Scribner but does not detail their reaction. Mr. Shonnard is finally mentioned in the last letter as being willing to undertake the publication. Here the Edison laboratory record closes!

The issue of *Science* for December 31, 1881 contained an editorial which says in part: "Arrangements are in progress to increase the number of pages of *Science* from 12 to 16, the four extra pages being devoted to applied and practical science; in this division the most recent application of scientific principles to the arts and manufactures will find a place and novel inventions of real scientific merit will be fully described."

The issue of December 31 was Number 79. Number 80, which should have appeared on January 7, 1882, did not appear until January 14. It was still 12 pages in length and did not contain the promised description of practical discoveries and inventions. Number 81 appeared on January 21 and contained a long editorial on Standard Time, by C. A. Young, of Princeton, New Jersey, an account of the New York Academy of Science meeting on December 19, the meeting of the American Chemical Society on December 16, and that of the Microscopical Society of Illinois on December 9, together with two long reviews of Appleton books. Although there had been occasional book reviews in the magazine before this time, they had never before taken up as large a part of a single issue.

Number 82, which appeared on March 4, consisted of 12 pages, two of which were full-page maps of the Croton water shed, which presumably had been an interest of Michels for some time. Aside from the maps, three of six cuts used to illustrate an unsigned article on the contamination of the Croton water supply to New York are attributed to Michels in the legends. F. E. [R. is correct] Upton, who wrote for Volume 1, Number 1, also has in this number a theoretical paper on "Electric Conduction and Discharge."

Number 82, the last issue of the early *Science*, contains the obituary of Prof. John William Draper, professor of chemistry and physiology at New York University, who had died on January 4, 1881, at the age of 70 years; and by strange coincidence, the first issue of the new *Science*, published on February 9, 1883, and called Volume 1, Number 1, contains the obituary of Prof. Henry Draper, John Draper's son, who in the summer of 1878 organized the party that viewed the eclipse of the sun at Rawlins, Wyoming Territory, on July 29.

Thomas A. Edison and the Naval Research Laboratory

A. Hoyt Taylor, *Chief Consultant for Electronics, Naval Research Laboratory, Washington, D. C.*

ON JULY 7, 1915, SECRETARY OF THE Navy Daniels wrote to Thomas A. Edison, stating that one of the most important needs of the Navy was machinery and facilities for utilizing the natural inventive genius of Americans to meet new conditions of warfare, and that the Secretary intended to establish a department of invention and development to which all ideas and suggestions from either the service or civilian inventors could be referred for determination as to whether they contained practical suggestions for the Navy to take up and perfect. The Navy, he stated, had no present means of handling inventions received from the public except to send them to the various bureaus of the Navy, which were overcrowded with routine work and could not always give them the attention they deserved. The Secretary felt that the Naval officers on sea duty were in a position to note improvements but that they had neither the time, space, ability, nor, in many cases, the natural inventive mind needed to put ideas into definite shape. The Secretary had in mind a general plan of organizing a department for the Navy which met with the ideas of Edison as set forth in an interview by Edward Marshall and published in *The New York Times*. He therefore asked Edison if he would be willing, as a service to his country, to act as chairman of such a board.

On July 13, 1915, M. R. Hutchison, personal representative of Edison, visited the Secretary in Washington and advised him that Edison had consented to head such a board. The Secretary and his aide afterward visited West Orange and discussed the salient features of this board. The Secretary then wrote to the presidents of the 11 largest engineering societies of the United States and asked them to nominate two members each, to serve on this "Naval Advisory Board," a title which was afterward changed to "Naval Consulting Board of the United States." The original members of the Naval Consulting Board were: Thomas A. Edison and M. R. Hutchison, selected by the Secretary; L. H. Baekeland and W. Whitney, by the American Chemical Society; Frank J. Sprague and B. G. Lamme, by the American Institute of Electrical Engineers; R. S. Woodward and Arthur G. Webster, by the American Mathematical Society; A. M. Hunt and Alfred Craven, by the American Society of Civil Engineers; B. M. Sellers and Hudson Maxim, by the American Aeronautic Society; Thomas Robins and Peter Cooper Hewitt, by the Inventors' Guild; Howard

E. Coffin and Andrew L. Riker, by the American Society of Automotive Engineers; William L. Saunders and Benjamin B. Thayer, by the American Institute of Mining Engineers; Lawrence Addicks and Joseph W. Richards, by the American Electro-Chemical Society; W. L. R. Emmett and Spencer Miller, by the American Society of Mechanical Engineers; and Elmer A. Sperry and Henry A. Wise Wood, by the American Society of Aeronautic Engineers. D. W. Brunton, chairman of the War Committee of Technical Societies, was appointed to the Board after its formation by the Secretary of the Navy.[1]

(Photo by courtesy Naval Research Laboratory)

Naval Consulting Board of U. S. Left to right: unidentified; L. H. Baekeland; M. R. Hutchison; Thomas A. Edison; Josephus Daniels, Secretary of Navy; and Franklin D. Roosevelt, Assistant Secretary of Navy. Other members of the group could not be positively identified.

At the organization meeting of the Board on October 7, 1915, the members saw the necessity for the construction of the Naval laboratory in order to get the best results from the work which they proposed to do along lines of science and invention, it being realized that the Navy Yards and their facilities were fully occupied with the active work of construction and with the maintenance of the Fleet as their primary function. A committee, consisting of Edison, Baekeland, Whitney, Woodward, and Coffin, was formed to make a study of the subject of a Naval laboratory.

Nearly all of the numerous recommendations made by this committee were ultimately carried out with the exception of the first one, which was that the laboratory should be located on tidewater of sufficient depth to permit a dreadnought to come to the dock. The majority of the committee was in favor of establishing the laboratory at Annapolis, but Edison made a minority report in favor of Sandy Hook. The present site on the old Bellevue Magazine Grounds on the Potomac, at the south end of the District of Columbia, was considered as a possible compromise. Edison was apparently somewhat displeased that his suggestion of locating the laboratory at Sandy Hook was not finally adopted, and, I am sorry to say, he never visited the Laboratory, although his son, Charles Edison, when he was Secretary

[1] I am indebted for information on the history of the Board and its original organization to a book entitled *Naval Consulting Board of the United States*, written by Lloyd N. Scott, formerly Captain, U.S.A., and liaison officer to the Naval Consulting Board and War Committee of Technical Societies, and published by the Government Printing Office, Washington, in 1920.

of the Navy, visited the place a number of times and was always much interested in it. Many other members of the Board also visited the Laboratory from time to time, particularly Baekeland, Saunders, Robins, Whitney, and Maxim.

Subsequent administrations made little or no use of the Naval Consulting Board, and finally it was abolished. It is the opinion of many of the old-timers at the Laboratory that, had it been allowed to take a more active interest in the Laboratory during its very early history and had its advice been followed, the growth of the Laboratory would have been greatly accelerated. The Laboratory definitely owes its existence to the work of the Board and particularly to its *chairman, Thomas A. Edison, who, even as early as 1910, had recognized the necessity of a research organization within the Navy.* Congress appropriated the money for its establishment in 1916.

Science is fortunate to have been intimately connected with two great 19th-century scientist-inventors. Edison's birth on February 11 preceded by less than a month the birth of Alexander Graham Bell on March 3, 1847.

Alexander Graham Bell was vice-president and organizer of the Scince Company, which in 1883 published _Science_, first in Cambridge and later in New York City. Associated with Bell in this venture were his father-in-law, Gardiner G. Hubbard, of Washington, founder of the National Geographic Society; Daniel C. Gilman, president of Johns Hopkins and president of the Science Company; O. C. Marsh, of New Haven; and Samuel H. Scudder, of Cambridge, who was treasurer of the Company and served as editor of the magazine.

The Nature and Development of Operations Research

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OPERATIONS RESEARCH IS A SCIENTIFIC method for providing executive departments with a *quantitative basis for decisions.* Its object is, by the analysis of past operations, to find means of improving the execution of future operations.

The principles of operations research were developed during the war as the application of the scientific method to the broad strategical and tactical problems of warfare. Small teams of civilian scientists worked at the highest operational level in a number of major Allied commands on all aspects of military staff problems: planning, intelligence, operations, and training. Among such scientific groups were the Operations Research Group on the staff of Fleet Admiral E. J. King; the Directorate of Naval Operational Research on the Naval Staff of the British Admiralty; and the Operational Research Section of the RAF Coastal Command.

The scope and power of the operations research method has been demonstrated by five years of successful application in practice. Since the end of the war several progressive government and business activities have established operations research programs for peacetime objectives.

The specific primary purpose of operations research in the war was to discover means for making the best use of the military forces and weapons currently available. The main fields of activity have been classified as the study of weapons, the study of tactics, and the study of strategy—that is, the analysis and evaluation of the performance of existing weapons and tactics; and the determination of the cost in national resources of attaining various strategic objectives. Operations research is thus distinguished from laboratory research for military purposes, which is concerned with the continual improvement of the weapons of warfare. Furthermore, the elapsed times between the inception of a new proposal and its realization in large-scale combat are radically different for laboratory and operations research. The big "secret weapons" of the war, such as microwave radar, proximity fuses, jet propulsion, V weapons, magnetic mines, airborne rockets, and atomic bombs, were