

# 21ST CENTURY WAVES: FORECASTING TECHNOLOGY BOOMS AND HUMAN EXPANSION INTO THE COSMOS

by

**Bruce Cordell**

## INTRODUCTION

“On the following pages...may be one of the most important scientific symposiums ever published by a national magazine. It is the story of the inevitability of man’s conquest of space...(It) is not science fiction. It is serious fact...the US must immediately embark on a long-range development program...”

These stunning words appeared in 1952 in the famous March 22<sup>nd</sup> issue of *Collier’s Magazine*.<sup>1</sup> The headline asked, “What Are We Waiting For?” while the preceding page insisted that “Man Will Conquer Space Soon” and featured an image of some of the Space Age’s key heroes, including the great rocket scientist Wernher von Braun, Harvard astronomer Fred Whipple, famous space writer Willy Ley, and the unparalleled space artist Chesley Bonestell.

They were right. Only 17 years after the *Collier’s* article, Apollo astronauts Neil Armstrong and Buzz Aldrin landed on the Moon in 1969. But it is important to realize that, although we are well into the first decade of the 21st century, our economic, technological, and strategic position today—viewed in the context of long-term trends—is highly analogous to that of von Braun in 1952. In fact, it is forecast here that, in less than 20 years, we will experience the next wave of extraordinary events in space, including probably the first humans on Mars and major tourist and industrial operations in space and on the Moon. The purpose of this article is to briefly sketch answers to the following questions: 1) How can we scientifically make a forecast like this with high confidence? 2) What are

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## CONTENTS

**The Future of Collecting and Auctions**  
by James L. Halperin .....5



**21st Century Waves: Forecasting Technology Booms and Human  
Expansion into the Cosmos**  
by Bruce Cordell.....21

**The Mechanization of Mind: A Deconstruction of Two Contemporary  
Intelligence Theorists**  
by Marcus Anthony .....43

## SPECIAL FEATURE

**Best Recent Books and Reports: Selections from *Future Survey* for  
Leaders and Readers (Part I)**  
by Michael Marien .....63

we waiting for this time? 3) What are some of the near-term economic, technological, and political events we can expect that will culminate near 2025 in the greatest technology and space spectacular ever seen?

A decade ago, I wrote in *Space Policy*<sup>2</sup> that long-term trends in science, technology, and human history strongly suggested that the decade from 2015 to 2025 would be the economic, technological, and political analog of the 1960s. We should expect unprecedented “activities in technology, engineering, and human exploration... the focus will be on large-scale human operations in space.” This forecast was reasonable if one views 1960s-style space exploration within the context of other science, technology, and exploration activities of the last 200 years. Indeed, it became clear that major episodes of human exploration (e.g., Lewis and Clark), huge state-of-the-art engineering projects (e.g., Panama Canal), and exceptionally destructive wars (e.g., Civil War) cluster together roughly every 56 years near the times of economic booms. I hypothesized that a Human Exploration (HE) wave—driven mostly by intangible psychological and spiritual needs—exists with a period of approximately 56 years and could be documented over at least the last 200 years. The exploration wave is in phase with surges in macro-engineering projects (MEPs) and major wars apparently because they are driven directly by the same thing: an economic boom about every 56 years.

This empirical, historical approach enables useful predictions for the 21<sup>st</sup> century to be made solely by analogy with waves and events of the last 200 years. However, without a theoretical basis for these long-term trends, a full understanding was not possible. Two extraordinary things occurred within the last 10 years that have reinvigorated this field: 1) Professor Martin E. P. Seligman<sup>3</sup> (University of Pennsylvania) and his colleagues established the academic field of Positive Psychology in 1998; and 2) the NATO Advanced Research Workshop in Portugal on “Kondratieff Waves, Warfare and World Security”<sup>4</sup> brought together in 2005 the world’s key experts to explore the latest data and models for long waves in the economy, technology, and politics.

In particular, Seligman and the Positive Psychology Network have for the first time provided a firm, scientific basis for the value of personal optimism in human life; they’ve shown statistically through numerous studies that optimists do better in school, work, and life, and they even live longer. Positive Psychology provides the

basis for understanding the crucial importance of these extraordinary, decade-long intervals every 56 years when human curiosity—which always exists—is finally unleashed by unusually good economic conditions, producing a brief flurry of major human explorations (such as the 1960s when Apollo occurred). I refer to these ebullient decades as “Maslow Windows.” On the other hand, the NATO Kondratieff Symposium, based on highly significant long-wave analysis in 1991 by Professor Brian Berry<sup>5</sup> (University of Texas at Dallas) and others, showed that current data and analyses support more strongly than ever before the idea that long waves (with 50- to 60-year periods) can be seen in the economy, technology development, and major wars. This recent quantum leap in understanding supports my earlier tentative conclusion that long waves in the economy were somehow modulating the space program as well as earlier major explorations. In essence, current long-wave theory provides the “missing link” that explains why the unparalleled, positive vision of the human future in space did not result in continuous human explorations and settlement of the Moon and Mars since 1969. Instead, major explorations (including but not limited to space) have been limited only to decade-long Maslow Windows approximately every 56 years.

Major economic booms can be thought of as Maslow Windows. These are brief intervals when the “24/7” obsessive nature of humankind’s 200,000-year-old psycho-cultural drive to explore, is released from bondage. When the physiological, financial, and safety constraints that typically hold societies in bondage are loosened, Maslow<sup>14</sup> believed that people and societies feel freer to play, explore, and self-actualize. The last Maslow Window was in the 1960s when the US spent \$120 billion to send 12 men to the Moon. The next will be between 2015 and 2025.

In addition to major HE events like Apollo, Maslow Windows are typically inhabited by MEPs,<sup>15</sup> as well as tragic large wars<sup>16,4</sup>. In the last 200 years there is only one instance when a Maslow Window did not include all three entities, and that was in 1801 when there was no bona fide MEP<sup>2</sup>.

In summary, the two major themes of this article are: new scientific evidence for the psychosocial power of the space vision suggests it is capable of providing a revitalizing force for human civilization in the near future; and, despite its compelling nature, the space vision will not fully materialize until around 2025 when long-term

trends in economics, technology, and society are favorable again.

The newly appreciated global power of the space vision, plus the discovery of its modulation by well-documented long waves, make the timing of this next chapter in human expansion seem almost inevitable.

## THE SPACE VISION

Today, NASA's space program has regained everyone's attention, but this is often because of concerns for the safety of shuttle astronauts, and not as a result of the extraordinary prospect of human expansion into the cosmos as envisioned by President Kennedy more than 40 years ago. However, humans should have another opportunity to colonize space within 20 years. One key reason is that, when we combine ancient human obsessions about exploring far away places with alluring new high-tech capabilities, we create a powerful cocktail known as the "space vision."

For example, by 1997, entrepreneurs plan to offer the public sub-orbital flights for only about four times what a luxury suite cost on the Titanic. And Earth-orbiting, zero-gravity hotels can't be far behind. A little further downstream, imagine visiting Neil Armstrong's still-pristine footprints made in 1969 at the Apollo Tranquility Museum celebrating humanity's first landing on another world, while on your honeymoon on the Moon.

For people who are serious about colonizing space, as opposed to just visiting it, imagine the settlements and later the major cities that will grow on Mars to support a new way of human life as we search for alien Martian life.<sup>6</sup>

## NEW SCIENCE AND VISION

Human society is a complex system subject to chaos theory where accurate information is usually scarce, the future is hard to predict, and unexpected catastrophes occur. Physicists have established that large interactive systems eventually organize themselves into a critical state (i.e., self-organized criticality) in which a minor event starts a catastrophe<sup>7</sup>. Examples include falling snowflakes piling up on a mountainside until a little jiggle triggers an avalanche, or economic stresses building up until a "butterfly" effect produces a Great Depression. Because it is not possible to forecast solely by

analysis (e.g., with mathematical models and computers) in a complex system, since the whole is greater than the sum of its parts, a positive view of the future—such as the space vision—is essential to avoid negative trends and events.

The hints of a scientific revolution have swirled around us for a long time. For example, one successful businessman who was a talented skier and tennis player was instantly transformed into a quadriplegic by an auto accident. Instead of giving up, he founded a now-successful Internet-based company that links professional speakers with speakers' bureaus. His attitude was simple, "If I chose to be angry, it wouldn't change things. So I chose to be happy. I saw happiness as a choice we can make everyday." Even the hospital staff was puzzled. His doctor wrote that he had exhibited "excessive happiness," and recommended that he be isolated from family, friends, and other patients, so he could get over his denial and accept the gravity of his situation! The quadriplegic's intense optimism and its spectacular impact on his personal and professional performance is reminiscent of a famous mind/body effect known for decades as the "placebo." In this case, a person's beliefs and expectations about medical treatment may have a major biochemical effect, regardless of the pharmaceutical potential of the drug. One University of Connecticut researcher says, "The critical factor is our belief about what's going to happen to us. You don't have to rely on drugs to see profound transformation." He is convinced that the effectiveness of Prozac and similar drugs is almost entirely due to the placebo effect: i.e., the expectation of the patient.

Evidence suggests that negative vision (e.g., depression) works as effectively as positive vision (optimism). For example, depression is linked with heart disease. One California health official stated, "Treating depression, even in cases without severe impairment, may be important in both the prevention and treatment of cardiovascular disease."

For the first time, scientists have provided the empirical and statistical basis plus the key insights that firmly establish the link between our vision of the future and our prospects for prosperity, longevity, and expansion. Many revealing studies by Professor Martin Seligman<sup>3</sup> and the Positive Psychology Network show that optimists (i.e., people with a positive vision of the future) perform better in school and college, and are more successful at work and home. They are also usually healthier and typically live longer. Their work con-

firms that individuals will naturally benefit from a societal vision that is highly positive and easily communicated, and one that addresses aspirations and values of fundamental human interest.

Because personal optimism is now scientifically linked with health, performance, and success, national visions significantly guide the future by influencing individual attitudes and beliefs. In the absence of a positive societal vision, many people will not be routinely reminded of their moral and ethical foundations, nor will they be encouraged to act intuitively in socially positive and supportive ways. Most importantly, many people may not become fully integrated with their highest goals in life.

Adding urgency to this story is commentary by one of the 20<sup>th</sup> century's greatest sociobiologists, Rene Dubos: "The most distressing thing about the modern world is not the gravity of its problems...it is the dampening of the human spirit...Our very survival as a species depends on hope." Von Braun's concern was that—analagous to the 15<sup>th</sup> century Chinese who inexplicably pulled back from their new frontier (e.g., North America)—the "dampening" of our spirit and the lowering of our "hope" might be the troubling signs of a sputtering civilization that has hesitated too long at the portals of its new frontier; i.e., the one that we opened in 1969, when men first stepped onto the Moon.<sup>10</sup>

In addition, Seligman—father of the Positive Psychology Movement—states we are in an "epidemic of depression, one that through suicide takes as many lives as the AIDS epidemic and is more widespread." A popular notion among some political commentators is that "one US institution after another is losing its legitimacy among the people." Some view what's going on today as a kind of "social disintegration" that will lead to a "huge social upheaval in the US and abroad."

This is not good news for individuals trying to cultivate personal optimism or a vulnerable generation of young people whose vision of the future is dominated by drugs, MTV, and global terrorism.

## WHY NOT NOW?

In 1989, at a meeting of scientists, administrators, and corporate leaders in Aspen, Colorado, NASA chose to ask the big questions: What about sending humans to Mars? What is it about the space vision?

It was clear in that Aspen meeting<sup>11</sup> that space is a highly visible, highly positive, adventure-saturated symbol of human exploration. Indeed, the space vision's powerful connections with fundamental human values (especially teamwork, exploration and search for truth mega-technology), its versatility in terms of potentially including other visions of the future (e.g., globalization, nano- and biotechnology), and its impressive parallels with historically successful visions as identified by Polak,<sup>8</sup> suggest strongly that the space vision may be civilization's most culturally powerful vision of the future. If such a liberating vision were ever to be embraced by our civilization, it would trigger a reinvigoration of modern institutions and life that would ultimately penetrate to our core.

So if Space is really this stimulating, why isn't its colonization happening now? And why did it die so ingloriously in the early 1970s, when the last three Apollo missions were abruptly canceled even after the monumental Saturn V launch vehicles had been built?

One problem is lack of commitment and questionable marketing. Space opportunities that are framed in terms of fundamental human values and needs will be perceived as positive. For example, in 1992 I published a detailed concept for an international space agency<sup>12</sup> in which the US, Japan, the European Space Agency, and Russia would share power equally. All other countries would have continuous opportunities to contribute and to share governance.

Space colonization requires a large initial investment of money, people, and resources, and major exploratory thrusts (like space) are usually precluded except at times of societal peace and unusual prosperity. That's the fundamental reason that the post-Apollo lunar base and manned Mars plans of NASA Administrator Thomas Paine went unfulfilled in 1969 and the reason they don't exist even today.

Over the last 200 years, Maslow Windows are separated by about 56 years and are part of what's known as the "long-wave" phenomenon, first recognized by the Russian economist Kondratieff<sup>4</sup> in the 1920s. His K-Waves pulsate every 50 to 60 years and are based on pricing and other economic data. Other long waves also exist including the 56-year energy use wave<sup>17</sup> discussed here. Discovered in 1989, the total energy consumption cycle is approximately sinusoidal with an amplitude of about 20% and a 56-year period; it is documented back almost 200 years. According to Modis,<sup>17</sup> "the whole world seems to be pulsating to this rhythm."

In effect, each of us—whether we know it or not—spends each

moment of our lives “surfing” the long waves until we reach a Maslow Window and have our own 1960s-style experience. Many of us get to surf through two Windows, but very few ever see three.

## EXPLORATION/MEP WAVES—THE LAST 200 YEARS

Table 1 summarizes the major events<sup>2</sup>—Human Exploration, Macro-Engineering Projects, and major wars—that cluster together, along with economic booms, approximately at the peaks of the 56-year energy cycle, over at least the last 200 years. Energy cycle peaks are in 1801, 1857, 1913, 1969, and (in the future) 2025. Secondary events are shown indented after their primary counterparts.

Major HE events are recognized by: 1) the exploration of significantly new geographical sites; 2) their ability to capture the attention of a large audience, usually of an international or global scale, for a variety of reasons, including competition, nationalism, and/or danger; and 3) expeditions that are often aided and/or enabled by state-of-the-art technology.

Jefferson’s purchase of the Louisiana Territory in 1803 from Napoleon was one of the pivotal events in world history because it triggered an expansive era (until 1870) when the United States was the fastest growing nation in the world, in both geographical area and population. Lewis and Clark opened the floodgates to colonists and resulted in the USA becoming a bi-coastal entity. The Lewis and Clark expedition is a superb example of an epochal pulse of human exploration coinciding with a peak in the energy cycle (Maslow Window #1).

The fact that Henry Stanley’s phrase—“Dr. Livingstone I presume?”<sup>18</sup>—is famous even 150+ years after the event, clearly suggests the intensity of interest in this major HE, which coincided with the 1857 energy peak (Maslow Window #2). David Livingstone was a missionary, doctor, scientist, and anti-slavery activist. He spent 30 years in Africa, exploring almost a third of the continent, from its southern tip to the equator. He returned to Britain in 1856 and received a gold medal from the London Royal Geographical Society for being the first to cross the entire African continent from west to east. Although he was from Scotland, concern about Livingstone was so high in the US and around the world that a New York newspaper sent Stanley to locate him.<sup>18</sup> However, despite his honors and world fame, in the late 1860s Livingstone had difficulty raising funds to

continue his African expeditions. Livingstone’s fate was similar to that of his spiritual brothers in exploration a century later—the initially triumphant Apollo astronauts—whose last three Moon trips were canceled to save money shortly after their energy cycle peak in 1969.

**TABLE 1 – MASLOW WINDOW EVENTS**

<b>ENERGY PEAKS: 1801, 1857, 1913, 1969, (2025)</b>	
<b>(D = Initial Event date – Energy Peak date)</b>	
<b>Major Human Exploration</b>	
Lewis and Clark/American NW (1804-1806)	D = +3 yr.
Livingstone/Africa (1852-1856; 1858-1864)	D = -5 yr.
King/American West (1863-1866)	
Peary/North Pole (1909)	D = -4 yr.
Amundsen/South Pole (1911)	
Apollo/Moon (1960-1972)	D = -9 yr.
Gargarin/1 <sup>st</sup> to Orbit (1961)	
<b>Macro-Engineering Project</b>	
None (1801)	
Suez Canal (1859-1869)	D = +2 yr.
Great Eastern Ship (1854-1858)	
Trans-Atlantic Cable (1866)	
Panama Canal (1904-1914)	D = -9 yr.
The Titanic (1907-1912)	
Apollo (1960-1972)	D = -9 yr.
Gargarin/1 <sup>st</sup> to Orbit (1961)	
<b>Major Wars</b>	
Napoleonic Wars/Europe (1803-1815)	D = +2 yr.
War of 1812/North America (1812-1815)	
Civil War/US (1861-1865)	D = +4 yr.
WWI (1914-1918)	D = +1 yr.
[WWII (1939-1945) Trough]	
Vietnam (1965-1973)	D = -4 yr.
The Cold War (1953-1962; 1979-1985)	

Although significant breakthroughs in science and technology can occur at any time, MEPs are recognized by the criteria of Eugene Ferguson<sup>15</sup>: 1) they are at the state-of-the-art of technology for their time; 2) they are extremely expensive and usually large; and 3) although sometimes practical in purpose, they are often aimed at satisfying intangible needs of a spiritual or psychological nature and are highly inspiring. Notice that this is a demanding definition that excludes many extraordinary projects like trans-continental railroads or large highway systems because, while expensive and significant, they do not usually stretch technology.

The MEPs of Table 1 are clearly the most extraordinary major engineering projects of their times over the last 200 years. For example, the Suez Canal was the technological jewel of the 19<sup>th</sup> century<sup>21</sup>. Although a small canal at the Suez site was created and temporarily operated as early as the 13<sup>th</sup> century, the 19<sup>th</sup> century canal was the brainchild of French engineer and diplomat Ferdinand de Lesseps and the Egyptian government. Initially costing nearly \$1 billion (and about 100 miles long (without Panama-style locks), the Canal was originally owned by Egyptian and French interests, until the British purchased Egypt's shares in 1875.

Although wars of all sizes occur almost continuously throughout history, only the largest wars cluster around energy cycle peaks (Table 1). The Napoleonic Wars, the Civil War, World Wars I and II, and Vietnam were clearly the worst wars of their times.

Maslow Window #2 was terminated by the Civil War (1861-1865), which was extremely destructive for America. The ratio of those in the military relative to the whole population was over 11%, a value only (slightly) exceeded by WWII. Civil War deaths exceeded 550,000 and estimated dollar costs dwarfed all other 19<sup>th</sup> century conflicts.

World War I, also known as "The Great War," brought the ebullience of Maslow Window #3 to a destructive end and was clearly the worst war of its time. Many historians believe that it led directly to WWII. In trying to understand WWII's relation to the long-wave pattern, one thing is immediately apparent: it doesn't fit. WWII was a major war that occurred at an energy cycle trough. Goldstein<sup>16</sup> explains that major wars usually occur at energy cycle peaks because that's when countries are economically able to fight them. Probably the best explanation for its timing is from historians who explain WWII as "unfinished business" from WWI.

Unfortunately, the transition from ebullient Maslow zeitgeist to catastrophe can be abrupt. For example, historians Harrison and Sullivan<sup>24</sup> comment on the social mindset just prior to WWI, “To a visitor from Mars, it must have appeared that the Western world in 1914 was on the brink of Utopia.”

Economic collapse was experienced after Window #2. According to historian Eric Hobsbawm<sup>25</sup>, “In the early 1870s economic expansion and liberalism seemed irresistible. By the end of the decade they were no longer.” Indeed, the descent from Maslow Window #2 was precipitous and deep. According to Hobsbawm, “...1873, the Victorian equivalent of the Wall Street Crash of 1929... began an unprecedented disturbance and depression of trade, commerce, and industry.” Although Hobsbawm (writing in 1975) makes no reference to long waves, it is eye-catching that *both* the Victorian Depression of 1873 and the Great Depression of 1929 started 16 years after their respective 56-year energy cycle peaks.

## 21ST CENTURY FORECASTS

Does the documented existence of Maslow Windows over the last 200 years empower us to predict events in the 21<sup>st</sup> century? Assuming that long waves will continue into the 21<sup>st</sup> century, the answer is yes and no. It is important to keep in mind that individuals have free will and are capable of making independent decisions consistent with natural laws and their own beliefs, interests, and goals. However, Maslow Windows mark the times during long waves when certain key things almost always occur—e.g., economic booms, exploring new regions, large engineering projects, a descent into war—and so they can be viewed as a framework for the future, but they do not inform us of exactly what will occur.

There is every reason to believe that long waves (i.e., K-Waves and the allied 56-year energy cycle) will continue well into the 21<sup>st</sup> century. The most obvious reason is the fact that they have faithfully pulsated for at least the last 200 years. Indeed, some historians and world system theorists claim to be able to trace economic long waves back to Sung China, about one millennium ago.<sup>4</sup>

Joseph Schumpeter (Harvard economist of the 1930s) has shown, as have many subsequent economists, that each K-Wave is triggered by the bunching of basic innovations that launch technological revolutions which ripple through the global economy and

create new leading industrial or commercial sectors. The new technologies that could propel us into the next wave are already visible and include supersonic airplanes, maglev trains, and the convergence of the nano/bio/infotechnologies. New, environment-friendly energy sources that could power the economic drive to Maslow #5 might initially include LEO satellites that collect solar energy and microwave it to Earth for use as electricity.<sup>26</sup> In the absence of a global environmental catastrophe, or something else that would disturb the development of new technologies and the economic forces which drive them, we can expect the K-Wave and 56-year energy cycle to continue indefinitely.

Several interesting trends allow specific inferences about events near 2025 during the first 21<sup>st</sup> century Maslow Window (i.e., Window #5). The forecasts include:

- There will be at least one major human exploration event; it will feature space activities on an unprecedented scale near 2025.
- There will be at least one macro-engineering project; it will be integrated with the human exploration space activities (like Apollo) and will culminate near 2025.
- There will be a major war near 2025.

WWII is unique in the last two centuries because it occurred during the energy cycle trough immediately preceding the 1969 peak (the Apollo Window). The lack of a global war in the 1990s energy trough suggests the circumstances of the upcoming Maslow Window (2015-2025) may have more in common with the Polar Expedition Window #3 (1904-1913) than the 1960s. For example, immediately following WWII and the Marshall Plan, the Western world was more unified than it has been since the end of the Cold War, and especially since the onset of the War on Terror.

From the Lewis and Clark Window #1 in 1801—when there was no Ferguson-style MEP—to the most recent Window featuring Apollo, the growth in MEPs has been consistent and phenomenal. The last three Windows have included multiple MEPs, with one being dominant. For example, during the Polar Expedition Window, the Panama Canal was dominant, while the Titanic was secondary. All MEPs were physically distinct from their corresponding HE events until the 1960s. Apollo reversed this trend and thoroughly

integrated both human exploration and MEPs into the greatest human project up to its time. This trend will continue into the 21<sup>st</sup> century.

It is highly likely that human exploration in the 21<sup>st</sup> century will focus on space because of the fact that space is the only exciting, unexplored place left to go, and because of the impressive power of the space vision in general. The arenas will include large-scale operations on the Moon and human bases on Mars. Private space entrepreneurs will serve human desires to personally visit Earth orbit and to eventually take vacations on the Moon. Because of the large up-front expense and risks, governments will still dominate deep space frontiers (e.g., Mars) during Window #5.

The National Advisory Committee on Aeronautics (NACA) was created in 1915, partly as a reaction to the outbreak of WWI in Europe to advise the US government on the development and potential uses of aeronautical technology. In 1958, NACA was absorbed by the new National Aeronautics and Space Administration, whose scope included human space exploration. NASA was formed in response to the Soviet's launch of Sputnik in the context of Cold War tensions during the International Geophysical Year. Since Maslow Window #5 will feature major international efforts toward the large-scale development and colonization of space, it is forecast here that NASA will be absorbed into a larger, global organization like the author's concept, Interspace<sup>12</sup>. Energy cycle timing and NASA's birth date allow us to forecast that the new, international space organization will take shape by 2014, clearly signaling the onset of Maslow Window #5.

During the last 200 years, all Maslow Windows have featured major wars near their energy cycle peaks. Some political scientists anticipate that our next major global conflict may occur around 2025. Although currently unknown, the detailed timing of this hypothesized war may negatively impact Maslow space enterprises much like Vietnam distracted popular support for Apollo in the 1960s. The War on Terror may continue into the 2020s and have similarities to the Cold War, including hot, asymmetric flare-ups. This global security wildcard is the greatest threat to the projected technology and space activities of Maslow Window #5.

Shortly after WWII, the United States rebuilt the economies of Western Europe with an eye toward increasing political stability, stimulating economic growth, and eventually producing good trading

partners. History has shown that the Marshall Plan was a good investment for everyone. As we move into the 21<sup>st</sup> century, it is likely that we will develop a Global Plan for Space (GPS)—basically an international Marshall Plan—as an integral part of the successor to NASA. As an outgrowth of Barnett-style globalization<sup>27</sup>, wealthy countries will provide security, infrastructure, and financial investments for a variety of GPS programs from Earth orbit, to the Moon and beyond. These initial investments will be returned many times over as less developed countries expand and prosper—economically and psychologically—from their involvement with space technologies and resources, and settlements on other worlds.

The energy cycle indicates that our next Maslow Window after 2025 will culminate around 2081. Unless we achieve independent bases on the Moon or Mars by 2025, humans will be largely confined to Earth (much like now) until our next opportunity for expansion in 2081.

## FORECASTING THE SIZES OF FUTURE MEPS

If we take seriously the model of this article that economic long waves are modulating human explorations and MEPS, it's possible to forecast the sizes of future space-related MEPS assuming they will occur near an energy cycle peak (the pattern for the last 200 years) and based on real growth in the economy extrapolated from the last 200 years. (Dollar conversions and historical GDP data are from Note #28.)

Table 2 lists the fraction of GDP expended on the last three MEPS: Suez was 0.003, Panama was 0.001, and Apollo was 0.002. Fraction of GDP is basically a level of societal commitment to a project; it's a spending priority requiring political support. Multiplying this number by the GDP in 2025 gives an estimate of the potential dollar cost of the next Maslow Window's space/MEP projects.

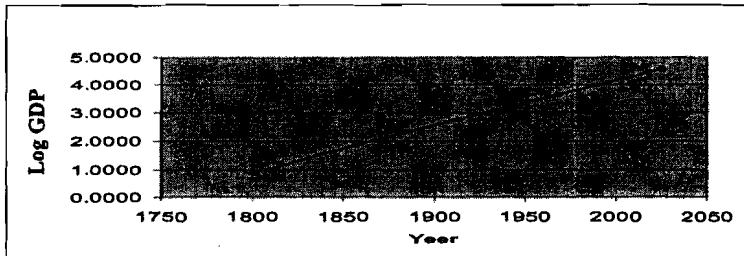
Table 2 shows real data for three MEPS: Suez, Panama, and Apollo, and three columns of projected data for 2025; all data is in US 2005 dollars and in millions of dollars (unless otherwise stated). The US GDP for 2025 is estimated using three models: 1) extrapolating historical GDPs for the four energy cycle peaks; 2) using the mean ratio of GDPs for energy peak years versus GDPs for years 20 years prior to their respective peak; and 3) simply using the GDP for 2005 (the most conservative and most unrealistic method).

TABLE 2 – MEP DATA

MEP Country		Suez GBR 1869	Panama USA 1914	Apollo USA 1969	Mars+ USA 2025	Mars+ USA 2025	Mars+ USA 2025
Year	Pre 1875						
M US\$							
Cost	44% to OBR	22.36	375	25,400			
Years		10	10	12	10	10	10
Annual Cost	100%	5.08	37.50	2,116.67			
Nom GDP (US \$)		6,898	36,500	984,600	Peaks	Ratios	2005
Real GDP (2005 US \$)		118,140	550,100	4,224,000	37,127,900	36,879,000	12,491,000
Annual costs:							
Annual cost (2005 US \$)		87.0	573	9,082	38,145	27,615	12,833
So- Annual Rel Cost 2005		1.00	6.59	104.39	438.45	317.42	147.51
Pe- Annual Rel Cost 2005		0.152	1.00	15.85	66.57	48.19	22.40
Ap- Annual Rel Cost 2005		0.0096	0.063	1.00	4.2	3.04	1.41
Frac GDP		0.00324	0.0019	0.0021	0.0010	0.0010	0.0010
Total Costs:							
Total Cost (2005 \$M)		870	5,730	108,984	381,451	276,154	128,332
Total Cost (2005 \$B)		0.87	5.73	108.98	381.45	276.15	128.33
Pe-Rel Total Cost 2005		0.152	1.00	19.02	66.6	48.2	22.4
Ap-Rel Total Cost 2005		0.01	0.05	1.00	3.50	2.53	1.18

Figure 1 is a plot of GDPs for the US economy for the four energy peak years back to 1801; all dollar values are in 2005 US \$. Since the logarithmic plot is linear, it's straightforward to extrapolate the GDP for 2025 (i.e., 37.1 T). The mean 20-year difference GDP ratio—e.g., GDP (1857)/GDP(1837)—is 2.15 (+/- 0.29); multiplying this ratio by the GDP for 2005 will extrapolate the GDP for 2025 (i.e., 26.8 T). The GDP for 2025 (12.5 T) is used simply for comparison. It's clear that the 2025 GDP will be much higher than for 2005 or long waves will have been suspended and the psychological and economic benefits of the economic boom will not produce a Maslow Window.

FIGURE 1 – US GDP vs. YEAR



Assuming a Panama-like GDP fraction of 0.001 gives us potential MEP costs of 381, 276, and 128 billion (2005 \$), and costs relative to Apollo of 3.5, 2.5, and 1.2, for 2025 GDP models based on peak extrapolations, 20-year ratios, and the 2005 GDP, respectively. A Panama-like GDP fraction of only 0.001 is a pretty half-hearted societal commitment by Apollo standards. If we assume an Apollo fraction of 0.002, all the numbers above double and it becomes clear that the US will have the capability—due to ongoing real growth in its economy especially during the next Maslow Window—to create space MEPs that will dwarf Apollo.

The Maslow #4 analog of this year (2006) is 1950, and we are now entering the economic, technological, and societal analog of the 1950s, complete with a 1950s-style zeitgeist. If you are around 60 years old or older, you should have personal recollections of this time. Some things have changed—this is an analog not a duplicate—such as the Cold War being replaced by the War on Terror, and there was no WWII analog five years ago, and the level of technology is greatly advanced versus the 1950s. However, the last 200 years of economic history indicate that the GDP between now and the next energy cycle peak in 2025 will experience spectacular real growth of a factor of at least 2.2. This economic boom will be unlike any since the 1960s and will dramatically change attitudes, activities, and goals, momentarily unleashing society's powerful Maslow exploration drives.

## A CHRONOLOGY FOR MASLOW WINDOW #5

Figure 2 shows a possible chronology for Maslow Window #5 from 2006 to about 2030 assuming that the long-wave model of this article has predictability for the early 21<sup>st</sup> century. I have shown a nominal chronology with 1:1 correspondence between Maslow #4 and #5, but the dates can be expected to vary by amounts comparable to the D values in Table 1.

Notice that in the early 1950s, people got excited about technology and space by reading about them in *Collier's*. Fifty-six years later, they will be thrilled by personally experiencing suborbital flights by private companies. The price will rapidly drop so that tens of thousands will have personally entered space by 2012. Dator<sup>29</sup> has suggested that since the Millennials—the Strauss and Howe<sup>30</sup> generation born since 1982—are “Civics,” they will be especially sup-

portive of Maslow #5 activities because Civics love technological progress, economic prosperity, and public optimism! For example, Civics have been responsible for the Louisiana Purchase and the Apollo Moon landings; two Civics presidents are John Kennedy (Apollo) and Ronald Reagan (Space Station).

In 1957, the US was shocked into action by the launch of Sputnik by the Soviets. A similar shock can be expected around 2013 when China, Japan, Europe or some combination of these officially announce their intentions to send humans to the Moon and Mars and create a space-based civilization. (In fact, a top official in China's space program has already publicly identified 2024 as the target year for China's first Moonwalk!) This, plus Americans' personal experiences in space, will trigger formation of the new NASA (i.e., an Interspace analog) and the election of the "Space" President in 2016 if he/she wasn't already elected in 2012. President John F. Kennedy was elected in 1960, and we can expect another extraordinary, charismatic figure like this who will lead us into the unprecedented, highly international, technology and space adventures of Maslow #5.

NASA already has official plans to return to the Moon by 2020 and the first human landing on Mars will be near 2025. The big difference this time will be the acknowledged requirement for rapid achievement of self-sufficiency in all lunar and Mars settlements. It will be understood that economic and social support for human expansion into space will rapidly erode away shortly after the energy cycle peak in 2025, and the next opportunity for expansive human adventures will be 2071 to 2081. Also, the specter of a major war looms in the 2020s. If the war is early, the Mars landing itself may be precluded! If it is late, all the human aspirations in Figure 2 may actually occur. The timing of a major war in the 2020s—a tragic feature of all Maslow Windows of the last 200 years—is completely unpredictable.

## WHAT'S NEXT?

The greatest modern proponent of large-scale space colonization was Princeton physicist Gerard O'Neil, who wrote *The High Frontier* in 1977; four years later he wrote another book entitled, *2081—A Hopeful View of the Human Future*.<sup>31</sup> The ironic coincidence is, of course, that 2081 is the date of the last Maslow Window of the 21<sup>st</sup> century. It is challenging to imagine what life might be like then.

**FIGURE 2 – MASLOW WINDOWS #4 AND #5**  
(Maslow #4 + 56 Yr = Maslow #5)

<b>Maslow #4 (History)</b>	<b>Maslow #5 (Forecasts)</b>
1987 Stock Market Crash	2043
1973 Oil Crisis	2041 Stock Market Crash?
1972 Vietnam War ends Last Apollo Moon flight	2029 War Window closes? Economic slowdown begins? Humans continuously on Mars?
1971	2028
<b>1969 Energy Cycle peak</b> <b>1st Apollo Moon landing</b>	2027 Self-sufficient Mars bases established?
1968 Apollo 8–1 <sup>st</sup> humans to Moon orbit; last X-15 Flight	<b>2025 Energy Cycle Peak-</b> <b>1st Human landing on Mars</b>
1966	2024
1965 Vietnam War Begins Gemini Program	2022 Humans to Mars' moons? Robotic probes mine water on Mars for Propellants?
1963	2021 War Window opens? Water and oxygen mined on Moon?
1962 John Glenn 1 <sup>st</sup> American to orbit Earth	2020 1st Lunar Bases?
<b>1961 Gagarin 1<sup>st</sup> to orbit</b> Shepard 1st American in space; <b>President Kennedy: Moon by end of decade speech</b>	2018 NASA plans return to Moon
1960 Apollo Program Begins; 1st X-15 Flight President Kennedy elected	<b>2017 "Space" President announces Moon/Mars program goals?</b>
<b>1959 Maslow #4 Decade Begins</b>	2016 "Space" President elected?
1958 NASA Formed 1 <sup>st</sup> US satellite in orbit	<b>2015 Maslow #5 Decade Begins</b>
1957 Sputnik launched	2014 Interspace formed?
1956	2013 China, Japan, Europe announce human space programs?
1955 North American selected to develop X-15	2012 "Space" President Elected?
1954 More Collier's space issues	2011 Earth orbital hotel vacations routine and affordable?
1952 Collier's space issues	2010 Public hotels in Earth orbit?
1951	2008 Space Adventures plans public flights to Moon
<b>1950 56 years ago today</b>	2007 Virgin Galactic plans public sub- orbital space flights
1948	<b>2006 Today</b> 2004 SpaceShipOne captures X prize

O'Neil envisioned only three possible outcomes for human civilization: stagnation, annihilation, or expansion. The limits to growth

imposed by a system (e.g., the Earth) with limited resources would eventually result in severe social controls and stagnation. And until humans are diffused into the Galaxy, annihilation by extraterrestrial or internal forces<sup>32</sup> will always be a real possibility. O'Neil felt that long-term security and prosperity for human civilization can only be guaranteed by our expansion into space.

The next Maslow Window is potentially the portal to ultimate human expansion and prosperity, as we finally become what we've endlessly trained for during the last 200,000 years: the first real Star Trek generation!

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## Table 2 MEP DATA

MEP		Suez	Panama	Apollo		Mars+	Mars+	Mars+
Country		GBR	USA	USA		USA	USA	USA
Year	Pur 1875	1869	1914	1969		2025	2025	2025
M US\$								
Cost	44% to GBR	22.36	375	25400				
Years		10	10	12		10	10	10
Ann Cost	100%	5.08	37.50	2116.67				
						Projected GDPs:		
Nom GDP (US \$)		6898	36500	984600		Peaks	Ratios	2005
<b>Real GDP (2005 US \$)</b>		118140	550100	4224000		<b>37127900</b>	<b>26879000</b>	<b>12491000</b>
<b>Annual Costs:</b>								
Ann Cost (2005 US \$)		87.0	573	9082		38145	27615	12833
Su-Ann Rel Cos/05		1.00	6.59	104.39		438.45	317.42	147.51
Pan-AnnRel Cost/05		0.152	1.00	15.85		66.57	48.19	22.40
Ap-AnnRel Cost/05		0.0096	0.063	1.00		4.20	3.04	1.41
<b>Frac GDP</b>		<b>0.00324</b>	<b>0.0010</b>	<b>0.0021</b>		<b>0.0010</b>	<b>0.0010</b>	<b>0.0010</b>
<b>Total Costs:</b>								
Tot Cost (2005) \$M		870	5730	108984		381451	276154	128332
<b>Tot Cost (2005) \$B</b>		<b>0.87</b>	<b>5.73</b>	<b>108.98</b>		<b>381.45</b>	<b>276.15</b>	<b>128.33</b>
Pan-RelTot Cost/05		0.152	1.00	19.02		66.6	48.2	22.4
<b>Ap-RelTot Cost/05</b>		<b>0.01</b>	<b>0.05</b>	<b>1.00</b>		<b>3.50</b>	<b>2.53</b>	<b>1.18</b>