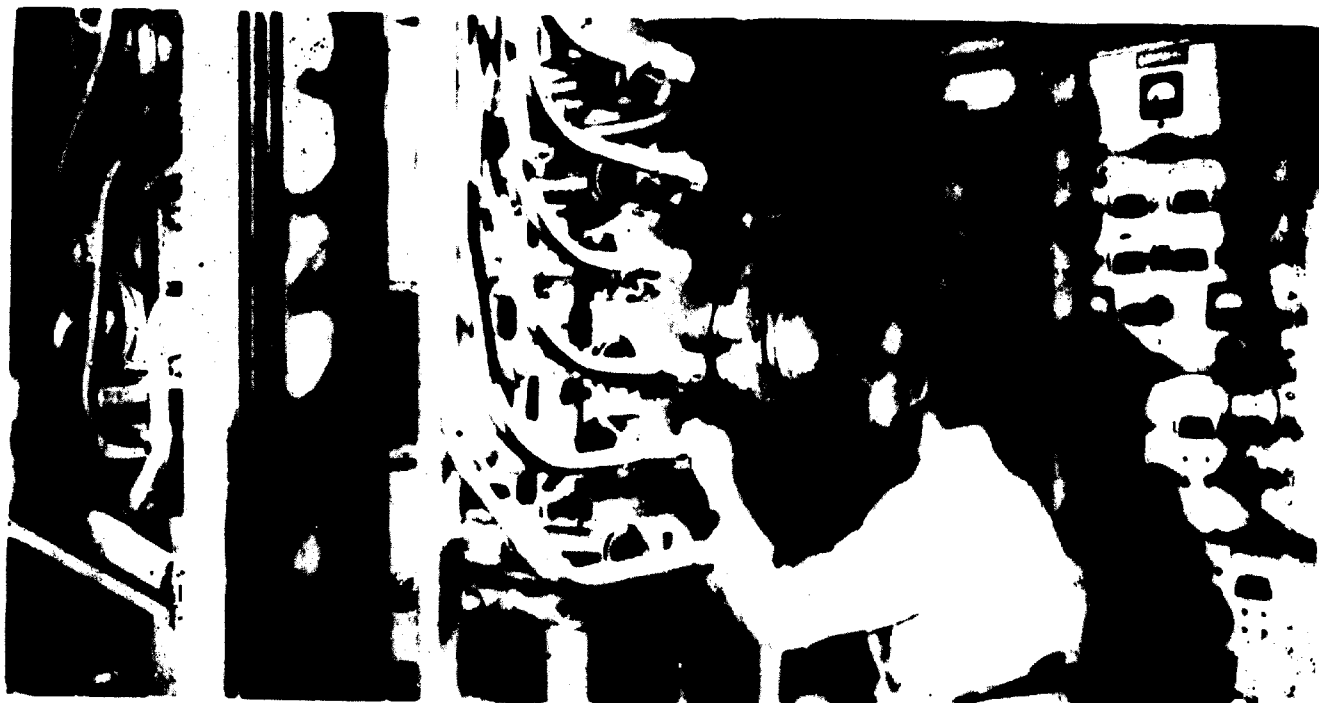
In their efforts to determine the realistic hazards of man's exposure to radioactive materials, biologists at Battelle-Northwest have developed an experimental animal that is nearly ideal in the study of many life science problems: the Hanford Miniature White Swine, a long-lived omnivore comparable to man in size and in a number of physiological characteristics.

The transportation needs of Alaska were studied and projections of economy of this state and its surrounding territories were made to 1980 by our Columbus staff.

A study of the physical, economic and personnel requirements for a heavy machinery manufacturing complex in the Guayana region of Venezuela has recently been completed.

A major study of the forces that are changing the patterns of world iron production has just been initiated by the Columbus laboratories with the collaboration of Frankfurt and Geneva for more than forty companies based in North America, South America, Europe, Australia and the Far East. The research involves detailed evaluation of the technology, economics and logistics of iron ore mining and of iron conversion processes in the major steel-producing areas of the world. Projections of technical and economic trends on a world-wide basis will be made to 1980.

Food supply and demand prospects through 1980 for six Central American countries and Belize have just been analysed and forecast in an economic study supported by the United States Department of Agriculture. Involved were Belize (British Honduras), Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama. The study provides data for use in long-range planning by the United States Government, as well as by the individual Central American countries and by the region as a whole. Such data will be useful in establishing future government policies, technical development activities and agricultural extension programmes.



Research arrangements

Battelle's research studies originate in various ways. The idea for a project or programme is sometimes initiated by a potential sponsor. On occasion, research supported by the Institute itself gives promising results, which are brought to the attention of a prospective sponsor for further development. At other times, a problem of a particular industry results in joint research efforts by the industry and Battelle.

Battelle's contractual relationship with an organization for which it is undertaking research is preceded by confidential discussions to define the precise nature and objectives of the investigation. The confidential nature of these discussions is honoured whether or not a research relationship is established.

After details have been discussed, a proposal is prepared and sent to the prospective sponsor for approval. This proposal describes the method of approach and outlines the research programme. It is accompanied by a contract which, when signed, authorizes Battelle to initiate the work and gives all necessary guarantees concerning the secrecy of the project and the ownership of its results.

The contract also stipulates that the sponsor pay the research costs and a dollar limit is set. Research costs are identified as staff time, use of equipment, laboratory supplies etc., as well as undistributed expense. At Battelle-Columbus this latter figure is 82 per cent of staff costs.

The importance of research is generally recognized today throughout the world. It has been Battelle's observation, however, that those sponsors—whether nations or industrial corporations—which appear to receive the optimum benefits from their research are those which have intelligently and objectively developed realistic goals. To assist in fulfilling the long-range research plans of some of its sponsors, Battelle has been involved in the development and upgrading of research facilities, both private and governmental, including research institutes.

Currently, for example, a team of Battelle technical and management specialists sponsored by the United States Agency for International Development (AID) has been working closely with Korean experts in planning the establishment of a Korean Institute for Science and Technology. This planning programme is expected to lead to a long-term association, with Battelle providing advisory services to the Korean research organization on construction, staffing and research operations.

Similar assistance was recently provided to the Governments of Spain and India. After extensive studies by technical management teams, recommendations were made which hopefully will lead to increased productivity in various governmental research organizations.

Encouragement of education

As a research institute, Battelle has always exercised an obligation to encourage and support educational efforts. Each of the Institute's research centres is urged to identify and develop opportunities for furthering the education of its staff members and for co-operating with colleges, universities, and professional and technical societies.

Typical of these activities are the seminars and symposia which it undertakes. Examples of those recently sponsored are: "Phase Stability in Metals and Alloys" (at Battelle-Geneva); "Gastrointestinal Radiation Injury" (at Battelle-

Northwest); and "Computer and Information Sciences" (at Battelle-Columbus). In addition, many staff members accept invitations to lecture and participate in seminars at various universities throughout the world.

Other activities

Implicit in the founder's will establishing Battelle was the charge not only to conduct research and to encourage educational efforts, but to assume an active role in transforming scientific knowledge into useful products and processes that serve mankind. Accordingly, Battelle has created mechanisms for nurturing promising research and carrying it to a point where it becomes a reasonable venture for private industry. These programmes involving research expenditures approaching \$US 1 million in 1965—are the responsibility of two subsidiary organizations: the Battelle Development Corporation and Scientific Advances, Inc.

The Battelle Development Corporation, established in 1935, evaluates inventions and provides funds for the initial high-risk research necessary to determine their technical and economic feasibility. It has a policy of granting non-exclusive licences at reasonable royalty rates to all qualified licensees. The Xerox process for duplicating printed material is the best known of the inventions nurtured by the Corporation.

Scientific Advances, Inc., in existence a little more than three years, is proving to be a useful mechanism for demonstrating the manufacture and marketing, on a profit basis, of products reflecting *bona fide* scientific innovation. To date, a principal interest of SAI has been the manufacture of a subminiature absolute-pressure transducer for specialized research, engineering, and medical applications.

Outlook

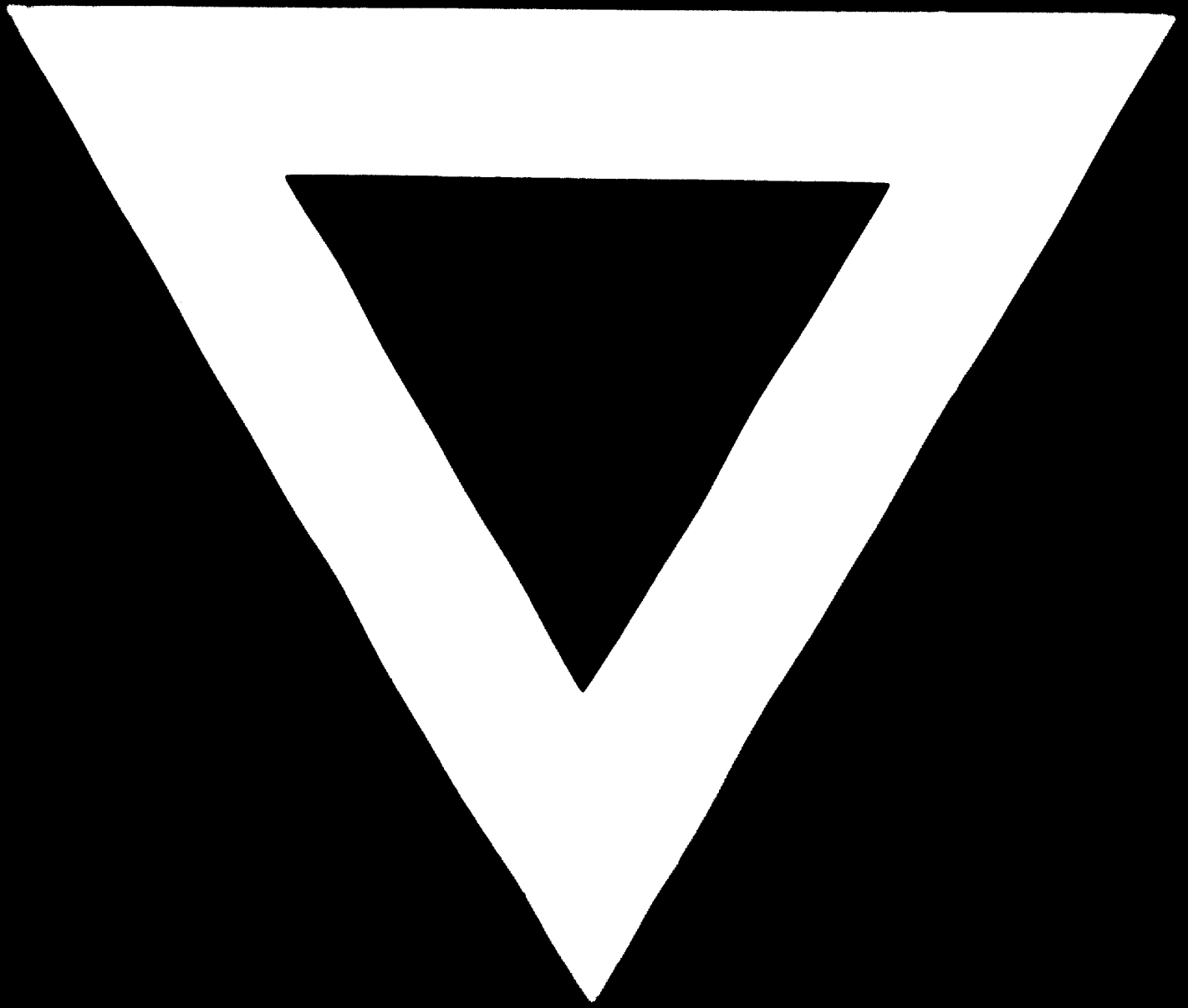
The entire Battelle organization is geared to fulfilling the Institute's role in putting science to work for the benefit of man. While its international character is already well established, it proposes in the future to expand its spheres of service and capability still further and to draw together the best minds to solve problems that may cross international boundaries.

While some research institutes have been disappointingly ineffective, Battelle is optimistic about the future role of such institutes. As the factors limiting their productivity become better understood, that understanding will help remove such limitations.

Battelle recognizes that many of the large problems facing modern man can best be solved through the co-operative efforts of leaders in science, business, government and education. It recognizes also the need for bridging the gap between the scholarly analysis of the academic world and the problems of business, industry and government. It seeks a role as a catalyst between men of thought and men of action.

Figure III. (right) To determine structural requirements, air-flow patterns and forces on buildings, smoke-stacks, mobile homes and other structures are studied with models in this subsonic wind tunnel at Battelle-Columbus. The adjustable-pitch fan can generate air-flow velocities up to 200 miles per hour.





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