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“Should pure science be publically funded?”

In the adolescence of the 21st century, the United States copes with economic turmoil, a deteriorating infrastructure and never before experienced competition from other countries. For the last two years, the budget crisis has evolved from concerning to alarming. As the strains in these trying times, politicians and their constituents must inevitably ask: what is the most important? Some say preservation of military might, others social welfare. Some promote public infrastructure, other encourage private competition. Wealth spreads thinner as the cost of university education rises, and it becomes necessary for households and treasuries alike to prioritize what matters. When the question of funding science arises, it must therefore be treated as a matter of investment. To understand that the funding of pure science is not only a good but necessary investment, the problem needs to be defined in philosophical as well as fiscal terms. Examining history, the only logical conclusion to be reached is that is in fact the nation's greatest fiscal responsibility.

A government exists to protect the rights and welfare of her people. The purpose of all government spending is to ensure the long-term stability of the state: the military, public roads, and poverty relief all aim to achieve this by different means. No matter the

nature of the program, its ultimate purpose is to serve and protect the public. This has been true since the dawn of western civilization. The empire model established by Rome was based on a theory of conquest: send in the military and capture a territory, then fund future campaigns on the spoils of war. The process only becomes unsustainable when the cost of preserving the state exceeds the wealth generated by its territories. Philosophically speaking, wealth is not measured in gold or dollars – but aqueducts and roads. If wealth were capital itself, a nation with larger borders would always be the richer – this is not the case. Rather, wealth is the amplification of control over resources. The reason Rome would bother to capture a poorer territory than itself could only be to profit by its strategic inclusion in the empire. All Imperial Roman Officers in the golden age of Rome were required to be trained as road engineers – and their work still stands all over Europe today. A road dramatically lowers the cost of transporting goods and armies, making conquered territories richer under improved economic infrastructure. In the eyes of the army and empire, the investment was justified and therefore knowledge of road engineering valuable.

At some point, a nation's wealth can only be improved through technological advances. The roads and aqueducts can only create so much opportunity before innovation is demanded to create new opportunity, wield more power over the resources at a nation's disposal. By knowing how nature works, we exert our will upon her. The scientific revolution and the perfection of the empire-imperialist model would come to depend on this cold fact. In the early 17th century, Galileo Galilei created his telescope. His insatiable thirst for knowledge motivated him to learn lens crafting and

perform fundamental investigations in the field of optics – then point the product of his labor towards the sky and gaze upon the heavens. In *Intellectual Curiosity and the Scientific Revolution*, Dr. Toby Huff explains that Galileo’s telescope earned him patronage and thus a means to devote his life to scientific inquiry. Dr. Huff’s background is in astronomy at Harvard and policy studies at Dartmouth – the ideal authority to consult on the question of funding pure science. What’s more according to Huff, the reason Europe rose to prominence in this era was due to a fundamental rejection of the scientific endeavor by other cultures at the time. The telescope was brought to China and not looked upon with much interest – but in the rejection of the device was also the rejection of curiosity. Four hundred years later, the West is still supreme while the developing world clambers for technology. All wealth is derived from applied technology, and all applied technology is born from pure scientific exploration. If a government wishes to improve the lives of its people, its people must have a firm grasp on the principles which govern their lives.

When analyzing the risk of investing in pure science, cost should be measured in dollars of taxpayer money. But to quantify benefit, it is also necessary to consider *intellectual* capital. Where soil, water, gold, and food have limited investment capacity, intellectual capital is an inexhaustibly useful resource. Even where the immediate application is not obvious, research is inherited by the people who treasure it and eventually makes itself useful. Great leaders have always recognized this. Take for example the first functional military submarine, funded by George Washington during the American revolution. Washington wrote to Thomas Jefferson regarding its inventor

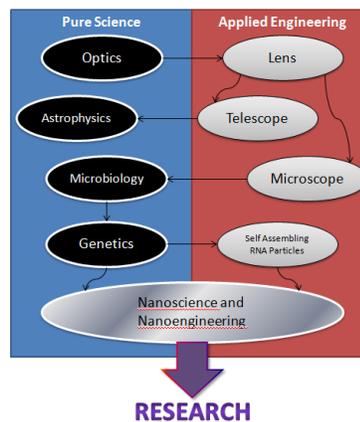
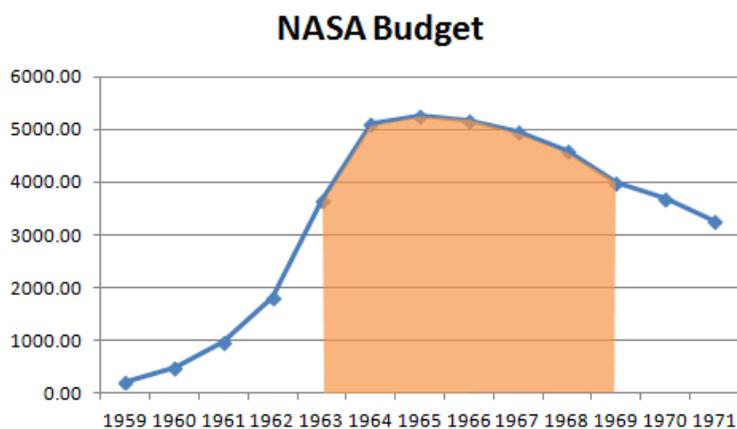
in 1785, "Bushnel is a man of great Mechanical powers - fertile of invention... Although I wanted faith myself, I furnished him with money, and other aids to carry it into execution. - He laboured for sometime ineffectually, & though the advocates for his scheme continued sanguine he never did succeed - One accident or another was always intervening. - I then thought, and still think, that it was an effort of genius..."

Bushnel's turtle was clumsy and by no means instrumental in winning the war. In a conservative fiscal sense, it was a poor investment. Yet today, America's Navy is superior to the entire world. Without patronage from the first Commander In Chief, could there have been generations of legislators willing to invest so heavily in superior naval power? The number of historical divergences that could have occurred without the presence of the Navy is incalculable – but it was the allure of designing a machine "to carry a man under water at any depth he chose, and for a considerable time & distance" that mattered, not how many British ships the machine eventually sunk.

The labor of "Pure Science" is to deduce truth in a body of knowledge based on what can already be shown to be true. It has no other purpose affixed to it that is not harbored in the minds of men. Taking an example from one of the greatest scientific minds to ever live, one of Einstein's "miracle papers" on the photoelectric effect gave birth to what is now modern physics. Those familiar with Einstein know he was the furthest thing from an applied scientist – to him, whatever wealth that lay in creating technology was far less interesting than uncovering knowledge itself. In contrast, the pursuit of "Applied Science" is to intentionally leverage accumulated knowledge to some end. Less than 50 years later, plenty of advancements both theoretical and applied

were made in the burgeoning field of quantum theory. One of those advancements would eventually destroy two Japanese cities and end the second world war – but the balance of power could have easily shifted had Dr. Einstein and his colleagues not written the famous letter to President Roosevelt warning him of the threat of a German nuclear weapon. The response was the Manhattan project – an obscenely expensive undertaking of theoretical science with an applied goal in mind. If the budget had been reduced, and the capture cross section of Uranium and Plutonium not calculated – what could the final cost have amounted to? Even today, nuclear physics research promises to deliver electricity. We live on an intellectual estate inherited from previous generations, paid for by the nation itself.

Science and engineering depend on each other to advance forward in a mutually beneficial manner. The process of discovery and invention is relevant to the preservation of the state on many levels, and investments in intellectual capital eventually yield far more benefits than their initial monetary cost. Accepting this, the question becomes how to disburse these investments in the most productive manner, especially when pockets are shallow. According to the Office of Naval Research, the



US budget for the ONR has remained relatively stable over the last fifty years. Meanwhile, National Science Foundation budgets have steadily increased, nearly tenfold the ONR budget by 2010. Many NSF programs involve funding university research and grants. Both programs are successful models in their execution of funding research. For the ONR, a consistent but fixed budget ensures that Naval research stays relevant and productive towards navy-relevant scientific investigation. But in the words of Wernher von Braun, "Research is what I'm doing when I don't know what I'm doing." The most valuable intellectual capital is mined on the cutting edge, and NSF grants promote competition among researchers. The hungriest applicants take the cake, so there is no need to cut the slices so small. It is pure intellectual capitalism – even if the budget is reduced, academic competition on the cutting edge prioritizes the taxpayer's investment ipso facto. The spirit of pure scientific exploration is akin to the spirit of free market competition. Capitalist freedom is a point of American pride, a point particularly salient during the Cold War. The competition between Soviet Russia and the US was about more than military might or economic power: it was just as much a war of ideas. NASA's budget skyrocketed during the space race – costing over \$29 Billion dollars between 1963 and 1969. There was no immediate economic benefit to be seen in placing a man on the moon. Our astronauts brought back some rocks and performed important research, but they also planted a flag. Spinoff technologies from the space race have well paid for their cost – even something as simple as orthopedics, initially pioneered for astronauts, today has a \$3 billion market worldwide. But the fact that the US has patents in this industry pales in comparison to knowing that one of our own set foot on that magnificent globe in the night sky. Innumerable examples of successful

investments in pure science can be dredged up: the \$2 billion market in vascular implants created with Nitinol, originally developed in the Naval Ordnance Laboratory. Intellectual capital in its essential form is the ability to create wealth based on some body of knowledge. Our knowledge of medicine ensures that every dollar spent on the National Institute of Health generates \$2.21 of additional economic activity within 12 months.

These are the hard facts, depended upon every day by millions of people. The power and wealth to be gained from voyages into the unknown can be cited on paper in dollars and cents, roads and aqueducts. Infrastructure depends on innovation to stay healthy, so research absolutely must be funded. The American Society for Civil Engineers recently issued a “Failure to Act” study which details exactly the cost of letting such funding slip. But when asking if pure science should be funded by the public, what we are really asking is: what is the value of our ideas? They are worth empires built and destroyed. They are worth weapons that can kill thousands, or medicines that can save millions. They are worth freedom itself. If we do not band together as a nation to open our pockets to science, we close our hearts to discovery. Pure knowledge is an expedition undertaken by a community; no corporation or individual researcher can participate alone. Glancing up at the heavens with the sacred thought that someone has actually set foot on that celestial sphere, there could be no better way to spend a dollar.

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