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Chapter 1

Heinz-Hermann Koelle and His Contributions to Space Development*

Charles A. Lundquist† and Francis L. Williams‡

Abstract

Heinz-Hermann Koelle was an early leader of the team that conceived, promoted and defined the Saturn Program that put mankind on the Moon. He did this in his role as Chief of the Preliminary Design Office of the U.S. Army Ballistic Missile Agency (1955–1960) and subsequently as Director of the Future Projects Office of the NASA Marshall Space Flight Center (1960–1965). His earlier career began in Europe, where he was born in the free state of Danzig on 22 July 1925. During World War II he was a pilot in the Luftwaffe. After the war, he got his Dipl.-Eng in mechanical engineering in 1954 from the Technical University Stuttgart. He was a founder of the post-war German Society of Space Research. In 1955 he was recruited by Wernher von Braun to join his team at the Army Ballistic Missile Agency in Huntsville, Alabama. Besides Koelle's engineering expertise, he was a gifted writer and editor. He could skillfully organize, consolidate and clearly present large bodies of factual material, a valuable capa-

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bility for a future planner. Several publications illustrate his editorial skills: (1) *Literature-Index of Astronautics*, with H. J. Kaeppeler, 1954, (2) Project Horizon, 1959, (3) a collection of some 100 technical reports demonstrating MSFC systems capability, 1961 and (4) *Handbook of Astronautical Engineering*, 1961. Of these, the Project Horizon report became a key study and document in the U.S. manned spaceflight activities. Koelle's contribution to the study, including serving as chairman of the report editorial board, provided a fresh new option and catalyst for the "Space Race with the Soviets." Remarkably, in 1963, Koelle found time to complete his Dr.-Eng at the Technical University at Berlin, while still satisfying von Braun's continuing requirements that he formulate future project options for MSFC and the U.S. In 1965, he succumbed to the call of academia and accepted a professorship of space technology at the Technical University in Berlin (1965–1991). After retirement in 1991, he remained active in the International Academy of Astronautics. He resided in Berlin until his death on 20 February 2011.

Early Career in Germany

Heinz-Hermann Koelle was born on 22 July 1925 in the then-free city-state of Danzig, on the Baltic Sea between Germany and Poland. His father was a police lieutenant-colonel. After Germany's 1939 invasion of Poland, the free city of Danzig was abolished and its territory became part of the Reichsgau of Danzig-West Prussia.

During World War II, Koelle joined the German Luftwaffe and became a pilot, thus beginning his association with aerospace activities [1]. During the closing days of the war, he spent time in a prisoner-of-war camp in Texas, U.S.A.

Koelle is recognized as founder in 1948 of the resurrected German Society for Space Travel (Verein für Raumschiffahrt, or VfR), which had become moribund in 1933. In this context he had contacts with other advocates of rocket flights, including some individuals who had worked on German military rockets.

To further his formal education, Koelle studied mechanical engineering at the University of Stuttgart. In 1954 he was granted his Dipl.-Eng. by that University. Also in 1954, while in Stuttgart, he coauthored with H. J. Kaeppeler a *Literaturverzeichnis der Astronautik,* or *Literature-Index of Astronautics* [2]. This index used a classification scheme for astronautics proposed by Eugen Sänger. This publication is an early example of the writing, compilation and editing skills that Koelle exhibited throughout his career.

Initial Career in the U.S.A.

Koelle's post-war space activities in Germany brought him to the attention of Wernher von Braun and his rocket team in Huntsville, Alabama. In 1955, Koelle agreed to join the team as an employee of the U.S. Army. In early 1956, the Army Ballistic Missile Agency (ABMA) was established with Koelle heading its Preliminary Design Branch [1]. In this role he became von Braun's close associate for studying future rocket and space activities, Figure 1–1.

Figure 1–1: Heinz Hermann Koelle and Wernher von Braun in von Braun's office. Credit: NASA.

Earlier, in 1954, von Braun had written his landmark memorandum, which contended that by combining existing Army rockets an artificial Earth satellite could be launched [3]. This possibility was promoted under the name Project Orbiter.

While most of the members of ABMA were occupied with final work on the Redstone Short Range Missile and with the development of the Jupiter Intermediate Range Missile, Koelle and his office associates were able to refine the design of a satellite launch vehicle, Jupiter-C, based on the Redstone as its first stage. Following *Sputnik I* and *II* and failures of the United States Vanguard rocket, ABMA was authorized to launch satellites. Koelle was on the launch team for *Explorer I* on 31 January 1958.

However, the most challenging role for Koelle and his Preliminary Design associates was the definition of the Saturn Launch Vehicle system. This began in August 1958 when the Department of Defense, Advance Research Projects Agency funded ABMA for the initial design, development and demonstration of a new National Space Launch Vehicle—Saturn. It would have a total liftoff thrust of 1.5 million pounds and a payload capability to Earth orbit of 20,000 to 30,000 pounds [4]. The significance of such a new space transportation capability was also a topic addressed by the Program Development personnel. Among the mission potentials considered was a manned trip to the Moon and return.

As these preliminary designs were being worked, Cold War competition between the U.S. and the Soviet Union was at its peak. The Soviet Union announced openly its intension that some of its citizens would celebrate on the Moon the 50th anniversary of the October Revolution in 1967. Knowing that the Saturn study was focusing on a lunar transportation capability, it was natural for U.S. Army officers to contemplate an early American presence on the Moon. A result of these contemplations was a directive, dated 20 March 1959, from Army Lieutenant General Arthur G. Trudeau, Chief of Research and Development, to the Chief of Ordnance, Department of the Army [5]. Paragraph 1 of the document stated: "The Army is engaged in determining objectives and requirements for outer space operations. The most challenging and perhaps the most urgent is that of establishing a manned lunar outpost on the Moon."

Paragraph 3 includes the instruction:

> You are therefore requested as a matter of urgency to make a preliminary investigation to determine the probable means and techniques of accomplishment and to develop a plan, including estimated time scheduling and costs, for establishing a lunar base by the quickest means possible. The investigation should include a determination of the feasibility of landing a manned vehicle by 1966 and of establishing a permanent base as soon thereafter as possible.

The penultimate paragraph directs that "Specific emphasis should be given to the Army-wide capability to contribute to this project. The results of this preliminary investigation are requested by 15 May 1959."

Leadership of this investigation was assigned to the Army Ordnance Missile Command in Huntsville, Alabama. Within ABMA, Koelle had the responsibility for leading the study. He and his preliminary design team were already well advanced on the Saturn study.

The comprehensive Project Horizon team involved many elements of ABMA and members of the Army's seven Technical Services. Leading team members and responsibilities by report sections are given in Table 1–1 and Table 1–2, copied from the report generated by the team [6]. A transmission letter, giv-

ing the provenance of the study, was signed by Major General Medaris, as documented in Figure 1–2.

"The individual portions of this report {Horizon} were coordinated and compiled by six technical working groups headed by the individuals indicated below."

I	OUTPOST, Chairman: H. N. LOWE, Corps of Engineers
II	FLIGHT MECHANICS, Chairman: R. C. CALLAWAY, ABMA, Guidance and Control: J. H. W. UNGER, ABMA
III	TRANSPORTATION SYSTEM INTEGRATION, Chairman: F. L. WILLIAMS, ABMA, Payload Preparation and scheduling: CAPTAIN ROBERT MENDENHALL, Quartermaster Corps
IV	SPACE VEHICLES, Chairman: C. H. BARKER, Jr., ABMA, Carrier Vehicles: H. RUPPE, ABMA, Payloads: A, WARREN, ABMA
V	COMMUNICATION AND SURVEILLANCE SYSTEM, Chairman: S. P. Brown, Signal Corps
VI	COST AND SCHEDULE Chairman: W. G. HUBER, ABMA

Table 1–1: Horizon Report Subject Leadership.

"The senior representatives of the individual Technical Services on this task force who were assigned the responsibility of coordinating the work on this volume with their respective organizations were."

1	Mr. S. P. BROWN, Communications Department, U.S. Army Signal R&D Laboratory, Fort Monmouth, N. J.
2	Colonel R. H. HOLMES, R&D Division, Office Surgeon General, Washington, D. C.
3	Mr. H. N. LOWE, Project Director, Office Chief of Engineers Washington, D. C.
4	Dr. W. W. DORRELL, Office of the Chief Chemical Officer, Washington, D. C.
5	Colonel A. H. JACKMAN, Assistant Chief of R&D Division, Office Quartermaster General, Washington, D. C.
6	Lt. Colonel H. R. DELMAR, Chief Transportation Office, AOMC
7	H. H. KOELLE, Chief, Future Projects Design Branch, Development Operations Division, ABMA, AOMC

Table 1–2: Horizon Report, Army Technical Services Representatives.

8 June 1959

The attached study has been conducted in accordance with a directive from the Chief of Research and Development, Department of the Army. Elements of all of the Technical Services of the Army participated in the technical investigation and in the preparation of the report. Each volume has been reviewed by a duly authorized representative of each Technical Service and approved this date.

J. B. MEDARIS
Major General, USA
Commanding General
Army Ordnance Missile Command

Figure 1–2: Letter by Major General Medaris transmitting the Project Horizon Report.

The report [6] was duly circulated and evaluated in the highest Army organizations. Additionally, ABMA personnel made oral presentations in Washington, D.C.

The lunar outpost proposed for Project Horizon was a permanent facility capable of supporting a complement of twelve men engaged in a continuing operation. Figure 1–3 (from Vol. I of ref. [6]) illustrates the Horizon outpost as it was proposed to appear after about six months of construction effort.

The basic building blocks of the outpost were expected to be cylindrical metal tanks 10 feet in diameter and 20 feet in length. The habitable cylinders would be covered by lunar material. All pertinent branches of the Army were to help in establishing and maintaining the outpost.

Project Horizon envisioned use of Saturn I and Saturn II vehicles to provide the required rocket transportation to the Moon. At the time of the Project Horizon Report, the Saturn I parameters were fairly well defined and the final Saturn I vehicles that eventually were launched were not greatly different. The Saturn II was based on using a new more powerful liquid H_2 and liquid O_2 engine that would increase the payload capability by 50 percent. The Horizon Report discussed the relative features of direct flight to the Moon and of mission profiles

using orbital staging. Given that a proven, very large rocket motor did not exist at the time, a staging in Earth orbit was favored. Several flights of a Saturn I or II to an Earth orbit with a 96-minute period would be required to stage a roundtrip mission to the Moon. The Saturn V that eventually carried men to the Moon was a later evolutionary development [7]. The Project Horizon study mentioned that a much larger rocket vehicle than Saturn II would be advantageous and possible, but not with a 1966 lunar landing schedule.

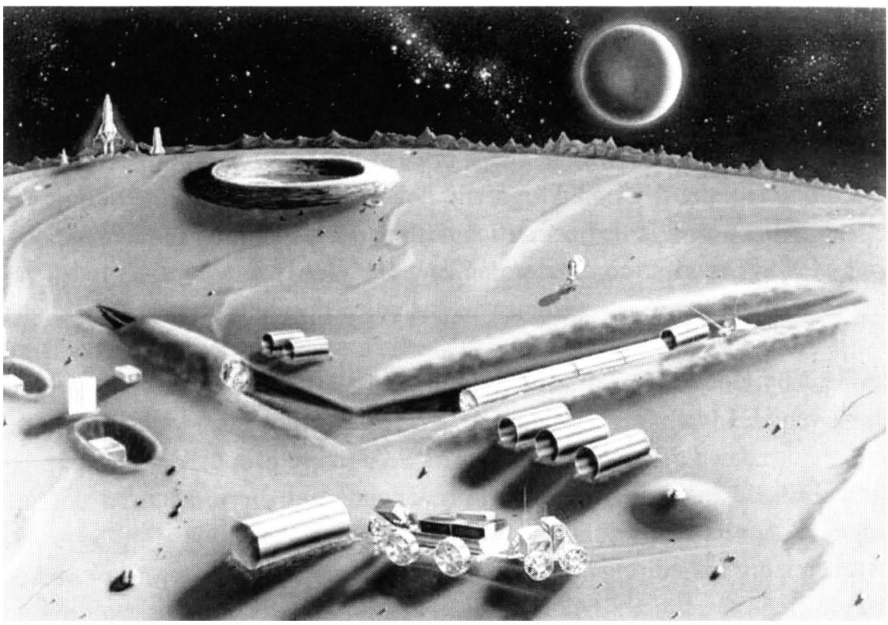

Figure 1–3: Artist's concept of the lunar outpost (from Project Horizon Report).

Meanwhile, on 1 October 1958, the National Aeronautics and Space Administration (NASA) had been created by an act of Congress and a National Policy was established that called for "The Peaceful Uses of All Space Assets." An open question subsequently being debated through 1959 and early 1960 was whether the Army rocket team in Huntsville should be transferred to NASA or to the U.S. Air Force. Therefore, given the increasingly unlikely prospect that the Army would be authorized to occupy the Moon, the Secretary of the Army suggested that Project Horizon be recast as a national project. Frank Williams, Koelle's deputy, who had led the project presentations to Army officials in Washington, drafted most of the report revisions. The principal modification was removing the flavor of an Army base and eliminating the military objectives. In a few days, the revised national Project Horizon was published [8]. This then secret

document circulated in the highest government circles. On 7 March 1960, a copy of the revised Project Horizon was transmitted to T. Keith Glennan, NASA Administrator, from Herbert F. York, Director of Defense Research and Engineering, DOD. [9].

NASA Career in the U.S.

On 1 July 1960, after a presidential decision, the Marshall Space Flight Center (MSFC) was formed as an element of NASA. Responsibility for developing the Saturn family of vehicles was transferred to the new Center. The former organization headed by Koelle became the Future Projects Office, with the role implied by its name. As was standard practice when the preliminary design phase was completed, the detailed design and development phase of the Saturn vehicles became a function of a Project Office with major support by the technical laboratories of MSFC and its contractors.

The Future Projects Office was asked to do many forward-looking tasks. This is illustrated by a collection of Koelle's "weekly notes" to von Braun, as compiled by Koelle himself [10]. One critical aspect of reliability of large rocket launch vehicles is system engineering, a relatively new concept in the 1960s. In a weekly note dated 30 October 1961, Koelle wrote, "More than 200 reports have been submitted to this office for evaluation and inclusion into a ten-volume collection of reports demonstrating MSFC systems capability." Here again, Koelle was exercising his editing skills. Emphasis on system engineering played an important role in the success of the Saturn Programs.

While nurturing the Saturn Program and documenting the system engineering it required, Koelle found time to complete another major editing effort. He identified and convinced 140 subject matter experts to write appropriate parts of a massive *Handbook of Astronautical Engineering*. The list of "contributors" reads like a Who's Who in astronautics in 1960. Koelle edited the 1,850-page handbook, which was published in 1961 [11]. The publication was timely because 1962 brought the need to introduce many new engineers to an exceedingly ambitious new effort.

On 25 May 1961, President John F. Kennedy committed the United States "to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to Earth" [12]. Although it is difficult to document conclusively and quantitatively, there is reason to believe that the analyses in the Project Horizon report helped convince President Kennedy that missions to the Moon were technically feasible. To the extent this may be true, the Koelle-Williams effort on Project Horizon played an historic role.

From 1962 onward, the Future Projects Office played a key role in evolving the plans for the Apollo lunar missions and their sequels, such as a space station (*Skylab*). However, Koelle did not remain in Huntsville to participate in the lunar landings. Remarkably, he had found time in 1963 to complete his Dr.-Ing. at the Technical University in Berlin. This qualified him for a German academic position. In 1965, he accepted a professorship of space technology at the Technical University Berlin [1]. Thus had Heinz-Hermann Koelle completed an amazingly productive decade in the United States.

Final Career in Europe

After returning to Germany in 1965 and becoming a space technology professor in Berlin, Koelle soon expanded his involvement in international technological societies. In 1966 he was elected to membership in the International Academy of Astronautics (IAA). He was active in the affairs of the IAA for the rest of his life. From 1985–1997 he served as chairman of its Subcommittee on Lunar Development. He thus continued for many years his early interest in settlement of the Moon. When this subcommittee was originally organized in 1985 at the International Astronautical Federation Congress in Stockholm, it was titled the "Return to Moon Committee." For subsequent Congresses, the committee compiled relevant information about future lunar activities. A preliminary report by the committee with the title "The Case for an International Lunar Base" was published in *Acta Astronautica* in 1988 [13].

The International Astronautical Federation (IAF) is composed of organizations, such as national institutes, that represent astronautical interests. The IAF organizes the annual International Astronautical Congresses held at various venues around the world. Koelle was vice-president of the IAF from 1967 to 1969.

Still later, for nineteen years until his death, Koelle was the coordinating editor of *Lunar Base Quarterly*, the publication of the IAF/IAA Lunar Development Forum. This forum is an informal group whose members observe and participate in the public discussion of current and future activities to return to the Moon and beyond.

Heinz-Hermann Koelle retired from the Technical University Berlin in 1991. He died in Berlin on 20 February 2011. Of course, he had received many awards and recognitions [1]. From a historical perspective, his most demonstrable contributions to space development probably occurred during his decade in the United States. Although he did not remain in the United States through the lunar landings, he was one of the people who contributed significantly to their accomplishment.

Koelle was disappointed that many years passed without mankind returning to the Moon. Always a writer and editor, he reflected thoughtfully on the history of lunar affairs in an article, "Opening the Door for a New Phase of Space Development and a New Generation of Space Vehicles" in the issue of the *Lunar Base Quarterly* published a month before his death [14].

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