

FRANK J. SPRAGUE

Seventy-fifth Anniversary

1932

A Meeting of Appreciation and Tribute

to

FRANK J. SPRAGUE

on the occasion of his

SEVENTY-FIFTH BIRTHDAY

July 25, 1932

Foreword

The invitation to write letters of tribute to Frank J. Sprague, in recognition of his distinguished service and in commemoration of his seventy-fifth birthday, was directed by a small, informal committee.

This limited committee appeared to us and to others with whom we conferred as the most suitable plan, considering the time and opportunity as well as the character and detail of this work. We are mentioning this by way of explanation and apology, if need be, to others who would have gladly taken part in the work of this committee.

The letters are bound in permanent and fitting manner, and form a valuable collection enhanced markedly by the generous inclusion of photographs.

We thank all for their cordial support and interest.

FRANK HEDLEY
WILLIAM B. POTTER
GUY A. RICHARDSON
FRANK H. SHEPARD

Committee

Introduction

Some six months ago a few of Mr. Sprague's oldest associates and admirers thought to arrange for the recognition of his 75th birthday—believing that the engineering profession owed it to itself, as well as to one of its most distinguished members, to proclaim his achievements to the world. The outcome was the splendid reception of which the proceedings are recorded in this souvenir volume.

The plan originated with an Informal Committee consisting of F. H. Shepard of the Westinghouse Company, W. B. Potter of the General Electric Company, Frank Hedley, President of the Interborough Rapid Transit Company, and Guy A. Richardson, President of the American Electric Railway Association—the lion's share of the burden was borne by these men.

The key idea of the plan was the suggestion for a number of letters and photographs of the writers from Mr. Sprague's friends and associates, dating as far back as his Naval Academy days, and including representatives of all his many interests. The response to the request for letters and photographs was most enthusiastic; nearly five hundred were received. These letters and photographs were handsomely bound into six volumes, and were presented to Mr. Sprague by Admiral Robison at the meeting, as a complete surprise to him, this feature of the birthday party having been kept a close secret.

The Informal Committee, after doing most of the work, organized the Frank J. Sprague Anniversary Committee, consisting of the presidents of the several engineering societies, the presidents of universities which had given Mr. Sprague honorary degrees, a number of his early friends and associates, and many men prominent in electrical science and industry. The Chairman of the Anniversary Committee was Gano Dunn, Esq., President of the J. G. White Engineering Corporation, who presided at the meeting. Philip Torchio, Esq., Senior Vice-President of the New York Edison Company, served most efficiently as Treasurer and the writer was Secretary.

The Anniversary Committee was exceedingly fortunate in securing exactly the appropriate speakers to cover the range of Mr. Sprague's activities. Dr. John H. Finley, Associate Editor of the New York Times, spoke with distinction and charm of the importance of the work of such engineers as Sprague to the welfare of the world. Mr. Frank Hedley, President of the Interborough Rapid Transit Company, spoke with force and authority of the noteworthy contribution of Sprague to transportation, and finally Rear Admiral Robison talked of the career of Sprague as a naval graduate, ending his address with the presentation of the six volumes of letters and photographs to Mr. Sprague.

Mr. Sprague, in response, gave a brief outline of his early life and his entrance into the Navy. He dwelt on the importance of the work of his many associates, to whose zealous support success was largely due.

Following his address at the meeting, Rear Admiral Robison spoke over the National Broadcasting Company's nation wide radio chain, summarizing Mr.

Sprague's career. Probably never before has an engineer been honored by such a broadcast.

The addresses of these speakers, together with the graceful introductions by the Chairman, and Mr. Sprague's splendid response, are all included in this volume.

After the formal proceedings, Mr. and Mrs. Sprague received their friends in the lobby of the Engineering Building, where many old acquaintanceships were renewed.

The Anniversary Committee and the Informal Committee met with wholehearted response from all whom they approached. Mention should be made of Charles W. Price, E. E. Dorting, and F. E. Case; also of the secretaries, B. McLaughlin and M. E. Turner, for their invaluable assistance. Every one joined enthusiastically and all felt the occasion offered a most welcome opportunity to honor their friend and his splendid work.

CARY T. HUTCHINSON,
Secretary

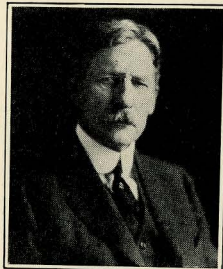
A Meeting of Appreciation and Tribute to FRANK J. SPRAGUE

1857 ~ Seventy-five Years ~ 1932
Engineer

MONDAY
July 25, 1932
8:00 P.M.

Members
of
Societies
and Friends
are
invited

Scientist



Inventor

Pioneer electrical applications ~ electric motors ~ railways ~ elevators

AN ENGINEER'S CONTRIBUTION TO THE WORLD'S WELFARE: *Dr. John H. Finley*
AN ENGINEER'S CONTRIBUTION TO TRANSPORTATION: *Mr. Frank Hedley*
FRANK J. SPRAGUE — A TRIBUTE: *Rear Admiral S. S. Robison, U. S. N. (ret.)*
Response: *MR. FRANK J. SPRAGUE*

FRANK J. SPRAGUE ANNIVERSARY COMMITTEE

GANO DUNN, *Chairman*

CARY T. HUTCHINSON, *Secretary*

| | |
|----------------------------------|---|
| C. E. SKINNER | President, American Institute of Electrical Engineers |
| C. N. LAUER | President, American Society of Mechanical Engineers |
| H. S. CROCKER | President, American Society of Civil Engineers |
| SCOTT TURNER | President, American Institute of Mining Engineers |
| C. P. PERIN | President, American Institute of Consulting Engineers |
| O. H. CALDWELL | President, New York Electrical Society |
| H. HOBART PORTER | President, The Engineering Foundation |
| H. A. KIDDER | President, United Engineering Trustees |
| G. A. RICHARDSON | President, American Electric Railway Association |
| J. F. OWENS | President, National Electric Light Association |
| G. P. JESSOP | President, Naval Academy Graduates Association of N. Y. |
| J. HOWLAND GARDNER | President, Society of Naval Architects and Marine Engineers |
| CHARLES M. SCHWAB | President, American Iron and Steel Institute |
| NICHOLAS MURRAY BUTLER | President, Columbia University |
| THOS. S. GATES | President, University of Pennsylvania |
| HARVEY N. DAVIS | President, Stevens Institute |
| HOWARD McCLENAHAN | Secretary, Franklin Institute |
| C. G. ABBOTT | Secretary, Smithsonian Institution |
| GEO. LEBOUTILLIER | President, New York Railroad Club |
| THOS. ROBINS | Secretary, The Naval Consulting Board |

| | | | | | |
|----------------------|------------------|-------------------|------------------|-----------------|-------------------|
| Bion J. Arnold | E. E. Dorting | William J. Hammer | James H. McGraw | E. W. Rice | Elihu Thomson |
| Merlin H. Aylesworth | Ralph Earle | J. H. Hanna | W. S. Menden | A. W. Robertson | Philip Torchio |
| G. P. Baldwin | W. L. R. Emmet | Frank Hedley | F. A. Merrick | S. S. Robison | J. H. Van Alstyne |
| C. A. Benton | Thomas Ewing | Frank B. Jewett | W. S. Murray | F. A. Scheffler | S. M. Vauclain |
| E. R. Carichoff | John H. Finley | A. E. Kennelly | R. B. Owens | F. H. Shepard | H. H. Vreeland |
| John J. Carty | Bradley A. Fiske | Myles B. Lambert | W. B. Potter | William S. Sims | Edward Weston |
| Mortimer E. Cooley | George Gibbs | S. H. Libby | Charles R. Pratt | L. B. Stillwell | W. J. Wilgus |
| Oscar T. Crosby | L. P. Graner | A. D. Lundy | Charles W. Price | Ambrose Swasey | Owen D. Young |
| | Howard F. Gurney | C. O. Mailloux | Michael I. Pupin | Gerard Swope | |

ENGINEERING SOCIETIES AUDITORIUM, 29 WEST 39th STREET, NEW YORK
Secretary's address — 52 WILLIAM STREET, NEW YORK CITY

(REPRODUCTION OF ANNOUNCEMENT)

Radio Broadcast

National Broadcasting Co.—Blue Network

July 25th, 1932. 10:30-10:45 P. M.

SPEAKER: ADMIRAL S. S. ROBISON

A Tribute to Frank J. Sprague "Father of Electric Railroads"

| | |
|------|---------------------|
| WJZ | —New York, N. Y. |
| WBZ | —Boston, Mass. |
| WBZA | —Springfield, Mass. |
| WHAM | —Rochester, N. Y. |
| KDKA | —Pittsburgh, Pa. |
| KWCR | —Cedar Rapids, Ia. |
| WENR | —Chicago, Ill. |
| WCKY | —Cincinnati, O. |
| WIBA | —Madison, Wis. |
| KFYR | —Bismark, N. D. |
| WWNC | —Asheville, N. C. |
| WIS | —Columbia, S. C. |
| WIOD | —Miami, Fla. |
| WSM | —Nashville, Tenn. |
| WFB | —Atlanta, Ga. |
| WJDX | —Jackson, Miss. |
| KPRC | —Houston, Tex. |
| KTBS | —Shreveport, La. |

FRANK JULIAN SPRAGUE

Scientist, Inventor, Engineer
"Father of Electric Traction"

CHRONOLOGY:

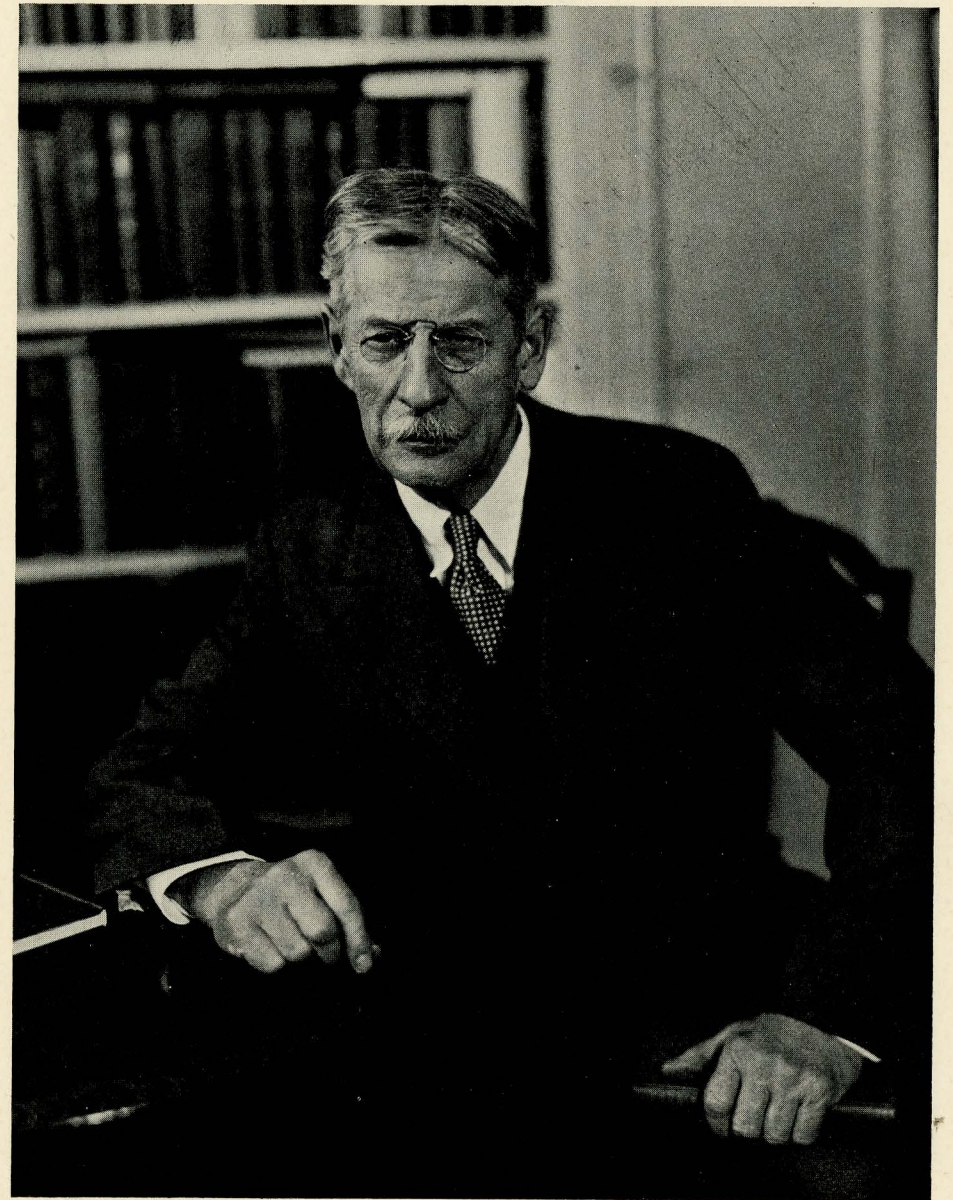
Born, Milford, Conn., July 25, 1857.
U. S. Naval Academy—1874-78
Crystal Palace Exhibition—1882.
Resigned as Ensign U. S. Navy—1883.
Assistant to Thomas A. Edison—one year.
Sprague Electric Railway and Motor Company—organized 1884.
Contract for Richmond Railways in 1887, followed by 110 other railways before merger with Edison General Electric in 1890.
Sprague Electric Elevator Co.—1892; elevator development and promotion.
First battery in Postal Telegraph Building.—1892-3.
Invention of the "Multiple Unit" system in 1895, and its application on the South Side Elevated in Chicago in 1897-98.
Sprague Electric Co.—1897, absorbed by General Electric Co.—1902.
Sprague, Duncan and Hutchinson—1892-93.
Commission for Electrification of Grand Central Terminal—1903-8.
Automatic train control—1906. Sprague Safety Control & Signal Corporation.
Dual Elevator system—1927. Electric Signs—1929.

AWARDS:

Gold Medal—Paris Electrical Exhibition—1889.
Grand Prize—St. Louis Exhibition—1905.
Edison Medal—A. I. E. E.—1910.
Elliot Cresson Medal—Franklin Institute—1904.
Franklin Medal—Franklin Institute—1921.
D. Eng.—Stevens, D. Sc.—Columbia, L. L. D.—Pennsylvania.
Honorary Member A. I. E. E.—1932. N. E. L. A.—Franklin Institute, Engineers Club.
Past President—A. I. E. E., N. Y. E. S., A. I. C. E., Inventors Guild.
Member—U. S. Naval Consulting Board.

ACCOMPLISHMENTS:

Early activity in U. S. Navy, resulting in numerous inventions in electrical field, including the "inverted" type of dynamo and series parallel control in 1881.
Universal Under-contact railway system—1882.
Jury and tests at Crystal Palace Exhibition—1882. Report to Navy Dept—1883.
Mathematical determination of electrical distribution in 1883.
Constant speed motor, which developed into wide industrial use, 1884-9. Endorsed by Edison interests—1885. Regenerative control—1884.
Initial tests Durant Sugar Refinery and New York Elevated to demonstrate practicability of motors for railway use—1885-6. 3-point geared motor suspension—1884.
Advised active prosecution of alternating current development—1886.
The operation at Richmond, beginning in 1887, established present standards which ensured successful railway operation.
Notable accomplishment in remote control and equipment for elevator operation now universally used. First operative model of dual elevator, 1926.
The invention and practical application to service of the "Multiple Unit System," by which two to four times the traffic capacity of track and terminals is realized, now used throughout the world.
Constant promotion underground rapid transit.
As a pioneer who personifies vision, persistence, courage, energy and zeal—an unsurpassed example.



FRANK JULIAN SPRAGUE

SPRAGUE
SAFETY CONTROL AND SIGNAL
CORPORATION
421 CANAL STREET

NEW YORK, Aug. 11, 1932.

FRANK J. SPRAGUE,
PRESIDENT

Dr. Gano Dunn, Chairman,
Anniversary Committee.

Dear Dr. Dunn:

Pending futile attempts to make personal reply to the greetings with which my friends recently deluged me, - not only those whose letters and photographs have found resting place in my Golden Books but many others, I must try to express my deep sense of obligation and gratitude to all who as organizers, committee members and contributors have made my birthday a memorable event.

The past half century may rightfully be called the Electric Age, one which in developments and consequences will probably never be equalled. In that period electricity has been harnessed - and will increasingly continue - as the universal servant of mankind, contributing in increasingly varied fields to the comfort, welfare and happiness of the human family, and altering the face of civilization.

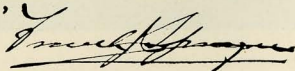
It was my good fortune to have early entered - and by a kindly Providence been permitted to remain in - the ranks of the workers, or pioneers as some choose to call them, and now many have thought well enough of my work to join in a unique celebration as a medium of expression of approval and friendship.

As I and my family pore over the letters which have been assembled in such splendid form, I feel both pride and embarrassment because of the generous assignment of praise, but at the same time great happiness because in spite of the tenseness of atmosphere which seems inescapable from pioneer work a mellowing time has left a heritage of inestimable value - that of warm friendships.

May I, through you and the Committee, express by this letter a tithe of my appreciation to each and all who, in whatever capacity, have thus honored not only me but my Alma Mater and the engineering profession in such a gracious and notable fashion.

With individual greetings and hopes for continued health and happiness, I am

Very gratefully,



LETTER FROM FRANK J. SPRAGUE TO DR. GANO DUNN



REAR ADMIRAL S. S. ROBISON AND FRANK J. SPRAGUE

Program

FRANK J. SPRAGUE ANNIVERSARY

Auditorium, United Engineering Building,

Monday, July 25th, 1932—8 P. M.

Auspices: Frank J. Sprague Anniversary Committee

GANO DUNN, Chairman CARY T. HUTCHINSON, Secretary

8:15—Opening remarks by the Chairman

8:20—Address:

An Engineer's Contribution to the World's Welfare—Dr. John H. Finley

8:40—Address: An Engineer's Contribution to Transportation—Mr. Frank Hedley

9:10—Address:

Frank J. Sprague—A Tribute—Rear Admiral S. S. Robison, U. S. N. (ret.)

9:30—Presentation of the volumes of birthday letters and photographs (surprise)

9:40—Response by Mr. Sprague

10:20—Reception by Chairman, Mr. and Mrs. Sprague, main floor lobby

10:30—Radio broadcast from studio station WJZ with radio receiving station in auditorium.

Seated on platform with the Chairman and Mr. Sprague: Messrs. Finley, Hedley, Robison, Hutchinson, Torchio, Potter, Shepard and *Richardson.

Seating:

First row seats—Committee

Group seats on left—Mr. Sprague's family

Group seats for guests (350) next rows following

Remaining seats, members of societies and friends.

Appointments:

Lapel microphones—Public Address System

Broadcast—courtesy National Broadcasting Company

Receiving set—courtesy Westinghouse Supply Co.

In charge of arrangements:

E. E. Dorting, assisted by A. Pettijohn

—courtesy New York Electrical Society.

E. H. McCabe

—in charge of public address system and radio reception.

Ushers:

C. W. Doncourt, John J. Hayes, R. E. LeVino, O. E. Putnam

A. M. Schoettgen, G. Steffan, C. H. Thomas.

*Unavoidably absent

The ushers will on signal proceed from rear, down centre aisle to deposit volumes on table to be placed on platform.

Following the speeches, each volume to be placed on a table in front of stage for inspection.

Fruit punch served in main lobby during reception—Courtesy Engineers Club.

Note by Secretary—The main auditorium was well filled, with many ladies in the audience; the schedule was well kept and most of those present joined in the reception which lasted until midnight. The universal comment was of gratification at the opportunity to join in this tribute to a great engineer.

The Proceedings

A Meeting of Appreciation and Tribute to FRANK J. SPRAGUE convened at eight-fifteen o'clock on Monday evening, July 25, 1932, at the Engineering Societies Auditorium, 29 West 39th Street, New York, Mr. Gano Dunn presiding.

CHAIRMAN DUNN: Mr. Sprague, Ladies and Gentlemen: We are here tonight to indulge in two pleasures: the pleasure of recognition and the pleasure of participation.

Thomas Carlyle was right in saying, "The eye only sees what the mind brings means of seeing." Because our minds are capable of recognizing and forming judgments on the long perspective of Sprague's great accomplishments in their relation to what we call civilization, or the industrial era, or the progress of humanity towards more leisure for self satisfactions, to say nothing of his lifting the engineering profession into a place of greater honor, we see in him the great personality, the gifted intellect, the imaginative creator in the realm of invention. In short, we are here as a jury that for many years has been taking evidence on a great case and is now ready to pronounce its verdict. This verdict, of which this whole unusual occasion is the evidence, is the first of our two pleasures.

The second is a pleasure of the heart. There are joys in this world too numerous to mention, and we have all tasted many of them, but if there is a joy that goes deep into the fibre of engineers, it is the joy of creation. It corresponds to the joys of poets, painters, authors, statesmen, in their own fields.

This joy Frank Sprague has tasted as few men have tasted it, and I will leave it to the other distinguished witnesses who speak tonight to tell the basis on which it rests, but we, his friends and admirers, cannot refrain from drinking some of the drops that spill from his full cup. We cannot refrain from catching the infectious spirit of his insatiable passion for invention, and we cannot refrain from sharing with him the joy of creation which he must feel. In this we are, perhaps, unconsciously enjoying the second of our two pleasures, participation in our own verdict.

If ever there was a scholar who was a man of the world, or a former college president and editor of a great newspaper who was a judge of men and events with an almost inerrant perspective and imagination, it is the speaker whom I now call upon to discuss Sprague's work in its larger relations to the affairs of life, Dr. John H. Finley, Associate Editor of the New York Times. (Applause)

DR. JOHN H. FINLEY: Mr. Chairman, Mr. Sprague, Ladies and Gentlemen: I am now tied to this desk by this electrical device (laughter), and I am sorry for you that I cannot leave it until I am released by Mr. Dunn. (Laughter)

I find myself, may I say informally, somewhat out of character here tonight. I am generally introduced as a pedestrian, and as a pedestrian I am paying homage to the pioneer in rapid transit. (Laughter) At any rate, what I may have to say will be disinterested.

Mr. Dunn reminded me this afternoon that many years ago I spoke in this hall, (and I was proud that he could remember it), at a meeting of the Institute of Electrical

Engineers, and I dared at that time to make a prophecy. I looked up my notes and found that I had fallen into verse, and I present a few of the lines as the background for what I may say here tonight:

'Tis prophesied that all the quick and dead,
From Boston to Bombay and back again,
Shall at one moment hear the selfsame sound,
The stirring sound of Gabriel's final trump;
But long before that day shall come, perchance,
A Carty, or his scientific heir
(Mr. Carty presided at that meeting)
Will make the universe his "Carty Hall"
Wherein each earth-encircling day shall be
A Pentecost of speech, and men shall hear,
Each in his dearest tongue, his neighbor's voice
Tho separate by half the globe.

That was fifteen years ago. (Applause)

That prophecy has been fulfilled already, and even without wires. Tonight we are to speak of the achievement of a more intimate mobility on the face of the earth itself, and to congratulate one who is called "the pioneer engineer and prophet of terrestrial rapid transit." (Applause)

Almost the very first use made of the word "engineer," so far as lexicographers have been able to trace it, was in a sentence not altogether complimentary to those who make speeches. Back in 1592 someone referred to such a person as myself as "an engineer of phrases instead of thunderbolts." The characterization would seem particularly pertinent tonight as I attempt to speak in his presence of the achievements of an engineer who has spent his life in working with the force of which real thunderbolts are made. He must look with dread, if not contempt, upon an engineer of mere phrases. Yet I would assure him that these phrases are not what the Latins called *brutum fulmen*—inconsiderate speech, indiscriminate thunder, even though the wording of the subject assigned me might permit me to speak of any engineer since Archimedes and fulminate over the whole skies of science, if I so chose.

One might rapidly and readily believe that a certain Roman poet had Mr. Sprague in mind when he wrote (I will use the pronunciation which I fear you will not understand, so you will not be able to criticize mine) (Laughter):

Solvit animis miracula rerum,
Eripuit Jovi fulmen, viresque tonanti,

which suggests that Mr. Sprague has done what would have been left to demi-gods in ancient times. In my English translation it is written: "He has dismissed from our minds the fear of wonders; he has wrested from thundering Jove his thunderbolt and strength."

As the demi-god Prometheus stole the fire of the gods on Olympus and gave it to men, Mr. Sprague has wrested from the invisible the force which he has transmuted into motive power for mankind. We may well speak of him as one of the major prophets of the Televictorian Age, (as I have called this age into which we have come, the age of the telephone, the telegraph, the television, the age of the conquest

of the far) along with the engineers of communication through the ether by wire and wireless, and of transportation by land and sea and air.

I once turned to my Greek dictionary to find how many *far* words there were in the vocabulary of the ancients. I discovered that there were four columns, whereas there were full sixty columns of *near* words; and their far words would now be near words:

| | |
|-------------|---|
| telebolos, | the far-striking—only as far as one could throw a spear; |
| teleplanos, | the far-wandering, one who had gone perhaps as far as Boston; |
| teleskopos, | the far-seeing, one who could see no further than his naked eyes could discern; |
| telephanes, | the far-seen; |
| teleboas, | the far-shouting; |
| telephilon, | the far-away loving; |
| telouros, | the far-far-away, perhaps as far as Chicago. |

But you, Mr. Sprague, have made a unique contribution in that you have through your persistent and triumphant inventing, which is the original meaning of engineering, conquered the *far* by the use of electricity in two directions: Perpendicular and horizontal. Others will speak more in detail of that double contribution to human mobility. There is this general observation that may be made, however, by way of preface; that man's evolution has been a struggle toward a higher and higher state of mobility, toward more and more rapid transit, as is witnessed by his dream of wings with which he equipped his gods and angels.

One thinks of you, Mr. Sprague, first of all as a human "uplifter" in the sense, the physical sense, (laughter) that your invention made possible the carrying of millions by "lifts" every day to heights never dreamed of before your day. The builders of the tower of Babel did get on without the use of elevators. It was a toilsome ramp that man had to climb to the upper stories. The remotely controlled electric elevators have, with steel, made possible our skyscraper cities. It is said that the Babel builders in their ziggurats aspired to carry their towers so high that the gods would come down and dwell in them with men. And here is the interpretation of our tallest tower by one who has never seen with her eyes, nor heard with her ears—that remarkable person, Helen Keller.

I saw her picture one day in the newspapers showing her in the Observation Tower of the Empire State Building, and I wrote her and asked her, "Helen, what did you see?" This is a part of her answer, this blind woman, who has never seen a human face; nor heard a human voice:

"It was a thrilling experience to be whizzed in a 'lift' a quarter of a mile heavenward and to see New York spread out like a marvellous tapestry beneath us . . . Let cynics and supersensitive souls say what they will about American materialism and machine civilization. Beneath the surface are poetry, mysticism and aspiration that this mighty tower somehow symbolizes. In that giant shaft I see a groping toward beauty and spiritual vision."

That is again a groping toward the Prime Mover of the universe, whose laws the engineer has sought by search and research to find out. When one of your great brother electrical scientists was asked why this mysterious force acted in this or that

fashion, he said that it was "the will of God." But He can get His will expressed physically only through the help of inventive man.

Mr. Sprague's genius has shown itself not only by erecting the perpendicular; he has also increased the horizontal mobility of millions on

This crust whereon we dwell,
Whereon our loves and shames are begot and buried.

The first prophecy of a trolley car, with its spitting fire, has, by some, been thought to be found in the Book of Nahum, which reads:

The chariots rage in the streets
They jostle one another in the broadways.
The appearance of them is like torches
They run like the lightnings.

But I am informed that it was not until he ran a trolley car in Richmond, Virginia, that the prophecy had fulfillment. That was back in 1888. Now there are enough urban and interurban electric tracks in the United States alone to reach twice or three times around the land parts of the earth (I am quoting from a good encyclopedia, 35,500 miles) with 70,000 passenger cars and 20,000 freight cars. When we add the electric trackage and cars of other countries, and multiply these by the number of passengers who use them, we can get some notion of what an engineer's contribution has been to the world's welfare in horizontal mobility.

Assuming, as one may I think through a layman, that mobility, swift transit, freedom to move beyond the reach of pedestrian feet, makes for human welfare and heightened civilization—and I could support that, and should if there were time—I think that we may express your particular influence, Mr. Sprague, by the Pythagorean proposition (if, indeed, we are still permitted by the mathematical physicists to accept its finality). Let us imagine a line drawn from the top of the tallest building, which you have made possible (the perpendicular), to the extreme end of the horizontal, which you have described by your inventive engineering. We shall then have a right-angled triangle of achievement, and be able to say that the square of human welfare described on this line, the hypotenuse (I do not need to tell this audience) will equal the sum of the squares described on the other two sides—the perpendicular and the horizontal. (Laughter and Applause) Quod erat demonstrandum! (Applause) The perpendicular being the taller, and the horizontal being longer because of your double contribution to human welfare, it should be increased to the sum of their greater squares.

It has been suggested that there should be described in electric lights on the Sahara Desert a vast right-angled triangle with the supplementary lines used in demonstrating the Pythagorean proposition, large enough to be seen by the inhabitants of Mars, so that they might know how far we have progressed in mathematical science—if indeed they are themselves sufficiently advanced to understand its significance. (Laughter)

But after all, we have gone far beyond Pythagoras in the application which has been made of pure mathematics by the engineer in building cities both perpendicularly and horizontally, while his associates have been flying about the earth and est-

ablishing the truth of another proposition of Pythagoras (whose truth I prophesied as I just told you on this platform fifteen years ago.)

Pythagoras was right; the earth is round,
Tho smaller than he estimated.
To its circumference we all are bound
And can't be wholly isolated.
Its $2\pi R$ is our predestined lot
Till we become at last tangential,
That is till sun and moon and stars forgot
We fly alone to our sequential.

(Laughter and Applause)

May it be many years, Mr. Sprague, before you become tangential to this sphere of ours, but when you do go, you may be sure that you will be attended by more clouds of glory than trailed you when you came seventy-five years ago to this earth, whose transit you have quickened for the human race. (Applause)

CHAIRMAN DUNN: After this delicious comment on the work of engineers in its relation to the rest of life, inspired by the work of Mr. Sprague, we will hear a voice from another quarter, from the world of hard realities, from a valiant warrior who knows, if any man knows, what Frank Sprague has contributed to electric railroading. This man is the phenomenally successful operator of one of the world's greatest railroads—our own subway—Mr. Frank Hedley, President of the Interboro Rapid Transit Company. (Applause)

MR. FRANK HEDLEY: Mr. Chairman, Ladies and Gentlemen: We are here this evening to pay tribute to a man from whose achievements we have all been beneficiaries. His contributions to electrical progress have vitally affected many industries. Every one of us, naturally, should be proud of Frank J. Sprague, and thankful for his seventy-five years of outstanding usefulness to the world.

We, who are engaged in transportation, properly take a particular pride in Mr. Sprague because of the major contributions which he has made to transportation. He, more than any other one man, must be regarded as having brought electric transportation into practical being. I consider it an especial honor, therefore, to acknowledge our debt of gratitude upon this occasion to this great pioneer in this field. It gives me genuine pleasure to express my personal appreciation of Frank Sprague, because I have known him and his work for nearly fifty years. At the time Mr. Sprague tested his constant potential motor on the New York Elevated Railroad Lines, about forty-five years ago, I was employed in the Third Avenue Elevated shops as locomotive inspector, and I remember still doing some tinkering on his machine under instructions, although I did not know Frank Sprague personally at that time. However, I do know that Sprague proved by practical demonstration that he was right.

Frank Sprague is the "Father of Electric Traction." He installed in Richmond, Virginia, in 1887, the first electric railway system of any size in the world. This is the parent of all modern trolley lines. Successful operation of the now famous Richmond Union Passenger Railway brought about a revolution in transportation.

The invention of the multiple-unit system of train operation a few years later marked the opening of another new epoch in transportation and an important one in that it permitted the make-up of a train of any length with all the characteristics of a single car. This system of combining a group of individual cars, each complete in all respects, and providing for operating all controllers simultaneously through a train line from a master switch on any car, offers the only possible method by which the exacting conditions, particularly of rapid transit in congested territory, may be met. Therefore, I say that in addition to being called the "Father of the Trolley Line," Frank Sprague should be called also the "Father of Rapid Transit."

As an evidence of the progress which has taken place in transportation largely through Frank Sprague's efforts in a comparatively few years, let me quote from an article appearing in the New York Sun as late as 1887, commenting on some experimental work which Mr. Sprague was then conducting in New York:

"They tried an electric car on Fourth Avenue yesterday. It created an amount of surprise and consternation from 32nd Street to 117th Street that was something like that caused by the first steamboat on the Hudson. Small boys yelled 'Dynamite' and 'Rats' and made similar appreciative remarks until they were hoarse. Newly appointed policemen debated arresting it, but went no further. The car horses which were met on the other track kicked without exception, as was natural, over an invention which threatens to relegate them to a sausage factory."
(Laughter and Applause)

As we all know now, the car horses mentioned in this item were gifted with prophecy, or perhaps it was the reporter with the fertile imagination who wrote the article. At any rate, this account from the New York Sun is interesting because it helps to recall dramatically how rapidly and extensively developments in transportation have occurred since the day, within the memory of many of us, when it was written.

Of course, as is usually true of such an epochal invention as that of electric traction, the entire credit for the development belongs to no one individual. That long line of experimenters in this field includes such distinguished names as Davenport, Davidson, Field, W. B. Potter, Edison, and many others. They all made their contributions to the whole, and Mr. Sprague himself would be the last to deny to any of these pioneers his due measure of credit and his full meed of praise for his accomplishments. However, Frank Sprague's own contributions to this advance have been so essential that it has rightfully been said that he bears the same relation to electric transportation that Thomas A. Edison bore to electric illumination. (Applause)

Let me here recount some of these important contributions to the field of electric transportation which began while Mr. Sprague was serving in the United States Navy. They have issued from his fertile mind with regularity before and since he resigned from the Navy in 1883:

In 1882 the universally adjustable under-running contact system of railways now in use throughout the world on trolley and most main line electric railways.

In 1885 the wheel-barrow type of geared motor suspension, which has been in almost universal use on trolley lines, subway and elevated railways and many main line equipments.

In 1886, four-motor locomotive car, each motor a twin one, connected to a common gear, and with the tandem field flux, which principle appeared many years later in the New York Central Batchelder type of electric locomotive. This general method of gearing is now used on the New Haven and Pennsylvania electric locomotives.

The next year, or in 1887, the installation of the Richmond Union Passenger Railway, which really marked the transition from the experimental to the practical stage of electric railway.

The next three years he spent in active trolley development, as evidenced by the installation by the Sprague Company of 110 railways in the United States alone in a two year period, the installation of the first modern road in Italy, and in Germany the first modern road was installed by his licensees.

In 1895 came the invention of the multiple-unit system of railway train control, which I have already mentioned, and by means of which any number of motorequipped cars or locomotives, with or without unequipped units, may be combined in any order and be controlled from any number of points through the medium of a secondary train line and master controllers.

Two years later in 1897, this daring young man made a contract with the South Side Elevated Railroad, in Chicago, to equip these lines electrically for operation with his new multiple-unit system displacing the steam locomotives. The speaker was then the General Superintendent of the Lake Street Elevated in Chicago, operated by locomotives. At this time, locomotive engineers and those in charge of motive power on railroads, I think I can say, unanimously expected and a great many of them hoped, that the Sprague system would prove a failure. (Laughter) However, it is obvious at this time, and in fact, has been for several years past to those of us who know Frank Sprague as well as I know him, that it is not wise to say that any prediction he has made, or may make, is not practicable.

When Sprague was making this first application of the multiple unit system on the South Side Elevated in Chicago, he had with him as his right-hand man, Frank H. Shepard. (Applause)

The speaker had opportunity to observe this installation and its operation, and the eternal vigilance that Frank Sprague personally extended to this work day and most of the night must have represented a tremendous personal sacrifice. It is needless for me to say that the system conceived and installed by Frank Sprague operated successfully from the start; in fact most of those cars are still in service on the South Side Elevated with the same equipment that Sprague put on them about thirty-five years ago. (Applause)

From 1903 to 1907 he served as a member of the Commission for the Electrification of the New York Central, and was responsible for many of the decisions in connection with the important project.

In recent years he has been active in the development and construction of his automatic train control system to supplement manual control. The remarkable thing about this system is that it takes control out of the hands of the operator of the train only when he makes a mistake.

I have not attempted to give you anything like a complete account of Frank Sprague's contributions to electric transportation. Time would not permit of that.

For a half century he has been contributing ideas to the art, and the transportation industry owes an enormous debt to this pioneer in the field of the electric motor, the trolley car, and the multiple-unit system. In the transportation line, and especially as concerns rapid transit railroads, Sprague has been looking many years ahead and beyond the power of conception of any other man in the railroad engineering field. In other words, he has been thinking and talking over the heads of all of us, and he still can do it. (Laughter and Applause)

Consider, for instance, the suburban service on the steam railroads. With Sprague's multiple-unit installation those trains can accelerate at the rate of $1\frac{1}{2}$, in fact more than 2 miles per hour per second. This compares with about $\frac{1}{2}$ mile per hour per second as the best the steam locomotive can do in the same service. In other words, the Sprague system permits over 200 per cent faster acceleration than the steam locomotive.

Again, the Sprague multiple unit system has increased train terminal capacity over 40 per cent in most cases.

To digress for a moment from the transportation field, it may be interesting to consider one or two wide possibilities of the devices that have been introduced to the world by this ingenious young man, Sprague:

With the Sprague principle of remote control there really is no reason why stores, banks, trust companies and other such establishments should continue to submit to hold-ups or robberies. With his apparatus it may be arranged that from any location, or any number of locations in the bank, the mere pressing of a button, either by hand or by foot, will cause all the iron doors, both entrances and exits, immediately to close, imprisoning not only the robbers but everyone in the bank until the police arrive.

Another possibility is in connection with fire doors and asbestos curtains. Sprague's remote control system can be applied for safety purposes in theatres and moving picture houses, by arranging to have push buttons in convenient locations so that should any emergency arise, the pushing of any one of these buttons by any person will cause the asbestos curtain immediately to fall in front of the stage and all fire doors, or emergency exits, to be thrown wide open.

But he has not rested with the mere inventing or suggesting of new methods. He has recognized that the world is often too busy to pay attention to new and advanced ideas which are considered revolutionary, or to give them a trial unless forced to do so, and he has made it his business to do the necessary forcing. It is fortunate for the electric railway industry that he has made it his business to see that a new idea in which he had faith, was followed through the experimental stage and put into successful use.

I know that he has not always had a clear track in his struggle for recognition for the products of his inventive talent. He knows what it means to have the signals set against him and to be forced onto a side track and delayed. Nevertheless, we are here this evening because his inventions have proved worth while, and he had sufficient faith in them to fight for them, even when confronted with discouraging conditions and fierce competition.

As an illustration of Mr. Sprague's strong faith, and of the obstacles which at

times he has met and surmounted, consider for a moment his experiences in connection with that first great installation at Richmond, and remember, please, that this took place about forty-five years ago. His contract, briefly stated, called for the completion in ninety days of a road having about twelve miles of track, at that time unlaaid and with even the route only provisionally determined; the construction of a complete steam and electric central-station plant of 375 horsepower capacity; and the furnishing of forty cars with eighty motors, and all the necessary equipment for their operation. This, by the way, was nearly as many motors as were in use on all the cars throughout the rest of the world. Thirty cars were to be operated at one time, and grades as steep as eight per cent were to be mounted. And, finally, this extraordinary contract called for the payment of \$110,000 for accomplishing all this, "if satisfactory." (Laughter) Some nerve! People must have been honest then, more so than they are today.

Moreover, upon his first inspection, he found the track, which he did not supply, to be poorly constructed, with sharp curves and steeper grades than eight per cent, and other conditions which must have seemed almost impossible to overcome. Yet how Mr. Sprague succeeded in Richmond is well known.

Again, on the South Side Elevated installation, Mr. Sprague staked all on a successful demonstration of his multiple-unit system. The contract provided the most rigid guarantees as to time within which the work would be completed, and exhaustive tests, step by step, with the understanding that if at any stage of the work the equipment proved unsatisfactory the contract might be cancelled and the railroad relieved of any obligation. But again Sprague proved he was right.

To face such conditions as these requires vision. It requires energy, courage and complete faith in one's ideas. It is largely because Frank Sprague has always had these qualities that the railroads, and especially the rapid transit lines, are able to render to the public a far superior service than otherwise would have been possible. For instance, the New York subways, equipped with the most up-to-date installations known to the art, are operated by Frank Sprague's multiple-unit system, with which they are able to give the public faster acceleration, greater frequency of train service at a higher speed and factor of safety than ever would have been possible without Frank Sprague's inventive genius.

If I were called upon to name the most powerful influence contributed by Frank Sprague to the railway industry, I think I should say it was his pioneering vision, supplemented by his fighting spirit. His vision has been translated into accomplishment to such an extent that transportation, while considered by us a dynamic industry, has become very commonplace in the public mind. The passenger is seldom conscious of the almost miraculous devices employed in carrying him back and forth through the city and country, under rivers and over mountains, with a remarkable degree of safety and comfort. It is only on occasions such as this that an opportunity is afforded to remind people of what is going on around them that is so necessary to their daily lives and to which they naturally give no thought.

The traveling public using our rapid transit lines here in New York City, with which most of you are familiar, owe, and always will owe, a tremendous debt to Frank Sprague for his remarkable inventive genius, which has given them a type of

service which never could have been rendered without the use of Frank Sprague's ingenious devices; and, of course, this is equally true with respect to rapid transit travelers wherever such facilities exist throughout the world.

Frank Sprague is primarily responsible for some of the most important miracles of transportation, and tonight I am very proud to express, first, on behalf of the great electric railway industry, which I have the honor to represent, and second, on my own behalf, our appreciation of his efforts, his accomplishments and his fine personal characteristics. (Applause)

In conclusion I ask you all to join me and show your appreciation and respect for Frank Sprague, the "Father of Electric Traction" and the benefactor of the whole World, by rising from your seats in tribute to him.

« « « The audience arose and applauded « « «

CHAIRMAN DUNN: And now for a further and different part of our program, which is confined to Admiral Robison. Men's equipment and points of view change, but their characters rarely or never, and a man's early associates know him through life.

The next speaker is, like Sprague, a graduate of the Naval Academy. He is competent not only on account of many years of personal relation, but on account of his prominence in the history of the United States; a distinguished naval officer rising through the successive eliminations of that great service to its highest rank in the onerous command of our great battle fleet, a brave and skillful servant of his country in two wars, an engineer and author of high authority in radio telegraphy and telephony, I have the honor of calling upon Rear Admiral S. S. Robison. (Applause)

REAR ADMIRAL S. S. ROBISON: Mr. Chairman, Ladies and Gentlemen: It may not be known to you all that our guest of honor is not only a graduate of the U. S. Naval Academy, but served in, and with, the Navy more than a half score of his first three score years and ten.

I am grateful for the opportunity, as a graduate of the same school, to tell you a little about his naval service and his environment while a midshipman and an officer.

He entered as a midshipman in 1874, fifty-eight years ago, at the age of seventeen, and graduated near the top of his class in 1878, standing particularly high in Physics and Chemistry, which included what was then known of electricity.

Each year the President of the United States appoints a Board of Visitors, composed of distinguished civilians (educators and others) to inspect the Naval Academy—personnel, material, and curriculum. The Board reports to him its opinion of the state of each of these, and makes such recommendations as it sees fit for the betterment of the nation's naval school.

In 1876, the Centennial year, when Midshipman Sprague was about to achieve the dignity of becoming a second-classman, Daniel C. Gilman, already a distinguished educator and then President of Johns Hopkins, was a member of the Board of Visitors, by appointment of President Grant. He was selected by his fellow members to address the corps of midshipmen, and what he said has been preserved.

He stimulated the pride of the midshipmen in their chosen profession by recounting the deeds of the Navy in war, and its scientific work in peace. The latter was more prominent then, than at the present time, because while we were possessed of

a fine officers' corps we had in commission only a few ships of doubtful fighting value in which to employ them at sea, so that a large percentage of officers was available for scientific work, more so than at present.

President Gilman said that it was his belief that naval officers liked pithy sayings better than moral platitudes, and among the former, he quoted in English, Caesar's celebrated announcement: "I came, I saw, I conquered."

I would not for a moment undertake to analyze the character or temperament of a famous man, and much less would I do it in his presence and in that of this distinguished audience, but I venture the statement that the words, "I conquered," appealed more to Midshipman Sprague than all other parts of President Gilman's valuable address.

It may have inspired him. Even if it did not influence, it fitted his character. The will to conquer, not the will to win, nor the will to achieve, but the will to master what he undertook was, and still is, his dominant characteristic. What he came to in the Navy, and what he saw, we like to think helped him to conquer. Like Sprague, the Navy never stops. It carries on.

Just as the Navy assisted pioneers in wireless telegraphy, and still operates the largest and most comprehensive radio organization in the world, so during Midshipman Sprague's four years at Annapolis, it was assisting pioneers in electricity, and pioneering to some extent on its own account. It collected, tested, compared and used more dynamos than any other institution in the United States, if not abroad.

This work was carried on primarily at Newport, Rhode Island, where midshipmen were taken on one or more of their summer cruises, and secondarily at Annapolis, where Commodore Foxhall A. Parker, Chief Signal Officer of the Navy, carried on his work with the electric light produced by a dynamo built at Newport by Professor Moses G. Farmer. Professor Farmer gave what would now be called post-graduate courses to classes of naval officers at Newport for nearly two decades.

Admiral Bradley Fiske, than whom there is no better qualified judge, said of Professor Farmer that he was the most experienced practical electrician in the United States. The dynamo he built for the Chief Signal Officer reached Annapolis sometime in 1874. It was called in the official report, "an electric-light and magneto-electric machine" built "with a view to its usefulness aboard ship for signaling purposes, searching for torpedoes, preventing collisions or surprise, etc." This dynamo operated one arc light, then called "a carbon-point lamp," also built by Professor Farmer.

The Naval Torpedo Station, at Newport, was during these years, a centre of practical electrical information in the United States.

Unlike many midshipmen, Sprague benefited by what he saw. He had an inquiring mind, which leaned specially towards physics. What he studied and observed about electricity at the Naval Academy, and what he saw at Newport, he mastered.

The Naval Academy method of instruction on all subjects where it can be applied was then, and is largely now, the problem method, the students being given problems, to the solution of which the principles of the subject must be applied. The instructor does not teach the midshipman. The midshipman learns by solving problems propounded by the instructor.

Dr. Millikan, the great physicist and successful teacher, says the problem method is the best method of acquiring accurate knowledge.

It has been said that "exact measurement is the very life and soul of all technical application of science."

Midshipman Sprague learned to reason in figures; that is, accurately.

Sprague's class on graduation in 1878 comprised fifty men; thirty six of the line and fourteen of the engineers. Of the line, six became rear admirals: T. S. Rodgers, J. H. Glennon, H. S. Knapp, W. L. Rodgers, H. P. Huse, and G. R. Clark. Of the engineers three were R. S. Griffin, G. W. McElroy and L. E. Burd. Two of his engineer classmates, who like him resigned after a short commissioned service, became widely known educators and consulting engineers: I. N. Hollis of Harvard and Worcester "Tech" and Mortimer E. Cooley of Ann Arbor. A notable class, that of 1878!

Before being commissioned, all graduates then served two years at sea as passed midshipmen, returning to the Naval Academy for final examination and final graduation. These two years, Sprague spent on the sloop-of-war "Richmond," on a cruise in the Atlantic and to the Far East, via the Mediterranean. The "Hartford," flagship of the South Atlantic station, had been supplied with a dynamo and an arc light, about the time he graduated, but the "Richmond" carried nothing more important than a call-bell, if that.

For most of the two years Midshipman Sprague could only dream of electricity, but he had started experimenting at Newport while in home waters. After being commissioned an Ensign in 1880, and attached to the training ship "Minnesota," which was in an inactive status at Newport, he resumed his experiments and built a small dynamo, which he tested both as a dynamo and a motor.

Failing orders to the Paris Electrical Congress in 1881, he secured a transfer to the "Lancaster," on the European station, and later was ordered to the Crystal Palace Exhibition, early in 1882.

Sprague at twenty-five seems to have been in his element at the Crystal Palace, associating with the world's most distinguished scientists. He conceived a complete electric railway system while riding in the Underground. His work there seems to have lasted about a year. His final report to our Navy Department was dated on the "Lancaster," at Havre, March, 1883, and it made a volume of 150 pages.

The main subjects were results of tests of generators, arc and incandescent lamps, current distribution, and the merits of series, shunt and compound windings. He included full reports of gas engine tests, and wrote, "The importance of heat engines, other than those working through the medium of steam, is becoming every day more apparent."

That report on gas engines was printed by the Navy Department in a small pamphlet, with a little blue back, and distributed, but it was about thirty years before its time.

For ship use, he recommended direct-connected, compound-wound dynamos, so that current for both arc and incandescent lights could be supplied from one generator. He also reported on the value of storage batteries—then new, and called accumulators. He has said that to the best of his recollection no motors were exhibited, which is indicative of the fact that he, himself, is the real originator of the motor put to practical mechanical work. His report did not include motors.

His report, together with its own information obtained at Newport, put our

Government in possession of a complete exposition of the state of the art, and was of great value. It also convinced its author of the tremendous future of electricity.

In the spring of 1883, he resigned, with a year's leave, and returned home, and worked for the major part of that year with Edison. These two strong wills were bound to clash to some extent, and Sprague soon went on his own, as the English say.

A young man of twenty-seven, he formed the Sprague Electric Railway and Motor Company, and began to make history. He soon had motors in use and on exhibition. Admiral Fiske in his autobiography speaks of meeting Sprague at the Franklin Institute Electrical Exhibition in Philadelphia in 1885, where he said that Sprague's motors formed one of the most interesting of the new inventions exhibited.

Fiske, himself, was a prolific inventor even in his early days. His application to his electrical studies and his enjoyment of them were both intense. He felt, to use his own words, "that keen and peculiar mental stimulation, which work in the physical sciences produces." During a period of leave in 1882 he had been associated for a short time with Park Benjamin, a member of the Naval Academy class of 1867, who had been editor of the "Scientific American," and had just then opened an office on Broadway as a scientific expert and patent attorney; but the plans Fiske had formed for resigning from the service were set aside, owing to the persuasions of his own and his wife's families. His continuance in the Navy, however, did not occasion the relinquishment of his electrical studies. In 1885 he was in charge of the Navy's electrical exhibit at the Franklin Institute. He classified Edison's exhibit as the largest, the Navy's as attracting the most attention, and Sprague's as the most interesting.

He writes of this occasion, to quote again, "One night, after the exposition had closed, a dozen or twenty of us, including Sprague, were drinking beer at a saloon nearby," (laughter)—those were the days when men were men and beer was beer—"in order to clear our minds for the next day's work. We got into an argument in which Sprague was on one side and we were on the other side. We all decided that while Sprague had a very good motor, the theory on which he built it was scientifically wrong. Later events proved that Sprague was scientifically right and the rest of us were scientifically wrong."

In those days due to Edison's invention and Bell's invention, the public interest all over the world was in the advance of electricity. Electrical exhibitions and congresses were the order of the day. Paris, London and Vienna followed each other in quick succession. These were followed by the Franklin Institute Exhibition, which lasted four months. The Navy's interest in these matters was shown by the fact that we not only had an exhibit there, but we had seven delegates: two professors of mathematics (one was Simon Newcomb, the great astronomer; the other was Professor Harkness) and five line officers of the Navy, Duncan, Fiske, Jewell, Murdoch and Sampson. Sprague found himself associated there with the same men he had served with in London three years before. Fiske says: "Sir William Thomson, Mr. Preece and many other electricians of world-wide fame enlightened us with lectures."

The exposition was held at 33rd and Market Streets, and drew vast crowds. The Pennsylvania Railroad protested against the use of the Navy's 36-inch searchlight because it so blinded their engineers that they could not read signals. At a

town twenty miles distant its beam broke up a colored camp meeting. They thought the Day of Judgment was at hand. (Laughter)

In May, 1887, Sprague accepted an invitation to lecture before the U. S. Naval Institute at Annapolis. Cadets studying electricity, of whom I was one, attended this lecture. He told us of the theory of the electric motor and something of the work on which he was engaged. I looked upon him then with awe and wonder, which has not decreased to this day. He was then on the eve of starting work on his Richmond line. You have just heard that this was a ninety-day contract.

In the race for the command of the Lakes, during the War of 1812, Bergh and Eckford made records in transforming forest trees into ships. In the Civil War we had ninety-day gunboats. At the close of the World War, Fore River could assemble a destroyer thirty days after the parts were made. Nobody but a Sprague, however, would undertake to produce the equipment on a novel plan for a complete street railway in ninety days. He is well called, inventor, scientist and engineer. To these should always be added a man of courage, "the will to conquer."

The delightful Old Cattleman of Alfred Henry Lewis classified courage under many heads: "Thar's hoss-back courage and foot courage, thar's gun courage and knife courage and no end of courage beside. Then thar's the courage of vanity. Courage is sometimes knowledge and sometimes ignorance. Sometimes courage is desperation and then again it's innocence."

Sprague, himself, said that taking over this contract shows "the valor of ignorance," but it was in fact the courage of knowledge; and many of his helpers then, and afterwards were, from the good old Naval Academy. They spoke his language.

It has been said, "When Sprague invaded Richmond, in 1887, resolutely plunging into a pool of difficulties from which only unceasing fertility of invention and tireless industry could extricate him, he awoke the world of transportation to an acknowledgment that the electric railway, though an infant, had a future."

This success, as you have just heard, brought him contracts for one hundred and ten street railways within two years.

His fame went on increasing with the passing years. When the World War befell, he anticipated our entry into it, and accepted a nomination by the American Institute of Electrical Engineers for membership on the Naval Consulting Board. The Board included two other Naval Academy graduates who had gone into civil life, A. M. Hunt and W. L. R. Emmet. (Applause)

In 1916 the Board organized a nationwide Industrial Preparedness Campaign, which served, in some degree to make up for our supineness in the face of the European conflagration.

Among its many activities, the Naval Consulting Board acted as a Board of Inventions for the Navy, and later for the Government. Sprague served as a member from November, 1915, until the end of the war. He was Chairman of the Committee on Electricity, and also of the Committee on Ship Construction, and a member of the Committees on Submarines, Ordnance, Explosives and Special Problems.

After the war, Sprague took off his naval harness and donned again his field industrial armor.

It was of such men as he that Socrates wrote, when he described "The Rings of Samothrace:" "For that stone not only attracts iron rings, but also imparts

to them similar power of attracting other rings; and sometimes you may see a number of pieces of iron rings suspended from one another so as to form a long chain . . . Now this is like the Muse, who first gives to men inspiration herself, and from those inspired—her sons—a chain of other persons is suspended, who will take inspiration from them."

Twenty-one years ago, May 16, 1911, I had the honor and pleasure of reading in this room, an article on Sprague's naval service. This was the occasion upon which the Edison Medal was presented to him for achievements in electricity. Mr. Potter, who is with us tonight, made the main address on that occasion. Now it has become my duty to make another presentation. Perhaps, Mr. Sprague will remember that they used to appoint a Board of Visitors in Newport, to which was fired a salute of thirteen torpedoes on its arrival. Now the Board of Visitors here, as I conceive it tonight, is this audience, and I wish to tell you and Mr. Sprague that he is being saluted, or is about to be saluted by some five hundred of his personal friends and admirers.

« « « Ushers walked down the aisle to the platform with books » (Applause)

CHAIRMAN DUNN: These testimonial volumes, a veritable Libro D'Oro, or golden book of the life of Frank J. Sprague, speak for the absent as well as the present.

Their testimony is eloquent in this hall, which has rung with the battlecry of the systems, now become a battlecry of admiration and affection, with Frank H. Shepard, who has done so much to make this occasion a success (applause), and William B. Potter sitting together on this platform (applause), and as I look over this distinguished audience, with so many of the former valiant warriors and combatants here with only one object, namely, to unite in this tribute to one of their former leaders and opponents.

Mr. Sprague, this whole occasion falls short of what we would make it, but accept it as a token of our profound respect and affection for you and admiration for your great work.

« « « The audience arose and applauded » » »

MR. FRANK J. SPRAGUE: Mr. Chairman and Members of the Committee, Old Companions and Friends: It is difficult for me to find words to express what is in my heart tonight, for it is embarrassingly full, in fact it is pretty nearly running over. How can I, in any adequate words, express my thanks to you, and to those who planned this evening and who have been indefatigable in effort, for so kindly a reception and such generous evidence of friendship and good will, and for this imposing library, which I and my family will treasure all our lives. It has rather knocked me out, the kind of salute that I have received, for volumes sometimes speak louder than words. I have been receiving today a number of telegrams and personal letters from old friends whom I have not seen in many years, but I was not aware that I was to be glorified by a permanent record of so imposing a character. You have indeed done me great honor, (Indicating books)

I have listened with embarrassment to my distinguished eulogists: an international scholar, educator and editor; the chief executive of a vital network of urban transportation, and a distinguished Naval Commander who as before has brought

greetings from that Alma Mater and Service to which I owe so much in training and discipline.

These walls have long echoed to the voices of leaders in the van of the world's progress, as they have disclosed engineering achievements or demonstrated important scientific discoveries; and from this dias many a praise has been spoken and high honors have been conferred. But never has there been a gathering here for so unique an occasion as a birthday party.

The ceaseless march of the calendar has, however, conspired to raise me to a sort of deanship in electric transportation, and thus made an excuse to single me out as your special guest tonight. But deeply touched as I am by your manifestation of esteem and the meed of praise for things done, I cannot assume that it is all for me as an individual, but in a greater degree a testimonial to that profession of which, although a devoted member, I am but one of many who each in his own way, and according to his opportunities, has tried to solve the economic and social needs of a turbulent world.

You have, in a sense, made me a color bearer, but of what use is such without the fife and the drum, the shock troops in the front line and reserves in the rear, all pressing forward, animated by like spirit and with a common aim? So it is in honor of the engineer, the man in the rank and the file, as well as in the lead, that I am glad to be the medium for this tribute to his elemental integrity, his painstaking and fact-finding power of analysis, his high purpose and ethical standards, his courage, vision and his great works. If I may paraphrase a letter received from that beloved engineer whom I see sitting in front of me, Ambrose Swasey, of whom none is closer to all our hearts (applause), I must accept this tribute not alone for myself, but chiefly for our great profession. May I also add the Navy.

Man is largely the "creature of circumstance," but he is also the partner of opportunity, and if he embraces the latter with the fervor of youth, and is faithful to his ideals, life will bring him many compensations, regardless of, and more to be cherished than any financial return. But a leader can rarely travel alone, nor should he, for the highest, and sometimes the only worth-while result will be had when he associates with himself a zealous and hardy band of co-workers. In many ventures in life it has been my good fortune to be so favored, and I hope that tonight I may be able to in some measure express my debt to the many who, oft-times welcome critics and unafraid, have been steadfast in purpose, unwearied in effort and loyal in heart.

I doubt if the lives of many men illustrate the truth of what I have said more strikingly than my own somewhat varied career. Let me assume that we are gathered in intimate fashion around a birthday table, and compress in tabloid style some of the high lights of a fifty-eight-year trip around the world, from the Berkshire Hills to Manhattan. It may, too, be an encouragement to some of my younger brethren who in a time of universal trial, discouragement and distress may feel that opportunity has taken a perpetual holiday, although it has not.

I was not born with a silver spoon in my mouth, not even a pewter one, but concluded to continue my English line of descent in 1857, the year of a great panic and of the first unsuccessful attempt to lay the Atlantic cable. My advent was in Milford, Connecticut, in a house whose cellar was reputed to have been the refuge of the English regicides.

But as an encouragement to the boy or the young man who feels that things have gone wrong, that the future holds nothing for him, let me compare this occasion and this night with a little picture which appeared a few days ago in the Milford News. In a reminiscent sketch of early school life by Mrs. Susan Amelia Shove, she said:

"One day word came that sudden death had taken the mother of one of our little boys. Soon after, the father decided to move his family from Milford and the little fellow came for his books. I can see him now, a pathetic figure standing in the doorway, with spelling book, reader and slate under his arm, while we at the teacher's bidding all shouted in unison: 'Good-bye Frank!' That boy was Frank J. Sprague, seven years old, just my age."

I have not seen the lady that penned those words in ignorance of tonight's events, in sixty-eight years, and did not know that I had an early classmate alive.

So, with my younger brother, I was shunted to the care of a maiden aunt—later Anna Parker—then living in North Adams, Massachusetts, while my father sought fortune in the West.

She was a woman of the finest New England type and of striking beauty. Living in a modest, frugal way, as an occasional school teacher, with great sacrifice she devoted herself to her charges with sanity of judgment, but with a high regard for much needed oversight. She was indeed a stern disciplinarian, but I think that something vital must have been instilled in me by this devoted woman which race inheritance alone could not account for, something which was augmented by my later career in the Navy. I know well that as a youngster I was no different from the general run of mischief-seeking village boys. But one day came opportunity, for while attending old Drury High School, where curiously enough at a later date Chairman Delaney, of the New York Board of Transportation, was also a pupil, I was urged by the Superintendent to enter a competitive examination for appointment to West Point. I was not interested particularly, but on arriving at Springfield, with a couple of dozen other competitors, I found it was not for West Point at all, but for the Naval Academy at Annapolis. A career afloat was far from my ambition, but having won out I decided to at least try it, and borrowing from various sources four hundred dollars, to meet existing and prospective expenses, I started on my long journey.

I landed here in '74. The New York of that day was not the great metropolis of the present. There were no bridges, no river tunnels and no subways. There were no telephones, electric lights, or electric cars, and no subways. Transportation was by horse-drawn street cars or buses, while automobiles were still of the dream world. On the corner of 42nd Street and 5th Avenue was a great stone reservoir, and the vast territory running north of 72nd Street was largely barren and the home of goats and squatters.

I little dreamed that I should ever in any way be a factor in the city's growth, but determined to make the most of this, my first visit, I climbed half-way up Trinity steeple to get a panoramic view of the city. Now that territory is occupied by a forest of skyscrapers, and all one can see from that vantagepoint would be across the cemetery.

Well, I entered Annapolis, and four years of hard study and drill took some of the New England freshness out of me. There I developed something of a flair for mathematics, and particularly for naval architecture and physics, the latter under the

teaching of that great admiral, William T. Sampson, one of the Navy's most brilliant officers.

A short leave was followed by orders to the U. S. S. "Richmond," soon to leave for duty as flagship of the Asiatic Squadron, en route to pick up General Grant, then on his famous tour around the world. Some good friend put me in contact with the Boston Herald, and I got them to agree that I could be a special correspondent. Most of the time, however, I wrote about my own experiences, because it took about six months to get to Yokohama, and we didn't catch up with General Grant until we arrived in the Gulf of Pechili, whence we took him through the beautiful Inland Sea of Japan.

In all the later period of my duty on this station I felt the continued urge to get back to the United States, even if at my own expense on a sailing ship, to enlist in what I felt was to be a period of great electrical development. While at the Academy, following the demonstration of the Bell telephone at the 1876 Philadelphia Exhibition, the names of Bell, Gray and Edison fired my imagination, and just before my graduation I had written the latter to see if it were possible to get some apparatus to use in a projected telephone development. Unable to let me have it, I was invited to stop on my way home, and was received with democratic kindness and courtesy, a lasting impression on this, my first, meeting with the great inventor who was so soon to make the world his debtor.

The urge for invention seemed to have taken many forms at this period, and I still cherish an old midshipman's notebook in which, mixed with sketches of sailing equipment and a record of my cruise, there are detailed no less than 57 different inventions (Heinz was not in them), covering a wide range of electrical and mechanical subjects, several of which I still think were well worthwhile provided I had had the money and time to devote to their development. (Laughter)

I finally got back to the United States in the spring of 1880, passed my final examinations as a midshipman, and at once began experimental work at Stevens Institute and the Brooklyn Navy Yard, but my activities were soon cut short by orders to the training ship "Minnesota," the duties on which—routine instruction of embryonic sailors—were particularly distasteful. It seemed to me much more important to try to displace the ship's crude system of oil lighting, and spying an unused steam pump I planned to convert it into an engine to drive a dynamo. For this purpose I sought the loan of one, but was refused, and very rightly so, on the ground that the irregular motion of the engine would for the time being effectually damn the light and delay its introduction.

About that time I was privileged to meet Professor Moses G. Farmer, the Government electrician at Newport, and soon opportunity again crossed my path. The ship being ordered to Newport, I got permission to use the equipment in the machine shop, with the result of the invention of "inverted" type of dynamo and the series-parallelism of armature circuits, this in the summer of 1881. That seems a long time ago.

About that time the Paris Exposition was on, the first electrical exposition aboard, and although I was only a midshipman I tried to get over there as an assistant to the officer in charge. My application was refused, but on the suggestion of a good friend in the Department I managed to get orders to the U. S. S. "Lancaster," with permission to go on leave for three months, at my own expense, on arrival abroad. On

the delayed passage over I busied myself with installing the first crude call-system in our Service. I was too late for the Paris Exposition, so I procured orders to go to London to what was called the Crystal Palace Exhibition at Sydenham. I was determined to see something while I was over there, and I put up a bait to the Department that I might go by way of Essen, the great Krupp works, and possibly bring home knowledge of importance. I didn't go that far, but I did get to London, with about \$20 in my pocket, and reported to the U. S. Dispatch Agent, and later to the exhibition authorities.

Again came opportunity, for I was made a member of the jury, and thus fortunately became associated with many eminent scientists. The particularly important thing was that I was made secretary of the jury, which was composed of very distinguished men. Being secretary gave me the possibility to initiate an extended series of tests of dynamos, electric lights and gas engines, on which I made the report that Admiral Robison has told you about, which probably saved me from a court-martial for overstaying my orders about six months. (Laughter) Meanwhile I had indulged in a wild dream for electrifying the Metropolitan District Railway, and to use for conductors the tracks and a center-line over-head network, with universal under-contact, the fore-runner of the modern trolley.

In London I had met E. H. Johnson and W. J. Hammer, and when in the following spring the former made me a proposition to join Mr. Edison in New York I for the time put the Navy back of me for a new venture. I worked with this great master pioneer for about eleven months, but at Brockton I had already begun motor development, and believing in the enormous field for power I wished to pursue this new activity, but not under restraint. Mr. Edison was devoting himself more particularly to electric light development, which was keeping him pretty busy, but my chief interest was the development of the electric motor. It seemed to me that there was a greater field in the use of power than there was in light. Hence my resignation, a laconic rejoinder, and the formation of my own motor company, principally a paper one, in the spring of 1884. I became the electrician, office boy, treasurer, mechanic and administration man, but we made pretty good headway and in the fall we had a well commended exhibition at Philadelphia.

The new enterprise grew apace, with official endorsement of my constant-speed motors by the Edison companies in the spring of 1885. After we got going pretty well my mind went back to the question of transportation. Following experiments on the "L" railroad, again came opportunity, when a group of promoters procured a franchise to build and equip a railroad in Richmond, Va. I got the opportunity to bid upon it, and Mr. Finley has told you that we took a rather foolish contract, to equip the Richmond Union Passenger Railway, in ninety days, with payment of \$110,000 "if satisfactory." This equipment was equal to that of the combined experimental work throughout the world. It was not child's play, but I had a great crew with me: Oscar Crosby, Dana Greene, A. D. Lundy, Pat O'Shaughnessy, Dave Mason, Parshall, Emmet, Wetmore, Lewis and many others, who knew no hours and no cessation of work, who never lacked enthusiasm, never sought encouragement, and who were always faithful. Well, the romance of that enterprise has been sung many times, and I think it is fairly recognized now as the prototype of the modern

trolley, and that it marked the real beginning of modern electric transportation. Anyway we had a very live development for quite a while.

Then I went out of the consolidation, and entered partnership with my dear friends, Dr. Louis Duncan and Dr. Cary T. Hutchinson, the latter Secretary of this Committee, and we had built a large electric locomotive, one of 1000 H. P., for Mr. Henry Villard. The locomotive was all right, but the enterprise itself did not succeed.

I had been severely disappointed and disillusioned by the suppression of my name in the railway field, and I turned to the problem of vertical transportation, the replacement of the steam and hydraulic elevator by the electric. In this I had a new crew in part, Pratt and Gurney, Carichoff and Hill, Van Alstyne, Scheffler and Franzen, Benton, and again my faithful Pat O'Shaughnessy, yoked up for victory. A crude experiment at the first large installation, that of six Sprague-Pratt multiple-electric elevators in the Postal Telegraph Building about 1893, where in over-confident conduct of the test several of us nearly lost our lives, was primarily responsible for the "multiple-unit" system of train control. This was the temporary operation of all six elevators from a single switch. After building nearly 600 elevators, including the equipment of the highest buildings, as well as the largest installation—that for the Central London elevators—the business was transferred to our largest competitor in a new combination.

Meanwhile, in 1895 what I think may fairly be called an inspiration—the multiple unit system—blossomed into full growth in theory and plan of practice. This made possible the combination of any number of equipped units, regardless of sequence or end relation, all controllable from any desired points, but for two years no effort on my part could win a chance to prove its possibilities. I had long since committed myself to the practicability of an electrically-operated underground system for urban transportation, and had often offered to back my belief that the first essential to determine was the method of operation, and that it must be electrical.

Just as I was about to sail for London on elevator business again came old opportunity, in a call to act as a consultant for the South Side Elevated Railroad in Chicago. I was crippled at the time, having been nearly killed by stepping backwards from a construction platform, and was still using crutches. I had never heard of the South Side and I tried to stall the engagement by quoting a fee which would eliminate me, because I wanted to get to Europe. Suddenly two of my friends came on here. I found that they were the directing engineers of the road, Fred Sargent and A. D. Lundy. In the meantime I had opportunity to talk to that talented commercial engineer, William J. Clark, of the General Electric Company, and his able assistant, Frank Shepard. They sensed the possibilities of the new system, and when the matter came up in Chicago I received active support. That was a personal contract, later shifted to a new corporation—the Sprague Electric Company. So another milestone, and in the carrying out of this enterprise, with its subsequent developments for world-wide adoption, again a capable crew of old and new men took to the oars in back-breaking effort. To Hill, Carichoff and O'Shaughnessy were added Libby, and particularly those valiant musketeers, Shepard, McIver, Pattison and Campbell. Again came absorptions and combinations because of the vital character of the new development, and later some years of service as a member, with Arnold, Gibbs and Waite under

Wilgus of the Commission for Electrification of the N. Y. Central Terminal, meanwhile continuing my efforts for raising operating potentials.

Then I took up a somewhat different problem, trying to make railway travel safer by enforcing obedience to signals. Those of the old crew who had not "gone West" on the trackless way had scattered and taken on new responsibilities, so a younger group, Graner, Knab, Donovan, Hauck, Shannon, Vogel and my eldest son Desmond, were the mainstays. But while successful technically in actual equipments installed on a number of railroads, the changing conditions in the world of transportation have not been conducive to further present developments.

Meanwhile the outbreak of the World War had plunged me into new responsibilities as a member of the Naval Consulting Board, in connection with the development of depth charges and delay-action fuses.

As I review these many years I sometimes wonder what were the mainsprings of endeavor, why the creative urge seemed always to possess me. Apparently I inherited from my forebears a physical strain which has enabled me to outlive the Biblical limit, with a reasonable residue of resistance. Impatient of restraint, I have always rebelled at negation, and when someone has said "It cannot be done," I have replied "I know now it can be." (Applause) In brief, a challenge is inevitably a tempting invitation. This sort of obstinacy is not productive to a quiet existence, but is an obsession with me, for after reaching a decision, following full analysis, I have never hesitated to back it without limit of endeavor or financial risk. As mad as such practice may seem, and ordinarily is, it has often proved the only way to break through the barriers of inertia and disbelief in order to effect real progress.

Now, my friends, I have arrived at the home station, and as I cut off the current I find old companions, with later friends and associates, come to bid me welcome on the platform, not because I hold public office or can bestow private emoluments, but simply to express in an unusual fashion that good will and appreciative spirit which animates our common profession.

It has been an intoxicating experience to have lived and taken part in the world's affairs in this last half century, and if what I have done has added to the sum total of human happiness and social well being, and has set an example worth while, I am indeed glad, and I am sure that those of my immediate blood will find something of satisfaction in the fact that a notch has been etched in their New England granite. (Applause)

And now in final word may I again, in the role of a John the Baptist "crying in the wilderness," venture a constructive prophecy. Transportation is the key of civilization—in fact it *is* civilization—for without it our existing social structure would collapse. Regardless of all other means of travel, whether on land, sea or air, a vital foundation is the country's vast network of trunk line railroads, now according to the recent decision of the Interstate Commerce Commission to be consolidated into a number of balanced systems. A cursory glance at the map indicates much interlacing of these aggregations, and how they lend themselves to ultimate dependence upon common sources of power supply, attainable and available only through the use of electricity, now commercially possible over long distances because of the developments in high tension transmission, and conversion, largely thru Westinghouse efforts.

It would be folly to predict, in the present low state of competitive traffic and world-wide financial depression, that general electrification is advisable or even

permissible in the near future, but if some of the hundreds of millions of capital which the national government is ready to dole out for unproductive public works were diverted to legitimate and sane electric railway equipment, a long step would be taken toward economic recovery. (Prolonged Applause)

But for the greater progress in this direction cooperative technical and manufacturing effort is vital. Happily, one of the first—and the greatest—advance in this direction has recently been effected. While in much of my own work I have driven hard along self-determined lines, I long ago realized that as one grows older one becomes more tolerant in judgment, less assertive of individual opinion and more charitable with regard to that of others, even perhaps more receptive of critical advice; and in this respect I have in my later years profited much from my associates.

In this spirit, and realizing the necessity of coordinated action, I some years ago urged the necessity of a combination of diverse experience and engineering judgment, the determination of operating facts, and a frank facing of the technical and financial problems involved in trunk line equipment, with the object of softening professional jealousies and trade rivalries, so as to coordinate manufacturing facilities to a common end—trunk line electrification.

I am glad that to a large extent this objective seems now to have been reached, as exemplified in the plans for the extensive electric equipment for the Pennsylvania Railroad, through the untiring efforts of the chiefs of the Heavy Traction Departments of the great electrical manufacturing companies, with the support of their executives and technical associates. This was no child's play, and that the end was finally achieved was in my opinion, as stated in a recent paper before the New York Railroad Club, in largest measure due to the dogged persistence, patience and ingenuity of two old friends, George Baldwin of the General Electric Company, and Frank Shepard of the Westinghouse. The importance of this achievement cannot well be over-estimated, and coupled with the progress already made is warrant for my prediction that the progressive electrification of main trunk line railways is not only inevitable, but after the present depression it will be the next great advance and its initiation is not far distant. (Applause)

And now I must say, not good-bye, although some of us may not meet again, but rather au revoir, for the current is still on the line, the pantograph is up and I am headed for another station. But be it near or far it will not be, it cannot be, quite like this one. The road may be rough for lack of proper upkeep and the going a bit risky for all, but what matters it? We can, if necessity demand it, "take it on the chin" without flinching, and carry on. So God bless you all for your remembrance and encouragement.

« « « The audience arose and applauded » » »

CHAIRMAN DUNN: Ladies and Gentlemen: This sincere and unusual meeting is not yet nearly over. The attendants will now bring down to the front here the volumes of the Libro D'oro, and you are all invited to come forward and look at them. While you are looking at them, I am to take Mr. Sprague quickly by a back way down to the ground floor of this building in the foyer, where he will be joined by Mrs. Sprague, and there receive all those who want to bid him many happy returns of the day. (Applause)

« « « The meeting adjourned at ten-fifteen o'clock « « «

Radio Broadcast

National Broadcasting Co.—Blue Network

July 25th, 1932. 10:30-10:45 P. M.

SPEAKER: ADMIRAL S. S. ROBISON

A Tribute to Frank J. Sprague,
"Father of Electric Railroads"

Ladies and gentlemen of the radio audience, tonight the National Broadcasting Company takes pleasure in presenting Admiral S. S. Robison, who will give you an account of the unusual meeting of appreciation and tribute paid to Frank J. Sprague the "Father of Electric Railroads" at the Engineering Societies Auditorium in New York City this evening on the occasion of Mr. Sprague's seventy-fifth birthday.

This meeting was attended by distinguished leaders in the Engineering, Scientific, Railroad and Industrial world and was sponsored by the leading Engineering and Scientific organizations, together with a committee of 60 distinguished persons.

I now introduce Admiral Robison.

It is indeed a great privilege and honor that I have been asked by the Frank J. Sprague Anniversary Committee, which is composed of most of the leading scientific societies in this country, together with more than sixty leaders in the field of engineering and industry, to convey to radio audiences to night a description of the great tribute that was paid to Frank J. Sprague before nearly 1000 of the outstanding personalities of the engineering profession at the Engineering Auditorium this evening.

Of the hundreds of autographed letters from friends and admirers all over the world, one was received from President Herbert Hoover, who writing as an engineer, expressed his tribute in the following terms:

"My Dear Mr. Sprague:

I send you my cordial felicitations on your 75th birthday and all good wishes for the future.

Your contribution in the development of the electric motor, followed by the application of electricity to street railways and to elevators, links your name for all time with that distinguished group of inventors and engineers whose pioneer work made possible so many of our present utilities, comforts and conveniences.

It is fitting that the engineering and scientific world should show general recognition of your noteworthy services to the electric art, and it is with regret that I find I shall not be able to be present at your anniversary celebration.

Yours faithfully,

HERBERT HOOVER."

Frank Julian Sprague was born in Milford, Conn., July 25, 1857. He graduated from the U. S. Naval Academy in 1878. He resigned from the Navy in 1883. He was assistant to the late Thomas A. Edison for one year. He formed the Sprague Electric Railway and Motor Company in 1884.

While in the Naval Service Midshipman Sprague was in service on the flagship "Lancaster", flagship of the Mediterranean Squadron, and was assigned by the Navy Department to report on the electrical exhibit at the Crystal Palace Exposition. His enthusiasm and industry there led to his appointment as Secretary of the Jury of Awards, presided over by the late Sir William Thomson.

There he met the late E. H. Johnson who at that time was in charge of the electric inventions of Thomas A. Edison. Johnson was greatly impressed by Sprague's ideas and visions of the future of electric traction, and although skeptical of the value of anything that came from the Navy, as Johnson himself says, yet was so impressed by Sprague's advanced ideas that he induced him to resign, and procured for him a position with Edison at a salary nearly twice as great as the Navy paid him. Sprague was with Edison only a year—he was not long vitally interested in Edison's work—the urge to develop his own ideas drove all else from his mind; so he, with Johnson's backing, formed a company to develop his electric motors.

Sprague is rightfully called the "Father of Electric Traction." He installed in Richmond, Va., in 1887, the first electric railway system of any size in the world. This is the parent of all modern trolley lines. Successful operation of the now famous Richmond-Union Passenger Railway brought about a revolution in transportation. His invention of the multiple-unit system of train operation a few years later marked the opening of another new epoch in transportation, and an important one in that it permitted the make-up of a train of any length with all the characteristics of a single car. Therefore, we might add that in addition to being called the "father of the trolley line," Sprague should be also called the "father of rapid transit."

I believe it will be interesting to note that Sprague evolved his idea of this wonderful multiple-unit control now used in all subways and other railroads from his earlier work with electric elevators, of which he is also the originator. The first installation of six electric elevators was made in the Postal Telegraph Building in New York City, and was the beginning of using electric motors for that purpose.

In other words, due to his inventions, Sprague is responsible for moving more people vertically and horizontally by means of electricity than any other individual.

Tonight in reviewing Sprague's inventions in the field of rapid transportation Mr. Frank Hedley, President of the Interborough Rapid Transit Company, the largest electric transportation system in the world, described Sprague's contributions as giving him the same relation to electric transportation that the late Thomas A. Edison bore to electric illumination. Mr. Hedley also included in his review of Sprague's activities the following statement:

"I have not attempted to give you anything like a complete account of Frank Sprague's contribution to electric transportation; time would not permit of that. For a half-century he has been contributing ideas to the art, and the transportation industry owes an enormous debt to this pioneer in the electric motor, the trolley car and the multiple-unit system. In the transportation line, and especially as concerns rapid transit railroads, Sprague has been looking many years ahead and beyond the

power of conception of any other man in the railroad engineering field. In other words, he has been thinking and talking over the heads of all of us, and he still can do it. Consider, for instance, the suburban service on the steam railroads. With Sprague's multiple unit installation those trains can accelerate at the rate of $1\frac{1}{2}$, in fact more than 2 miles, per hour per second. This compares with about one-half mile per hour per second as the best the steam locomotive can do in the same service. In other words, the Sprague system permits over 200% faster acceleration than steam locomotives.

Again, the Sprague multiple unit system has increased train terminal capacity over 40% in most cases.

Sprague has not rested with the mere inventing and suggesting of new methods. He has recognized that the world is often too busy to pay attention to new and advanced ideas which are considered revolutionary, or to give them a trial unless forced to do so, and he has made it his business to do the necessary forcing. It is fortunate for the electric railway industry that he has made it his business to see that a new idea in which he had faith was followed through the experimental stage and put into successful use.

As an illustration of Sprague's strong faith and of the obstacles which at times he has met and surmounted, consider for a moment his experiences in connection with that first great installation at Richmond, Va., and remember, please, that this took place about 45 years ago. His contract, briefly stated, called for the completion in 90 days of a road having about 12 miles of track, at that time unaided and even with the route only provisionally determined; the construction of a complete steam and electric central-station plant of 375 horsepower capacity; and the furnishing of 40 cars with 80 motors and all the necessary equipment for their operation. This by the way, was nearly as many motors as were in use on all the cars throughout the rest of the world. Thirty cars were to be operated at one time, and grades as steep as 8% were to be mounted. And finally, this extraordinary contract called for the payment of \$110,000 for accomplishing all this—"if satisfactory."

Moreover, upon his first inspection, he found the track, which he did not supply, to be poorly constructed, with sharp curves and steeper grades than 8%, and other conditions which must have seemed almost impossible to overcome. Yet how Sprague succeeded at Richmond, Virginia, is well known."

To face such conditions as these requires vision, it requires energy, courage and complete faith in one's ideas. It is largely because Sprague has always had these qualities that the railroads, and especially the rapid transit lines, are able to render to the public a far superior service than otherwise would have been possible. For instance, the New York subways equipped with the most up-to-date installations known to the art, are operated by Sprague's multiple-unit system, with which they are able to give the public faster acceleration, greater frequency of train service at a higher speed and factor of safety than ever would have been possible without Sprague's inventive genius.

If one were called upon to name the most powerful influence contributed by Sprague to the railway industry, I think I should say it was his pioneering vision. His vision has been translated into accomplishment to such an extent that transportation, while considered as a dynamic industry, has become very commonplace in the public

ARTHUR SPENCER BEVES.....Past Treasurer, Sprague Electric Ry. & Motor Co.
 BERNARD BLUM.....Chief Engineer, Northern Pacific Ry. Co.
 W. P. BORLAND.....Director, Bureau of Safety, Interstate Commerce Commission
 RICHARD R. BOWKER.....Editor, Publisher & Industrial Director
 J. C. BRACKENRIDGE.....Consulting Engineer
 C. O. BRADSHAW.....Investor
 DR. ROBERT BRIDGES.....Literary Advisor, Charles Scribner's Sons
 F. M. BRINCKERHOFF.....Consulting Engineer
 H. M. BRINCKERHOFF.....Consulting Engineer
 HOWARD BROCKWAY.....Composer
 MILES BRONSON.....Past General Manager, N. Y. Central Terminal
 RAYMOND BROOKS.....Consulting Mining Engineer
 A. A. BROWN.....Executive, Westinghouse E. & M. Co.
 LUCIAN C. BROWN.....Industrial Executive
 W/M. M. BROWN.....Industrial Executive
 D. J. BRUMLEY.....Vice President, Illinois Central R. R.
 M. C. BRUSH.....President, American International Corporation
 RICHARD S. BUCK.....Consulting Engineer
 BRITTON I. BUDD.....President, Chicago Rapid Transit Co.
 RALPH BUDD.....President, Chicago, Burlington & Quincy R. R. Co.
 FRED G. BUFFE.....Railway Executive
 DR. NICHOLAS MURRAY BUTLER.....President, Columbia University
 FRED W. BUTT.....Engineer, N. Y. Central R. R.

C

O. H. CALDWELL.....President, N. Y. Electrical Society
 A. D. CAMPBELL.....Railway Executive
 W. L. CAPPS, REAR ADMIRAL.....U. S. N. (ret.)
 L. M. CARGO.....Executive, Westinghouse E. & M. Co.
 E. R. CARICHOFF.....Electrical Engineer, General Electric Company
 DR. ALEXIS CARREL.....Rockefeller Inst. of Medical Research
 JOHN J. CARTY.....Past Vice President, American Telephone & Telegraph Co.
 FRANK E. CASE.....Engineer, General Electric Co.
 THOS. W. CASEY.....President, National Pneumatic Co.
 J. Mc KEEN CATTELL.....Editor, Science
 THE REV. EDWARD M. CHAPMAN.....Author
 JAMES R. CHAPMAN.....Engineering Executive (ret.)
 STARLING W. CHILDS.....Financier

F. X. CHILSON.....Business Consultant
 N. A. CHRISTENSEN.....Inventor
 L. W. CHUBB.....Director of Research, Westinghouse E. & M. Co.
 W. J. CLARDY.....Engineer, Westinghouse E. & M. Co.
 CHARLES L. CLARKE.....Consulting Engineer, General Electric Company (ret.)
 BARRETT H. CLARK.....Author and Editor
 EDWARD HARDY CLARK.....Lawyer and Financier
 W. T. CLUVERIUS, REAR ADMIRAL.....U. S. N.
 FRANK R. COATES.....Financier and Executive
 HOWARD E. COFFIN.....Inventor & Industrialist
 ELLWOOD COLAHAN.....Lawyer
 S. K. COLBY.....Vice President, Aluminum Co. of America
 ALPHAEUS P. COLE.....Artist
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