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PILLARS ON MARS
LINKING THE DESTINIES OF ANCIENT GREECE AND FUTURE MARS

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CHAPTER 1: INTRODUCTION

As civilizations have risen and fallen, so have many human customs and traditions. However, it seems as if the human tendency to expand, whether it be to push further the borders of an empire or to push further the borders of knowledge, has always been present, from the very first human civilization on up.

The ancient Egyptians of the Old Empire managed to forge the first great human empire, which endured for almost 3,000 years. They rose from a small, nomadic desert people, whose main daily activity was to secure water and food for the next day, to become the creators of the great pyramids. Exactly how they were able to build these pyramids is still a mystery to modern history and science. Even today, with our modern construction technology and advanced mathematics and science, such a feat would be monumental, and so it is a testimony to the ancient Egyptians' drive and tenacity that they were able to build these huge funeral monuments with nothing but man and animal power.

The Greeks, whose civilization and culture dominated the Mediterranean world for nearly 400 years, were less concerned with the construction of monuments and more concerned with the building of human knowledge. You cannot find one area of modern philosophy, science or politics that did not have its origin with, or was not affected by, the Greeks. They tirelessly and persistently asked the question "why" and tirelessly and persistently sought an answer, and it seems with great success. Some modern scholars claim the Greeks single-handedly advanced civilization over a thousand years.

The Romans, who succeeded the role of the Greeks as the dominant force in the Mediterranean, took many of the Greek concepts to heart. However, the Romans were altogether a more practical people, and their advancements tended to be on a more practical, useable scale. They were among the first people to have a city with over a million inhabitants, and some of the systems they developed to support such a metropolis are still used today. The Romans built huge aqueducts to allow a constant influx of fresh water to the people of Rome. Irrigation projects had been done before, but nothing like the aqueducts had even been conceived of until the Romans. Also, the Roman

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Empire was among the first to build and maintain an extensive paved road system, linking its empire together. Many thought such a feat impossible, but the Roman nevertheless attempted it, and indeed, some of the roads they built are still in use today!

Perhaps the greatest example though of the innate human tendency to expand and explore is illustrated by the European Age of Exploration. This era is characterized by fleets of ships, staffed with hard, adventurous men, sailing off into the unknown waters of the western world. Common knowledge of that day was that if you sailed to far west, you would be attacked by giant sea serpents. Or, if you were lucky enough to avoid them, you would still fall off the edge of the earth! Nevertheless, these men were willing to risk their lives for the adventure and riches that the unknown offered.

It has now been several hundred years since the Age of Discovery. With the help of satellites, we have mapped nearly every crack and crevice on the face of the earth. The adventure that people once found in sailing off on ships to the west has become common place. However, there is another frontier, one that humans have just recently opened up and one that offers the greatest challenge and promise that humanity has ever faced. That frontier is space, and the first most likely candidate of human exploration is the planet Mars. The reason the planet Mars is most likely the next object of our exploitive efforts in the next century is that humans by nature are colonizers. Trips to the moon are fun and inspiring, but we as a race have rarely been content with just visiting a new place, and then coming right home. We as a race like to expand and settle permanently, and the only planet in the near future on which that is possible is Mars.

In the introduction to my senior year world history class, my teacher asked the class, by way of a group discussion question, why we should study history. Many interesting ideas were brought up, but the one that fascinated me most was the idea that we can use the past to predict the future. History is after all just one big soap opera, with this empire rising and this empire falling, these people attacking those and this person doing that. We can take examples in history that are comparable to examples today, and then extrapolate what the future might hold by how things turned out with our historical counterpart. Indeed there is much to be learned by examining the past.

When one looks over the various great civilizations in the past, the Greeks stand out as representing an unusually great flourishing of new ideas. There are many theories as to why this is so. Some historians claim that the harsh countryside of Greece molded the Greeks into a creative and enterprising people. Says one scholar, "The country, to a large extent, determined the character of its inhabitants. Greece is a land which makes its own terms, and which imposes certain requirements on those who come to live there." Others attribute it to a few great men, such as Plato and Aristotle. Both of these are valid theories, and will be revisited throughout this paper. However, I believe that the primary source of this great flourishing of ideas was the Greeks fundamental government structure, that of the independent city-state, or polis. The nation of Greece was really a collection of thousands of independent governmental units known as polises. Each one of these polises was free to do as it pleased, and therefore many pursued and developed different ideas on a multitude of topics, and the net result was a great flourishing of knowledge.

It is known that a great expansion of knowledge took place in ancient Greece, and it is also pretty firmly understood how and why this took place. However, the real question is what will be done with this knowledge? Is it possible that this example from the past could be used to set up another great flourishing of knowledge in the future? Those circumstances that caused this unusual flowering of knowledge could be recreated to actually induce a second one? The opportunity to make such an attempt presents itself as humans begin to strike out into space and colonize the planet Mars. If development of future Mars colonies is directed in the same way as the Greek city-states, then it stands to reason that the results might be the same, i.e. that Mars colonies could become the source of a second great blossoming of knowledge. For years we have used the past to predict the future. Why not use it to help create the future?

CHAPTER 2: GEOGRAPHY, GEOGRAPHY, GEOGRAPHY

Around 750 BC, small villages located on the Greek peninsula began to organize themselves into city-states. One might think it curious that the Greeks chose the Polis type govemment format as they began to organize politically. Off across the Mediterranean, to their southeast flourished the great Persian Empire, a political body that was blooming and spreading across hundreds of miles. The Mycenaean civilization, which had preceded the Greeks in the Mediterranean also, had an empire of sorts, whose power encompassed the Mediterranean for nearly 200 years (Bowra 32). It seems that, as examples of political bodies, the Greeks had all about them models of large, far ranging empires. Why then did the Greeks not seek large unified state encompassing the whole of the Greek peninsula, and instead opt for the smaller, more local city-state government type? The answer in large can be attributed to the geography of Greece and the restrictions it placed on those early villagers.

Greece, despite all its majestic beauty and grandeur, was not a nice place to live back in the time of the early Greeks. The literature describing it is harsh, to say the least. " . . . *A land of hard limestone mountains separated by deep valleys, it is cut almost in two by the narrow divide of the Corinthian Gulf*." (Bowra 12) The country itself is amazingly small, not even as large as the Yemen or Florida(Bowra 12). When this is taken into account with the fact that nearly three-quarters of all the land in Greece is covered with mountainous terrain of the kind described above, you begin to see the situation of the early Greeks. There were no huge open plains where they might have grown large fields of crops, no convenient river valleys upon which to build an empire. The peoples of Greece had to content themselves with living in the narrow spaces between the mountains, where the soil was rich enough to sustain their crops. (Bowra 65)

The settlements that developed in these small patches of fertile ground were very much isolated from one another. The harsh terrain of Greece made communication and travel between these settlements very difficult. As these settlements grew it became necessary for more political organization. Seeing as it was not feasible to unite with other settlements, each of these settlements started up their own political bodies, and thus the city-state is born in Greece.

The literature describing the geography of Mars is also harsh, to say the least. ". . . *The Martian terrain is incredibly varied. It includes canyons, chasms, mountains, dried river/lake beds, flood runoff plains, craters, volcanoes, ice-fields, dry-ice fields, and chaotic terrain, to name just a few. . ..*" (Zubrin 139) Mars has a total surface area of 144 million square kilometers, a land area equal to all the usable land surface of earth. The various features mentioned above are distributed all throughout the planet, with such famous features as the 4,000 kilometer long Valles-Marineris canyon system, and also the extinct volcano Olympus Mons, the largest known mountain in the Solar System. Another very important aspect of Mars is its atmosphere. Mars has a very thin atmosphere, which exerts only about a hundredth of a percent of the pressure at MSL on Earth. Also, the major component of the atmosphere is Carbon Dioxide, which makes up approximately 95.3% of the atmosphere. Also, the mean surface temperature on Mars is -53 degrees Celsius.

This description of Mars makes Greece sound rather mild, geographically speaking. Some considerations should be brought up, though. The geography of Mars is very similar to that of ancient Greece, *with respect to the technological sophistication of its settlers and inhabitants.* On the surface, the two geographies may seem vastly different, with Mars being by far the harsher of the two environments. However, it must be remembered that at the time the Greeks were establishing themselves in ancient Greece, there were no airplanes or highways with which to travel from place to place. There were no advanced agricultural equipment or techniques to aid them in their cultivation of fields, and there were no construction machines to help them build their cities. People traveling to Mars, although Mars is much harsher, will have technology that will allow them to effectively survive on the surface. The specifics of these technologies will be addressed later in this paper, but suffice it to say at this point that they do exist. Now, this will not be the easiest existence, it will be challenging. The whole argument though is that it will be as much a challenge for Mars colonists to survive in the Martian environment as it was for the Greeks to survive in the harsh environment of Greece.

This similarity is perhaps more easily seen when the effect that the geography has/will have on the colonizers is examined. We have seen that the harshness and lack of land in ancient Greece served to isolate groups of people into small, self-reliant communities. The general ruggedness of the landscape also discouraged travel and communication between the different city-states. The Martian environment requires that some sort of pressurized shelter be built for humans to live in. This will prove to be a major limiting factor in the size, and hence population, of future Martian colonies. Restated, the Martian environment will naturally serve to isolate people into small, self-reliant communities. Although communication between these various shelters will not be a problem due to modern advancements in satellite communication, travel between these different groups will be difficult. Pressurized rovers or highly expensive train systems would be needed for any kind of reliable long-range commuting between colonies. Restated, the geography of Mars will discourage travel between the various colonies. Can you see the parallels?

The same geographic features that kept Greece from developing as a single unified state also served to help protect them from being conquered and ruled by a single empire. In the Greeks/Persian

War, which constituted the greatest threat to Greek independence, the geography of mainland Greece was perhaps the most powerful ally the Greeks had. The ruggedness of the Greek landscape hindered the movement of the Persian army through Greece, and also made supplying the army with food and supplies difficult. The seven hundred Greeks fighting at the battle of Thermopylae were able to use the strategic advantage of the narrow canyon pass to hold back the entire Persian army for almost seven days. The ruggedness of the Greek landscape in fact discouraged invasion by reputation alone. Potential invading countries saw that not only would it be hard to conquer all these little towns placed sporadically among the mountains and valleys of Greece, but also even if that were managed, effectively enforcing their rule if the conquered city-states tried to rebel would be almost impossible.

Future Martian colonies will also be in a position where external, established powers will find it extremely difficult to maintain comprehensive control of them. Mars is nearly 134 million miles away from Earth, a six-month journey through space, thus any attempt on the part of an earth based power to rule any substantial number of colonies on Mars would be nearly impossible if the colonies did not want to be ruled. If the colonies chose to rebel or ignore orders from Earth, it would be nearly 6 months before earth could make any kind of response. Also, rule of all the Martian colonies by a single Mars-based power would also be difficult, for reasons already discussed. Transportation of humans between colonies is so expensive that any kind of large troop movement would not be easily done, therefore rule would be extremely difficult to enforce.

Mars and Greece do have many geographic similarities. These geographic similarities led, in ancient Greece, to the rise of the independent Polis, and in future Mars, will point colonies to developing in the same way, for the same reasons.

CHAPTER 3: MARS

Thus far we have discussed the similarities between Greece of the past and Mars of the future. The main point of this paper in many ways relies on using the situation of ancient Greece as a metaphor and projection for what might happen someday on Mars. Justification has already been put forward as to how these two are related, and it has been established to a degree that the two have common geographies and that these geographies have the same effect on the people settling them. However, before this discussion can go forward, further justification is needed that there will indeed be a future Mars, i.e. that Mars is capable of being settled by humans, and that it has the necessary allure and resources to sustain permanent human settlements.

Mars, although extremely harsh environment-wise compared to Earth, has all the raw materials necessary to sustain human life. When examining Mars as a possible home for future settlers, the two elements of primary importance are oxygen and water. Fortunately, Mars has a plentiful supply of both, although not in the forms we are used to on Earth.

Mars has an atmosphere composed of 95 % carbon dioxide, 2.7 % nitrogen, 1.6 % argon, and is quite devoid of diatomic oxygen. However, carbon dioxide itself contains two oxygen atoms per

carbon-dioxide molecule, and through a process of direct carbon dioxide-reduction, which involves heating the carbon dioxide molecules to 1100's Celsius, the molecule can be split into carbon and atmospheric O2. (Zubrin 152). While this method exhibits a fair amount of reliability, it is also quite energy expensive and probably will not be utilized on a large scale on Mars. The primary source of oxygen will most likely come be water. Water can be reduced by a process known as electrolysis, into its component parts, hydrogen and atmospheric oxygen. The oxygen can then be utilized for creating breathable air, while the hydrogen, as we will see, has its own very important uses. (Zubrin 151)

If water is to be utilized not only to provide nourishment to settlers, but also to create air for those settlers, Mars must be able to provide a more than abundant source of it. Luckily, Mars does not disappoint. However, Mars has no oceans or flowing streams, so where will all this water be coming from? There are actually several different sources of water on Mars. The most convenient and attractive source of water to a Mars settlement would be an underwater spring, a geothermally preserved pocket of water inside the Martian crust. A colony or water distribution station would situate itself directly on top of or near to an underwater well of water. This water would then be pumped up for use in the colony, and would most likely also be packed as ice for export to other colonies. While these underwater stores of water have not been directly observed on Mars, there is good reason to believe they exist. Earth has hundreds upon hundreds of underground springs, and there is no reason to believe that the same isn't true of Mars. Other sources of water that, although not as convenient as a geothermal spring, would provide water in the bulk necessary to sustain colonies are subsurface ice deposits, above surface ice deposits (for colonies located far enough north for above ground ice to exist in bulk), and directly from permafrost soil. (Zubrin 185)

Mars contains the basic substances necessary for human survival, oxygen and water; that has been established. However, if Mars ever hopes to be home to colonies of human settlers, it must be able to offer an existence beyond just barely surviving. Simply mining air and water on Mars may be enough for early precursor missions to the red planet, but if colonies are ever to thrive, they must be able to develop large industries and agricultural centers. It would not be practical for these industries to import all their raw material and so forth, due to the high costs of transporting off-planet materials to Mars. Thus, materials, which would support large-scale industrial and agricultural projects, must be available on Mars if we ever hope to successfully colonize there. Once again, Mars does not disappoint. The most easily accessible and abundant industrial products on Mars are iron and carbon. An oxidized form of iron known as hematite, covers the surface of Mars and is actually the substance that gives Mars its red color. Extracting pure iron from the hematite is no novel procedure and has been used on earth from the time of the first iron weapons. Carbon dioxide is the primary component of the atmosphere on Mars. Methods of extracting oxygen from carbon dioxide have already been discussed, and as we have seen, leave free carbon as a by-product.

It may have already occurred to you that these two elements, iron and carbon, are the primary components in manufacturing steel. With an initial investment in reactors and furnaces, an infrastructure can be set up on Mars that will allow steel to be produced for relatively low cost. The importance of this infrastructure alone cannot be over emphasized. The ability to produce steel

means the ability to produce large-scale construction projects and the ability to provide a diverse number of industries with an important manufacturing material.

Steel is not the only metal of importance that can be produced on Mars however. Elements such as copper, silicon and aluminum are also postulated to be available in relative abundance on Mars. Methods for extracting and refining these minerals, as well as producing other products such as plastics, ceramics, glass, and fertilizer, are discussed in great depth in the book, "The Case for Mars," written by Robert Zubrin. All the specific methods employed will not be covered in this paper, but suffice it to say that it is possible to produce them.

So, we have seen that Mars not only houses the primary necessities of life, but also contains all the raw materials necessary to sustain large-scale human colonies and industry. The only question that remains is whether or not we have the technology to make all this work; whether or not we have the know-how to set up settlements and utilize the raw materials present on Mars to make colonization practical. The answer to this question is both yes and no.

Right now humans possess the technology to mount a short-term humans-to-Mars exploration program. We have the necessary launch capabilities and technologies to send a small crew to Mars and return them safely to earth. Although there has been much theoretical work done in the area, we do *not* at present possess the technological sophistication to set up a permanent human colony on Mars. However, this is to be expected, and should not be viewed in any way as a discouraging thing. Much of the activities of the early human missions to Mars will be centered on exploring ways for doing things on Mars. They will work to set up a cache of actual experience in dealing with the Martian environment and will perfect the techniques that have only been theoretically explored thus far. For instance, at this point in time, crops have never been successfully raised on Mars. Now while there is a lot of theoretical work on how this could be done, until humans actually go there and test it out, it can not be substantially stated that humans possess the technology to raise crops on Mars. The other main technological areas that these early missions will center on developing are the sciences of processing Martian resources into usable forms, and building structures on Mars using indigenous Martian resources. All three of these areas have comparable counterparts on Earth, and thus we have only to take what we have learned on Earth and modify it to work in the Martian environment. This will not be an easy task, but it will not be so difficult as to prevent humans from settling the red planet.

CHAPTER 4: GREECE

Chapter two was justification for comparing Ancient Greece to future Mars. It was support that such a comparison is not out of context. Chapter three was to show the feasibility and strong possibility that the colonization of Mars will take place, that this whole discussion is not about just some fantasy idea that never has a chance to come to fruition. Both of these were needed to set the stage for the grit concept of this paper; the great experiment that happened in Greece, and how we can set up the same flourishing of knowledge to happen on Mars.

Something unusual happened in the nation of Greece, something that had never happened before, something that only the recent rise of science and technology in the western world can compare too. The Greeks were not an especially wealthy group of people. The nation of Greece itself is rather small, both in size and population, as we have already seen. They were not genetically superior in any special way, or any kind of super human race. Yet, the Greeks of the mid-millennium before Christ single-handedly managed to advance civilization over a thousand years. The Greeks made breakthroughs, not simply discoveries, but true *breakthroughs*, in nearly every aspect of human inquiry, from politics, to economics, to philosophy, to science, to aesthetics. The Greeks revolutionized thought on all aspects of human existence, and the ideas they originated have been and are being practiced by every nation on earth, in one way or another. To understand this great flourishing of knowledge in ancient Greece and what made it possible, it is necessary to understand the basic governmental unit of the ancient Greeks: the Polis.

Richard Hooker, world cultural expert, explains the development of the Polis.

The single greatest political innovation of the ancient Greeks was the establishment of the polis, or city-state. In the Mycenean age, the Greeks lived in small, war-oriented kingdoms, but for reasons unknown to us, they abandoned their cities and their kingdoms sometime between 1200 and 1100 BC. From that point onwards, they lived in either sedentary or nomadic tribal groups; the period is called the Greek Dark Ages and lasted until sometime between 800 and 700 BC. The tribal or clan units of the dark ages slowly grew into larger political units at the end of this period; beginning around 800 BC, trade began to dramatically accelerate between the peoples of Greece. Marketplaces grew up in Greek villages and communities began to gather together into large defensive units, building fortifications to use in common. On this foundation, the Greek-speaking people who lived on the Greek peninsula, the mainland, and the coast of Asia Minor, developed political units that were centrally based on a single city. These city-states were independent states that controlled a limited amount of territory surrounding the state. The largest of these city-states, for instance, was Sparta, which controlled more than 3000 square miles of surrounding territory.

The overwhelming characteristic of the city-state was its small size; this allowed for a certain amount of experimentation in its political structure. The age of the city-state in Greece is an age of dynamic and continual experimentation with political structures; this period of experimentation gave the European world most of its available political structures. Its small size also allowed for democracy, since individual city-states were small enough that the free male citizens constituted a body small enough to make policy decisions relatively efficiently. The overwhelming importance of the polis in the evolution of European political structures is betrayed by the word "political" itself: derived from the word polis, "political" etymologically means "of or relating to the polis."(Hooker)

The key statement in the above quote is, *"The overwhelming characteristic of the city-state was its small size; this allowed for a certain amount of experimentation in its political structure."* Not only did the small size of the city-state allow for experimentation in the political style of the city, but it also allowed for a wide range of cultural and scientific experimentation. But before this train of though is pursued, some examples of the contributions of the Greeks will be given. It is easy to state that the Greeks advanced civilization a thousand years, but further evidence is needed to give that statement merit. So before it is explained how the city-state set the stage for this blossoming of knowledge and culture, it will first be substantiated that there in fact *was* a blossoming of knowledge and culture. If you are already familiar with the many contributions of the Greeks, you may wish to merely skim through or even skip over the following section, seeing as it is pretty extensive. It is essential to the purpose of this paper, though, that this information be given.

I

It is probably in the political arena that the Greeks made their most influential discoveries to the world. As stated by Mr. Hooker, "*this period of experimentation gave the European world most of its available political structures*." Perhaps the political system most easily drawn back to Greece is democracy, and its place of origin, Athens.

Athens has achieved great fame in the western world for being the "birth place of democracy." Democracy had its start in Athens in 503 BC, with Cleisthenes. While Cleisthenes was Chief Archon in Athens, he initiated political reforms that were vital to the development of democracy there. Cleisthenes' reforms were meant to bring "isonomia", that is, equality before the law of all citizens, a further step toward democracy. The reforms started by Cleisthenes finally came to their full fruition in 462 BC, when Ephialtes, also acting as Chief Archon, increased the power of the Athenian Assembly (the democratic power of Athens) beyond that of any other political party. (Chronological) This is generally considered to be the true start of democracy in Athens.

The Athenian Assembly was the main law making institution in Athens, and it was composed of every free, male Athenian over the age of thirty. The Assembles deliberations were made more manageable by the work of a smaller council. The council itself had 500 members elected from out of the assembly, fifty chosen to represent each of the ten Attic tribes. The council prepared an agenda and list of proceedings for the general assembly. The council, although smaller than the general assembly, was really too large to manage the day-to-day tasks of government, so another inner council of fifty men was elected from out of the council for this job. The inner council served as the main-direct governmental administrator for the democratic city-state of Athens. (Bowra 93) The democracy that was begun in Athens does not much resemble our modern day notions of a democratic government. Still, Athens was the first government of any magnitude to actually put democratic principles into play. It was the first test bed of democratic ideas the world had, and thus is credited with being the source of the democratic system of government.

The Athenian democracy was not the standard in ancient Greece; rather it was the exception. The majority of city-states in Greece had a form of government known as an oligarchy, which simply means "rule by few." The variety in structure and format of these oligarchic governments varied

largely between the different city-states. In some cities, the wealthy held the real political power, and thus there was a wealth oligarchy, known as a timocracy. (Hooker) In others it was the artisans, or philosophers. Or in others, like Sparta, it was the military that held all the power.

Sifting through all these different governments, one finds aspects of communism, socialism, fascism, monarchialism, and many other government types. Such a fact is hardly surprising when one really grasps that there were literally hundreds of these little city-states, all with different government types, being ruled independently, however they pleased. There may not have been city-states that were "all-communist" or "all-socialist", but these many city-states were the first to really take these different governmental ideas for a test ride, to see how they actually worked in the real world. They may not have originated all the ideas themselves, but they were the first to test them out with real life experience.

The Greeks contributed a lot to the field of politics, but it was by no means the only area to which they contributed. The Greeks have been renowned for centuries for their intellectual inquiries into philosophy.

There had been many established religious and philosophic systems before the time of the Greeks. However, the Greeks constituted the first large-scale emergence of rationalistic beliefs, and thus their philosophic contributions are largely in the realm of rational inquires into the nature of the world and the humans living in it.

Rationalism, for what ever its value, appears to have emerged from mythology with the Greeks. In engaging in this intellectual exercise, the Greeks assumed, of course, that nature would play fair; that, if attacked in the proper manner, it would yield its secrets and would not change position or attitude in midplay. Over two thousand years later, Albert Einstein expressed this feeling when he said, "God may be subtle, but He is not malicious". There was also the feeling that the natural laws, when found, would be comprehensible. This Greek optimism has never entirely left the human race. (Wilson Pre-Socratic)

Thales, born in 624 BC in the city-state of Miletus, was the first of the Greek philosophers, and arguably the greatest of the pre-Socratic philosophers. He is the first man we know of to have asked the question, "Of what is the universe made?" He postulated himself that the fundamental element of the universe was water, and that the earth itself was nothing more than a flat disc floating on an infinite ocean. This theory has long since been proven false, but it was never his answer that was important to the area of philosophy. Rather, it was the question that he posed that would be his legacy, for it would be the basis for the work of all the Greek naturalistic philosophers to come for the next hundred years. (Wilson Pre-Socratic)

The three great patriarchs of Greek philosophy and, without argue, the most famous of the Greek philosophers, were Socrates, Plato and Aristotle.

Socrates was born in Athens in 470 BC. He spent most of his life roaming the streets and

marketplaces of Athens, talking with those who would talk with him, and trying to set people strait in their erroneous thinking. He is the originator of the Socratic style of teaching, that is, of teaching someone by leading him or her, through intense conversation,to arrive on their own at the conclusion you want them too. (Gaarder 65) His philosophic project was one of getting the Athenian citizens to examine their life in respect to philosophy, to step back and see the bigger picture. Socrates commanded a large following among the youth of Athens. Among his disciples was a young man who would later even surpass his master in fame– the philosopher Plato.

All that we know about Socrates actually comes through the writings of Plato. Plato, who was born in Athens around 427 BC, wrote a series of dialogues to expound upon his philosophic ideas. In most of these dialogues, Plato used Socrates as his main character, and this is the source of all our information about Socrates. Plato was convinced that the world as we see it is really just a shadow of reality, that behind every object in the physical realm there existed somewhere an ideal form of that object, which was perfect and flawless in every way. Plato said the only way we could ever come to really grasp what these ideal objects might be like is through the use of our faculty of reason. (Gaarder 82)(Wilson Plato) Plato also had a student who would one day rival him in fame and intellectual prowess, Aristotle.

Aristotle was born in Stagira, which was a province of northern Greece, in 384 BC. As a young man he traveled to Athens where he enrolled in Plato's Academy. He excelled there and was even reported by Plato himself to be the "the intelligence of the school." Aristotle based all of his philosophic and scientific conjectures on his experiences directly with reality. He believed that the physical realm was the only objective base humans had for gaining knowledge, and that a fact was only a fact if it could be empirically reduced to a physical observation. This constituted Aristotle's greatest contribution to philosophy, this idea which was in direct opposition to Plato's theory of Ideals, but which would later become the basis for modern science. (Wilson Aristotle)

Aristotle also did a great deal to advance science. Aside from being a philosopher, he was also an excellent field researcher, and pretty much single handedly started the field of biology. However, he was only one of many, many Greeks to make major advancements in the sciences.

The Greeks were very imaginative people, and a natural wonder that very much captivated their interest was the sky that revealed itself as night fell. The Greeks were fascinated by the stars and moon and planets, and hence, one of the areas of their greatest contributions to science was astronomy.

Around 370 BC, there lived a talented Greek astronomer named Euxodus of Cnidus. He developed a mechanical system to explain the movement of the planets, in which he placed the earth at the center of the universe with everything else revolving around it. Although we now know this to be incorrect, it still represents a tremendous theoretical exercise in mathematics and astronomy. (Ancient...Astronomy)

Eratosthenes, born in 276 BC, was a diversely educated man. His major contribution to the

sciences was that he managed to calculate the circumference of the Earth with remarkable accuracy. He is also remembered for his work with prime numbers. (O'Connor Erotosthenes) (Ancient...Astronomy)

Hipparchus, who was born around 140 BC, was an excellent astronomer. During his life, he classifieds the stars into groups based on their apparent brightness, estimated the size and distance of the moon, found a way to predict eclipses, as well as calculate the length of the year to within six and a half minutes. (Ancient...Astronomy)

Another Greek astronomer who made great advancements to the field was Heraclides of Pontus. He proposed that the seemingly westward movement of stars in the sky was actually caused by the eastward rotation of the earth. He was also among the first astronomers to advocate a more heliocentric theory of the universe. He taught that Venus and Mercury rotated around the sun, not the earth. (Ancient...Astronomy)

The Greeks also made advancements in the field of Medicine, although not as in depth as in astronomy. The most prominent Greek physician in history was definitely Hippocrates of Cos. Hippocrates is known as the "Father of Medicine," and rightfully so. He made scientific explorations into nearly every field of medicine including surgery in general, bone fractures, ulcers, head injuries, and even hemorrhoids. He is also known for his work in the field of bio-ethics. The Hippocratic Oath, a code of ethics by which a physician should conduct himself, is still required to be taken by aspiring physicians to this day. (Hippocrates)

Much of the information gathered by Greeks in the fields of astronomy and medicine, although extremely important and significant in their own right, have become somewhat outdated in the present day and age. However, the advancements made by the Greeks in Mathematics have served as the foundation upon which all modern math has been developed, and indeed much of what the Greeks worked out nearly 2000 years ago is still in everyday use.

The well-known trigonometric formula known as the Pythagorean theorem is a good example of this. The Pythagorean theorem is named after its developer, the Greek philosopher/mathematician, Pythagoras of Samos.

Pythagoras was born in 582 BC on the Aegean island of Samos. As a young man he departed Samos for the southern Italian peninsula known as Croton, then under Greek control. There he was to found his famous cult known as Pythagoreanism. Although very mystical in belief and practice, this cult also very much revered the study of mathematics and science. In particular, Pythagoras was intrigued with numbers. He attributed almost divine importance to numbers, and saw them as a way to understand the universe. He was the first man known of to understand the relationship between the length of a string on a musical instrument and the note it produced, and computed the ratios between string length and pitch. He was also very interested in irrational numbers; that is, numbers that cannot be expressed as a fraction but rather keep repeating as a decimal (an example is the number denoted by Pi). (Wilson Pre-Socratic)

Zeno of Elea, born about 450 BC, is another great Greek mathematician. Zeno combined mathematics and logic to come up with some strange theories. One of his stranger theories was that motion is impossible-" *he argued that motion is impossible:- If a body moves from A to B then before it reaches B it passes through the mid-point, say B_1 of AB. Now to move to B_1 it must first reach the mid-point B_2 of A B_1. Continue this argument to see that A must move through an infinite number of distances and so cannot move.*" (O'Connor The Rise)

Archimedes, born in the mid 2nd century BC, made significant contributions to the field that would later be termed as calculus. Among other things, Archimedes, using a rudimentary form of integration known as exhaustion, was able to calculate the surface areas of circles, cones, ellipses and parabolas. (O'Connor The Rise)

There has been much discussion of the great intellectual achievements of the Greeks, about their scientific and philosophic and mathematical discoveries. However, that is only half the story of the ancient Greeks. The Greeks had very demanding intelligences, but also commanded vast and creative imaginations, and made many significant contributions to the arts. Perhaps the most lasting and influential of the Greek arts was their creative writings.

Almost every school child has heard the story of the goose that laid golden eggs or the fox and the grapes. These are part of a collection of short stories that have come to be collectively known as Aesops fables, named after their author, Aesop of Samos. Aesop was a Greek slave who lived in the early 6th century BC. His stories, although somewhat simple and straightforward, all have a deeper message, alluding to some vice or virtue of mankind, otherwise known as a moral. (Ancient...Literature)

Aeschylus, also known as the father of tragic drama, was the earliest of the three great Greek dramatists. Aeschylus is credited with being the first dramatist to introduce a second main character. All previous drama had used a single main character supported by a chorus. However, by introducing another main character, a more personal and potent drama could be developed in his stories. He is credited with producing some 90 dramatic plays, only seven of which have survived to the modern day. Among these are Agamemnon, Choefori and Eumenides, collectively known as the Oresteia trilogy. (Ancient...Literature)

Aristophanes was the greatest of the Greek comedic play writes. He developed a biting style of comedy, known as "old comedy", which centered on comedically criticizing political and social abuses. He is credited with having written 54 plays, only 11 of which have survived to the modern day. These include the Clouds, the Frogs, the Knights, Lysistrata , Peace, and Plutus .(Ancient...Literature)

The Greeks were not only writers, but also very gifted in the art of sculpting. They pretty much invented the art of sculpting life-like, fluid sculptures. Their style very much departed from the old Egyptian tradition of large, blocky structures, and tended to focus more on movement and

action. Their art also had more humanist overtones than those of previous civilizations did; the Greeks didn't only sculpt living things in movement, they sculpted living man in movement. The creations of Greek artists such as Myron and Polykleitos inspired artists for thousands of years to come. Indeed, not only did roman art reflect the tradition set by the Greeks, but even sculptures as late as the Renaissance, such as Michelangelo, based their works of the Greek tradition.(Classical...Sculpture)

From democracy to sculpting and everything in-between, the Greeks managed to revolutionize the worldview of people during and after their time. The debt that modern man owes to the Greeks for their contributions is almost unfathomable; indeed, the Greeks molded the bricks and set the foundation upon which we have been building a tower of knowledge since the time of the renaissance.

So there was a great blossoming of knowledge in ancient Greece, this has been established. How exactly does the city-state tie in, though? To return to the previous statement made by Richard Hooker, *"The overwhelming characteristic of the city-state was its small size; this allowed for a certain amount of experimentation in its political structure."* It is true that the small size of the city-state allowed for experimentation in the political structure of the state, but that is not the whole story. The opportunity the city-state opened up for different political systems to emerge and be tested out also applied to cultural developments. Just as an area that is dominated by a single political power will not be able to experiment politically, so an area that is dominated by a pervading culture will find it exceedingly difficult to depart from that path. What the small, local city-state governments provided to the Greeks were small pockets of civilization that were not controlled by a larger, national culture. It provided small kingdoms where there were not any set-in-stone beliefs and doctrines about the natural world, or how art was to be done, a place where enterprising Greeks could take their new ideas for a test run. And as we have seen, the Greeks did just that.

You may think that the democratic style of government in use by the United States currently offers the same options as the city-state did, that it allows for the free, uninhibited development of ideas. "Why do you need a polis," you might ask, "when you have the U.S.?" While the US does stand for freedom and liberty, the one thing it doesn't offer is the uninhibited testing of new ideas.

The clearest way to illustrate this is to look back at England during the time the Americas were being colonized. At that time in history, England was a world power with a long and illustrious history, a history dominated by the monarchy and aristocracy. The England of this time was very established, with a long tradition of how to carry out the function of government, of how to implement justice, of how to fight wars, etc. While this served to aid England in maintaining its status as a world power, it also served to stifle the development of new ideas. Just as one cannot pour more water into a full glass, one also cannot implement new ideas into a culture that has pre-existing established traditions.

It was also at this time that English citizens who were tired of the old traditions began making the journey from England to the New World. In North America, these colonists found freezing

temperatures, starvation, scurvy, and any number of other hardships, but they also found a land without an established tradition. They found a vacuum of power and culture that they had the opportunity to fill in their own unique ways. The greatest result of this was the establishment of the United States in 1776, signified by the ratification of a constitution that been the product, not of English tradition, but the rational minds of American settlers.

While the United States of the present bears little resemblance to England of the 16th century, the same basic principles are still at work. The US has a very established tradition of rule and culture. It has been dominated for over 200 years by concept of rule-by-democracy and the Judeo-Christian ethic. The United States is, for all purposes, a full glass. It has an established culture with little room for change. An example of this is the ineffectiveness of Socialist and Communists interest groups in the United States. There have been groups actively promoting the transformation of the US government to a socialist or communist type government for over 70 years. The ideas of these groups clash, however, with the prevailing political and cultural ideas of the US, and therefore they have found only limited footing in the US. Only in a land lacking established cultural and political ideas can humans really be free to experiment with new ideas of this nature.

The Greek city-states provided such an opportunity to the early Greeks. Although the Greeks did have common historic traditions in the area of religion, these beliefs were more fairy-tale like, and did not necessarily dictate any specific philosophic tradition or ethic to them. Each separate state was like an open shell, waiting to be filled with the culture and political institution that its residence desired, whether it be right or wrong, good or bad, beneficial or harmful. This allowed Greeks in general, a great amount of freedom to experiment with different ideas, and allowed specific Greeks such as those mentioned previously, to develop new and never before seen ideas on science and philosophy and aesthetics. There was a void to be filled in ancient Greece, and the Greeks filled it in fascinating and diverse ways.

This flourishing of knowledge in ancient Greece has been termed by some scholars as the "Greek Experiment." Besides being a catchy name, this term as applied to the situation in ancient Greece is actually very appropriate. An experiment, as defined by Webster's New World Dictionary, is "*a test or trial of something; specifically, any action or process designed to find out whether something is effective, workable, valid, etc.*" An experiment is an action taken to find out whether an idea really fits with reality or not. What made the situation in ancient Greece so amazing and beneficial to human kind at large was that, not only were they able to originate many different ideas and concepts in the areas of politics and philosophy, etc, but they were also able to put these ideas into actual use and test them out. It was like a giant experiment, where each separate city-state adopted a different set of political and cultural beliefs, and then tested them out. The contribution of the Greeks was not only the production of ideas, but also an example of how those ideas actually worked in reality. The Greeks were not only great men of the mind, who were able to invent new theoretical ways of doing things, but they were also men of action, who had the proclivity to put their new ideas into use in the real world.

CHAPTER 5: MARS AS GREECE

This flourishing of knowledge in Greece was special. It only worked because the conditions were right both geographically and politically, that led to the development of the Polis, and that in turn set the stage for the Greek Experiment. Now, we have seen that Mars shares many of the same characteristics as those of ancient Greece. Is it possible, then, that by playing with the factors involving the colonization of Mars, we could, in effect, set ourselves up for another type of Greek experiment, but this time on Mars?

The thought that such a possibility exists is both exciting and enticing, but how might one go about doing this? The key is to let Marian colonies develop as independent political units. In ancient Greece, the colonies were left to make up their own society and politics, they were not dictated to by foreign powers, or throttled by the tyrannical rule of a single Grecian dictator. Each colony was left to work out its own society and politics, and we have seen the result. The key to setting up a similar Martian experiment is to allow colonies to rule themselves as independent city-states.

This may not exactly be possible on the get go of Mars colonization, and for a very simple reason. The initial colonization of Mars will be very, very expensive. The establishment of colonies will require huge amounts of capitol, such that only large corporations or governments will be able to finance them. The factors involved in setting up a colony are very complicated, and would take a number of years to complete. First, a corporation or government agency would have to come up with mission plan, or perhaps more importantly, a charter, in which they would extensively describe the entire mission, including all mechanical systems, a time line for completion and a cost estimate. Then they must get this approved, and appropriate funding. Then the long and extensive process would begin in which the mechanical systems are contracted and built and tested out on earth. These systems must then be transported at great expense to the surface of Mars, and landed at a designated site. Parallel to the construction of the colonies' mechanical systems would be the selection process of the colonists. These people would most likely have to be cross-trained and familiarized with the mechanical systems of the colony, and then, again at great expense, transported to the Martian surface. Then comes the difficult task of setting up the colony and achieving self-sufficiency; i.e. erecting the actual structure, setting up an industrial infrastructure, getting the agricultural system running reliably.

Needless to say, after investing the amount of money and capitol necessary to establish a colony on Mars, the corporation or government sponsor will not likely give up control of that colony. They will want to maintain a presence in its governing, and rightfully so. It is also conceivable that certain large corporations may be interested in setting up colonies for a specific, economic purpose. If large amounts of precious ore or other valuable materials are discovered on Mars, it may be economically profitable to set up a mining colony. In such a case, the colony would surely be managed as just a division of that company.

Colonies created under these circumstances would in all likelihood remain under the

immediate control of their sponsor. If that is in the best interest of the world or these colonies is irrelevant; the reality is simply that such a sponsor would not relinquish control of such a major investment. How then will independent colonies come to exist on Mars?

The first colonies will be expensive because they will be the fountainheads. They will need to develop the new technology; they will need to figure out how to transport masses of humans to mars; they will need to establish new methods of working in the Martian environment; and most importantly, they will have to figure out all the little bugs that are sure to arise in every step of the colonization process. However, once the method of putting colonies on Mars becomes more routine, and the technologies used become more robust and efficient, then the price tag associated with Mars mission will inevitably decrease. When a new and novel technology is introduced to a market, it starts off very expensive. However, as better methods are found to do the same job, the cost of the technology is driven down. This has happened with almost every high-grade technology produced in the last fifty years, including personal computers, cell phones, home entertainment devices, etc. The same pattern will also happen in relation to Mars colonization. As the price for setting up a colony on Mars decreases, it will become possible for independent groups of people to sponsor their own way to Mars. There are two primary ways in which this will most likely take place.

The first is the sponsorship of a colony by a large space-related organization. Space societies of the future, analogous to the modern day Planetary Society or National Space Society may choose to use member funds to sponsor an independent Martian colony, as such a feat becomes feasible. Member support for such an activity will most likely be high, for what loftier goal could a space society ascribe to than to establish an extra-planetary colony. Even more member support could be elicited if the colony members would be chosen from among the qualified people within the society. While the sponsor in this case would still want to maintain ties to the colony, actual administration of the colony would almost assuredly be left up to the chosen colonists.

While sponsorship by space-oriented societies will be a means by which independent Martian colonies will be created, it nonetheless remains very limited in scope. The bulk of independent Martian colonies will most likely be what I have termed "communal colonies." In the communal colony scenario, a charter is issued via-the Internet or some communal colony corporation saying that a Martian colony is to be formed with a certain number of colonists. There is a price quoted, per person, for joining the expedition and becoming a colonist. If a person has sufficient sums, he can sign up on the charter as a colonist. This would continue until the quota of colonists was filled, at which point the funds collected from the colonists would be enough to establish the colony, and the whole group would take off for Mars. Thus, in the communal colony scenario, each colonist buys his own way to Mars.

While the price of establishing colonies on Mars may decrease, it will most likely never be an inexpensive venture. The cost each individual would have to pay to join in a communal colony will therefore be very expensive. It may range from a couple hundred thousand to millions of dollars per person. However, while such fees are very expensive, they are not unfeasibly expensive. Even if the price were as high as two million dollars per person, there would surely still be people who would have the economic clout and desire to join the charter. It is not too unrealistic to imagine a

person selling all of his possessions on earth, such as his house and car, to finance his way to Mars. The same thing was done all the time in the old U.S., with people moving west. It is also conceivable that an extended family may wish to support an enterprising nephew or son with the funds to join such an expedition. Or perhaps organizations might offer to pay the charter fee as reward for certain student contests, similar to present day student scholarships. Or perhaps there would be Entrance Fee lotteries, where thousands of people would buy tickets, and the winning person would be provided with the funds to join the expedition. In any case, it is conceivable and probable that if such a charter were issued, even if it was expensive, there would be enough people with the funding to fill it.

These are the two most probable ways in which independent colonies will come to exist on Mars. Perhaps the countries or corporations sponsoring the first of the colonies will be willing to take a back seat and relinquish control of the colonies the colonists; maybe other ways for establishing independent colonies on Mars will be developed in the future. In any case, though, free Martian colonies have the potential to exist.

With the establishment of free colonies on Mars, the stage will be set for a Martian experiment. Initially, most of the free colonies will probably very much resemble each other, and will probably be run in a way similar to governments on Earth. However, as time progresses and the colonies begin to face different challenges and opportunities, each will start to develop in its own unique way, adapting and changing to meet the new requirements placed on it. Hopefully colonists of these independent states will seize the opportunity to try out new political systems. These future colonists will have the freedom and opportunity to actually do what others have only dreamed about; to take from Earth the best it has to offer, and build a new society based on those ideals, leaving behind all the bad. The governments of Earth are to immersed in their own tradition to be able to objectively evaluate themselves, and are to hopelessly caught in their own cultural rut to ever make any kind of true change. For this to happen, humans must start anew, and we will have the opportunity on an independent, polis oriented Mars.

The new developments on Mars will not, by any means, be limited to the area of politics. The Martian environment is completely and utterly alien to the environment of Earth. People living there will be forced to deal with challenges that humans have never, in the whole of history, had to deal with before. Such a situation will most definitely bring out an ingenuity in the colonists; an ingenuity that will be necessary for their survival. Coupled with the almost unlimited freedom the polis has to offer, this environment by all rights should be perfect for the flourishing of new scientific and technological ideas.

Just as the Greek peninsula molded the Greeks into enterprising and ingenious people, so will Mars with its colonists. And just as the Greeks, when allowed the freedom to meet these challenges in their own way, came up with an almost limitless set of ingenious solutions, so will the future settlers of Mars.

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