NATIONAL ACADEMY OF SCIENCES

HARRY HAMMOND HESS

1906—1969

A Biographical Memoir by

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HARRY HAMMOND HESS was one of the truly remarkable earth scientists of this century; indeed it would be difficult to name another of comparable depth, breadth, and impact. His was a rare, perhaps unique talent. It combined far-ranging interests and a brilliant intuiton with a capability and willingness to carry out work calling for extreme detail and precision. His career was an extraordinary one: a mineralogist of world repute who became even better known for introduction of new concepts on the origin of continents and oceans and for his leadership in space science affairs; a quiet and unassuming scientist of puckish disposition who became a wartime Navy commander and rose ultimately to the rank of Rear Admiral.

Harry Hess was born in New York City, the son of Elizabeth Engel Hess and Julian S. Hess, who was a member of the New York Stock Exchange. His paternal grandfather, Simon Hess, was a leader in construction work in New York, first in harbor dredging and later in dam construction. Harry's middle name, Hammond, derives from the town of Hammond, Indiana, where his maternal grandfather, Julius Engel, operated a liquor distillery. Harry had one brother, Frank, who graduated from Yale in 1931 and is now in real estate and retailing in Huntington, New York. Harry's heritage was Germanic, yet there was so little in his personality and career that whould fit the supposed Germanic mold that one must again conclude that this stereotype, like that of the humorless Englishman, should be abandoned for all time.

Harry Hess entered Yale University in 1923 from Asbury Park High School in New Jersey, where he had specialized—with no great distinction—in foreign languages. At Yale he began with a major in electrical engineering but soon shifted to geology, where he came into contact with a distinguished faculty, including the outstanding mineralogist and petrologist Adolf Knopf. Possibly apocryphal—though related by Harry himself—is the story that he failed his first course in mineralogy, and that Knopf, a hard taskmaster, predicted no future for him in a field in which he subsequently was to become a world leader.

After award of the B.S. degree from Yale in 1927, Harry then spent two strenuous and memorable years as an exploration geologist in northern Rhodesia, working in the bush most of the time with a native African crew. Harry loved to recount tales of this venture; obviously, despite hardship and danger, he enjoyed it hugely and in all likelihood it strengthened those innate traits of humor, tolerance, quiet competence, and coolness under stress that were to be his hallmarks in later life. In 1929 he returned to the United States to begin graduate studies at Princeton University. A persistent story is that his original intent was to enter Harvard, but that as an inveterate smoker he was turned away by the No Smoking signs that dotted the buildings there.

At Princeton, Harry was a member of an extraordinary and diversified group of graduate students working principally under A. F. Buddington, A. H. Phillips, R. M. Field, and Edward Sampson. Each of these major professors left a mark on Harry's subsequent career: Buddington in petrology, Phillips in mineralogy, Field in oceanic structure, and Sampson in mineral deposits, particularly those of the stratiform complexes. In a curious, yet absolutely typical way, Harry's future research was to combine and extend concepts and approaches drawn from all these sources. His debt to all, but particularly to "Bud," his teacher and close friend, was freely acknowledged. He became a classic example of one who stood on the shoulders of giants to reach further, just as we who follow will stand on his. His doctoral dissertation was a field and laboratory study of an altered peridotite body at Schuyler, Virginia, and he was awarded the Ph.D. degree by Princeton in 1932.

After completion of his graduate studies at Princeton, Harry taught at Rutgers (1932-1933) and was a Research Associate at the Geophysical Laboratory in Washington, D.C. (1933-1934). In 1934 he joined the Princeton faculty and married Annette Burns, daughter of George Plumer Burns, professor of botany at the University of Vermont. Annette was to be his strong support for the rest of his life, and in later years was to be his constant companion at scientific meetings and conferences. Harry is survived by two sons: George, who is a physicist at the University of Virginia; and Frank, who is with a publishing firm at Whitehorse, Yukon Territory.

It is not easy to summarize Harry's career, because only superficially does it fall into neat categories of time. Buddington has written elsewhere that Harry Hess lived five lives contemporaneously. This is true, yet these separate activities intermeshed and complemented each other, in ways often unknown to his associates in any one area. The distinctive aspect, in fact, is one in which every thread of activity and research interest, beginning with those of student days, becomes imperceptively interwoven with time into a pattern of increasing breadth, color, and complexity.

In 1931, while still a graduate student, Harry participated in a submarine gravity study of the West Indies under F. A. Vening Meinesz. This work was extended in the next few years to the Lesser Antilles, using a U.S. Navy submarine obtained through the persuasion of R. M. Field, and Harry acquired a reserve officer rating of Lieutenant (J.G.) in order to facilitate operations. These studies resulted in Harry's first major paper (1938) on island arcs and their origin. Still a reserve officer at the time of the attack on Pearl Harbor, December 7, 1941, Harry took the 7:42 train the next morning to report for active duty and served for the remainder of World War II. His first assignment was in New York with responsibility for detection of enemy submarines in the North Atlantic. His leadership and incredible intuitive ability to perceive patterns of operation led ultimately to a very high "kill" rate and within two years to virtual elimination of the submarine threat. Harry then maneuvered affairs so that he was assigned to the decoy vessel *U.S.S. Big Horn,* which provided him with a firsthand test of the effectiveness of the detection program, and thereafter he managed to remain on sea duty. Ultimately he became Commander of the attack transport *U.S.S. Cape Johnson* in the Pacific and participated in the landings on the Marianas, Leyte, Linguayan Gulf, and Iwo Jima.

Typically, Harry's strenuous wartime activities did not halt his scientific curiosity. The *Cape Johnson,* like most ships of its class in World War II, was fitted with sounding gear, and by discrete choices of travel routes —perhaps not always in strict accord with orders—and continuous use of the equipment, bathymetric knowledge of the Pacific was vastly extended and the submerged flat-topped mounts now known as guyots (in honor of the first professor of geology at Princeton) were first found. The results of these investigations were published shortly after the end of the war (1946, 1947, 1948), but publication of these papers was by no means to be the end of his involvement with marine affairs. His continued interest led him in the fifties to take leadership in a proposal to drill through the thin oceanic crust into the earth's mantle, an idea originating with oceanographer Walter Munk. Project Mohole was launched by the spontaneously generated American Miscellaneous Society (AMSOC), and funds were allocated by the National Science Foundation in 1958 for preliminary work. The project came to an inglorious end in 1966, in part because of escalation of costs and the entry of partisan political factors, in part because of disagreement among scientists and engineers as to the need for intermediate steps, and in part because of failure to recognize that the lighthearted origins of AMSOC were only a thin cover for deeply serious intent and commitment. The project did, however, establish feasibility of dynamic positioning for deep water drilling, and the experience was invaluable to the present highly successful ocean drilling program being sponsored by The National Science Foundation.

Harry's detailed mineralogic studies began in the laboratory under A. H. Phillips at Princeton and in the field under Arthur Buddington and Edward Sampson. These studies resulted in many papers, two of which are classic: "Pyroxenes of Common Mafic Magmas," published in 1941, and *Stillwater Igneous Complex, Montana,* published in 1960. The pyroxene paper remains the foundation for all modern studies. Few people who knew Harry for his broader speculations on the crust and mantle of the earth realized that throughout the years he was a major contributor to an understanding of this important group of rock-forming minerals. In 1938, he and Phillips showed that the fine-scale lamellae of calcium-poor orthopyroxene were due to subsolidus exsolution of calcic pyroxene, rather than to twinning; in 1952 he produced a definitive paper on unit cell dimensions. It is significant that at the time of his death Harry was a designated NASA Principal Investigator for the pyroxenes of the returned lunar samples. The long-delayed monograph on the Stillwater complex stemmed in large part from work with fellow graduate students Arthur L. Howland and Joe Webb Peoples in the early thirties. Though now supplemented and enlarged by more detailed studies, it remains a marvellous example of sound conclusions drawn by brilliant intuition from limited data. The same ability that led Harry to detect patterns in enemy submarine activity in World War II was the despair of those students of crystal-settled complexes who saw him reach the right answers with only a skimpy amount of data.

Peridotite—its origin and significance—probably was the object of Harry's deepest scientific devotion. Almost from the beginning of his involvement with the subject in his doctoral thesis, he realized that this mantle-derived rock was a key to the understanding of the deeper crustal structure of the earth and to the recognition of older orogenic belts. His 1939 paper presented to the 17th International Geological Congress was his first exposition of the relation between island arcs, gravity anomalies, and peridotite. Many of his initial ideas later were abandoned —Harry was never hesitant to discard an earlier view if the evidence called for it—but the role of this unusual rock was to be the critical factor in his later theories of the nature and behavior of oceanic crust. His last field study, like the first, was on peridotite. In July 1969, only a month before his death, he went to Barberton Mountain Land, in South Africa, to examine the evidence for extrusive lavas of peridotite composition, which had been reported to him by his former student, A. E. J. Engel.

Harry Hess was a pioneer in development of the now widely accepted theory of ocean-floor spreading. In 1960, in a widely circulated report to the Office of Naval Research, Harry proposed that the mid-oceanic ridges were the loci of upwelling mantle convection cells that progressively moved mantle material outward and eventually under the continents, a brilliant concept that now appears to be confirmed by the symmetrical distribution of magnetic anomalies on both sides of the ridges. His paper was published formally in 1962, and a study made in 1969 indicates that it was the most referenced work in solid-earth geophysics in the years 1966-1968. Whether his concept of a serpentinized peridotite under the ocean floors proves valid or not, this paper stimulated intense research and is part of what is the major advance in geologic science of this century.

In 1947, after returning from the wars, Harry rejuvenated the Princeton activity in the Caribbean. The Princeton Caribbean Research Project, supported by Princeton University, the National Science Foundation, the Office of Naval Research, several oil companies, and the governments of Puerto Rico, Venezuela, and Colombia, explored every aspect of Caribbean geology. It still continues, and it already has resulted in the publication of thirty-four Ph.D. dissertations and has been the graduate training ground for a host of students from many parts of the world. Special tribute was paid to Harry during the Venezuelan Geological Congress in November 1969, in recognition of his great contributions to geologic understanding of the region.

As a reserve officer in the Navy after World War II, Harry spent several weeks on active duty in Washington each year, and was on call for advice on emergency issues such as the Cuban missile crisis, the loss of the submarine *Thresher,* and the Pueblo affair.

Following his election to the National Academy of Sciences in 1952, Harry increasingly was called upon to serve as an adviser to federal scientific organizations. In succession he was chairman of the Committee for Disposal of Radioactive Wastes, chairman of the Earth Sciences Division of the National Research Council, and, until his death, chairman of the Space Science Board. In this last role, he was highly influential in design of space exploration of the earth's moon and of the planets.

Harry was chairman of the Department of Geology at Princeton from 1950 to 1966 and served on many important University committees. He was, despite a quiet, low-keyed approach, extremely effective here as in other affairs; one dean was heard to remark of Harry that his bite was worse than his bark. He was an outstanding teacher—but in a highly unorthodox way. Though an excellent lecturer when the spirit moved him, basically he believed that students "learned by doing," not by being talked to. Any student, graduate or undergraduate, who showed the spark of scientific curiosity could depend on personal attention; Harry would supply him with ideas and references to the key literature that would spur him on.

Many honors were awarded Harry Hess. He was elected to the National Academy of Sciences in 1952, to the American Philosophical Society in 1960, and to the American Academy of Arts and Sciences in 1968. He was President of the Geodesy Section of the American Geophysical Union, 1951-1953, and of the Tectonophysics Section, 1956-1958. He was President of the Mineralogical Society of America in 1955 and of the Geological Society of America in 1963. He was an honorary Foreign Member of the Geological Society of London, the Geological Society of South Africa, and the Sociedad Venezolana de Geologos. In 1966, the same year he received the Penrose

Medal Award of the Geological Society of America, he was elected Foreign Member of the Accademia Nazionale dei Lincei and was awarded the $32,000 Feltrinelli Prize. In 1969, Yale University awarded him an honorary doctorate degree. Posthumously, he was awarded the Distinguished Public Service Award by the National Aeronautics and Space Administration. The Navy awarded him the Victory Ribbon, World War II; the American and European Theater Ribbons; the Asiatic-Pacific Ribbon (four stars); the Philippine Liberation Ribbon (one star); and the Naval Reserve Medal.

Harry's trademark, always evident in his doodles, was the rabbit. But, as many found, this slightly built, quiet, unobtrusive man was no rabbit in fact; he was a fierce fighter for science, a dedicated and steadfast defender of any cause he thought to be just. Yet withal he was a gentle and kindly person, tolerant of the foibles and weaknesses of mankind—including his own. Those of us who knew him lost a great friend, and the world lost a great scientist and a scientist-statesman.

In compiling this biographical memoir of Harry Hess I have received aid from a number of people, notably from Annette Hess and Frank Hess on family matters, and from Arthur Buddington, John Maxwell, Benjamin Morgan, and William Thurston on Harry's professional career. I am particularly indebted to Dr. Buddington, who made available to me his extensive files and drafts of a memoir to be published elsewhere, and to Mrs. Guenever P. Knapp for the bibliographic compilation and other materials.

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KEY TO ABBREVIATIONS

Am. J. Sci. = American Journal of Science
Am. Mineralogist = American Mineralogist
Bull. Geol. Soc. Am. = Bulletin of the Geological Society of America
Econ. Geol. = Economic Geology
J. Geol. = Journal of Geology
Proc. Geol. Soc. Am. = Proceedings of the Geological Society of America
Trans. Am. Geophys. Union = Transactions of the American Geophysical Union

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