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Chapter 2

Fred L. Whipple, Pioneer in the Space Program*

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The Seminal Years

The years 1945 to 1960 were seminal in the formation of a U.S. space program; indeed, these years marked the beginning of the global space age. In these years, from the astronomical community, Fred Lawrence Whipple was the foremost space pioneer and advocate.

Before World War II, writers and experimenters, such as Robert Goddard, Hermann Oberth, and Konstantin Tsiolkovsky, expounded the possibilities of rockets and space exploration, but their thoughts were little known to their respective citizenries. During the war, the German development, production, and use of the V-2 rocket brought the stark reality of rocketry to the attention of the general public.

In 1945, the transplantation from Germany to Fort Bliss, Texas, and White Sands, New Mexico, of the rocketry team around Wernher von Braun brought their capabilities to the United States. This translation was greatly facilitated by the transportation to White Sands by the U.S. Army of large stores of captured

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V-2 rockets and components. Hence, the von Braun team, augmented by U.S. personnel, was promptly able to continue V-2 flights from White Sands.

By 1960, the seminal years of the U.S. space program were largely over. Earth satellites became commonplace after the launch of *Sputnik 1* on 4 October 1957, *Sputnik 2* on 3 November 1957, and *Explorer 1* on 31 January 1958. Starting in 1958, the U.S. National Aeronautics and Space Administration (NASA) was assembled from diverse federal agencies, with the last step being the addition on 1 July 1960 of the Marshall Space Flight Center in Alabama, directed by Wernher von Braun.

The events in the years from 1945 to 1960 were fast moving and historic. These were the exciting years during which Fred Whipple facilely performed as the principal spokesman for space affairs from the astronomical profession. This unique role is substantiated by his inclusion as the only astronomer with his biographical sketch in the contemporary first three volumes of *Men of Space.*[1]

Roles of Fred Whipple[2]

Starting in 1945, the U.S. Army obviously had motivations for planning experimental V-2 flights from White Sands. The first launch occurred on 16 April 1946. However, U.S. scientists also had research objectives that the rocket flights could promote. For this research, a V-2 rocket panel was formed with James A. Van Allen as chairman. Fred Whipple was a participant in activities of the panel. For some V-2 flights, he used cameras developed for meteor observations to record the trajectories of the rockets at White Sands, and analyzed the resulting photographic plates.[3]

Scientific results from the first U.S. flights of the V-2s were reported to the public at a meeting of the American Association for the Advancement of Science in Chicago on 29 December 1947. The session was chaired by J. Robert Oppenheimer.[4]

On 12 October 1951, the American Museum–Hayden Planetarium held its First Symposium on Space Travel. Willy Ley organized the symposium. Following introductory remarks by representatives of the host organization, papers were presented by Willy Ley, Robert Haviland, Fred Whipple, Heinz Harber, and Oscar Schacter. Fred was the only astronomer, and spoke on "The Upper Atmosphere and Empty Space."[5]

The Second Symposium followed a year later, again coordinated by Willy Ley. As before, Fred spoke for the astronomy community, with the subject "Astronomy from the Space Station."[6] Other speakers were Robert R. Coles, Willy Ley, George O. Smith, Fritz Haber, Milton Rosen, and Wernher von Braun.[7]

In November 1951, the U.S. Air Force made a major entry into space activities by convening the First Symposium on Physics and Medicine of the Upper Atmosphere, held at the School of Aviation Medicine in San Antonio, Texas. A large number of military people, engineers, and scientists attended, including James Van Allen, Wernher von Braun, and Fred Whipple. Fred presented a paper, "Meteoritic Phenomena and Meteorites."[8] He was one of only a few astronomers attending.

While these and other public scientific sessions and symposia were being held, the Department of Defense and its contractors were engaged in classified studies of the practical possibility and utility of artificial Earth satellites. The Rand Corporation was one newly formed "think tank" that undertook such studies. Fred Whipple was a participant in the Rand studies, contributing a paper, "Possible Hazards to Satellite Vehicles from Meteorites."[9] His interest in this problem led to a patent filing by him on a meteor bumper concept. His concept was employed in practice to protect large, human occupied, spacecraft, such as Skylab and the International Space Station.

During several public and private discussions of space opportunities, Fred Whipple formed a strong friendship and working relationship with Wernher von Braun. Both men recognized the importance and value of promoting an understanding of space matters by the public at large. This recognition was demonstrated when they contributed to a series of articles in *Collier's*, a popular magazine with large readership at the time.

Figure 2–1: Scientists and illustrators for the *Collier's* space articles: left to right, Rolf Klep, Willy Ley, Dr. Heinz Haber, Dr. von Braun, Dr. Whipple, and Chesley Bonestell. Credit: *Collier's*.

One of Fred's contributions to the series was an article, "Man on the Moon, The Exploration," coauthored with Wernher von Braun.[10] Others, by him alone, were "The Heavens Open,"[11] and "Is There Life on Mars?"[12] This series brought the authors, including Fred Whipple, to the attention of the reading public.

Perhaps the most noteworthy and constructive event in the 1945 to 1960 interval was a meeting on 25 June 1954 at the Office of Naval Research in Washington, D.C.[13] Commander George Hoover of the Navy hosted the meeting. He was anxious to take concrete action toward a U.S. satellite, rather than further discussion. Frederick C. Durant III, president of the International Astronautical Federation, arranged for Wernher von Braun to join him at the gathering. Also present were S. Fred Singer of the University of Maryland, David Young of Aerojet General, Fred Whipple of Harvard, and staff members of the Office of Naval Research. The assembled group laid out tentative plans for a U.S. satellite. This was the first meeting of what became Project Orbiter. Project Orbiter was in the direct line of development for *Explorer 1*. Thus Fred Whipple was one of half a dozen individuals, and the only astronomer, responsible for jump-starting the U.S. satellite program.

During subsequent months, Project Orbiter evolved as a joint Navy–Army effort. One substantial advance embraced by the project was a secret report by von Braun dated 15 September 1954, "A Minimum Satellite Vehicle Based on Components Available from Missile Development of the Army Ordnance Corps."[14] A proposal corresponding to this report was presented to the Assistant Secretary of Defense for Research and Development on 20 January 1955.

During the first half of 1955, Project Orbiter had intense planning meetings, most attended by Fred Whipple. For example, on 23–24 May, the project team assembled to watch a Redstone rocket firing at Cape Canaveral.

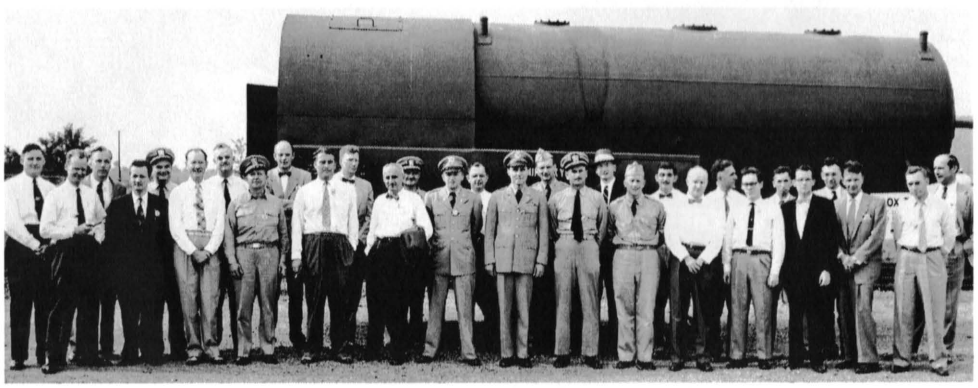

Figure 2–2: Project Orbiter team at the time of the 23–24 May 1955 meeting when they watched a Redstone Missile firing. Fred Whipple is 6th from the left. Credit: U.S. Army.

Project Orbiter included a subproject to be directed by Whipple to optically observe the satellites as a function of time and to compute the satellite orbits.[15]

By summer 1955, the satellite concept had worked its way up in the government to President Dwight D. Eisenhower, who announced on 29 July that the United States would orbit a satellite during the International Geophysical Year (IGY) (July 1957 through December 1958). Later, to the dismay of the Orbiter team, the role of launching the satellite was assigned to Project Vanguard, another Navy team that needed, however, to develop a new rocket system to do the job.

The sad history of Project Vanguard with its initial failures is well known. From summer 1955 until fall 1957, Project Orbiter personnel went underground, but continued working under other auspices. Of particular importance was the successful September 1956 launch of a Redstone boosted multistage rocket vehicle (#27) by the Army Ballistic Missile Agency. Its fourth stage had a dummy rocket. If the rocket had been live, it could have put a satellite in orbit. A like vehicle (#29) with a live fourth stage did indeed put the first U.S. satellite, *Explorer 1*, in orbit on 31 January 1958.

While the U.S. rocketry teams were striving to launch a U.S. satellite, Fred Whipple had his own daunting task. In response to a proposal from the Smithsonian Institution Astrophysical Observatory (SAO), in late 1955 the U.S. National Committee for the IGY, through the National Academy of Sciences and the National Science Foundation, assigned to SAO the responsibility for optical tracking of U.S. satellites launched during the IGY. The first grant to fund this function came in January 1956, and was followed by subsequent funding increments.

As envisioned by Fred Whipple, the SAO Director, the satellite tracking function employed two optical networks: (1) Moonwatch with small stationary telescopes staffed by volunteers, mostly amateur astronomers, and (2) twelve sophisticated satellite tracking cameras (named Baker-Nunn cameras for their designers) built specifically for that purpose and each operated by a professional staff. Both networks needed timing capabilities, the latter to millisecond accuracy. Both networks needed communications to convey predictions of when and where to observe, and to return results of observations. Arrangements and international agreements had to be made for observing sites around the world, and for buildings to hold the necessary equipment. At SAO headquarters in Cambridge, an orbit determination and computing capability had to be established. All this was to be done between January 1956 and sometime in 1957 when the first satellite launches were scheduled.

To accomplish this massive crash program, Fred recruited a large staff of recognized experts in their respective disciplines and delegated appropriate responsibilities to them. J. Allen Hynek became Associate Director of SAO in January 1956. Karl G. Henize was put in charge of the Baker-Nunn camera stations in September 1956. The many other key individuals are too numerous to acknowledge here, but they and their roles are discussed by E. Nelson Hayes in *Trackers of the Sky.*[15]

Figure 2–3: Fred L. Whipple, left; Karl G. Henize, center; and J. Allen Hynek, right; with a model of a Baker-Nunn camera. Credit: Smithsonian Astrophysical Observatory (SAO).

The Soviet Union had announced its intentions to launch at least one satellite during the 18-month IGY. While most of the senior managers, engineers, and scientists working on U.S. satellites were aware of the Soviet intensions, the schedule date for the first Soviet launch attempt was not widely known. Thus the advent of *Sputnik 1* on 4 October 1957 came with little specific warning. On that date the SAO tracking program was on the verge of readiness. It is greatly to the credit of Fred Whipple and his whole SAO staff that interim measures were promptly employed that provided a rudimentary treatment of the *Sputnik 1* orbit. Over the following days and weeks, the Moonwatch capability came into mature operation. Innovative orbit determination techniques likewise evolved. *Sputnik 2* was launched on 3 November 1957 with a surprisingly large size and mass. In the last quarter of 1957, SAO became the leading source of information on the Sputnik orbits for the press and the western world. Thus Fred Whipple, who was a prophet of space operations in *Collier's*, had now become a voice of the start of the Space Age.

By 31 January 1958, when *Explorer 1* was launched, the SAO tracking program was operating relatively routinely. By mid-1958, all twelve Baker-Nunn tracking cameras were in operation. In subsequent years, the data from these cameras supported accurate measurements of the upper atmosphere density and its variations, detailed representations of the gravity field of Earth, accurate determination of observing station coordinates in a global reference system, and other scientific topics.[16] All these remarkable results were objectives predicted by Fred Whipple when he conceived the SAO satellite tracking program. For his leadership in designing and building the worldwide optical network for tracking satellites, Fred L. Whipple was presented the President's Award for Distinguished Public Service by President John F. Kennedy on 12 January 1963.

Figure 2–4: President John F. Kennedy presenting Award for Distinguished Public Service to Fred L. Whipple. Credit: U.S. Government, White House.

As rockets capable of rising above the atmosphere came into being, Fred Whipple was quick to promote the importance of astronomical observations in wavelengths that do not penetrate the atmosphere. Ultraviolet observations were a first choice. An SAO proposal to build a telescope with ultraviolet reflecting optics and an ultraviolet sensitive television camera was accepted for satellite flight by the newly formed NASA. This was Project Celescope. Again Fred was demonstrating a pioneering spirit by pursuing this new opportunity. After several

project restructurings by NASA, Celescope became a four-telescope ensemble, each functioning at a different ultraviolet wavelength. The ensemble was ultimately carried on *Orbiting Astronomical Observatory 2*. The data from the satellite operation was compiled into a catalog of ultraviolet stellar magnitudes for a representative sample of the sky. This early project was a forerunner for many later orbiting ultraviolet sensitive telescopes.

The Whipple Management Style[17]

The Whipple-initiated activities just described, and his traditional astronomical investigations, span a remarkable set of undertakings for one man. How did he do it all? The answer lies in part in his management style.

Fred Whipple was clearly an innovator who liked to initiate pioneering projects. Typically, he would then identify very competent individuals with the right knowledge for the new enterprise and would engage their services. He was quite willing to delegate responsibility for a project, but only to very well-qualified candidates whom he selected with care. This assured the projects could prosper with little detailed attention from him. However, he was always available to help if a project ran into unanticipated difficulties. Perhaps he acquired this concept of project execution and management from his wartime experiences. It allowed him simultaneously to have many diverse enterprises under his directorship.

Fred was an absolutely firm practitioner of organizational independence. When confronted with a bureaucratic request that SAO reports be approved by a funding agency, such as NASA, before the reports were published, he steadfastly refused. Consequently, the very valuable, useful and timely Special Report Series was published by SAO with appropriate internal scrutiny, but with no delaying external approval cycle. Some funding sources did not like this independent posture, but they learned to accept it.

Fred had a compelling desire to continue his personal research activities. This took the form of a strict discipline that he would devote his morning hours to administrative duties and afternoon hours to his personal scientific investigations. He was quite content to have an administrative issue settled by his assistant directors if the issue could not fit into his morning hours. This discipline assured that only the most important matters reached his attention, and all lesser matters were resolved elsewhere.

The value of international scientific cooperation was understood well by Fred, and he enjoyed operating in the international arena. A technique he frequently used was to invite world leaders and promising young scientists to spend

research time at SAO. He was generous in making the substantial data collections in Cambridge available to the visitors. For example, during many summers there was an influx from around the world of specialists in using satellite tracking data for scientific investigations. This parade of visitors added much to the productivity and reputation of SAO. It accomplished an effective international cross-fertilization of ideas and techniques. Many young alumni of SAO visits matured into scientific leaders in their home countries. They uniformly were grateful for the early opportunities provided by Fred. Broadly, the global astronomical community benefited from the legacy of Fred's generous treatment of visitors.

Fred understood his own personality very well. For example, he recognized he had an overwhelming passion for computing. As personal computers became prevalent among his colleagues, he refused to have one, fearing that using it would consume all his time. When he retired in 1973 as SAO Director and was free of most obligations, he got his computer.

Final Thoughts

Dr. Whipple died 30 August 2004 at age 97. His associates at the Harvard Smithsonian Center for Astrophysics hosted a "Celebration of the Life and Science of Fred Lawrence Whipple" on 4 December 2004.[18] The morning was a scientific symposium on topics of particular interest to Fred and the afternoon was devoted to selected remembrances shared by the attendees.

Other writers have properly emphasized Fred Whipple's outstanding personal research contributions to more traditional astronomical subjects. I hope I have reminded readers of other facets of this many faceted individual who had the foresight and initiative to stand with Wernher von Braun, James Van Allen, Willy Ley, and a few others as pioneers who built a solid foundation for the U.S. space program.

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[17] The author of this paper was privileged to be Assistant Director for Science at SAO from 1962 until Fred Whipple retired as Director in 1973.

[18] Irwin Shapiro, chair, "A Celebration of the Life and Science of Fred Lawrence Whipple," Harvard University Science Center, Cambridge Massachusetts, 4 December 2004.