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JOHN ADAM FLEMING

1877—1956

A Biographical Memoir by

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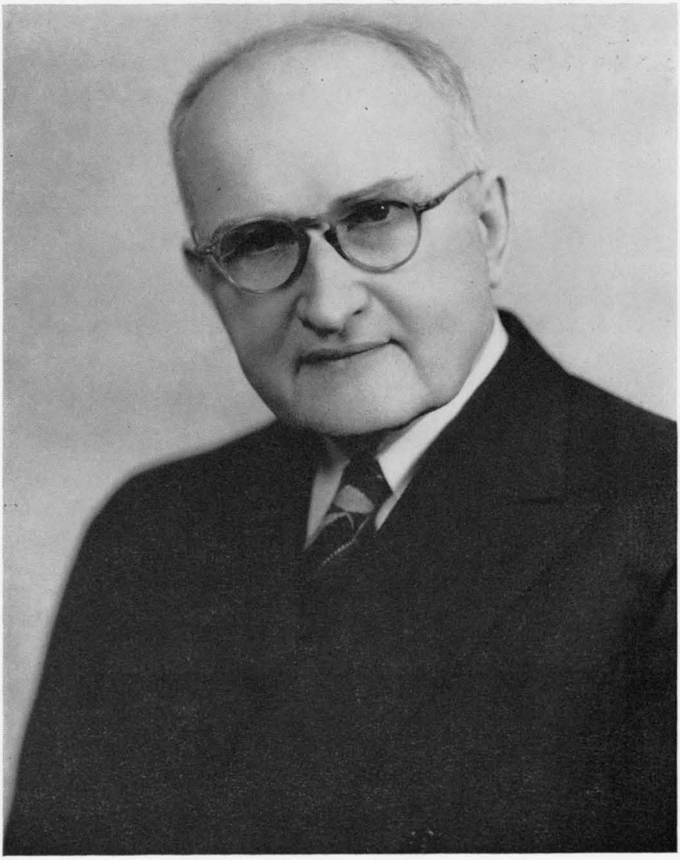
Biographical Memoir



Jno. A. Fleming

JOHN ADAM FLEMING

January 28, 1877–July 29, 1956

BY MERLE A. TUVE

JOHN ADAM FLEMING, who devoted his life to the study of terrestrial magnetism and atmospheric electricity (perhaps the most elusive of earth sciences), passed away quietly in San Mateo, California, on July 29, 1956. A resident of Chevy Chase, Maryland, for more than forty years, he was the retired Director of the Department of Terrestrial Magnetism, Carnegie Institution of Washington, where he had served forty-two years before his retirement in 1946.

Dr. Fleming was born in Cincinnati, Ohio, January 28, 1877, the son of Americus Vespucius Fleming and Katherine Barbara (Ritzmann) Fleming. He was married twice, first to Henrietta Catherine Barbara Ratjen on June 17, 1903, at Lawrenceburg, Indiana, and after her death in 1912 he married her sister, Carolyn Ratjen, in 1913.

He attended the University of Cincinnati during 1895-1899, majoring in civil engineering and chemistry, and received his B.S. degree in Civil Engineering "with highest distinction." The honorary degree of D.Sc. was conferred on him by the University of Cincinnati in 1933 and by Dartmouth College in 1934.

After graduating from the University of Cincinnati he was employed as Assistant Engineer for the complete redesigning of the Convention Building for the Sanderbund Society at

Cincinnati. His next position was with the U.S. Coast and Geodetic Survey, Washington, D.C., where he worked from 1899 to 1903. He resigned from the Survey to go into business in 1903-1904 as partner and superintendent of the Vulcan Copper Works in Cincinnati, designing special chemical apparatus for continuous distillation and manufacture of refined chemical products. For some time he was a building contractor with his brother.

His scientific work was resumed in 1904, and he was employed during 1904-1910 on a part-time basis as a Magnetician of the Department of Terrestrial Magnetism (DTM) of the Carnegie Institution of Washington (CIW), and as a Magnetic Observer of the U.S. Coast and Geodetic Survey (CGS). He gave up his part-time post with the CGS in 1910 to accept full-time employment with the DTM.

While with the CGS he was in charge of the construction of their Cheltenham Magnetic Observatory (now the Fredericksburg Magnetic Observatory) and he developed and designed nonmagnetic observatory buildings for them, including the above-ground type of constant temperature observatory, adopted for magnetic observatories of that Survey, at Cheltenham (Maryland), Sitka (Alaska), and Honolulu (Hawaii). He also took part in the magnetic survey of the United States, Hawaii, and Alaska by the CGS and in the reductions and compilations of magnetic data.

Dr. Fleming's main personal scientific geomagnetic research included cosmic relations of geomagnetism, particularly as regards diurnal variations and solar conditions, studies of the isoporic foci and their shifts with time, and the detailed study of accumulated magnetic world data during 1903-1945 in the discussion for and preparation of world magnetic charts for the epoch 1942. 5.

He was an indefatigable worker and a prolific writer, as

evidenced by his extensive bibliography. His work was his life and his hobby, and he possessed great skill in judging the future capabilities of the young men he chose as his associates. His influence was significant upon the lives of many of his scientific colleagues both in this country and abroad, and he was so self-effacing that only those who knew and worked with him could properly assess and testify to what he did for geophysics in the United States and in the world at large.

As a Director, he possessed several unusual gifts. He made each staff member who brought in a scientific paper feel that his work, however small, was appreciated, provided it had resulted from studious and persistent effort. When a man made a discovery, Fleming would praise him, but usually warn him not to overestimate the importance of the effort. In this simple and effective way he was able to encourage his workers, whether they were in difficulty or getting along very well. He was highly demanding, some thought almost unreasonably so, in insisting that all work must be clearly written up and presented, with all necessary hyphens in place, and with neatly arranged headings for tables and titles for figures. He won all the battles with his staff about format and presentation of scientific material. Since he was Assistant Editor and subsequently Editor of the *Journal of Terrestrial Magnetism and Atmospheric Electricity* (now *Journal of Geophysical Research)* from 1899 to 1948 and Editor of the *Transactions of the American Geophysical Union* until 1947, he probably won almost all similar battles with scientists the world over whose work he had the pleasure of editing.

Dr. Fleming took a major part in organizing and planning the magnetic and electric surveys of the earth after 1900. In the early years of this century there were few magnetic measurements on land, and the oceans were largely an open gap, insofar as man's description of this aspect of his environment was con-

cerned. The existing standards for the accuracy and intercomparability of observations were defective. It was largely through the driving force, initiative, and capacity of Fleming that so many of these deficiencies were removed. He designed and constructed new and improved instruments for use on land and especially at sea. Under his direction more than fifty major land magnetic-survey expeditions to all continents and three cruises of the *Galilee* and seven of the nonmagnetic ship *Carnegie* took place with immense practical as well as scientific benefits to mankind. His men participated in various polar expeditions of others, even to the extent of travel by zeppelin and submarine. He also directed what was probably then the most extensive program in physical and biological oceanography during the first quarter of the present century, especially in connection with the cruises of the *Carnegie*. Among a few of the major contributions were the greatly improved description of the geomagnetic field, the first isomagnetic world charts designating the major patterns of magnetic secular change, and the discovery of the diurnal variation on universal time of the atmospheric potential gradient.

Under Fleming, the DTM's observatory programs in geomagnetism, earth currents, ionosphere, cosmic rays, meteorology, atmospheric electricity, and solar physics were initiated and essentially completed. These programs resulted in noteworthy contributions to solar and terrestrial physics. Important pioneering laboratory programs were created in nuclear physics and biophysics. In all of these Fleming contributed his help and enthusiasm, though he did not participate much directly in the associated research activities.

He designed the DTM's Huancayo Magnetic Observatory in Huancayo, Peru (11,000 feet above sea level on the geomagnetic equator), selected its site, supervised its construction in 1919, and organized its activities. Solar and lunar magnetic variations

nearly three times as intense as observed elsewhere were discovered here. In 1947 the CIW transferred ownership of this observatory to the Department of Foreign Affairs of the Peruvian government. It is now known as the John A. Fleming Observatorio of the Instituto Geofisico del Peru.

Another DTM observatory designed and directed by him was the Watheroo Magnetic Observatory (about 800 feet above sea level) located near Watheroo, Western Australia, at the focus of the systems of currents that cause the daily magnetic variations. In 1947 the CIW transferred ownership of this observatory, considered one of the best-equipped geophysical observatories in the Southern Hemisphere, to the Bureau of Mineral Resources, Geology and Geophysics, of the Australian government.

Dr. Fleming also designed for the CIW the Kensington (Maryland) Field Station, where fundamental magnetic research was done and unique ionospheric equipment installed. This station later formed an important unit of the Naval Ordnance Laboratory at Silver Spring, Maryland. Before Fleming's retirement this station was discontinued, because of the interference caused by rapidly developing home construction in the surrounding area, and a new station erected and fully equipped on a site of some 29 acres near Derwood, Maryland.

Dr. Fleming planned and supervised the construction of almost all the buildings on the grounds of the DTM. He designed a number of magnetic instruments, including theodolite-magnetometer, universal magnetometer, magnetometer-inductor, and galvanometer for field use, and made improvements in the design of various instruments used in the Department's field work on land and sea. In the DTM's field magnetic surveys in Central, South, and North America he took an active part.

During World War I Dr. Fleming assisted Professor E. L. Nichols at the DTM in perfecting a magnetic type of under-

water mine that was used extensively in the North Sea area. Also during that war Dr. Fleming was the chief developer of several devices for detecting submarines.

During World War II, as Director of the DTM, he was in charge of all work under war contracts of the Institution concerned with ordnance devices, including proximity fuses, radio-wave and communications improvement, magnetic compasses and odographs, and uranium and ionospheric studies. Also during the war, the DTM undertook the task of preparing new isomagnetic and isoporic charts. In this way the results of voluminous surveys on land and sea, made over many years by the DTM and other agencies, were used in improving the description of the earth's main field and its secular change.

The work on the proximity fuse resulted in the formation of the Applied Physics Laboratory of The Johns Hopkins University after the original setup and personnel had been established and the successful results of the project had been demonstrated.

Dr. Fleming was largely responsible for the Conferences on Theoretical Physics which were held at the DTM, under the joint auspices of the George Washington University and the CIW. There were eight of these conferences, which began in 1935. Devoted solely to the clarification of the current status of the subject and to discovering the profitable directions for immediate attack, these sessions were subsequently evaluated by those present as uniquely effective in advancing the progress of their own researches. The high-voltage equipment at the DTM was used in January 1939 to give Professors Fermi and Bohr their first view of uranium fission, just thirty-six hours after the famous cryptic telegram, "Barium comes from the uranium," was received from Copenhagen by Professor Bohr, who was attending a Theoretical Physics Conference. The basic ideas of nuclear fission were promptly worked out in that meeting by Professors Bohr and Fermi.

Many important scientific discoveries were made with Fleming's stimulation and support, including the fundamental studies by Dr. S. J. Barnett in 1920-1921 on the gyromagnetic ratio for electrons in a conductor, which unexpectedly was found to be twice the Bohr value. The explanation of this discovery was found in 1926 in the spinning electron. The Breit-Tuve radio-echo experiments, which gave the basis for radar, and the world-wide cosmic-ray investigations using Compton-Bennett meters were fostered by Dr. Fleming as parts of his program, which later included some of the earliest efforts in nuclear physics in the United States.

Another major and almost personal accomplishment of Dr. Fleming was in connection with the growth of the American Geophysical Union. In 1920, a year after the organization of the Union, he became Secretary of the Section of Terrestrial Magnetism and Electricity, continuing until 1929. From 1925 to 1947 he was General Secretary of the Union. It was during these years and under his inspiration, in large measure, that the Union had its greatest growth, successfully initiating a number of outstanding research projects in geophysics which have since become commonplace. His great contributions to the development of the American Geophysical Union were recognized in his election as Honorary President for life in 1947, an office which was especially created for him by the Union. During his twenty-two years as General Secretary, over 13,000 pages were published in the *Transactions,* the editorship of which was almost solely his. He devoted his weekends, holidays, and evenings unselfishly to this work.

Dr. Fleming published as author more than 130 articles. The "Researches of the Department of Terrestrial Magnetism" (some 12 volumes), the *Journal of Terrestrial Magnetism and Atmospheric Electricity* (now *Journal of Geophysical Research)* during the years 1928-1948, and the early offset editions of the *Transactions of the American Geophysical Union* serve as nota-

ble monuments to him. Mention should be made of the 794-page book *Terrestrial Magnetism and Electricity* (Volume VIII of the "Physics of the Earth" series, sponsored by the National Research Council), which was prepared under his editorship in 1939, as also the earlier book edited by him on "Scientific Results of the Ziegler Polar Expedition of 1903-1905" (published under the auspices of the National Geographic Society in 1907).

Dr. Fleming took an active part in the planning of the new wing of the CIW's administration building, with its effective Elihu Root Auditorium, and after his retirement as Director of the DTM in 1946 he acted as adviser in international scientific relations to the CIW.

Fleming was awarded the William Bowie Medal of the American Geophysical Union in 1941, the Charles Chree Medal and Prize of the Physical Society of London in 1945, and was made a Commander of the Order of St. Olav of Norway in 1948. Following his death in 1956 he was posthumously awarded the first John Fleming Medal, established in his honor as an annual international award by the American Institute of Geonomy and Natural Resources.

He was associated with many committees and organizations: Member, Wave Propagation Committee, Joint and Combined Chiefs of Staff; Consultant, Section T, Applied Physics Laboratory (proximity fuse); Office of Scientific Research and Development, formerly Section T, Division A, National Defense Research Committee, from March 1941 to April 1944; President, Association of Terrestrial Magnetism and Electricity, International Union of Geodesy and Geophysics, 1930-1948; Member, National Research Council, and Chairman, National Research Council Committee on International Scientific Unions of the Council's Division of International Relations, since 1946; Member, Commission on Terrestrial Magnetism and Atmospheric Electricity of the International Meteorological Organization, 1930-1946; Acting Chairman, American Section of Aeroarctic,

1929-1933; Member, International Commission for Polar Year, 1932-1933, during 1931-1947; President, Commission of International Meteorological Organization on the Liquidation of the Polar Year, 1932-1933, during 1947-1950; U.S. Delegate from National Research Council and National Academy of Sciences to International Assemblies of International Union of Geodesy and Geophysics at Stockholm, Sweden, 1930, Lisbon, Portugal, 1933, Edinburgh, Scotland, 1936, Washington, D.C., 1939; Trustee and Member of Corporation, Woods Hole Oceanographic Institution, 1930-1953; General Secretary, American Geophysical Union, 1925-1947, and Honorary President, 1948-1956; Chairman, Temporary Nominating Group of Geophysics, National Academy of Sciences, 1942-1951; Chairman, Section of Geophysics, National Academy of Sciences, after formation July 1, 1951, through June 30, 1954.

He was a Fellow of the American Association for the Advancement of Science, American Physical Society, American Geographical Society, and the Washington Academy of Sciences, and a Member of the National Academy of Sciences (to which he was elected in 1938), American Institute of Mining and Metallurgical Engineers, American Geophysical Union, American Meteorological Society, Seismological Society of America, National Institute of Social Sciences, Maryland Academy of Sciences, Philosophical Society of Washington, Sigma Chi, and the Cosmos Club of Washington, D.C. He also was an Honorary Member of the State Russian Geographical Society and the Royal Society of New Zealand; a Corresponding Member of the Michelsen Institute of Science and Intellectual Freedom of Norway and the Geophysical Society of Finland; and Member of the Norwegian Academy of Sciences, Geological Society of Peru, and the Geographical Society of Lima, Peru.

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KEY TO ABBREVIATIONS

Am. Year Book = American Year Book

Beitr. Geophysik = Beitraege für Geophysik

Bericht Intern. Meteorol. Kom., Veröffentl. Kgl. Preuss. Meteorol. Inst. = Bericht über die Versammlungen des Internationalen Meteorologischen Komitees und dessen Kommission für Erdmagnetismus und Luftelektricität. Veröffentlichungen des Königlich Preussischen Meteorologischen Instituts

Carnegie Inst. Wash. Publ. = Carnegie Institution of Washington Publication

Carnegie Inst. Wash. Year Book = Carnegie Institution of Washington Year Book

ICSU = International Council of Scientific Unions

Nat. Bur. Stand. Misc. Publ. = Standards Year Book, Department of Commerce, National Bureau of Standards Miscellaneous Publication

Phys. Rev. = Physical Review

Proc. Am. Phil. Soc. = Proceedings of the American Philosophical Society

Proc. ____ Pacific Sci. Congr. = Proceedings of the ____ Pacific Science Congress

Res. Dept. Terr. Mag., Carnegie Inst. Wash. Publ. = Researches of the Department of Terrestrial Magnetism, Carnegie Institution of Washington Publication

Sci. Monthly = Scientific Monthly

Terr. Mag. = Journal of Terrestrial Magnetism and Atmospheric Electricity

Trans. Amer. Geophys. Union = Transactions of the American Geophysical Union

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