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A National Focus of Science and Research

Detlev W. Bronk

The title under which this is written appeared in the November 1922 issue of *Scribner's Magazine* (*1*). It was the subject of an article by George Ellery Hale, then honorary chairman of the National Research Council of which he had been a principal founder. He wrote:

> The stately plan of the City of Washington, conceived by L'Enfant under the personal inspiration of Washington himself, is rapidly assuming material form. The major axis . . . now terminates admirably in the massive Doric temple of the Lincoln Memorial. . . . Flanking it on its left, in the midst of a spacious square facing the Mall, another marble structure, also associated in its origin with the Civil War, is now rising. This is to be the home of the National Academy of Sciences and the National Research Council.
>
> As a center for the many activities organized by the Academy and Research Council the new building will bring together scientific investigators from all parts of the world. It will serve admirably for international scientific bodies when meeting in the United States, and in so far as may prove practicable it will be rendered available for meetings of the many national scientific and technical societies represented in the Research Council.

Now, 50 years later, the building begun by Hale, the creator of the Yerkes and Mount Palomar Observatories and of the California Institute of Technology, is completed. Increased in size for the needs of the present, its purposes and functions are the same. It had its origins in the election of Hale to the National Academy of Sciences 70 years ago.

Soon after his first attendance at a meeting of the Academy in the old red brick building of the Smithsonian Institution, Hale, never inhibited by his youth, wrote to Simon Newcomb, 30 years his senior: "The Academy should have a building where scientists could go whenever they visit Washington and there exchange ideas and develop wider friendships" (*2*). For 20 years Hale's persistent vision inspired his will to begin that which is now completed.

Hale built many monuments, physical and spiritual, throughout the world of science, but this is uniquely his. "It is indeed a temple that we now dedicate," said Gano Dunn, who was Hale's colleague in the creation of the first unit of the building that was being completed in 1924, "a temple that would not stand without the gifted vision and tireless devotion of George Hale. His spirit will be here always, for it was he who chose the words inscribed upon the dome: "Temple to Science, Pilot of Industry, Conqueror of Disease, Multiplier of the Harvest, Explorer of the Universe, Revealer of Nature's Laws, Eternal Guide to Truth" (*2*).

It was on a spring evening such as this that the spirit of Hale's temple of science first enmeshed me many years ago. I still recall that through the open windows came the soft fragrance of the magnolias many of us pleasantly associate with that place. I was impressed by Christian Herter's portrait of the founders, by the paneled dignity of the board room, by Robert Millikan, who presided. Of the proceedings I remember little, only the final question by George Stewart of Iowa: "Why are we here and what is the purpose of the National Research Council?" And then Millikan's prophetic reply, anticipatory of the roles wisely fulfilled by the Academy and its Council in the framework of the modern scientific endeavor.

The latter hours of that evening are vivid memories. Because Millikan was the father of my closest friend, he was to me a fatherly, friendly mentor. Until he and I took to our beds in the old Cosmos Club on Lafayette Square, he regaled me with memories of how the house of the Academy came to be. Hale had hoped that, by the time of the Academy's 50th anniversary celebration in 1913, Andrew Carnegie might have been persuaded to make a gift to the nation of an Academy building "of such a character as to unite the interests of the various scientific institutions" (*2*) of our country, some of which Carnegie himself had founded. But nothing came of his attempts to interest Carnegie in this project. In 1914, Hale again besieged Carnegie thus: "As the clearing house of American science, and its official center in both a national and an international sense, the building would be a contri-

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bution of the first importance to our intellectual and material progress (*2*). Replied Carnegie, "The project of a building to cost $900,000 is a very large one; to be productive, it would require a large endowment" (*2*). He added that he could make no pledge for the future.

Five years later it was 1919. The Academy had burgeoned during World War I, and its influence in maturing American science had widened through the constituent societies of the newly born National Research Council. The need for a home was more imperative than ever. Hale returned to the Carnegie Corporation a few months before its founder's death. By then, Hale's hopes were higher because the claims of the Academy were more secure. Soon thereafter, just 13 years since Hale's proposal to Simon Newcomb that the Academy should have a home of its own, the Carnegie Corporation sent Hale the news that he was close to the fulfillment of his dream. The promise was $5 million if he could secure and purchase a satisfactory site. With the help of Millikan and Gano Dunn, Merriam, and Angell, funds were secured within a month.

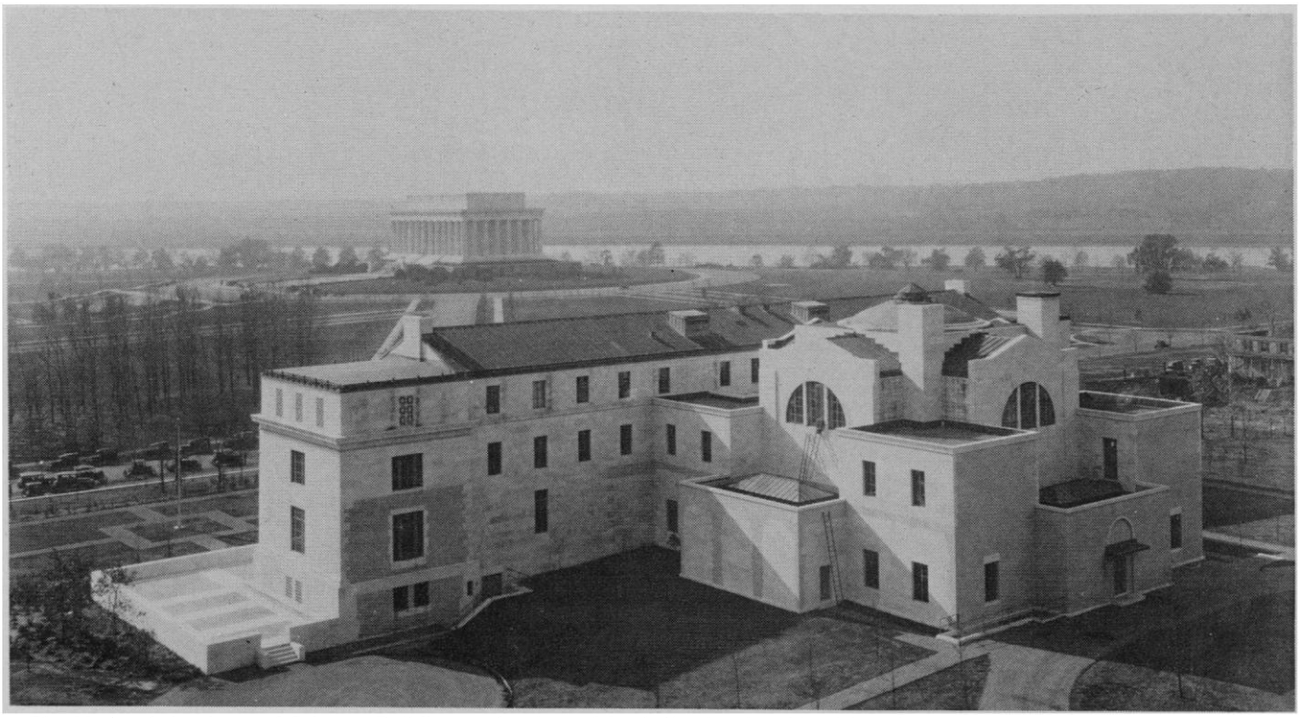
Hale was elated. For the next 5 years every detail of the design, construction, and decoration of the building was his concern. Characteristically, he chose his colleagues well. Gano Dunn, a recently elected engineer and classical scholar, was chairman of the building committee; Bertram Goodhue was the architect, "into whose office it was a delight to enter and very hard to leave" (*2*). Lee Lawrie, the sculptor, encouraged Hale to employ his interest in the Greek origins of science for the rich decoration of the building.

As the building neared completion, Hale found it difficult to stay away. One night, when he was in Washington with Millikan and Noyes, he asked that they go with him to see "our beautiful building gleaming white in the moonlight." Millikan recalled that as they looked across at the magnificent memorial to Lincoln also shining in the moonlight, Hale told of how he and Goodhue had endeavored to create a building of "extreme simplicity and refinement" that would be monumental, but unobtrusive so as not to detract from the nearby Lincoln Memorial. While they marveled at the beauty of the two buildings, Hale, who had the spirit of a poet, might have said the words of another poet, "they are a blessing to the eyes of those who have a sense of harmony."

Hale's old Chicago friend Professor Michelson was president of the Academy when that first part of Hale's conception was completed and dedicated in 1924. For nearly 20 years he had dreamed of that day.

Frank Jewett and Newton Richards are among the almost forgotten whose hopes and efforts are built into this building. During 5 years of war they worked here; as members of the Office of Scientific Research and Development, they helped Vannevar Bush use the resources of the Academy and its National Research Council; as presidents during postwar years, they redefined our future.

Jewett recalled Hale's success with the Carnegie at the close of the earlier war. And so, he suggested in 1946 that he and I fish the same waters. Supported by visions of how the Academy could carry forward the momentum and new stature science and technology had gained and of how we could help rebuild a sundered world, we called upon the president of the Carnegie Corporation. We told him that the plan of our building, like that of the city of Washington, had been designed for future expansion. We reminded him that in 1919 Carnegie had provided only the central portion and but one side of a contemplated square. Devereux Josephs was a gracious listener; he admired our plans for further use of what the Carnegie had already given. But he bid us goodbye with an ominous comment about foundations' dislike of "barnacles." On our return journey, Jewett hopefully remarked: "Hale didn't do so well either in his



The National Academy of Sciences Building at the time of its dedication in 1924. The Lincoln Memorial is in the background.

first encounter with Carnegie." I still have sad regret that the hopes of Jewett, friend of Hale and Millikan and Dunn, himself an engineer and builder, were defeated by distractions of the war and his death soon after.

Richards succeeded Jewett. Lovably human, painfully modest of his classic research, colorful son of a clergyman from whom he had learned his profane words in a different context, Richards loved this place at which he swore because he could not here do all that he wished to do. He once said to me: "Every time I look at those damned bricks on the back wall of the unfinished building, I am reminded of all the things I haven't done, all the planned research I'll never do."

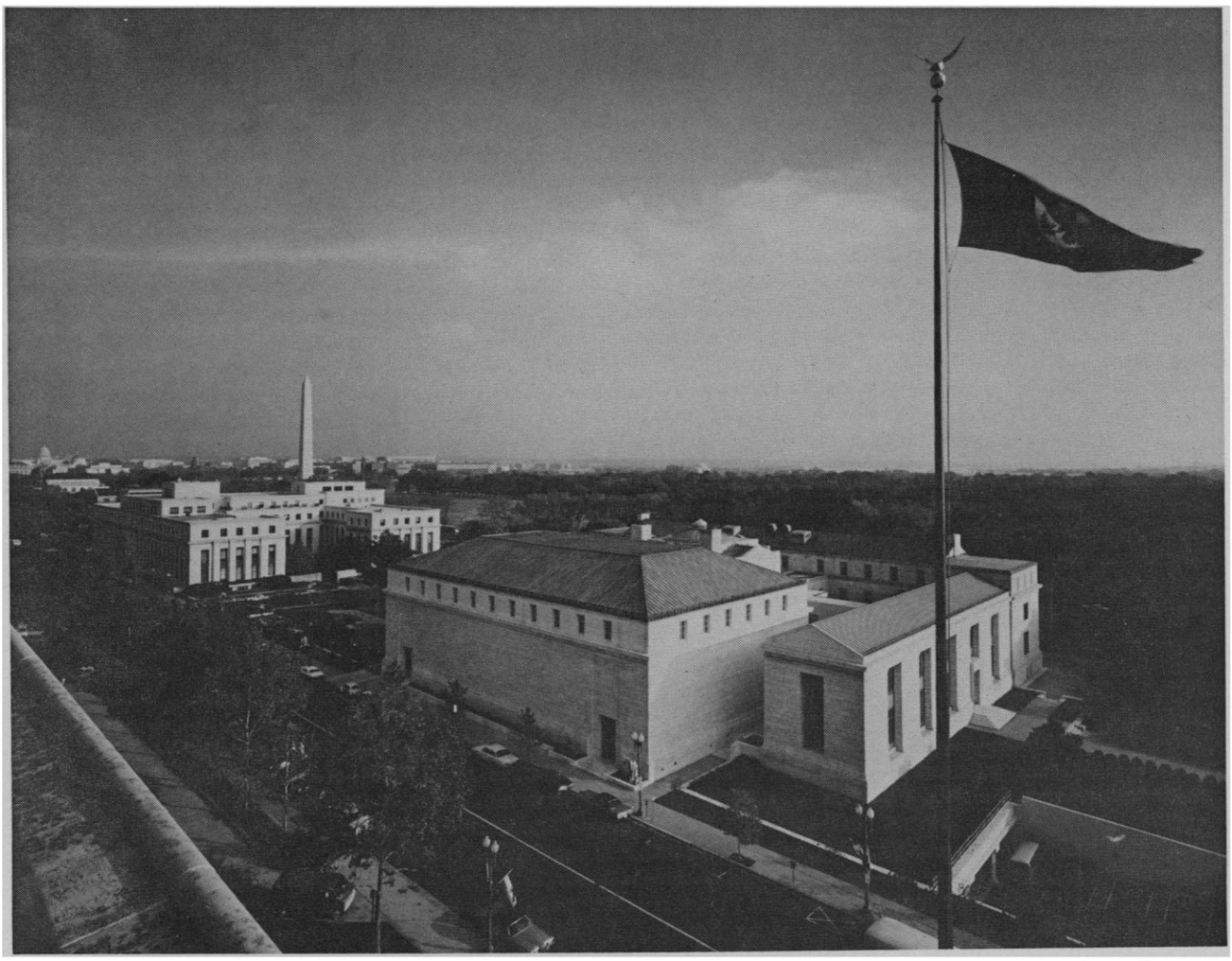
It was during his time that we built the first annex. Donald Meid and I reconstructed the little Safeway grocery at 21st and E Streets to satisfy our growing needs. Richards thought it shabby even though it was veneered with marble; the Academy's home secretary was sure it would bankrupt our shaky financial structure.

Ten years later, in 1958, Richards asked me in his home: "How many more Safeway stores have you and Meid acquired?" And then, with a sly smile, he added: "If you are smarter than I think you are, you may be able to finish before I die one of those things I've left undone; but I'll not be around much longer."

A few weeks later, Richards' friend A. R. Dochez, affectionately known as "Do" throughout the world of medical science, asked me to take lunch with Fordyce St. John, professor of surgery at Columbia. I later learned that Richards knew the reason for the luncheon; it was he who suggested that Dochez invite me.

St. John was a trustee of the Equitable Life Assurance Society and chairman of its centennial committee. "What," he asked, "did I think would be an appropriate means of using half a million dollars as a gift to the Nation in appreciation of the growth they had been privileged to enjoy during their first 100 years?" I fear I was a prejudiced adviser because we were planning the Academy Centennial 4 years hence. And I may have recalled Hale's suggestion to Andrew Carnegie that he "make a gift to the Nation of an Academy Building." That was my suggestion to Fordyce St. John.

Soon after St. John took me to the apartment of James Oates, president of the Equitable. He listened for a few minutes while I described the Academy and the National Research Council and our need of a completed building for the century ahead. Then, unlike Car-



The completed National Academy of Sciences Building at its dedication in 1971 as seen from the Department of State. The auditorium and the west wing are in the foreground, the original facade on Constitution Avenue is in the background; the east wing is not visible. The Federal Reserve Building is at the left.

negie's first repulse of Hale, Oates suddenly said: "Johnny, this is it, let's have a drink."

It was agreed that sketches of a completed building should be prepared within 3 months for consideration by the Centennial committee of the Equitable.

I was appalled by my problem. Goodhue was long dead; Hale and Dunn and Millikan too. Who could quickly plan the fulfillment of their vision?

Wallace Harrison, architectural genius of Rockefeller Center and the United Nations, had been my helpful colleague in the creation of many buildings. I asked him was there anyone still living who had been associated with Goodhue? He evaded my question, but soon sent me the 1924 issue of *Architecture* in which there was an article entitled: "The Building of the National Academy of Sciences—Goodhue's Last Completed Work." The author was Wallace Harrison. It was he who, when a youth, had been Goodhue's designer.

In September, Harrison and I dined nervously but well with the 16 members of Oates' Committee. After coffee Harrison showed his conception of the completed building comprising two wings with refectory, conference rooms, and offices and a handsome auditorium. Hesitantly, I said the first wing that I hoped would be their gift to the Nation might cost $750,000 rather than the proposed half million. Harrison and I rose to leave. "Stay," said Oates, "and hear the Academy's fate." The vote was man by man in favor until an awesome trustee rose solemnly to say: "I am firmly opposed." There was an embarrassed pause. My hopes fell low. Then the objector continued, "It would be shameful to give less than a million for a purpose so worthy."

"I'll go along with that," said Oates, "if Bronk will commit the Academy to completion of the entire building that Harrison has shown us."

"They can't fly on one wing," said St. John.

It was good Equitable brandy with which we toasted the second century of our two institutions.

That first wing was erected and the second was well under way at the time of the Academy centenary. The success of the successive steps gave impetus to securing the funds needed for completion of the final objective. In this President Frederick Seitz played a major role as he did in directing the construction of the auditorium which is the last unit.

There have been hundreds of donors: persons, corporations, public and private foundations. Their motives were diverse and many, but all I think were deeply rooted in respect for men and women who through a hundred years gave their time, their efforts, and their talents to the scientific endeavor. Many we have known, past and living, have endowed this building with precious meaning.

Ellery Sedgwick (*3*), a gracious editor of the *Atlantic Monthly*, once wrote of his family home as though it were built of memories of people, of memorable events, and of ideas that had been traded and tested in pleasant discourse. I thought of that one night a year ago

The new auditorium of the National Academy of Sciences.

as I dined in the Great Hall. It was the 20th anniversary dinner of the National Science Board; Philip Handler, who as newly elected president of the Academy had completed the auditorium, was our host. When he rose to speak, he first looked about him and up into the dome with an expression of admiration and affection. I was moved and very grateful to my friend and presidential successor, for I saw that he had already sensed the rare qualities of this house that had first been envisioned by George Ellery Hale. They are a blend of that endless quest for knowledge and wisdom that is our mission here and the beauty of the building. It is a fitting home for those whose minds have been trained in the splendid discipline of science, but whose hearts and eyes take also delight in the triumphs of art and the beauties of nature. It is our heritage from the past, our legacy to the future.

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Applied Research for the Public Good—A Suggestion

Methods used for application of research to technology should be tried for social problems.

Harold Gershinowitz

Much of the discussion about the utilization of knowledge and understanding for the solution of such problems as poverty, pollution, urban blight, or excess population has been concerned with the needs for research, with the relative weight that should be given "basic research" as compared with "applied research," and with the proper geographical and organizational location for whatever research is to be done. In contrast, very little is said about the processes involved in the application of research, about the mechanisms by which successful research could be used for the solution of major social problems.

The sequence of basic research, applied research (and, for some disciplines, development), and use of research seems an obvious logical and chronological order, particularly to research workers. However, in those areas in which the application of research has been most successfully accomplished, the reverse order has been prevalent. If one's primary concern is with the use of knowledge to produce change, then the order should be (i) the use of existing knowledge to produce the desired change; (ii) when existing knowledge is incomplete or insufficient, applied research to find the necessary knowledge; (iii) basic research for the understanding of nature (including man and his works), with particular emphasis on those areas in which lack of fundamental understanding limits the scope of applied research; and (iv) basic research without regard to its possible relation to any area of application. I hasten to add that, from the overall standpoint of human society and culture, the last is not the least.

In the latter sequence, the most essential element in the application of research is the mechanism for transforming knowledge into the action that produces the desired change. In science-based industry, the process that brings this about is sometimes called innovation (*1*). This term is deceptively simple, and I propose to devote most of this article to an analysis of just what is involved in the "application of research," primarily in terms of institutions and relations. For much of what I say I claim no novelty—it is well known to both practitioners and theoreticians of industrial research management. These persons, however, constitute a rather special group, the members of which talk mostly to each other. My experience in dealing with public officials and social scientists has convinced me that it is important to restate the problems and the principles in terms relevant to their interests. Although my own experience has been principally in the application of the physical and biological sciences, I think that my conclusions are equally applicable to the social and behavioral sciences.

Considered in this light, the "application of research" is very different from research, even "applied research." It is a very complex interdisciplinary activity. The application of research is not a simple or straightforward process. It takes place at the interface between knowledge and action. At this interface there are barriers of language, of psychology, and of values. Fields of knowledge are fragmented in different ways than fields of action are. It is not generally realized that, even in those areas in which research and development are unambiguously technological in character, many of the problems involved in the application of research are not technological at all.

In order to understand better the nature of the problems with which one is confronted in the application of research, let us look more closely at the two activities on either side of it, applied research and administration. I include in administration both policy-making and responsibility for the execution of policies and programs.

A great deal has been written about the differences between applied and basic research, often with more passion than understanding. For a balanced analysis, see the 1967 report of the

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