Mars or Bust:

Money and Profits in Space Research and Development

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Whenever I gain enough confidence to mention Mars exploration during a political conversation, I usually get a similar response in a similar tone from the critic: "Why do we need to *waste* money on space exploration?" The tone is simultaneously condescending and dismissive. It is as if anybody in their right minds would realize that space exploration *is* a waste. Now, if I believed that space exploration was in fact a waste, *like flushing money down the toilet*, then I would have to agree with the critic. However, and this is the idea that the critic finds utterly absurd, the exploration of space is not wasteful. In fact, I believe, and I have strong reasons to believe, that space exploration is both highly profitable and highly exciting.

Now, the 'highly exciting' part is largely a matter of personal taste, and I would have no logical argument to give to the critic who argues otherwise. It would be like trying to convince a vanilla-lover that chocolate ice-cream is a tasty flavor – in a word: *absurd*. Its not all a matter of personal preference, of course; otherwise this wouldn't be an analytical essay but modern art. I hope to present here the arguments for why the exploration of space is a **highly profitable** endeavor. In fact, my position is a stronger one – more extremist if you like – and that is that space exploration is perhaps the most profitable enterprise of the present age.

At this point, the great critic, whom I will call Critic Bob, will respond with what at first glance seems an utterly defeating statistic: "In the last couple of months alone, the loss of two Mars-bound space craft cost the citizens of the United States over $500 million in total immediate losses in just a few seconds of malfunction." Now Critic Bob may argue an even larger sum of money was lost to malfunctioning space craft over the course of the world's involvement in the Space Age. But the exact sum of money purported to be "lost" is largely immaterial to the argument I am going to make against this statement. (And he may even claim that the largest burden of this "money wasted in space exploration" came from the over-burdened tax-payers, on which point he will be exactly *correct*.)

The first response that I would give to Critic Bob is the following: the $500 million that is claimed to be "wasted" in actuality never really left the planet. What do I mean by that? (No, I am not crazy, though some will make that argument (without proof, of course).) What I mean is that the $500 million dollar figure that was cited by Critic Bob represents the amount of money spent on manufacturing and launching the spacecraft – which was done on earth of course! This means that the money went to pay the people who worked on manufacturing the space craft -- engineers, scientists, and technicians. What good did that do? A lot of *research* was done by these highly skilled people – the benefit of which we will return to shortly. So when it comes down to it, all of the money never actually left the United States economy.

The argument I just gave is not the main argument, because after all it is a rebuttal to the critic's position, but not a positive reason of why we should spend '*all that*' money on space exploration. The flaw in Critic Bob's analysis is that he counted *only* the money that was spent (notice, he would say 'wasted'), and *not* the money (i.e., the profits) that were generated. It would be like saying: "I *wasted* $100,000 on a new house" when the house is actually worth $1

million dollars. (I would call that a bargain, not a waste!) Or, it would be like saying, "I wasted $50 on a new pair of boots" when talking about high-quality imported boots that one really likes. You get the picture.

"But wait," Critic Bob would retort -- "Profits from space exploration? *That's absurd*!" To Bob, and to many others, that is a pretty absurd idea. In fact, at one point I actually believed the position was *a priori* obvious, and thus the only reason for space exploration is the 'highly exciting' part I alluded to earlier. Now, I understand there are better (maybe not better, but more practical) reasons for going out into space. In the remainder of this essay, I hope to demonstrate that space exploration is the *most* profitable enterprise of the present time.

Probably the biggest reason why most critics find the idea of space exploration generating profits absurd is their habit of thinking in very short terms. They are used to thinking in terms of a few months to several years, rather than in spans of ten or twenty years. For these people, only those projects that are profitable within the span of a few years are worth anything. Projects that take ten or twenty years to flower to full potential are viewed as "a waste of money."

To get a sense of the magnitude of the profits that are possible in such a long-term investment one needs only to consider the investments of King Ferdinand and Queen Isabella of Spain into the immortal voyage of Christopher Columbus. My crude but sufficient estimates place the whole undertaking at under $1 million in present sums. After all, the sailors who sailed under Columbus were paid at under minimum wage, almost at slave-labor rates, and the three ships that were given to Columbus (now immortalized as the Niña, the Pinta, and the Santa María), were the oldest (almost ready to be recycled for lumber) and the cheapest the Crown could find (a testament to that is the fact that just days into the voyage, two of the ships almost

went down!). Now that is not to say that the would-be astronauts who will fly to Mars will be poorly paid (and they will not be in it for the money, trust me), or that they will be sent in anything but the latest technology. This figure is cited simply to get a rough sense of the investment that the Spanish Crown made into the voyage of Columbus.

And now, just over 500 years later, that small investment has grown into a whole *continent*, full of peoples, trade, land – I can't possibly list everything that has flowered from the settlement of America. It is clearly impossible to try to tabulate the total net worth of the Western Hemisphere opened to the rest of the world by Columbus. But it is worth the effort to get a very rough estimate of the total worth in dollars of the two American continents. To get a sense of this value, it is enough to consider the 1999 Gross Domestic Product of the United States of America: $8.76 *trillion* dollars (*Source*: Executive Office of Management and Budget). And that is not counting the countries of Canada, Mexico, Brazil, and the hundreds of other, smaller countries, in this Hemisphere. That is a profit of 876,000,000% on the original $1 million dollar investment! That's $8.76 \cdot 10^8$ % profit in 500 years, or 1,752,000% annual profit. Can you find a business today that generates even one-billionth of a percent of those profits? I rest my case.

Now imagine that space exploration did in fact proceed. Just imagine, that after several decades of exploration, the first settlement was started on Mars. Also imagine, that after a few more decades more settlements were started . . . It does require some imagination, but we can see that within a short period of time we would have an entire *civilization*. Now imagine that today we invested $1 into beginning space exploration – and hence initial the first step in that sequence of events I have just described. What will that $1 be worth in, say, 100 years? $1 million? No. $1 billion? No. $1 trillion? No. My guess is that a $1 investment into space

exploration today would grow to be over $1 quintillion dollars (that's 10^{18}, an astounding number). Compare that to the amount you would have if you invested the same dollar into a savings account at a modest 6% interest rate. After 100 years, your $1 investment would grow to a measly $340. Also compare that to the amount you would have if you invested the same dollar into the stock market at an optimistic 20% interest rate. You would have about $83 million – pennies compared to the $1 quintillion projected profits from investing in space exploration – which is, I remind you, an estimate on the *low* side. Simple business intuition, and sound economic theory, tells us we should invest in space exploration.

"But space exploration is uncertain, and we are not guaranteed to get the profits you claim!" cries Critic Bob. Bob is correct in both of his assertions, but they do not lead to the conclusion he is implying. Firstly, any business is a risk, and any entrepreneur must be prepared to take that risk. Secondly, even the stock market, which most people invest into, is very volatile, and profits are never certain nor assured. Every so-often, there may be a market-crash – largely unpredictable and largely unavoidable. Like in any business, we must accept risk as an inevitable part of the game. The best we can do is learn to deal with risky situations as best as possible. The same reasoning applies to space exploration. All kidding aside, *it is a risky operation*. Our goal, like any businessman knows, must be to minimize risk as best as we can. But that is not the main issue we are trying to deal with here, and can be left to the scientists and engineers to deal with. (After all, they have made the automobile and the airplane relatively safe.) But even given the risks in the exploration of space, what businessman will not jump at the opportunity to make such an enormous profit? So why is society hesitating to make that investment? We have already examined the answer to that question – short-sightedness.

Now, even in spite of the argument just made, undeterred Critic Bob may retort as a last groping objection in his already lost debate: "You have described all of the *long-term* profits that will come of space exploration, and I grant them to you! But we have to wait 500 years for the fruition of space exploration! That's ridiculous! What about *today* and *tomorrow* – what about *next year*, and the year after that? Most businessman invest in those terms! Surely to them, space exploration is a lunacy!" Once again, Critic Bob would be grossly mistaken. And this time we do not need to consider fiscal projections, but only need to look at *history*. After all, the cliché goes: "History teaches the greatest lessons" and that "That man who does not study history is doomed to repeat his mistakes." Have we forgotten that the world has been involved in space science, space research, and even space exploration ever since Robert Hutchings Goddard launched the first liquid-fuel powered rocket in 1919?

The greatest success-story of the American people in this century is without a doubt the Apollo landings on the moon, *circa 1969*. The rest of the world had its eyes on America as Neil Armstrong set foot on the Moon. It's almost hard to believe that this momentous era is not in the distant past, but only 31 years past from this-year. Many Americans seemed to have forgotten that by-gone era. It is as if that great achievement was but a dream. But dream it was, until on July 4th, 1969, two men – Neil Armstrong and Edwin Aldrin – achieved Man's Dream since He first looked up at the Night Sky. After millennia of dreaming and yearning, Man had finally Stood on the Moon. That was the remarkable achievement of Man in 1969.

But this poetic interlude has distracted us from our main inquisition. What was the *use* of those first two men landing on the moon, aside from the childish dream-achieved? What was the *use* of the *billions* of dollars that went into the moon program? What we mean really, To what *profit* did all that money go? *Do you have all day?* The list of technologies that were developed

in the five to ten years before Apollo 11 actually achieved the impossible would stretch for pages. A better question would be what was *not* invented because of Apollo? Just to get a sense of the types of technologies that were developed, we only need to consider three: computers, microwaves, and yes – Velcro.

Velcro is perhaps the most commonly cited example of technologies that came out of the space age. After all, astronauts found it much easier to fasten Velcro than to close zippers on their suites – and Velcro was specifically invented with ease of fastening clothing in mind – for the astronauts, of course – but that did not stop the private sector from commercializing and selling the idea. (Apparently some pretty shrewd people made a billion or two in selling the idea to the American (and eventually world) people!) Another important example is micro*waves* (a form of electromagnetic radiation) – first utilized extensively in the space missions for various reasons (cooking food *not* among them). And, just like with Velcro, the micro*wave* has found uses in the private sector as well – in the microwave *oven* (to cook food, of course!)!

The least commonly cited, but perhaps the most important, example of technology that came out of Apollo is the personal computer. Pre-Apollo, computers were large, clumsy machines that filled entire rooms and requires staffs of experienced engineers and scientists to operate. The high cost of launching material into space forced a lot of very bright people to work on the problem of reducing the size of computers – a need that was not immediately present previously. They succeed so much so that computers could fit on top of a desk – and the *desktop* computer was born. That was the true computer revolution, because it made computers small enough and affordable enough for Everyman to own. And the more recent space missions of the present decade have forced computer sizes even further down – to a point where in a few years, even microwave ovens will be equipped with computer chips!

That ought to be a sufficient list of some of the extraordinary technologies that came out of the research work done to get Armstrong and Aldrin to the moon. Just as many technologies, though probably more, will be invented by the scientists, engineers, and mathematicians working on getting the first man to Mars. Undoubtedly, the technologies will seem strange at first, even absurd, just like Velcro did in 1969 (and some think still does); but soon enough, a venturous entrepreneur will come along and see a completely practical and useful thing in these would-be invented esoteric technologies – and our lives will be changed forever. That is not just conjecture; that is proven, historical fact. And nothing is better at predicting the future than history – just ask the historian! And so, we wrap up this long discussion by telling Critic Bob: *Don't want to go to Mars? Get rid of your Velcro fasteners, your microwave oven, and that computer (or two) you have sitting at your desk!*

We have exhausted Critic Bob, and he doesn't appear to have anything else to say. After thinking about it some more, we may even have a new convert to our camps! But we should not be overly optimistic that Critic Bob will come over to our side too soon.

We have dealt fairly well with most of the objections that Critic Bob has raised in regards to space exploration. But we have one more type of critic to deal with. Critic Bob can be understood as a critic coming from the politically 'right' perspective – the businessman and entrepreneur. A very different type of critic, which I will call Critic Jill comes from the politically 'left' perspective.

But that is another essay and a whole different argument . . .

TO BE CONTINUED