THE FRANKLIN INSTITUTE OF THE STATE OF PENNSYLVANIA

For the Promotion of the Mechanic Arts

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Committee on Science and the Arts Cases No. 2995 and No. 2996.

Hall of the Committee,

Philadelphia, January 9, 1935.

Report of Special Sub-Committee on recommending awards of The Franklin Medals.

Sub-Committee: Dr. Frederic Palmer, Jr., Chairman
Dr. James Barnes
Mr. Theobald F. Clark
Dr. H. Jermain Creighton
Mr. Clarence A. Hall

To the Committee on Science and the Arts:

Your Sub-Committee charged with the duty of selecting candidates for the award of the Franklin Medal recommends that this year two medals be awarded as follows:- one to

ALBERT EINSTEIN, theoretical physicist and mathematician,

"In recognition of his contributions of fundamental importance to theoretical physics, especially his work on Relativity and the Photo-electric Effect,"

and one to

SIR JOHN AMBROSE FLEMING, electrical engineer,

"In recognition of his many contributions to the improvement of the art of communication, and especially the invention of the thermionic valve which bears his name."

ALBERT EINSTEIN

"Albert Einstein was born ~~of Jewish parents~~ at Ulm, Wurttemberg, May 14, 1879. His boyhood was spent at Munich where his father, who owned electro-technical works, had settled. The family migrated to Italy in 1894 while Albert Einstein went to a cantonal school at Aarau in Switzerland. He attended lectures while supporting himself by teaching mathematics and physics at the polytechnic school at Zürich until 1900 and finally, after a year as tutor at Schaffhausen, was appointed examiner of patents at the patent office at Berne, where, having become a Swiss citizen, he remained until 1909. It was during this period that he took his Ph.D. degree at the University of Zürich and published his first papers on physical subjects. These brought him such prominence that in 1909 he was appointed extraordinary professor of physics at the University of Zürich. In 1911 he accepted the chair of physics in Prague, only to be induced to return to his own polytechnic school at Zürich as full professor in the following year. In 1913 he had become so distinguished that a special position was created for him in Berlin, namely that of Director of the Kaiser-Wilhelm Physical Institute. He was elected a member of the Royal Prussian Academy of

Sciences and given a stipend sufficient to enable him to devote all his time to research without any restrictions or routine duties. In 1921 he was elected a foreign member of the Royal Society, having also been made previously a member of the Amsterdam and Copenhagen Academies, while the universities of Geneva, Manchester, Rostock and Princeton conferred honorary degrees upon him.* In 1921 he received a Nobel Prize; in 1925 the Copley Medal of the Royal Society; and in 1926 the gold medal of the Royal Astronomical Society. At present he is a member of the staff of the Institute for Advanced Study in Princeton.

Einstein's chief contributions to theoretical physics lie in two fields: (1) that of Relativity; (2) that of the Quantum Theory.

(1) Relativity. The Special, or Restricted, Theory of Relativity was published in 1905, when Einstein was but twenty-six years old. The radical modifications in classical mechanics demanded by this theory were received with skepticism, but won their way to general acceptance within a dozen years. The theory indicates that our every-day conceptions of space and time derived from experience upon the earth cannot be applied to any body moving with uniform velocity with respect to the earth without proper modification. All motion is relative; hence the absolute reckoning of space and time is impossible. Perhaps the most important result to which this theory led is the law that mass and energy are equivalent, a law which has many important applications in Physics, Chemistry and Astronomy.

This theory of relativity for uniform motion proved to be only a special case of a more general theory. In 1915 there appeared the General

Theory of Relativity which gave us a new conception of the nature of gravitation, thus providing the first fundamental advance in this subject since the time of Newton. The general theory involves an interaction between gravitation and light, an astonishing conception which led to three sensational astronomical predictions:- (1) the motion of perihelion of Mercury by 43 seconds of arc per century; (2) the deflection of a beam of starlight, passing very close to the sun, by less than 1.7 seconds of arc depending upon the distance, measured in sun-radii, between light beam and sun; (3) the displacement toward the red of spectral lines in light from the sun of about two millionths of a wavelength, and in light from the more massive stars of a somewhat greater amount. It is remarkable that all three of these predictions were checked quantitatively, to the satisfaction of a majority of scientists, within ten years of their publication.

Einstein's final contribution to the theory of Relativity was made in 1929 when he announced a unified field theory which represents an attempt to discover a single mathematical equation so general in form that it includes both the law of gravitation and the law of electro-magnetism.

(2) Quantum Theory. Einstein was one of the first to recognize the far-reaching implications of the theory proposed by Planck that energy can be neither absorbed nor radiated except in units, or bundles, or quanta. The energy in each quantum is equal to the frequency of oscillation of the radiator multiplied by Planck's constant of action. Thus a quantum of blue light contains nearly twice as much energy as a quantum of red light. In dealing with

the transformation of these quanta when they impinge upon matter Einstein discovered his famous Law of the Photoelectric Effect, according to which the energy in a single quantum is employed in separating an electron from an atom and giving it kinetic energy.

Through the series of papers which appeared from 1905 to 1911 it became increasingly evident that the ideas of classical mechanics must be abandoned in favor of the radically different principles upon which the new quantum mechanics is based. In a paper on the variation of the specific heat with temperature, which appeared in 1907, Einstein made use of the new mechanics to explain certain puzzling anomalies in the behavior of solids at low temperatures, and the subsequent verification of the essential results in this paper proved to be a very strong argument in favor of the quantum theory.

In 1917 appeared another important paper containing the equation connecting absorption and emission coefficients which gave insight into the origin of Planck's Law of Radiation and provided new formulae of wide practical application.

In 1924 DeBroglie published his theory of matter waves, a theory of which many applications were immediately recognized by Einstein whose imaginative ideas in this field enabled Schrödinger to develop his well known wave mechanics.

Of Einstein's less important contributions mention will be made of only two:- (1) a simple theory of molecular agitation which provided a complete explanation of the puzzling Brownian movement; (2) a brilliantly conceived experiment, carried out with the coöperation of the Dutch physicist DeHaas, which resulted in the proof of the existence of the molecular currents which are the cause of magnetism.

Although Einstein has written very few books, and those largely collections of papers, essays, and speeches, he has published over a hundred scientific papers through which he has probably exerted a greater influence upon the scientific thought of the present day than any other one person.

## SIR JOHN AMBROSE FLEMING.

John Ambrose Fleming, M.A., D.Sc., Hon. D.Eng. (Liverpool), F.R.S., was born at Lancaster, England, November 29, 1849; he is, therefore, at the present time eighty-five years of age.

During his education as an engineer at University College, London, the Royal College of Chemistry, and St. John's College, Cambridge, he was the recipient of numerous honors, being elected successively Exhibitor in Natural Science, Foundation Scholar of his college, Hare Exhibitioner, Wright's Prizeman, and Hughes Prizeman, this last a special award to the Foundation Scholar most distinguished in mathematics and in natural philosophy. At the end of his third year in Cambridge (1879) he took the degree of Doctor of Science in the University of London and that of Bachelor of Arts at Cambridge with special distinction in the Natural Science Tripos.

In 1880 he became Lecturer on Applied Mechanics in the University of Cambridge; and in 1885 he was chosen as the first occupant of a newly created chair of electrical engineering at University College, London, a position which he occupied until his retirement in 1926.

While a student at Cambridge his mind was busy with plans for the development of the science of telephony, and after receiving his degree he became scientific adviser to the Edison Telephone Company, formed to set up telephone exchanges in London. Soon after this he turned his attention to the problem of the incandescent lamp and electric lighting, interests which brought him work as scientific adviser to the Edison Electric Light Company and later to the Edison and Swan Company. Since 1899 he has been scientific adviser to the Marconi Wireless Telegraph Company with whom he worked upon the design and the construction of the first long distance wireless station at Poldau.

"While making investigations on the incandescent lamp in the early years of this century Fleming observed phenomena in connection with the Edison effect which led him to ~~a~~ an extended study of thermionic emission, with the result that in 1904 he made the first form of thermionic valve." This was merely an electric light bulb into which he had inserted a metal plate. When the filament was glowing a current flowed through a circuit connecting filament and plate outside the tube provided the plate was held at a positive potential with respect to the filament, but not if the plate was held at a negative potential with respect to the filament. This property of passing a current in only one direction gave to the device its name "valve". "The invention of the thermionic valve is Fleming's greatest scientific achievement. ~~Without it~~ It made possible the tremendous advance in the science of radio communication, with which we are all familiar~~, would have been impossible~~."

~~Fleming~~ Sir Ambrose is an Honorary Fellow of St. John's College, Cambridge;

an Honorary Fellow of University College, London; an Honorary Member of the Royal Philosophical Society of Glasgow; a member of the Royal Institution of Great Britain; and has been President of the Victoria Institute and Philosophical Society of Great Britain, and Vice-president of both the Institution of Electrical Engineers and the Physical Society of London. At the time of the organization of the Physical Society in 1874 Fleming presented the first paper, on the new "Contact Theory of the Galvanic Cell".

Twice he has been awarded the Institution Premium of the Institution of Electrical Engineers. He has also been the recipient of the Hughes gold medal of the Royal Society, the Albert Medal of the Royal Society of Arts, the Faraday Medal of the Institution of Electrical Engineers, the Duddell Medal of the Physical Society, and the gold medal of the Institute of Radio Engineers, U.S.A. In 1929 he was created Knight.

Fleming is the author of some ninety scientific papers and sixteen books chiefly on matters related to electric wave telegraphy.

Respectfully submitted,

Frederic Palmer Jr.
Chairman.

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Clarence A Hall

[illegible signature]

James Barnes

# THE FRANKLIN INSTITUTE OF THE STATE OF PENNSYLVANIA

FOR THE PROMOTION OF THE MECHANIC ARTS

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Hall of the Institute,

Philadelphia, February 13, 1935.

Report No. 2995.

Investigating The Work of

Doctor Albert Einstein

of Princeton, New Jersey.

Application dated ____________

THE FRANKLIN INSTITUTE OF THE STATE OF PENNSYLVANIA

For the Promotion of the Mechanic Arts

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Hall of the Institute,

Philadelphia, February 13, 1935.

Committee on Science and
the Arts Case No. 2995.

The Franklin Institute of the State of Pennsylvania, acting through its Committee on Science and the Arts, has considered carefully the work of those who have contributed greatly to the advancement of science and to the application of physical science to industry - and has selected as the recipients of the two awards of the Franklin Medal for 1935 -

ALBERT EINSTEIN, theoretical physicist and mathematician, - and

SIR JOHN AMBROSE FLEMING, electrical engineer.

The award to Doctor Einstein is

In recognition of his contributions of fundamental importance to theoretical physics, especially his work on Relativity and the Photo-electric Effect.

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Nathan Hayward
President.

Howard McClenahan
Secretary.

[signature]
Chairman of the Committee on Science and the Arts.