NATIONAL ACADEMY OF SCIENCES

FRANK BALDWIN JEWETT

1879—1949

A Biographical Memoir by

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A statesman has been defined as one who shows unusual wisdom in treating or directing great public affairs. Among scientists and engineers there are few to whom this broad definition may be more appropriately applied than to the late Frank Baldwin Jewett, President of the National Academy of Sciences from 1939 to 1947. It was fortunate indeed that among the members of the Academy there was one so well qualified by disposition and experience to assume leadership of that body during the exacting times that followed his election. To his fellows and to the nation his service as president of the National Academy was the climax of a career of devotion that has left its enduring mark on the history of an epoch in the development of applied science.

Jewett came from a long line of New England ancestors, the first of whom had settled in Rowley, Massachusetts, in 1632. Many of the later generations played prominent roles in colonial New England, but his immediate forbears had settled in Ohio where his father, Stanley P. Jewett, and his mother, Phebe C. Mead, were living at the time they were married. A few years earlier, an uncle of his father had been one of a group that purchased the entire area of what is now Pasadena and Altadena, north-easterly of Los Angeles. This was largely unsettled and undeveloped country, and even Los Angeles itself at that time had a population of under 10,000. As an inducement to settle in and develop southern California, Jewett's grandmother, Belle Maria Stanley Jewett, purchased a twenty-five acre tract of this land and offered it to Jewett's father as a wedding present. The property was in Pasadena—a community at that time of some twelve houses. It was here that Frank B. Jewett was born, the elder of two children, on September 5, 1879.

Muscat grapes and oranges were the major crops, and raisins and wine were the chief products of this pioneering community. Jewett's father, however, was an engineer, and had attended Massachusetts Institute of Technology before his marriage. Although he actively managed his ranch, his heart was in engineering—particularly railroading, in which he had been engaged in Ohio. In the middle '80's he and two others organized the Los Angeles and San Gabriel Valley Railroad, and built a line from Los Angeles to Pasadena. This is now the main line of the Santa Fe, to which it was later sold, and of which Jewett's father later became a vice president. Jewett was fascinated by railroads as a result of his experiences with them during these early years, and until he was in college had intended to make railroading his profession.

By the time Jewett was eight, his father had sold their property in Pasadena and moved to Lamanda Park—some five miles directly east of Pasadena. Here Jewett attended a one-room, one-teacher school until he finished the eighth grade. He then went to the preparatory school of the recently founded Throop Institute of Technology, which has since become the California Institute of Technology. He later attended the Institute itself, and received the A.B. degree in 1898, when he was only nineteen years old.

During his first years at Throop, he had ridden back and forth each day on horseback. The morning, noon, and evening care of the horse that this entailed, however, was not entirely to his liking, and he later changed to a bicycle—first one of the high wheel affairs, but later one of the "safeties," then in their infancy. During his last year or two, he and his sister Pauline, who also attended Throop, drove to school. During all these early years, he lived an outdoor life and was subject to all the subtle influences of space and color that a seemingly endless expanse of desert and mountains can exert on a young, imaginative, and observing mind. He helped with the work in the apricot and orange groves, and at other chores around the place, but there was plenty of time for hunting and fishing, which were at that time entirely untrammeled by game laws and other restrictions.

In the meantime, his father had left the Santa Fe and had become interested in the power industry, which in the late 1890's had begun to install street railways and arc lights in fast-growing southern California. Jewett's was one of those versatile minds that become interested in whatever turns up to be done, and at his father's instigation he had planned to study electrical engineering to assist his father in this new field of interest. Since Throop was a small college, and there was thus the feeling that perhaps Jewett was not able to obtain from it the best instruction and the latest knowledge in the new and growing science of electrical engineering, it was planned that he should go to the famous M.I.T. for graduate study before assuming his electrical engineering responsibilities with his father. He had planned to enter Tech in the fall of '98, but his mother's death and his father's temporary absence from California required that he remain in Lamanda Park. It was the end of the year before he was free, and then it was too late to enter M.I.T. that year.

His former physics professor at Throop happened to be taking a sabbatical at the University of Chicago, and wrote Jewett to come there to take graduate work in physics. The proposal appealed to both Jewett and his father, and as a result in January, 1899, he entered the University of Chicago, which had only recently been founded and was blazing new paths in education.

John Mills, who was later associated with Jewett in the American Telephone and Telegraph Company, was an undergraduate at Chicago when Jewett came there to take graduate work, and since they were both working in physics, they became acquainted. At the time of Jewett's retirement, Mills wrote:

"Despite his youth Jewett was one of the most mature-minded of the graduate students at Chicago; and he associated on terms of congenial informality with professors and instructors as well as with his fellow students. A small group of the latter he organized for extra-curricular reading of mathematical physics. Not all his time, however, was spent in study and laboratory work for he was a leading spirit in a small and convivial group of graduate students whose bimonthly symposia were not entirely devoted to serious conversation. He also joined and was active in one of the national fraternities, Delta Upsilon. More importantly, he became engaged to Fannie Frisbie, a young graduate student in physics, whom he married a few years later."

His marriage in 1905 was a most happy one, marked not only by unusual devotion but by rare intellectual companionship. The death of Mrs. Jewett on December 17, 1948 was a deeply felt loss that perhaps hastened his own death, which followed within less than a year. Three children had been born to them: a daughter who died in infancy, and two sons who survive them: Harrison Leach, attached to the Brookhaven National Laboratory, and Frank Baldwin, Junior, of the General Mills Company of Minneapolis.

As a graduate student at Chicago, he served for a short time as research assistant to Prof. A. A. Michelson, and received his doctor's degree in 1902. Jewett next went to M.I.T. as an instructor in physics. Probably his decision some years earlier to attend M.I.T. had something to do with this move to Boston.

One day in the spring of 1903, during Jewett's first term at M.I.T., Dr. George A. Campbell of the engineering department of the A. T. & T. visited Professor Harry E. Clifford of M.I.T. to inspect a high-frequency generator that had just been acquired by the Institute for some experimental studies. While Campbell and Clifford were talking, Jewett happened to pass by, and Clifford introduced him to Campbell.

Campbell, who was in charge of the group concerned with loaded lines and the theory of telephone transmission, was on the lookout for young engineers and scientists to assist in solving the many difficult problems that faced the engineering department at that time. Jewett created a favorable impression immediately, and after he had left, Campbell asked Clifford about the possibility of employing him. On being told that Jewett was under contract with the Institute for another year, Campbell dropped the subject for the time being. Within another ten or twelve months, however, Campbell raised the question again, and as a result Jewett visited the A. T. and T. engineering headquarters in Boston. He created the same favorable impression on the executives of the engineering department that he had on Campbell, and a few days later it was agreed that Jewett would join the A. T. and T. at the end of his 1904 term at Tech. His starting salary was $1600 a year which at that time was very high for a man even of Jewett's training and experience.

In 1904 when Dr. Jewett began his association with the American Telephone and Telegraph Company, the telephone system had already made considerable growth, but it was still far from being able to give nationwide, to say nothing of worldwide, communication. Commercial telephone service over open-wire lines between New York and Chicago had been available for only three years. There were no long cable circuits such as now interlink all the major cities across the entire width of the country; there was no radiotelephony; and there was no broadcasting. A way had been devised to transmit three telephone conversations over two pairs of conductors by that time, but the means by which today we transmit 800 conversations over a single pair of conductors, and our present ability to talk, to telegraph, to send photographs, and even to transmit the living scene by television from almost any place in the world to any other, were still for the future to reveal. Of greater significance to the role Jewett was to play in future developments, however, was the fact that the knowledge, the techniques, and the tools that would make these advanced forms of communication possible had not yet come into existence.

One of the many and varied problems facing the Bell System at this time was the protection of telephone lines from noise and high voltages induced by nearby electric railways. This was among the major projects on which Jewett worked during his first few years. There were plenty of others, however, and one of them—a study and report of a recently issued patent—played a significant part in his advancement. The patent covered a number of schemes for improving transmission over long telephone lines. Jewett's report was based on both theoretical studies and experiment, and was so clear and fair that it attracted the attention of F. P. Fish, president of the A. T. & T. Company. In this report, as in Jewett's other early work, there were evident the keen analytical ability, the refusal to be blinded by superficial obscurity, and the perception of essentials that were characteristic of him throughout his life.

There were other characteristics of Jewett, however, that also became evident even in these early years. He recognized that the success of Bell System engineering in the years to come would depend to a large extent on the type of men brought into the System to carry out its program. As early as 1905 he laid the foundation of a splendid record as a personnel recruiting agent for the headquarter's staff, and many of the men he brought into the Bell System made signal contributions to its technical and material growth. His ability to select men who could ably direct and correlate the work delegated to them was largely instrumental in securing success in later years when only matters of broad general policy came under his direct supervision.

Jewett's first position with the A. T. & T. Company, in 1904, was as a transmission engineer under Campbell. By January 1906, he had succeeded Campbell as head of the electrical department in Boston. Late in the following year, the engineering department was moved to New York under John J. Carty, chief engineer, and with Jewett as transmission and protection engineer.

Late in 1908, Mr. Carty and a number of his assistants, one of whom was Jewett, made a trip to the Pacific coast to review the telephone situation there. Preparations were already under way for the Panama-Pacific Exposition—originally scheduled for 1914, but later postponed to 1915—and businessmen were urging that telephone communication with the east be ready for its opening. Carty had felt the absence of daily telephone conversations with his staff in New York, and he remarked to Jewett that he "was greatly impressed with the isolation of the rest of the country." Transcontinental telephony had always been an objective for the future, and in view of the pressure for its prompt realization, Carty and his staff spent long hours while on the coast studying the problems to be overcome in making it possible. Success seemed attainable, and before the group left the coast, President Vail, who had later come from New York to join them, told the management of the Exposition that he would attempt to complete a transcontinental line in time for the opening. The responsibility for meeting this promise was placed primarily on Jewett. It was the first large undertaking in which he demonstrated his abilities, and is typical of much of the work he did later.

One of the essential requirements for a transcontinental line was a satisfactory repeater: a device that would receive speech waves after they had been attenuated by passing over a line, and amplify them for further transmission. A repeater had been developed by the time Jewett joined the Bell System, and its first successful trial was made that year. This first repeater was of the mechanical type, and consisted of a telephone receiver placed face to face with a carbon transmitter—a single diaphragm being common to both. Through the winding of the receiver, incoming speech currents actuated the diaphragm and resulted in amplified speech at the output of the transmitter. Although this repeater had considerable use in the years following 1904, it had serious inherent weaknesses. As Jewett pointed out in a paper presented with Bancroft Gherardi before a joint meeting of the A.I.E.E. and the I.R.E. in October 1919: "The amplification is not, however, sufficiently independent either of the amplitude or of the frequency of the input to make them adaptable with best results to use in tandem, although they have been used to advantage on telephone lines the length of which did not require more than three repeater stations." This meant that telephone lines could be lengthened only until their increased losses equaled the gain of three repeaters. When it is realized that our present transcontinental circuit may employ as many as 400 repeaters in tandem, the seriousness of this restriction is evident.

Although by the use of large-size conductors and the application of loading it had been possible to provide usable telephone circuits between New York and Chicago, and a project was under way to extend this circuit to Denver, Jewett had long recognized that it would be economically unsound to attempt to reach San Francisco without an entirely new type of repeater. In a memorandum of December 10, 1910, he wrote:

". . . I am more than ever impressed with the very great need for producing a satisfactory repeater for operation on loaded lines if we are to establish a truly universal service on the North American continent on a paying basis as well as one of true economy.

"From a preliminary study of the situation, I feel very confident that if this repeater matter is tackled in the proper manner by suitably equipped men working with full coordination and under proper direction the desired results can be obtained at a relatively small cost. I feel, however, that to achieve this result it will be necessary to employ skilled physicists who are familiar with the recent advances in molecular physics and who are capable of appreciating such further advances as are continually being made, also that the work must be carefully supervised by someone having a full understanding of the requirements."

Early in the following year, he outlined more specifically what would be required:

"*Nature of Work*

"A general study to determine the proper characteristics for the best telephone repeater, its circuit, and the general terminal and line conditions that must be fulfilled to make this repeater available for both loaded and non-loaded lines. This study will include—

"(1) A complete study of the characteristics of the existing receiver-transmitter type of repeater with a view to determining whether the action of this repeater cannot be improved upon and whether modifications in the repeater element, its circuit or in the line conditions will make it suitable for general use on loaded lines.

"(2) A study of other possible repeater ideas, particularly in the domain of molecular physics. Certain characteristics of discharge of electricity through gases and vapors seem to offer considerable possibility of obtaining a telephone amplifier that will be suitable for use on loaded or non-loaded lines and which will give the desired amplification without a great deal of distortion.

"(3) A mathematical and laboratory study of two-way repeater circuits with a view to determining the best form of repeater circuits to be used in combination with any desired repeater element and any kind of loaded line.

"(4) A mathematical and experimental investigation of loaded line characteristics in the existing plant, and a determination of what changes, if any, must be made in the construction and installation of loading coils and cables in order to make loaded lines suitable for the application of telephone repeaters."

Jewett's active work in recruiting during these early years has already been referred to. In an effort to secure "skilled physicists who are familiar with the recent advances in molecular physics" of the above quotation, he approached Professor R. A. Millikan of the University of Chicago, with whom he had formed a close friendship during his years at Chicago. In his autobiography,* Dr. Millikan writes of him: "He (Jewett) was younger than I by nine years, and was taking his doctorate at the University of Chicago on a problem suggested by Professor Michelson, namely, the pressure-density relations of sodium vapor at temperatures up to the boiling point of sodium. We boarded together and developed a friendship which was destined to last throughout life."

In regard to Jewett's search for someone to undertake development work on a telephone repeater, Millikan wrote:

"It was in the fall of 1910 that Jewett, with whom I had kept in close contact since he took his doctorate in 1902, came from New York to see me at Chicago. . . . He started our conversation as follows: 'Mr. John J. Carty, my chief, and the other higher-ups in the Bell System, have decided that by 1914, when the San Francisco Fair is to be held, we must be in position, if possible, to telephone from New York to San Francisco. With the aid of the Pupinized lines we have been able thus far to talk between New York and Chicago, but to get through to San Francisco by the present methods is out of the question. The cost is completely prohibitive. We have

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got to develop somehow a telephone repeater that will boost up the speech currents when they become too attenuated, just as the enfeebled currents in dot-dash telegraphy are now boosted up by the repeater on a long telegraph line. You have been working ever since we were together from 1900 to 1902 on these pure electronic discharges in your very high vacua which you were developing at that time. It seems to me that these essentially inertialess electronic discharges are the best bet there is for a telephone repeater. This will be a very difficult task, that of following all the modulations of speech and boosting up their intensity without in any way distorting them. We want you to help us in this job, as follows: Let us have one or two, or even three, of the best of the young men who are taking their doctorates with you and are intimately familiar with your field. Let us take them into our laboratory in New York and assign to them the sole task of developing the telephone repeater. . . .' The first man whom I thus sent to the laboratory at 463 West Street, New York, to attack this problem was Dr. H. D. Arnold."

It was Arnold who within a very few years developed the high-vacuum electronic tube from the original deForest audion, and thereby laid a considerable part of the foundation not only for a transcontinental line but for all long distance communications since that time.

Much was needed besides the repeater, however. The open-wire lines required correction; the circuit associated with the repeater needed further invention and refinement to enable it to work both ways; and there were important problems of stability and control. In all this work, Jewett played an important part, although he made few direct technical contributions. He had moved too rapidly into executive work to have time for detailed technical studies. His part was to foresee needs, to perceive the most productive paths, to select, encourage, and stimulate those doing the detailed creative work and to guide all parts of it to a final consummation.

After Jewett's move to New York in 1907, his prestige continued to rise, and in recognition of his capable direction of the transcontinental line and other important engineering projects, he was made assistant chief engineer of the Western Electric Company in 1912.

Since 1881, the Western Electric Company had been the manufacturing organization of the Bell System, and it had a capable staff of engineers and inventors. Its engineering department occupied the building at 463 West Street, New York City since 1900, and had played a large part in developing the apparatus for the rapidly growing telephone system.

Beginning active direction of the research and development work of the Western Electric Company as assistant chief engineer in 1912, Jewett became chief engineer in 1916, and vice president and director in 1921. The engineering department of the Western Electric was much larger than that of the A. T. and T. Company, and it included extensive laboratories in which new apparatus and circuits could be tested, and where organized research was carried on. The two engineering departments had always worked in close cooperation. In general, the technical needs of the Bell System were determined by the A. T. and T. engineering department, which also carried out many of the theoretical studies leading to improved systems and apparatus. The engineering department of the Western Electric, on the other hand, carried out the development and design of the actual circuits and apparatus, and furnished drawings and specifications for the manufacturing department.

In 1924, the engineering department of the Western Electric Company was incorporated as Bell Telephone Laboratories. The legal steps were completed during the closing days of the year, and the new corporation with Jewett as its president began functioning in the opening days of 1925. At the same time, Jewett was made vice president of the A. T. and T. Company. Reporting to him in this latter capacity was Dr. E. H. Colpitts, who was in charge of the department of development and research. This department, together with the A. T. and T. engineering department, was the continuation of the group in Boston with which Jewett was associated when he joined the Bell System. In a period of just over twenty years, Dr. Jewett, after wide supervisory experience in the engineering departments of both the A. T. and T. and the Western Electric Company, had become—as vice president of the A. T. and T.

and as president of Bell Telephone Laboratories—the director of all research and development of the Bell System. In 1934, as the final move in consolidating the research and development of the Bell System, the development and research department was made part of Bell Telephone Laboratories, of which Dr. Colpitts had been made executive vice president during the preceding year. In 1940, Jewett relinquished the presidency of Bell Telephone Laboratories to become chairman of its Board of Directors, which position he retained until his retirement in 1944. His death occurred on November 18, 1949 at the Overlook Hospital in Summit, New Jersey.

In recognition of his many services to the Bell System, and as an endorsement of his farsightedness in stressing the need for fundamental physical research as a basis for successful industrial development, the American Telephone and Telegraph Company established the Frank B. Jewett Fellowships in the Physical Sciences at the time of his retirement. These are post-doctorate fellowships intended to stimulate and to assist research in the fundamental physical sciences, and particularly to provide their holders with opportunities for individual growth and development as creative scientists. They enable their recipients to devote themselves to research in pure science for a year or two following their doctorates.

Jewett's life was almost exactly contemporary with the first seventy years of the telephone. Bell's first patent was issued in 1876, only three years before Jewett's birth, and the Bell Telephone Company was formed in 1877. In 1881, the Western Electric Company became the manufacturing unit of the Bell System. The year 1885 saw the incorporation of the A. T. and T. Company, but only as a subsidiary to handle the long distance business; it was not until 1900, while Jewett was taking graduate work at Chicago, that it became the parent company. The year Jewett joined the A. T. and T. Company, there were fewer than two million telephones in the Bell System, but during the forty-year period he was with the Bell System, nearly 20,000,000 telephones were added—more than ten times the number in the Bell System when he joined it. The figure might have been larger but for the drastic curtailment in telephone installations made necessary between 1941 and 1944.

This growth in the number of telephones, however, is but one indication of the great expansion of communication facilities that occurred during Jewett's association with the Bell System. In 1904, the longest long-distance call that could be made was from Boston to Chicago, and there was only a single open-wire circuit over which such calls could be placed. In 1944, when Jewett retired, any Bell System telephone in the country could be connected with telephones in almost every country on the globe. Speech was being carried underground in cable, where it was protected from all the hazards of snow, sleet, and wind, beneath the sea in submarine cable, and through the ether of space. Besides carrying voice waves, Bell System circuits now provide teletypewriter, radio broadcast, and television channels not only over open-wire lines and lead-covered cable, but by coaxial and radio relay.

The year in which transcontinental telephone service was initiated also witnessed the first transatlantic telephone transmission. Telephone communication between ship and shore was demonstrated in 1916, and between plane and ground in 1917. Two years later, commercial radiotelephone service was being given between Los Angeles and Catalina Island, and the same year brought forth the first commercial public address system. As a form of communication, radio broadcasting had always been of interest to the Bell System, and their pioneer station WEAF set many precedents in methods and apparatus that have been followed ever since. The first radio broadcasting wire network was set up in 1923.

Studies of the recording and reproduction of sound in the Laboratories led to the orthophonic phonograph in 1925, and in the following year to the first commercial demonstration of synchronized sound and scene—in the Vitaphone—which paved the way for sound pictures. These studies in sound and speech transmission and reproduction were undertaken, of course, primarily with the objective of improving telephone communication. Of necessity they were far ahead of their economic application to commercial telephone service, and were climaxed in 1933 by the demonstration of the essentially perfect reproduction of orchestral music in auditory perspective. As Jewett said at the Philadelphia demonstration: "What has been demonstrated here today is perfection in the quality of the electrical pick-up, amplification, and reproduction of orchestral music with apparatus which can be arranged to give substantially perfect auditory perspective. There has also been demonstrated the ability of this apparatus to produce a range in volume, without impairment of quality, far beyond the normal possibility of direct orchestral execution."

In 1927, television transmission by both radio and wire lines was demonstrated, and within a few years the foundations were laid for the coaxial cable system that now forms the backbone of the television broadcasting network. Studies of waveguide transmission at the Laboratories during the early 1930's made techniques available that were of inestimable value in the development of radar during the war.

The summary of Jewett's work has so far been restricted to that in the Bell System, but his accomplishments were not limited to that field. Within less than fifteen years after joining the Bell System, he was achieving a nation-wide reputation. As a Lieutenant Colonel in the Signal Corps during the first World War, as an advisory member of the Special Submarine Board of the Navy, and as a member of the Special Committee on Cables of the State Department, he contributed extensively to the successful prosecution of that war, and was awarded the Distinguished Service Medal in recognition of his achievements. In 1918, he was elected to membership in the National Academy of Sciences, and thus became permanently associated with the scientific needs of the government for both peace and war.

This association became still closer in 1923 when he was made chairman of the Division of Engineering and Industrial Research of the National Research Council. In 1933, he was made a member of President Roosevelt's Science Advisory Board. His great abilities in organizing and directing scientific research were recognized in his election in 1939 as president of the National Academy of Sciences. He was the first engineer to be elected to this office, the first whose reputation was as a leader of applied research rather than as a research scientist in his own right. There was unrest in the world, and our government was in need of immediate advice on how most quickly and effectively to apply the scientific knowledge and personnel of the country to the urgent needs of national defense. For such a task Jewett was particularly suited. His wide acquaintance among scientists of distinction in all fields, coupled with his rare understanding and his winning personality made it possible for him to assemble committees to deal with every question directed to the Academy from the various government agencies, including such far-reaching ones as atomic fission and measures of defense against biological attack. When his first four-year term as president of the Academy expired in 1943, we were in the midst of conflict, and there was little question in the minds of the members as to who should fill the office for the ensuing term. Jewett was the inevitable choice, and he thus served the Academy and the nation through perhaps the most critical eight successive years in the country's history.

As Jewett pointed out in his review of National Academy activities for the years of his presidency, 1939-47, practically the entire interval was concerned with preparation for war, the war years, and the early postwar period. To a large extent the Academy, during this time, ceased to function as a learned society in the traditional sense, and functioned in its official capacity as the top scientific advisory agency of the Government. Jewett's role in the Academy is well set forth in a letter dated May 8, 1950, by Prof. Ross G. Harrison as follows:

"Jewett's unusual personality and character, together with experience in affairs and his technical know-how in the application of science, combined to inspire confidence in government officials and officers in the armed forces at high level, so that the Academy and Research Council became far better known to them and were looked to for advice and assistance in a measure not before attained. These obligations necessitated a new type of contract with the government offices, including provisions for general overhead expenses, which first required great patience to negotiate before a satisfactory formula could be arrived at. A successful appeal to the Carnegie Corporation for a rotating fund to be used as 'working capital,' made it possible for the Academy and Council to begin preliminary work on projects long before the contracts were actually signed.

"Jewett's sympathetic understanding of the relations between the Academy and the Research Council, and his wholehearted agreement with the Chairman of the Council that everything should be done to eliminate all sources of friction between the two bodies, have done much toward making the two organizations into a harmonious whole, working in cooperation and not in rivalry.

"Among his contributions to the work of the Academy was the reorganization of the finances, particularly the investment policy of the Academy, through the appointment of Mr. Horace Ford as Investment Counsel and the establishment of a group of Special Financial Advisors, who meet from time to time with the Finance Committee for the consideration of over-all investment policies. The finances of the Academy have thereby been greatly strengthened. Another was the establishment of a business office, headed by a competent Business Manager."

Jewett's work with the Academy was only one of the fields in which his active intelligence found scope. With the impact of war, it soon became evident that a new kind of agency would have to be created to make the full potentialities of the scientific talent of the nation available to the military services. The Academy was so constituted that it could not act as a contract agency to expend Government funds for research and development. Recognizing this fact, Jewett was one of the small group of scientists primarily instrumental in creating, in 1940, the National Defense Research Committee, and he became chairman of its Division C concerned with communication, transportation, and submarine warfare. In 1941, he was made a member of the Coordination and Equipment Division of the Signal Corps, and in 1942, consultant to the Chief of Ordnance.

In addition to his governmental and military services, he took part in the work of many organizations of non-military nature. He became vice chairman of the Engineering Foundation in 1919, president of the A.I.E.E. in 1922, and shortly thereafter became a member of the Committee on Scientific

Aids to Learning of the National Research Council. He also was made president and trustee of the New York Museum of Science and Industry, a life member of the Massachusetts Institute of Technology Corporation, a member of the Advisory Committees of the U. S. Departments of Agriculture and Commerce, and a trustee of Princeton University, of the Carnegie Institution of Washington, and of the Woods Hole Oceanographic Institution. He was a fellow of the American Institute of Electrical Engineers, of the American Physical Society, the Acoustical Society of America, the Institute of Radio Engineers, and of the American Academy of Arts and Sciences, and a member of the American Philosophical Society, and the Institution of Electrical Engineers (British).

As a result of the wide recognition of his abilities and achievements, he was showered with honorary degrees and scientific awards. He was made a Doctor of Science by New York University and Dartmouth in 1925, by Columbia and the University of Wisconsin in 1927, by Rutgers in 1928, by the University of Chicago in 1929, by Harvard in 1936, by the University of Pennsylvania in 1940, and by Boston University in 1944. He was given the Doctor of Engineering Degree by the Case School of Applied Science in 1928, and the degree of LL.D. by Miami University in 1932, by Rockford College in 1939, by Norwich University in 1944, by Yale University in 1946, and by the University of California in 1948. He was awarded the Edison Medal in 1928, the Faraday Medal (British) in 1935, the Franklin Medal in 1936, the Washington Award in 1938, the John Fritz Medal in 1939, and the Medal for Merit in 1946. The Hoover Medal and the Industrial Research Institute Medal were awarded him in 1949 and were to have been presented early in 1950. These various honors are eloquent and irrefutable testimony of his impact on society and of the effective results he obtained in his many fields of endeavor.

One of Jewett's many interests outside the scope of his nation-wide responsibilities was the promotion of scientific cooperation between this country and Japan. He quickly recognized the scientific and industrial competence of the Japanese people, and felt that besides being eager for assistance from us, they also had contributions to make to our own advancement. He became actively interested in Japan's behalf at the time of the Tokyo earthquake in September 1923, and rendered active and effective assistance for which he was later awarded the Fourth Order of the Rising Sun. In 1929, he presented a paper, jointly with Bancroft Gherardi, at the World Engineering Conference in Tokyo, where he had the opportunity to meet many Japanese leaders in science and industry. This was the beginning of a long association between Jewett and Japanese scientists with mutual advantages. As further recognition of his services to Japan, he was awarded the Third Order of the Sacred Treasure in 1930. Later, as president of the National Academy of Sciences, he was instrumental in organizing two scientific missions to Japan during the postwar years. In recognition of his many contributions to Japanese science, a memorial service was held by the Japanese in his honor at G.H.Q. Chapel Center in Tokyo on December 11, 1949. Over 200 scientists and friends were present.

None who has commented on Jewett in the past has failed to record his charm, his warmth, his ability to make friends of people readily and quickly, and at the same time to gain their confidence. Regarding this aspect of his character, John Mills wrote:

"It was in those maturing years at Chicago that Jewett began to display his amazing talent for friendship, an aptitude which has made him so rich in friends and endeared him to so many. To a character marked by frankness and sincerity, to a keen intellect with wide interests and human sympathies, to a sprightly manner and pleasant wit, nature had added a voice which expressed all those characteristics. The voice is particularly effective over the telephone, as anyone can testify who ever heard him say, 'This is Frank'; from that moment on, whether the message it delivers is pleasant or not, loyalty has been aroused. While its modest possessor may have thought that what was compelling was the idea, the compulsion was always aided by the sunny tone."

Writing of the early Boston years, he said:

"Here again his natural and unconscious ability to make friends rapidly enlarged his circle of influence. In a city where the formalities of social intercourse were strictly maintained and the informality of first names was something to be acquired by years of association, or to be born into, Jewett soon established many intimate friendships. The operation was essentially spontaneous—a few weeks, not months, of acquaintanceship would lead to first-name intimacy. He never presumed nor 'climbed'; his friendships always seemed the spontaneous result of natural affinity. They were just as natural with those of lower rank; and statistically more important because as he progressed the number below increased and that above decreased.

"Whatever the mechanism and however deep the subconscious motivation, this capacity for friendship has been one of the greatest assets to Jewett's career."

This characteristic of graciousness, and the capacity for making friends were among the elemental traits with which Jewett was endowed. His keenness of mind, the ease with which his intellect became interested in almost any problem or situation presented to it, and the logical precision with which his highly rational thought carried long and involved trains of reasoning to their only valid conclusion, these qualities go a long way toward explaining Jewett's rapid rise to positions of the greatest responsibility and his considerable influence within the Bell System, on national affairs, and throughout the scientific world.

There is no answer to the why or how of such a capacity for friendship. It was merely one of the outward marks of the inner personality that was Jewett. One can have no greater asset. It opens doors, and it elicits sympathy, assistance, and cooperation; it engenders the trust and confidence that is essential to great accomplishment. Those who possess it are blessed immeasurably, and there is no doubt that Jewett was one of them.

Kindness was his constant companion, and indubitably contributed to the "amazing talent for friendships" credited to him by Sir Frank Gill in "Nature" for December 17, 1949. Gill continued: "Those working under his direction did so, not only because his direction was good, but also because it was a labour of love for the leader. He gave an extraordinary example of how to manage men and how to weld together teams of persons (even difficult personalities) into efficient units."

Jewett's relationship to the telephone industry is an outstanding example of a situation needing a man and a man finding a career for which he was peculiarly fitted. The telephone industry was not an activity that Jewett had always dreamed of entering and for which he had particularly prepared. To the extent that he allowed his interests to be confined and focused in his earlier years, their objective was railroading or electric power. The abilities to plan, to organize, and to accomplish were his, but they could have been applied with success in any of a number of fields. The finger of fate, however, seems steadily and insistently to have directed him to the path we have found him following.

Chance prevented him from entering M.I.T. in the fall of 1898 to study power engineering as he had planned. Instead fate led him to Chicago and to four years of physics. This done, he picked up the thread of his earlier intention and went to M.I.T., but here again fate was subtly at work, because it was in Boston that the engineering department at A. T. & T. was occupied with its rising flood of problems, and it was here that Campbell and Jewett were brought together.

At this time the tide of the Bell System was rising, and Jewett cast himself into it, not to be passively carried along, but to direct it, to open new channels for its increasing volume, to reduce retarding friction, and to remove the obstructions that impeded its flow. While he strove to enhance its power and to increase its usefulness, it, in turn, carried him along with it. They became identified. Jewett was its personification, the embodiment and the representative of the rising tide of research and development that contributed largely to the greatness of the

Bell System, and that in turn made Jewett's greatness evident to all.

In no way and at no time did Jewett claim for himself any of the specific accomplishments that made possible the forward progress. He was always just and generous to his collaborators, giving to them full credit for their work. He pretended to no more than having opened and smoothed their paths. At the presentation of the Edison Medal in 1929, he said: "In accepting this medal, the highest and most cherished honor which American electrical engineers have it in their power to bestow, I do so with a deep feeling that in large measure I am accepting the expression of your appreciation for the work of all the numerous men who have been my intimate associates. On their behalf, as well as my own, I thank you for so signal a recognition of our endeavors."

There was about Jewett nothing of the ruthless drive, the self-seeking, and the disregard of others that so often is associated with a successful career. His intellect was cool, clear, and penetrating, never impassioned or combative. An infection in his early life had cost him the use of one eye and had seriously impaired the other. All his life he thus endured a handicap that must have been particularly trying to a student. It served to spur rather than to embitter him, however, and he made so little of it that many were never aware of his affliction. To some extent it perhaps partially explains his willingness to learn how things looked to others, which was always characteristic of him.

His character has perhaps best been summarized by one of his most admired friends, Gano Dunn, who at the posthumous presentation of the Hoover Medal said of him:

"As a person there was always about him an air of modesty and quiet distinction, an attitude of immediate and voluntary helpfulness to others wherever he learned of opportunity. His sweet and lovable character made him welcome wherever he went, and bound to him hosts of friends, not only in the fields of science and engineering, but in every walk of life. Disinterested and liberal, of acute intelligence and sensibility to humor, companionship with him was richly rewarded. The soul of honor in every commitment, to do business with him was a satisfaction and to be his friend an invaluable privilege."

KEY TO ABBREVIATIONS

Amer. Acad. Arts Sci. Proc. = American Academy of Arts and Sciences, Proceedings
Amer. Bar Assoc. Jour. = American Bar Association Journal
A.I.E.E. Jour. = American Institute of Electrical Engineers, Journal
A.I.E.E. Proc. = American Institute of Electrical Engineers, Proceedings
A.I.E.E. Trans. = American Institute of Electrical Engineers, Transactions
Amer. Phil. Soc. Proc. = American Philosophical Society, Proceedings
Amer. Rev. Rev. = American Review of Reviews
Bell Lab. Rec. = Bell Laboratories Record
Bell Syst. Tech. Jour. = Bell System Technical Journal
Bell Tel. News = Bell Telephone News
Conn. Soc. Civil Engrs. Proc. = Connecticut Society of Civil Engineers, Proceedings
Elect. Comm. = Electrical Communication
Elect. Eng. = Electrical Engineering
Elect. Jour. = Electrical Journal
Elect. World = Electrical World
Frank. Inst. Jour. = Franklin Institute Journal
Jour. Com. = Journal of Commerce
Jour. Pat. Off. Soc. = Journal of the Patent Office Society
Phil. Mag. = Philosophical Magazine
Phys. Rev. = Physical Review
Pop. Sci. = Popular Science
Sci. Mo. = Scientific Monthly
Trans. Amer. Inst. Chem. Eng. = Transactions, American Institute of Chemical Engineers
West. Soc. Eng. Jour. = Western Society of Engineers, Journal

BIBLIOGRAPHY

A new method of determining vapour-density of metallic vapours, and an experimental application to the cases of sodium and mercury. Phil. Mag., v. 4, ser. 6, 546-554, Nov., 1902.

The effect of high temperatures on the change of resistance of bismuth in a magnetic field. Phys. Rev., v. 16, ser. 1, 51-59, Jan., 1903.

The modern telephone cable. A.I.E.E. Trans., v. 28, part 2, 1079-1093, 1909.

Long distance telephony in America. International Electrical Congress at Turin, Italy, Sept. 10-16, 1911—Congresso Internazionale delle Applicazioni Elettriche, v. 3, 388-438, 1912.

The protection of telephone equipment. Elect. Jour., v. 11, 611, Nov., 1914.

Some recent developments in telephony and telegraphy. Second Pan-American Scientific Congress, Washington, D. C., Proc., v. 6, sec. V, 698-712, disc., 712-713, 1915-1916.

Industrial research with some notes concerning its scope in the Bell Telephone System. A.I.E.E. Trans., v. 36, 841-855, disc., 856-869, 1917.

Wireless telephoning. Am. Rev. Rev., v. 59, 500-503, May, 1919.

Developments in wireless telephony. Radio Amateur News, v. 1, 71, 88, Aug., 1919.

(With B. Gherardi) Telephone repeaters. Joint meeting of the American Institute of Electrical Engineers and the Institute of Radio Engineers, New York, Oct. 1, 1919. A.I.E.E. Proc., v. 38, 1255-1313, Nov., 1919.

Elements of industrial research. Chemical Age, v. 1, 285-286, Dec. 25, 1919.

(With B. Gherardi) Progress in the art of communication. Elec. World, v. 75, 202-204, Jan. 24, 1920.

Hundred years in electrical research. Elect. World, v. 76, 571-572, Sept. 18, 1920.

European water power and industrial situation. An interview. Elect. World, v. 78, 433-434, Aug. 27, 1921.

Presentation speech of Edison Medal to Dr. R. A. Millikan. Pacific Coast Convention of A.I.E.E., October, 1923. Extract A.I.E.E. Jour., v. 42, 1221-1222, Nov., 1923.

The national engineering societies, their problems of the past, present and future. President's address, A.I.E.E. Annual Convention, Swampscott, Mass. A.I.E.E. Trans., v. 42, 571-576, June, 1923.

Machine switching telephone system for large metropolitan areas. Discussion of paper. A.I.E.E. Trans., v. 42, 201-202, 1923.

Public address systems. Discussion of papers. A.I.E.E. Trans., v. 42, 83, 1923.

The axially controlled magnetron; gaseous ionization in built-up insulation; effect of transient voltages on dielectrics; two photographic methods of studying high-voltage discharges. Discussion of papers. A.I.E.E. Trans., v. 42, 953, 1923.

Appreciation of Dr. Charles P. Steinmetz. Elect. World, v. 82, 932, Nov. 3, 1923.

Permalloy loaded cable. Elect. Comm., v. 2, 232-234, Apr., 1924.

Telephone transmission unit. Electrician, v. 94, 562-563, May 15, 1925.

Development and application of loading for telephone circuits. Discussion of paper. A.I.E.E. Trans., v. 45, 293, 1926.

Transatlantic telephony. Sci. Mo., v. 25, 170-181, Aug., 1927.

Transatlantic demonstration talk. Joint Meeting of Institution of Electrical Engineers and American Institute of Electrical Engineers, Feb. 16, 1928. A.I.E.E. Jour., v. 47, 223-225, Mar., 1928.

The telephone switchboard, fifty years of history. Bell Telephone Quarterly, v. 7, 149-165, July, 1928.

Fifty years of science and engineering. American Bar Association at Seattle, Wash., July 25, 1928. Amer. Bar Assoc. Jour., v. 14, 460-464, August-September, 1928.

Edison Medal response. A.I.E.E. Jour., v. 48, 238-239, Mar., 1929.

(With Bancroft Gherardi) Telephone communication system of the United States. World Engineering Congress, Tokyo, Japan, Paper No. 489, Oct., 1929. Bell Syst. Tech. Jour., v. 9, 1-80, Jan., 1930.

Some wartime developments in electrical communication and allied fields. Conn. Soc. Civil Engrs., Proc., 36th annual meeting, 6-36, 1930.

What science achieved in 1929—communication. Pop. Sci., v. 116, 20, Jan., 1930.

The future service of electronics to mankind. Electronics, v. 1, 8-9, 22, April, 1930.

Carty—the engineer and the man. Bell Lab. Rec., v. 9, 9-13, Sept., 1930.

Utilizing the results of fundamental research in the communication field. Lowell Institute Lecture—Jan. 22, 1932—Boston, Mass. Bell Telephone Quarterly, v. 11, 143-161, April, 1932.

John Joseph Carty. An Appreciation. Science, v. 77, 41-43, Jan. 13, 1933.

John Joseph Carty. Biographical Memoir for National Academy of Sciences. Amer. Acad. Arts Sci., Proc., v. 68, 610-613, Dec., 1933.

Research and engineering. Elect. Eng., v. 53, 781-784, May, 1934.

Dr. George A. Campbell. Bell Syst. Tech. Jour., v. 14, 553-557, Oct., 1935.

Telephony—child of organized scientific research. Franklin Institute Medal Meeting, Philadelphia, Pa., May 20, 1936. Frank. Inst. Jour., v. 222, 133-140, Aug., 1936.

An engineer looks at the social implications of science. Abstract of Stafford Little Lectures. Princeton University, March 8-11, 1937. Science, v. 85, Supp., 10, March 19, 1937.

Influence of the patent system in the development of American industry. Trans. Amer. Inst. Chem. Eng., v. 34, 627-642, 1938.

The engineer and current trends in economic thought. Washington Award, Western Society of Engineers, May 5, 1938, Chicago, Ill. West. Soc. Eng. Jour., v. 43, 101-111, June, 1938.

Some of the changes in society which science is bringing about. Maddox Lecture, Rockford College, Rockford, Ill., Feb. 18, 1939. Bell Tel. News, v. 29, 21, March, 1939.

The relation of research and invention to economic conditions. Jour. Pat. Off. Soc., v. 21, 195-208, Mar., 1939.

George Ashley Campbell—qualification of the medalist. Presentation of Edison Medal at the A.I.E.E. Winter Convention, Philadelphia, Pa., Jan. 29, 1941. Elect. Eng., v. 60, 106-109, Mar., 1941.

Alexander Dallas Bache—a founder, first president and benefactor of National Academy of Sciences. Am. Phil. Soc., Proc., v. 84, 181-186, May, 1941.

Symposium—a sound patent system—are patents suppressed. Jour. Com., v. 195, 31-32, Mar. 11, 1943.

Vannevar Bush—1943 Edison Medalist, A.I.E.E. Convention—Jan. 26, 1944, N.Y.C. Elect. Eng., v. 63, 81-82, Mar., 1944.