"Two sides of the Moon" by David Scott and Alexei Leonov

This paper presents a review of the book "Two Sides of the Moon" by David Scott and Alexei Leonov, co-authored by Christine Toomey [1]. The book was published in 2004, originally in Great Britain by Simon & Shuster; all information in this paper is based on the 2004 US edition [1]. The review consists of 4 parts which are provided below:

- A critical examination of the book's authors and content
- A critical examination of the book's sources
- An assessment of the book's relevance to the larger Apollo project context
- An analysis and discussion of an engineering decision described in the book

Critical Examination of the Book's Authors and Content

"Two sides of the Moon" is a book about human spaceflight in the United States and in the Soviet Union / USSR with a particular focus on the early human spaceflight programs and lunar missions. The primary authors, David Scott, and Alexei Leonov, are uniquely qualified to write about this subject given their personal experiences: cosmonaut Leonov flew on Voskhod 2 (and performed the first Extra-Vehicular Activity ever), and commanded the Soviet contribution to the Apollo-Soyuz Test Project (ASTP), the first joint US-Soviet human spaceflight in 1975, and headed crew operations for the Soviet manned circumlunar flight program called Zond, and later the Salyut space station program. Astronaut David Scott flew on the Gemini 8, Apollo 9 missions and commanded the Apollo 15 mission [2], the fourth manned landing on the Moon.

"Two sides of the Moon" is written in the form of a dual alternating autobiography: both authors describe aspects of their life before, during, and after their participation in the space programs of their nations from a personal perspective; the accounts are alternating, describing roughly equivalent time periods. The biographies of the two men have many parallels: both were trained as fighter pilots before joining the space programs, served in management positions within their respective space programs, and after that went to industry. In the course of the space race of the 1960s Alexei Leonov and David Scott got to know each other, and briefly worked together during the preparatory phase of ASTP. The decision for writing the book was made in the mid-1990s.

However, given the nature of the involvement, location, and point of view of the authors, "Two Sides of the Moon" goes beyond a pure dual autobiography. It also provides:

- A technical eye-witness account of major achievements and complex operations in human space flight: descriptions such as that provided by Leonov on his first EVA, or by Scott on lunar surface EVA and living in the Apollo LM are similar in character to information captured in technical post-mission debriefings and offer experience and information that can be used for re-design and improvement of equipment and procedures for such activities. The book offers a number of descriptions on this nature, in particular related to spaceflight accidents such as the N2O4 poisoning of the Apollo ASTP crew, or the decompression accident and loss of crew on Soyuz 11.

- Insight into the practical workings of the respective Soviet and US human spaceflight management structures and organizations; this is essential complementary information to the documented organizational charts and performance data available through "official" documentation. This is especially significant in the case of the Soviet space program for which significantly less information and documentation is available in general.
- An implicit documentation and comparison of two very different world views and two different cultures and societies: Leonov offers the thoughts and impressions of a highly educated and critical, but also privileged member of the Soviet society "elite". Scott contributes the point of view of a Western / American officer with emphasis on the values of the "free world". Scott's and Leonov's account of their disagreement over views and values included in the book illustrates this point.
- Historical context for the space race with regard to the US, Europe, and the Soviet Union: both men grew up and were educated in a time characterized by World War II and the initial Cold War period, and both men traveled exhaustively as part of their job, and had an opportunity to meet historical figures such as Neil Armstrong, Yuri Gagarin, Wernher von Braun, US Presidents Nixon, and Ford, and Soviet leaders Khrushchev and Breshnev personally. This provides the book with a broader historical significance.

Critical Examination of the Book's Sources

The main sources of the book are the personal accounts of the two main authors. Due to the significant time that has elapsed between the events that constitute the focus of the book (manned lunar missions and ASTP) and the writing of the book (1995 - 2004), both Scott and Leonov must be considered secondary sources. Due to their positions in their respective space programs, the authors are capable of offering a significant level of detail that may in some cases supersede that available in official documentation. Another type of information that is not provided in the official documentation at all is, of course, the personal feelings and thoughts of the authors while executing their missions. It should also be noted that in some cases the authors are the only (remaining) direct sources (or one of the few remaining direct sources) for a particular type of experience or information, such as EVA in the Voskhod space suit and from the Voskhod spacecraft in the case of Leonov, or lunar landing and EVA at Hadley-Rille in the case of Scott.

In addition to their personal recollections, "Two sides of the Moon" provides a bibliography with references which fall primarily into the following categories:

- Books and autobiographies from fellow astronauts or engineers / managers who partook in the space race (e.g. books by Michael Collins or Chris Kraft); interestingly, these references are predominantly from individuals associated with the US space program.
- Third-party biographies and historical analyses of the US and Soviet human spaceflight programs and important individuals, such as von Braun.
- Mission- and program-related official documents such as the Apollo 15 mission report or Apollo program references.
- Books and documents concerning lunar geology.

References for bibliography items are not directly provided in the text; it is therefore difficult to assess what the specific intent of including the individual references was beyond "further reading".

Relevance of the Book to the Larger Apollo Project

Given the extensive body of literature for the Apollo program that has been built up over the past decades, it is justified to ask what the specific contribution of "Two sides of the Moon" to the understanding of the larger Apollo Project exactly is. Based on my reading of the book and my knowledge of the available body of literature, the following contributions of "Two sides of the Moon" to the understanding of the Apollo project are unique and unprecedented:

- Scott's and Leonov's personal accounts of their missions
- An informed side-by-side comparison of US and Soviet activities to develop, manufacture, and operate lunar exploration systems, carried out by two men who were deeply involved in all aspects of the programs
- A comparison of the Soviet and US space programs (and their successes and failures) as viewed by a member of the competitor's team and someone involved in each program

These contributions are, in my mind, very important to understanding the Apollo program in its historical and societal context, and make "two sides of the Moon" an worthwhile read and an important part of the Apollo literature; perhaps more important than another pure astronaut's biography.

A number of other contributions are neither unprecedented nor unique, but can still offer significant additional insight into the workings of the Apollo program:

- The structure and organization of flight crew selection, training, and operations in both programs
- Information on US and Soviet spacecraft
- Information on US and Soviet spaceflight accidents and root causes
- Information on the historical context of the space race and the post-war and initial Cold War periods
- Descriptions of historical individuals associated with the space programs

Discussion of a Selected Engineering Decision

This book review concludes with the analysis of a specific engineering / operational decision made during Apollo that is described in "Two sides of the Moon". The decision selected was that to reshuffle the Apollo mission sequence in 1968 and send Apollo 8 to the Moon, and its relation to the decision to launch Voskhod II and Leonov's struggle to fly Zond 8 as a manned mission. The decision to fly Apollo 8 to the Moon and its perception by Leonov is described in Chapter 8, "Did you see god?". According to Scott, the option to move the E mission (CSM in high Earth orbit, became Apollo 8) before the D mission (CSM and LM in LEO, became Apollo 9) and make it a lunar orbital mission was initially proposed by George Low, the Apollo spacecraft program manager. The historical context for this proposal was the publicly known fact that the Soviet Union had carried out a number of supposedly successful unmanned flybys of the Moon using Zond

spacecraft, which were capable of carrying humans. Although Scott did not have access to intelligence information, he suggests that the proposal may have been prompted by indications that the next Zond flight might have been crewed and the Soviets could have beaten the US to a circumlunar flight.

Carrying out a lunar orbit mission on Apollo 8 offered several advantages: the LM (which was delayed) was not required for the mission, and any Soviet circumlunar attempt could be pre-empted and surpassed by entering lunar orbit. The major downside of the mission was risk: it involved crewed launch on top of a Saturn V (not accomplished to that point, only 2 Saturn V launches overall at that point), and reliance on the Service Propulsion System engine for Trans-Earth Injection (TEI), a maneuver which absolutely had to work. While these risks were significant, it should be noted that the SPS was proven to be extremely reliable on Apollo 7 with a large number of burns during the mission; also the SPS would be used for mid-course corrections prior to committing to Lunar Orbit Insertion (LOI) while Apollo 8 was on a free-return trajectory, thereby allowing for a thorough analysis of actual engine performance. With regard to the Saturn V, the risks to the crew and the mission were no different for the Apollo 9 mission (which was supposed to go first in the old mission sequence), because it was supposed to launch on a Saturn V as well. Taking into account that these risk factors were two among many, the actual risk of Apollo 8 may actually not have been that much greater than that for the originally planned Earth orbital mission with the CSM and the LM. The choice of a circumlunar mission for Apollo 8 therefore seems justified given the political and programmatic benefits the mission offered.

Concluding the discussion a short assessment of Leonov's opinion on the Apollo 8 decision shall be provided here. In "Two sides of the Moon", Leonov states that he and his fellow cosmonauts were incredulous when they heard about the decision to launch Apollo 8 around the Moon; supposedly in the Soviet program it was customary to carry out two successful uncrewed flights before committing a crew to the same mission (Apollo 8 would have been the first of its kind). Leonov's argument, however, seems to be inconsistent with his decisions and opinions on two other missions that he was involved in: in "Two sides of the Moon" he describes how the uncrewed test mission for his Voskhod II mission failed and left only one spacecraft to carry out the mission. Asked (and urged) by a suggestive Korolov, Leonov and his commander agreed to fly the mission without any successful uncrewed test, accomplishing the first EVA. The second occasion where Leonov seems to ignore the rule is his volunteering to fly a manned Zond mission to beat the Americans to the circumlunar flight, albeit no fully successful Zond mission had been carried out. These two instances seem to suggest that Soviet cosmonauts were actually willing to take extreme (perhaps unjustifiable) risks for the sake of accomplishing space firsts.

References

[1] Scott, D., Leonov, A., Toomey, C., Two Sides of the Moon, Thomas Dunne Books,

St. Martin's Press, New York, 2004.

[2] Apollo Program Summary Report, NASA JSC-09423, 1975.