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ETHICS AND THE CONQUEST OF SPACE: FROM PEENEMUNDE TO MARS AND BEYOND

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ABSTRACT

Mankind's entry into outer space has presented ethical concerns since the dawn of the space age. From the fabrication and use of the Vengeance rockets in World War II, to the pollution and contamination of space and celestial bodies, ethical considerations can be raised in virtually every application of space activity. These ethical concerns are an inseparable part of the jurisprudence of outer space. While legal elements are actively discussed, the ethical questions have not received similar attention. This article identifies and discusses some of the primary ethical issues presented by the past, present and projected future activities of mankind in the use and exploration of outer space.

I. INTRODUCTION

The law of outer space is a reflection of a catena of considerations, including national security, international responsibility, and concerns. From the principle of freedom of exploration and use of outer space, to environmental protection, and the return of astronauts and other envoys of mankind, the *corpus juris spatialis* embodies and expresses obligations with an undeniable ethical component. Indeed, ethical issues can be found in virtually every aspect of the expansion of mankind from the confines of planet Earth. The legal issues and implications of the space age have been the subject of active debate and discussion. In recent years, the ethical considerations of mankind's conquest of space have begun to receive the focus of attention.

II. THE NATURE OF ETHICS

The concept of ethics is imprecise, yet ethical guidelines are essential for the conduct of human interrelationships. The dictionary definitions of "ethics" include "the philosophy of morals," and "any set of moral principles or values."[1] The Encyclopedia of Philosophy[2] does not itself contain a definition of "ethics," but rather lists dozens of cross references to specific sub-topics such as ethical subjectivism,

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1. THE AMERICAN HERITAGE DICTIONARY OF THE ENGLISH LANGUAGE 450 (1979).

2. 3 ENCYCLOPEDIA OF PHILOSOPHY 81 (P. Edwards, ed. 1967).

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conscience, history and value judgments, moral sense, religion and morality, moral and legal, and ultimate moral principles.

A common thread to these sub-topics is that ethics are founded on moral values. But morals are highly subjective. Nevertheless, a code of ethical obligations must be objective in its application, and derived from common standards. There are some moral values on which there is virtual unanimity in a civilized society. For example, there can be no debate that slavery is immoral, unethical and reprehensible.[3] That value judgment, however, is reached through the prism of modern society. At its inception, slavery was considered to be a moral and ethical development. Historically, the prevailing custom in the ancient world had been to utterly destroy one's enemies, for the victor to vanquish the defeated. The concept of taking prisoners alive did not exist. Slavery began as a humane alternative to this practice, as captured enemies were put to labor instead of death.[4] Ethics it seems, like physics, is relative.

III. METHODOLOGY

The study of ethics and outer space activities has prospective as well as retrospective implications. While the development of international instruments embodying ethical considerations must look to activities to be conducted in the future, it is important that the perspective of history not be lost, so that, in the words of George Santayana, we will not be condemned to repeat the mistakes of the past. For the preparation of this paper, we drafted a preliminary, non-exhaustive list of issues we believed were presented by the development of space technology. We also discussed various aspects of the topic and solicited comments from a small number of friends and colleagues. This was not done with scientific precision, but we did endeavor to include a relatively representative sample of legal and scientific interests in space, as well as some individuals not professionally involved in space.

There is a small but growing body of literature referencing the subject of ethics and outer space which was consulted. Included is Francis Lyall, *Long-term Expeditions and Extra-terrestrial Bases: The Protection of Astronauts as a Matter of Law*;[5] Marcia Smith, *The Vision for Space Exploration: Expanding the Envelope for Space Law Debates*;[6] Mark Williamson, *Space Ethics and Protection of the Space Environment*;[7] and Lotta Viikari, THE ENVIRONMENTAL ELEMENT IN SPACE LAW *Assessing the Present and Charting the Future*.[8]

A detailed study of the subject of the ethics of space has been conducted by the UNESCO World Commission on the Ethics of Scientific Knowledge and Technology (COMEST). In 2004, the UNESCO Executive Board adopted a resolution "concerning the advisability of drafting an international

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3. For a discussion of the nexus between slavery and the space age see section VI *infra*.

4. *See generally* W. DURANT, THE STORY OF CIVILIZATION, OUR ORIENTAL HERITAGE, chap. 1 (1935).

5. In press.

6. 32 J. SPACE L. 217 (2006).

7. IAF Paper No. IAC-02-IAA.8.1.03 (2002).

8. Doctoral Dissertation (2007).

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declaration on the ethics of outer space. . . ."[9] In furtherance of this goal, a preliminary document was drafted, entitled *The Ethics of Outer Space: Policy Document*, which contained suggested provisions for a proposed treaty. In addition, COMEST has participated in international conferences, including the ESA/UNESCO Joint Workshop in October, 2004 on "Legal and Ethical Frameworks for Astronauts in Space Sojourns," the ESA "Ethical and Legal Working Group on Planetary Protection, Exobiology and Manned Exploration of Space," and the ECSL Practitioners Forum "New Issues in Earth Observation and Data Policy" in March, 2004.

IV. COMEST AND THE ETHICS OF OUTER SPACE

UNESCO, acting through COMEST, prepared a detailed, preliminary report on the ethical implications of space activities entitled "The Ethics of Space Policy."[10] This preliminary study was summarized in the *Ethics of Outer Space: Policy Document*, which set forth the framework of a proposed treaty. COMEST noted that the transformation of the "Ethics of Space Policy" into a policy document must be an: "Affirmation of ethical principles that can be a basis for an international instrument. They must not be redundant with existing space treaties or reopen unnecessarily some already pacified debates."[11]

This statement by itself is a reflection of subjective, moralistic values. Leaving aside the matter of redundancy with other instruments (which is not an uncommon occurrence in international texts), the admonition to avoid reopening "some already pacified debates" is a moral judgment which begs the question. On a philosophical basis, it can be questioned as to why any issue should be declared off limits at the beginning of the discussion. On the other hand, there is a clear benefit in leaving settled issues out of the debate, as such settled areas provide, at a minimum, a set of common standards and ground rules on which the discussion can proceed.

The *Ethics of Outer Space: Policy Document* sought to articulate some of these common standards. The document stated that the principles of international space law are moral obligations as much as they are legal constraints. In addition, ethical requirements may be applicable even where legal requirements are absent. According to the COMEST proposed treaty:

> The ethics of outer space has special status because:
> - Space and celestial bodies in particular are non appropriable,
> - Space technology has a significant impact on technology used on earth,

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9. COMEST, *The Ethics of Outer Space Policy Document* at 3, http://portal.unesco.org/shs/en/ev.php-URL_ID=1959&URL_DO=DO_TOPIC&URL_SECTION=201.html [hereinafter referred as "COMEST, Policy Document"].

10. ALAIN POMPIDOU, THE ETHICS OF SPACE POLICY (2000), http://portal.unesco.org/shs/en/file_download.php/97b03b0164b6882267db490 323941e56Ethics+of+Space+Policy.pdf.

11. COMEST, *Ethics of Outer Space: Starting Point - Rereading the Ethics of Space Policy*, http://portal.unesco.org/shs/en.php-URL_ID=6353&URL_DO=DO_PRINTPAGE&URL_SECTION=201.html [hereinafter referred to as "COMEST Starting Point"].

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- Space technology allows unprecedented monitoring of the earth and the activities and communications of its inhabitants,
- Scientists have special responsibilities to meet the highest standards in order to guarantee the safety and well being of the persons involved,
- Governments have special responsibilities in order to safeguard present and future generations from potential harm and damages.[12]

The proposed international instrument was reviewed by a relatively small group of experts[13] (approximately 25 individuals), and a report was submitted to COMEST in 2005.[14] Even with this small group of respondents, consensus on basic concepts was elusive. For example, just in the passage quoted above, objections were raised to the references to special responsibilities for both scientists and governments. In recognition of the subjective nature of space ethics, COMEST has concluded that "On the basis of the consultations, the likelihood of reaching consensus on principles seems to be low."[15]

V. Survey of Ethical Issues

The results of our informal survey were consistent with the results of the consultations conducted by COMEST. Although we received numerous responses identifying issues extending from the novel to the mundane, we also received many responses which were either contradictory or diametrically opposed to each other. Thus, the attainment of any consensus does appear to be an elusive aspiration. One respondent objected to the equating of morality with ethics as a matter of definition. Another response objected to the use of the term "conquest" in the title of this paper, as it may carry negative connotations. In addition, one person took issue with the entire subject matter, as being too speculative and questioning our, and their own, ability to discuss the issues in a cogent manner. This comment was in direct contradiction to the prevailing sentiment, which was that the topic was deserving of in depth study across disciplinary lines.

A. *Ethics and Astronauts and Other Envoys of Mankind*

The issues identified by the survey fall into several broad categories. One of the most commonly identified issues relates to the well-being of astronauts, and these are among the most important, as they include matters of life and death. Questions were raised about the rights of astronauts to information, disclosures,

12. COMEST, Policy Document, *supra* note 9, at 4.

13. The use of the term "expert" is somewhat imprecise in this context, as COMEST has observed that there are no specialists in space ethics. COMEST Starting Point, *supra* note 11.

14. COMEST, *Report of the Consultation on the Draft Policy Document on the Ethics of Outer Space* (January 2005), http://portal.unesco.org/shs/en/file_download.php/b0fed2ec49b351deb0c8c485e17bfb77Consultationreport.pdf.

15. COMEST, *Ethics of Outer Space: Activities*, http://portal.unesco.org/shs/en/ev.php-URL_ID=6354&URL_DO=DO_PRINTPAGE&URL_SECTION=201.html.

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informed consent, privacy, and the applicability of basic human rights, such as embodied in the Universal Declaration of Human Rights. NASA has adopted procedural requirements and policy directives for the "oversight protection for the rights, medical safety, and well-being of human subjects involved in research,"[16] which are of "primary importance."[17]

The foregoing considerations present issues of a micro nature, in that they are matters which are personal to the individual astronaut. However, a similar list of issues can be compiled from a macro perspective, that is, from the point of view of the other crew members, or looking even further into the future, the inhabitants of a permanent settlement in space or on a celestial body. In this context, the ethics pertaining to the rights of an individual astronaut must be examined in relation to the rights of other persons who have an interest in the outcome.

A myriad of scenarios can be envisioned whereby a ship on a mission, or a facility in space or on a celestial body, is not sufficiently equipped to meet an exigent or emergency situation, whether caused by accident, illness, criminal activity, natural phenomena, etc., and choices of life and death presented.[18] The scenario can be made more complex where all of the choices are unacceptable in the abstract.[19] To some extent, these issues can be anticipated and provision made in training as well as legal documents, such as waivers of liability or other expressions of advance consent. But these provisions can raise as many questions as they answer, for example how broadly or narrowly a waiver should be interpreted, and whether advance consent was obtained with full and complete information and disclosures. COMEST has observed that astronauts have an ethic of sacrifice,[20] which implies a commitment to subjugate personal needs for the greater good of the whole. Nevertheless, COMEST also observed that there is an ethical question of the *quid pro quo* for the astronaut, that is, what should they receive in return for their personal sacrifice.

B. Ethics and the International Community

The ethics of space present issues of a macro character in contexts other than astronaut crews and facility inhabitants and residents. One such context is in relation to the international community. The existing space treaties all express these macro issues

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16. NASA Procedural Requirement 7000.1 *Human Research Subjects* (March 28, 2003).

17. NASA Policy Directive 7100.8E *Protection of Human Research Subjects*, (May 31, 2002, *as amended* June 14, 2007); *see also* 14 CFR Part 1230 (NASA) and 45 CFR Part 46 (Department of Health and Human Services).

18. Prof. Lyall, *supra* note 5, commented on art. 8(2)(b) of the Moon Agreement permitting personnel on or below the lunar surface *vis-a-vis* the burial of a deceased crew member.

19. *See, e.g.*, Fuller, *The Case of the Speluncean Explorers*, 62 HARV. L. REV. 616 (1949), which is a fictional account of trapped hikers who survive by engaging in murder and cannibalism by group consent.

20. Report of Symposium "Legal and Ethical Considerations for Astronauts in Space Sojourns" 2 (2004) http://portal.unesco.org/shs/en/ev.php-URL_ID=7191&URL_DO=DO_TOPIC&URL_SECTION=201.html (statement of Prof. Monica Konrad).

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throughout their provisions. The mandate that the Moon and other celestial bodies shall be used exclusively for peaceful purposes[21] is a fundamental ethical precept, as are the provisions concerning environmental protection,[22] freedom of access to space, and the declaration that the exploration and use of outer space is the province of all mankind.[23] In addition, the humanitarian provisions of the *corpus juris spatialis*, including the Return and Rescue Agreement,[24] reflect moral obligations as well as legal requirements.

The ethical considerations embodied in the law of outer space are not of equal clarity in their expression, such that there is a subjective element in the interpretation of the vagaries of treaty language. One respondent stated that the most important ethical issue was that of *pacta sunt servanda*, as states must act in good faith[25] in their international relations, and that the obligation of good faith is not restricted to formal treaties. Other respondents stressed the need to keep weapons from Earth orbit, and to ensure the political neutrality of interplanetary space. The fear was expressed, however, that ethical considerations could be used as a means to circumvent legal obligations.

Certain responses discussed the obligation of states to share and provide access to information and technology, and it was questioned whether the dissemination of public information from space agencies should be administered by the public agency or by a private enterprise. COMEST noted that there is a distinction between scientific, commercial, and environmental data, and raised the question "How can one define the risk of abuse of dominant position by space actors?"[26]

There was an absence of unanimity on the question of the use and exploitation of space in the first instance. The motivations of exploitation were questioned, as was the ethics of the allocation of limited government resources to space, and the subsidy of private enterprise. It was expressed that there was an ethical concern over the use of a personal political stance to hinder exploitation. On the other hand, the opinion was stated that as a

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21. Treaty on Principles Governing the Activities of States in the Use and Exploration of Outer Space, Including the Moon and Other Celestial Bodies, art. IV, *opened for signature* January 27, 1967, 28 U.S.T. 2410, T.I.A.S. No. 6347, 610 U.N.T.S. 205, *text reproduced in* UNITED NATIONS TREATIES AND PRINCIPLES ON OUTER SPACE 3 (2002)[hereinafter referred to as the "Outer Space Treaty"].

22. *Id.* at art. IX.

23. *Id.* at art. I. *See also* Treaty on Principles Governing the Activities of States on the Moon and Other Celestial Bodies, art. 11.1, *entered into force* July 11, 1984, UNITED NATIONS TREATIES ON OUTER SPACE 27 (2002)(regarding common heritage of mankind).

24. Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, *opened for signature* April 22, 1968, 19 U.S.T. 7570, T.I.A.S. No. 6599, 672 U.N.T.S. 119, *text reproduced in* UNITED NATIONS TREATIES AND PRINCIPLES ON OUTER SPACE 9 (2002).

25. Convention on the Law of Treaties, art. 26, *opened for signature* May 23, 1969, 1155 U.N.T.S. 331.

26. COMEST, Policy Document, *supra* note 9, at 10.

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matter of ethics, there should not be any exploitation of space at all. That latter opinion, however, was isolated to one respondent. The remaining respondents who commented did not question that exploitation would occur, and mechanisms were proposed to assist in the process. Included among the suggestions were better cooperation and coordination between the United Nations and the International Telecommunications Union, where expertise is complimentary and overlapping, but lines of communication are neither as broad nor as effective as they could be.

An extension of the concept of improved international coordination and cooperation is the proposal for a form of world space agency. This is not necessarily the same as the international regime referred to in the Moon Agreement, but may reflect similar ethical concerns. To the extent that a proposed agency can provide a forum for the pacific resolution of competing claims and disputes, it could be a valuable contribution to the maintenance of international peace and security. However, to the extent that such an agency may institutionalize an ethic of sharing of benefits, it may suffer from the same lack of acceptance that has beset the Moon Agreement.

C. Ethics and The Environment

Some respondents expressed concern over the responsibility of states to be good stewards of the space environment, and pointed to the obligation of intergenerational equity. In the view of these commentators, there is an ethical requirement for this generation to protect and preserve the space environment for itself as well as for generations to come. In addition, there is also a matter of international relations, as environmental contamination interferes with the rights of other participants to use, explore and enjoy that environment.[27]

Environmental contamination of celestial environments is not restricted to biological agents, but also includes discarded and spent hardware, and intrusions into and modifications of a pristine celestial body. Moreover, there is a historical element, such as preserving places like the Apollo landing sites, as well as a philosophical value to planetary protection. But there is also a view that concern over environmental protection for celestial bodies is misplaced, especially in regard to biological contamination of Mars. The argument begins from the postulate that the Earth and Mars have been exchanging meteorites for millennia. If so, it is likely that some of these interplanetary exchanges also carried examples of any life forms which may have existed on the originating planet. Thus, the argument goes, Earth and Mars already have been exposed to indigent life forms that may exist on the other, and that such exchanges and exposures have not resulted in any catastrophe.

The foregoing argument is logically flawed. Assuming that there has been an exchange of fragments between Earth and Mars, it also must be assumed that such fragments carried examples of indigenous life forms. It must be further assumed that such alien life forms were able to survive the voyage between the planets and arrived, alive, at the destination. But it can be argued that if an alien life form either cannot hitch hike on a meteorite, or cannot survive the interplanetary journey, then

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27. *See* Letter dated March 21, 1962, transmitting letter of March 20, 1962, from Chairman Khrushchev to President Kennedy, at 5, U.N. Doc. A/AC.105/2 (March 21, 1962).

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it proves the point that there is no danger of biological contamination. Nevertheless, there is a fundamental difference between the ability of an alien life form to survive exposure to interplanetary space travel, and the ability of that same alien life form to survive in a protected, sealed sample cannister returned by a terran space probe under carefully planned and executed conditions. In addition, the timing of the interplanetary exchange may be important, in relation to the evolutionary development of life forms on both sides of the exchange, as well as the prevailing environmental conditions of the recipient planet. Thus, an alien life form arriving on Earth millions of years ago may not have the same survival rate as that same alien life form with millions of years of additional evolutionary development, arriving under present day environmental conditions on Earth. Is it not ethical to err on the side of caution in this matter, or is it ethically acceptable to dispense with expensive forward and back contamination programs based solely on an unverified line of reasoning.

The protection of the environment of the Earth raises specific ethical issues. Article IX of the Outer Space Treaty obligates states to avoid adverse changes to Earth's environment from the introduction of extraterrestrial matter. Orbital debris was seen as a major source of ethical concerns, especially in regard to the intentional creation of debris, such as by the Chinese asat activities in early 2007, and the orbiting of other non-functional items, such as advertising billboards, and also human cremains. Some respondents questioned whether there is an ethical obligation to avoid the creation of debris, and if so, whether that obligation also extends to the removal of satellites and facilities, and remediation of orbits and other locations, such as LaGrange points or planetary bodies, at the end of the particular mission.

D. Ethics and Extraterrestrial Life

Fundamental issues of ethics are presented in relation to the search for alien life, especially alien intelligent life. Some responses questioned whether any alien life which is discovered should be left undisturbed. But once the discovery is made, is it already too late? Is the act of discovery in and of itself sufficient to cause a reaction by the alien life form, whether intelligent or not? Is this a case where the mere act of observing causes changes in both the observer and the observed? These issues become even more acute, and more complicated, in the event of the discovery of intelligent alien life, and lead to consideration of matters of metalaw.[28]

The International Academy of Astronautics, and the international community involved in the Search for Extraterrestrial Intelligence (SETI) have been grappling with these issues for several years. Two policy documents have been prepared dealing with the verification, announcement and response to the discovery of an intelligent signal from an extraterrestrial source.[29] A primary question is

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28. *See generally* E. FASAN, RELATIONS WITH ALIEN INTELLIGENCES THE SCIENTIFIC BASIS OF METALAW (1970).

29. IAA Position Paper, *A Decision Process for Examining the Possibility of Sending Communications to Extraterrestrial Civilizations* (2005) at Annex I (Declaration of Principles Concerning Activities Following the Detection of Extraterrestrial Intelligence); Annex II (Draft Declaration of Principles Concerning Sending Communications With

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"Who speaks for Earth?"

E. Ethics and Specific Projects

A number of respondents directed their comments to specific programs or projects. For example, ethical concerns were raised over the transmission through the atmosphere of electrical energy generated by solar power satellites. Another respondent pointed out the ethical implications regarding the use of the far side of the Moon for radio astronomy and other purposes which take advantage of the natural shielding the lunar far side provides from transmissions emanating from the Earth.

VI. ETHICS AND PEENEMUNDE

The discussion in the first part of this paper looks to the future, and seeks to relate the concept of ethics to activities yet to come. But the ethics of the space age have a historical reference as well.[30] Only two of the responses we received made any mention of the historical antecedents of Peenemunde. Both of these discussed the use of rocket technology as a weapon used to target civilians. One of these respondents passed along the quip about Wernher von Braun, that he aimed for Mars but hit London instead.

The use of rocket technology as a weapon presents a fundamental issue of ethics, however, it is not the only ethical circumstance concerning Peenemunde. As World War II entered its final days, the scientists, engineers, and other professional, technical personnel at Peenemunde were sought out by both the Russians and the Americans. The capture of top level personnel from Peenemunde by one side would not only be of assistance to their own post-war rocket programs, but also would deny that individual to the other side. The American program to bring German scientists to the United States was called Project Paperclip, and dozens of Wernher von Braun's crew and colleagues were brought to New Mexico, Texas, Alabama, and elsewhere within the United States. The Russians had their own program of capture and recruitment, and had their own collection of former Peenemunders in the Soviet Union. Both sides also had an extensive array of V2 ephemera, from component parts to virtually completed rockets.

The capture, recruitment and relocation of individuals from Peenemunde at the end of World War II raises its own set of ethical issues for all parties concerned. President Truman was aware of the ethical implications of allowing former Nazis to emigrate to America under Project Paperclip, and issued an order which excluded ardent Nazis and active supporters of militarism from entry to the United States. The State Department found itself in a battle with the Pentagon, which wanted the expertise of the Peenemunde scientists for their own military

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Extraterrestrial Intelligence), http://iaaweb.org/iaa/Studies/seti.pdf.

30. The information in this section was derived from numerous sources, including: YVES BEON, PLANET DORA *A Memoir of the Holocaust and the Birth of the Space Age* (1997); MICHAEL J. NEUFELD, THE ROCKET AND THE REICH (1995); ALBERT SPEER, INSIDE THE THIRD REICH (Touchstone ed. 1997); FRONTLINE, Episode #505, *The Nazi Connection*, (February 24, 1987)(video); THE HISTORY CHANNEL, *Modern Marvels, Nordhausen* (2000)(video); *see also* ILSE HENNEBERG, NIEDERGEFAHREN ZUR HÖLLE - AUFGEFAHREN GEN HIMMEL WERNHER VON BRAUN UND DIE PRODUKTION DER V2-RAKETEN IM KZ-MITTELBAU-DORA (2002).

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purposes, and were willing to overlook Nazi activities in the process. Ultimately, the Pentagon prevailed, and some of the files of the Peenemunde scientists were rewritten with official acquiescence (if not active collaboration) to delete references to their Nazi past.

In 1979, the U.S. Congress created the Office of Special Investigations, which sought to uncover war criminals that had been allowed entry into the country. The OSI investigated the case of Arthur Rudolph, a member of von Braun's team, and a former production chief for the V2 program at Peenemunde. Rudolph had played an important role as project manager in the development of the Saturn V rocket. However, Rudolph also had played an important role in the mistreatment of concentration camp prisoners. In 1984, rather than face charges as a war criminal, Rudolph surrendered his U.S. citizenship and returned to Germany.

It is at this juncture that the birth of the space age and ethics are forever intertwined and in irreconcilable conflict. The preceding paragraph referred to the "war crime" of "mistreatment of concentration camp prisoners," yet that phrase fails to adequately convey either the scope or the magnitude of the almost unimaginable barbarism from which the space age arose. We are all too familiar with the tragic losses of astronauts and cosmonauts that have occurred in the Soviet and American manned space flight programs. What is not as familiar is that the loss of life associated with the space age is not measured by multiples of "ten" but by the tens of thousands, and that rockets were developed on a foundation of slave labor. At the center of this horror was Camp Dora.

Peenemunde was a remote facility on the Baltic coast of Germany. Its isolated location was well suited to the secret Nazi rocket program. In April, 1943, Rudolph approved the use of concentration camp prisoners for the rocket production facility, partially for the purpose of maintaining secrecy. The first of 1200 detainees arrived from Buchenwald in June, 1943. Two months later, the Royal Air Force conducted a massive bombing raid on Peenemunde, and the German high command responded by moving the rocket production to a new hidden location, this time underground.

There was a suitable location about 250 miles southwest of Peenemunde, in the Harz mountains near Nordhausen. An old anhydrite mine had been converted to a storage facility in 1936. It was comprised of two main parallel tunnels, each 35 feet wide and 25 feet high, and almost one mile long. They were connected by 46 cross tunnels, like the rungs on a ladder. The facility was huge, comprising almost 1 million square feet, and in 1943 stored almost 4 million gallons of gasoline.

SS Reichsführer Himmler offered the use of concentration camp prisoners to expand the tunnels, build the production facility, and manufacture the rockets, under SS control. Concentration camp prisoners provided a simple means of ensuring secrecy, as the prisoners had no contact with the outside world. On August 28, 1943, the first 107 prisoners arrived at what became known as Camp Dora deep inside the mountains. They were quickly joined by thousands more, and by the end of November, 1943, the population had grown to 8,000 men, mostly Russian, Polish and French, and all living underground in the tunnels.

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The living conditions were unimaginably brutal. The men worked 12 hour shifts, and never left the tunnels. During the period of tunnel expansion, there was blasting with dynamite 24 hours per day. There were no living quarters as such, and the men had to share what meager provisions there were in the nearly freezing cold, dark, and damp tunnels. There was no clean water, no sanitation, no fresh air, no facilities, no real medical care, scant food, and for six months, no daylight. Punishment was swift and brutal, beatings for the fortunate, and death for the less so. The cranes that were used for production of the rocket were also used as a gallows, and it was very common for several bodies to be on display hanging over the heads of the prisoners.

Disease was rampant, including tuberculosis, dysentery, and pneumonia. If the men were not worked to death, they died from starvation, disease, or at the hands of the guards and Kapos, that is , German convicts who assisted the guards in administering terror. Sometimes the men would collapse from weakness or illness, and no effort was made by the guards to help them. Rather, the construction continued unabated, and countless souls had cement poured over the top of them, forever entombing them within the tunnel floors. In six months, almost 2,900 prisoners died, and a permanent crematorium was installed at Dora. In addition, approximately 3,000 more men were sent back to Buchenwald, as they were too sick and weak to be useful as laborers in the tunnels, and almost certainly were exterminated.

The prisoners expanded the tunnels by almost 135,000 square feet in seven months. Portions of the tunnels were converted to a production facility. The V2 was manufactured in an area near the center of the complex, in a section that came to be known as the Mittelwerk, or central works. Rudimentary housing for the prisoners was also constructed, and their population grew to about 19,000. Dora became the main camp of a group of concentration camps in the Mittelbau complex, which altogether held about 40,000 prisoners by March, 1945. It is interesting to note that very few of the prisoners were Jewish.

In December, 1943, munitions chief Albert Speer visited the tunnels, and in his memoirs acknowledged that the conditions were "barbarous" and mortality "extraordinarily high." Speer recounted that the entry for that day in the Office Journal recited that some of the men with him on the tour "were so affected that they had to be forcibly sent off on vacation to restore their nerves."[31] One can only imagine how brutal the conditions had to be for men who traveled with the upper echelons of the Nazi hierarchy to be so effected by merely observing the conditions of the prisoners.

Following the expansion of the tunnels, and the fabrication of the production facilities, the prisoners were put to work manufacturing the V2s. In the last 15 months of the war, approximately 6,000 V2s were built at the Mittelwerk, at times at the rate of more than 20 per day. The failure rate of the rocket was very high. Some of the failures can be attributed to the inherent complexity of the technology, and that the technology was being developed as the rocket program progressed. Some of the failures also can be attributed to the pressure of the Nazi command to produce large quantities of the rocket, even though the technology and production techniques were not refined. However, a significant number of the launch failures were the result of active sabotage by the

31. Speer, *supra* note 25, at 371.

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prisoners, which was about the only way a prisoner could rebel against his captors. It took extraordinary courage for a prisoner to intentionally sabotage a rocket, as certain death was the punishment if sabotage was suspected.

In the spring of 1945, the Allied forces were advancing on Nordhausen, and the Nazis evacuated and abandoned Mittelbau-Dora on April 5, 1945. Prisoners that were healthy enough to move were shipped out to other concentration camps. Prisoners that were too sick to move were either shot or just left at the camp. The U.S. 3rd Army arrived at Dora on April 11, 1945, and found only about 600 surviving prisoners amid countless corpses.

Pursuant to the Yalta Agreement, the area around Nordhausen was in the Russian zone, and the Mittelbau-Dora complex was turned over to the Soviets in 1945. The Russians dynamited the tunnels in 1948. In 1964, the Mittelbau-Dora Concentration Camp Memorial opened to the public. An access tunnel to a portion of the underground complex was opened in 1995, and it is now possible to visit the memorial and enter the tunnels where the prisoners subsisted, labored, and died.[32]

It is estimated that as many as 60,000 prisoners were brought to Mittelbau-Dora from October, 1943, to March, 1945. Further, it is estimated that between 20,000 and 25,000 of these prisoners perished, and half of these fatalities were linked to the production of the V2. During the same period of time, just under 6,000 V2s were produced at the Mittelwerk, and between 3,200 and 4,300 of the rockets were fired by the Nazis. These rocket attacks were responsible for 5,000 fatalities in Britain, France and Belgium. It is one of the ironies of history, of World War II, and of the birth of the space age, that twice as many people were killed by the Nazis to produce the V2 than were killed by the use of the rocket as a weapon.

It may be questioned why so much of this paper has been devoted to the history of the V2 and Camp Dora. Indeed, it is an ethical question as to whether this history should be recounted at all at this time. We were advised by a historian that the "dead horse" story of Dora had been "flogged enough," and that except for our own edification, he saw "little value in dredging up the subject again."[33] We disagree, and the results of our informal survey confirm our decision. Of all the responses we received, only one mentioned the connection between Peenemunde, slave labor, and the "morally challenged aspects of the beginnings of the space age." This was consistent with the results of conversations we have held with friends and colleagues during the years this study has been in progress, as less than a handful of individuals have indicated any knowledge of these events. Nothing can be gained by sweeping the story of Dora under the rug. Much can be gained by remembering and retelling this despicable episode of human history, so that the ease with which technology merged with barbarism will never be forgotten, and the men who perished receive the honor they deserve.

32. *See generally* www.dora.de.

33. Letter from Brig. Gen. J.H. Braun (ret.), to authors, March 21, 2000, copy on file at the offices of Sterns and Tennen.