On the NASA/SDIO Clementine Moon/Asteroid Mission

On August 21, 1992, Space Studies Board Chair Louis J. Lanzerotti and Committee on Planetary and Lunar Exploration Chair Larry Esposito sent the following letter to Dr. Simon P. Worden, deputy of technology at the Strategic Defense Initiative Organization, and Dr. Wesley Huntress, director of NASA's Solar System Exploration Division.

The Integrated Sensor Experiment (hereafter referred to as the Clementine mission) is primarily a Department of Defense mission intended to perform space verification of certain spacecraft subsystems. In one mission concept for the experiment, scientific data about the Moon and an asteroid could be returned while achieving the mission's primary objectives. As a result, the Strategic Defense Initiative Organization (SDIO) has engaged NASA's participation in mission planning in a consultative role regarding potential science content of the mission.

The Space Studies Board is the National Research Council's principal advisory body for civil space research. 1 In support of this broad responsibility, the Committee on Planetary and Lunar Exploration (COMPLEX) is charged with advising the Board on "the entire range of planetary studies that can be conducted from space." 2 This advisory purview includes "carrying out studies, monitoring the implementation of science strategies, and providing recommendations to NASA and other government agencies." 3 Thus, the Board and COMPLEX have examined the proposed mission and its position in NASA's wide-ranging program of planetary exploration.

COMPLEX and the Board recognize that initiation of the Clementine mission and of its possible successors raises a number of national science policy questions beyond the technical issues addressed here. Please note that the Board recommendations presented in this letter and in the accompanying scientific assessment prepared by COMPLEX do not address these broader issues. The letter and assessment also do not consider any aspects of the responsiveness of the Clementine mission to national security needs.

In this context, COMPLEX was briefed on the Clementine mission at a meeting in Washington, D.C., on April 27-28, 1992. The attached assessment presents the

committee's analysis of the extent to which the expected data return from Clementine addresses past COMPLEX recommendations for scientific exploration of the Moon and asteroids. 4,5,6 In this assessment, COMPLEX concludes that "Clementine's observations of the Moon and of the asteroid 1620 Geographos provide a significant opportunity to advance our scientific understanding of these objects."

COMPLEX also advises, and the Board concurs, that maximizing the scientific return from Clementine requires that a group of researchers be charged specifically with responsibility for carrying out the scientific aspects of the mission. Some aspects of these responsibilities (principally filter selection—see Attachment) are currently being discharged by a Clementine Science Working Group assembled by NASA's Office of Space Science and Applications (OSSA). In past NASA planetary missions, selection of science teams by peer review has helped ensure fairness and the best achievable science return by engaging the broadest possible community involvement in planning and execution of these missions. The Board and committee therefore recommend that NASA establish a science team for Clementine through a peer review process. Since this recommendation is not intended to reflect adversely on the membership of the current ad hoc Science Working Group, one approach would be to appoint the present Science Working Group members to the science team and then enlarge this science team by a traditional peer review process. The expanded duties of this team would include conducting, or assisting with, scientific calibration and documentation of the selected instruments, validating and archiving scientific data, possibly carrying out scientific studies with the acquired data, and, where appropriate, executing ground-based correlative studies. The science team should remain in place throughout the duration of the mission. The Board notes that it would recommend a peer-reviewed approach to science team formation for flight programs in any of the other space research disciplines within its purview.

In connection with the duties of a science team, the Board and committee recommend further that the Clementine mission incorporate plans and procedures for data archiving to provide data access by the scientific community at large. A successful scheme for the management of scientific data should embody the following principles: 7

- data formats to be designed for ease of use by scientists,
- appropriate ancillary data to be supplied with primary data,
- data to be processed and distributed in a timely manner, and
- proper documentation to accompany all data sets that have been validated and prepared for archival storage.

NASA's Planetary Data System (PDS) was established in accordance with these principles, and the Board and committee recommend that scientific data from Clementine be deposited in the NASA PDS to facilitate use by the scientific community at large.

The Board notes that an effective collaboration between NASA and SDIO on this mission may require that OSSA assume certain responsibilities (such as those recommended above) and cover corresponding expenses in support of the scientific component of the mission. In doing so, OSSA should carefully scrutinize these projected costs and evaluate them in light of the expected science returns and competing budgetary needs of other deserving space research programs.

The Board and COMPLEX look forward with interest to the development of the Clementine mission and plan to offer continued guidance on scientific aspects of the program.

1 National Academy of Sciences President detlev Bronk, June 26, 1958.

2 *Assessment of Solar System Exploration Programs: 1991,* Committee on Planetary and Lunar Exploration, Space Studies Board, National Academy Press, Washington, D.C., 1991, page 3.

3 Reference 2, page 3.

4 *1990 Update to Strategy for Exploration of the Inner Planets,* Committee on Planetary and Lunar Exploration, Space Studies Board, National Academy Press, Washington, D.C., 1990.

5 *Strategy for Exploration of the Inner Planets: 1977-1987,* Committee on Planetary and Lunar Exploration, Space Studies Board, National Academy Press, Washington, D.C., 1978.

6 *Strategy for the Exploration of Primitive Solar-System Bodies—Asteroids, Comets, and Meteoroids: 1980-1990,* Committee on Planetary and Lunar Exploration, Space Studies Board, National Academy Press, Washington, D.C., 1980.

7 *Data Management and Computation, Volume 1: Issues and Recommendations,* Committee on Data Management and Computation, Space Science Board, National Academy Press, Washington, D.C., 1982.

Scientific Assessment of the Strategic Defense Initiative Organization's Integrated Sensor Experiment (Clementine)