# On the Universality of Creativity in the Liberal Arts and in the Sciences

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This is the first time, in a formal structured way, I've been asked to speak before a group of academicians on this set of issues. It is a great honor to be invited to speak on behalf of one of the two "cultures" mentioned in the commentary by C.P. Snow (1905–1980) in *New Statesman.* It is also a great challenge to be so called upon to speak for an entire "culture." Of necessity, my comments were created from the vantage point of thirty or so years of working embedded within the academic/scientific culture, and specifically within the field of physics. My views have been molded by this experience.

In preparing for this conversation, I have given much thought to how I, as a scientist, could make a valuable contribution to this tradition established at Westmont College. I believe this is best accomplished by spending most of my presentation describing the attributes of the culture of science as I have experienced them and reflected upon this experience. I claim no special abilities or qualifications to be making this presentation. I am most certainly and woefully uninformed on what I am sure must be a vast liberal arts literature on science and culture. I am, however, a theoretical physicist who has made an effort to think on such matters.

Like most of my academic/scientific colleagues, I am only dimly aware of the other culture (the liberal arts) that nonetheless is present in the university world where I have worked for several decades. I may be a little less like my physicist colleagues as my career includes unusually large numbers of lectures and such to non-physicists and non-academicians both on and off campus. Some of these experiences include presentations on my home campus to philosophy classes and honors courses for non-science majors. Of the latter, I owe a special debt to a course entitled "Knowledge and its Human Implications" (supervised by Dr. Kathleen Staudt) that has provided me with an invaluable forum in which to formulate, discuss, and exchange ideas with non-scientific academic colleagues on topics relevant to this conversation.

The "Beyond the Two Cultures" theme of this conversation is very timely from several different perspectives.

It is occurring in the Einstein World Year of Physics (WYP) celebrating the great "annus mirabilis" of 1905 when Albert Einstein (1879-1955) wrote papers that set the course for physics and much of science to this day. The WYP is being recognized around the world as a time for physicists to reflect on past accomplishments of the field and prospectively look at the future. Due to this timing, I will in the following (perhaps more than I might otherwise) refer to statements he made when they seem to be relevant to this presentation.

We are also living at a time when science, through its application in technology, has been remaking the rules by which the wealth of nations will be determined in the future. The principal agencies of this are the Internet and World Wide Web. The implications of this presently seem hardly recognized in our general society. Resulting from new developments in science such as "nano-technology" and "genomic-based science," we appear to be living at the dawning of an age where technological application of science will potentially have the ability to remake the meaning of the word human. There is both great promise and peril in this.

Finally, there are increasing signs the general society in the United States is turning away from one of the greatest triumphs of Western civilization, the view that objective reality is governed by rational and comprehensible rules independent of human desires and emotions.

All I have to say assumes this fundamental article of faith, a fundamental proposition that allows for science as we know it to exist. Scientific culture promotes a rationalist reality-based view of the objective universe. This view of our universe, our working hypothesis, has been the chief enabler of scientific and technological progress over the last few centuries.

In a sense, the commentary of C.P. Snow can be seen as a premonition of the divergence of the culture of science from not just the "intellectual life of the whole of Western society," but perhaps also in the U.S. from the general culture of the nation. Many present day manifestations in U.S. society seem to follow as the natural evolution of Snow's observations.

One thing I find most interesting about these kinds of conversations and deliberations is my part of science, physics, evolved from a subject known as natural philosophy. So in a very real way, physics is a part of the liberal arts tradition. It is not entirely something separate. This is very different from other subjects known collectively as the sciences.

My field has been influenced positively from one perspective (perhaps negatively from another) by having intellects like René Descartes (1596-1650) and Galileo Galilei (1564-1642) participate in its intellectual birth. The latter "pushed," with his studies of motion, a particular way to view the world by using a very specialized language. I believe Snow understated the importance of this fact. In discussing the difficulty of communicating between the two cultures, he writes it is as "though the scientists spoke nothing but Tibetan." Actually, the language largely in use is mathematics. I believe language can influence culture. The language of mathematics has shaped scientific culture.

Of course, mathematics had been used well prior to Galileo in descriptions of the physical world. However, from what I understand of history, the subject of motion, trajectories, and rates of change leads to a fundamental increase in the mathematical basis of the physical sciences. Following Galileo, Isaac Newton (1643-1727) solved the problem of motion with the invention of "the Calculus." This proved a fundamental breakthrough in the development of physics and all of the physical sciences. It is also interesting to note that the mathematician Gottfried Leibniz (1646-1716) at about the same time made this same leap. Even more interesting is recent evidence calculus may have been created by Archimedes (287BC-212BC) but lost to humanity until the work of Leibniz and Newton.

Humanists may be surprised to think of mathematics as a language, but this is a part of life for physicists. Mathematics is, in fact, a very interesting and strange language with many properties in common with other languages. I tell non-scientists to think about mathematics as a language because this is the way scientists use it. It is a language tool. As my fellow conversationalist at the meeting, Dame Gillian Beer, reminds us, Sir Arthur Eddington (1882-1944) declared that the problem with the use of words for a discussion of scientific concepts is there are not enough tenses.

I also have described mathematics as an organ of perception. By this I mean theoretical physicists are working to gain insight into structures that make up levels of existence to which we have no direct access. We achieve this by the means of mathematics. We "see" these levels first with mathematics.

An illustration of this process can be seen in the ability to detect atoms. Using present day technology in the form of "atomic force microscopes," individual atoms can be directly imaged. This has only become possible within the last decade. Yet in a very real way, physicists have been "seeing" atoms for about one hundred years. We can trace this especially back to one of the great works of Einstein in 1905. On July 18 of that year he wrote "On the Movement of Small Particles Suspended in Stationary Liquids Required by the Molecular Kinetic Theory of Heat."

The work of Einstein firmly established the existence of atoms and their size. Thus, we physicists have "seen" atoms by way of their mathematical description in theories that explain observable behavior in our world. For us, mathematics really is another means for viewing the universe. I often tell young people mathematics is an extra sensory perception organ. Of course, I am not the first person to notice this very strange property of mathematics. Charles Darwin (1809-1882) said, "Mathematics seems to endow one with something like a new sense." So I would argue it is this strange tool that is responsible for how physics especially diverges from the rest of the liberal arts.

Even for those of us who make use of the tool of mathematics in physics or science in general, this tool has a lot of surprising properties. One of these properties I refer to as telepathy. All languages have the power to convey ideas from one mind to another. To this extent, the telepathic power of languages is ubiquitous. However, the precision of the transmittal of concepts using mathematics is striking when compared to other forms of human communication.

As my career has progressed, I am drawn into discussions with many people who are not scientists, nor even academicians. One ongoing discussion has been with someone involved in film production. Recently he posed the following question: Let us imagine true extra sensory perception exists. Could individuals possessing this gift be used to advance the study of the submicroscopic world? I ask the reader to indulge me a bit as there is a serious point to be made.

For the purpose of this discussion, let us grant this possibility. In this case, imagine the purported "remote viewer" actually perceived an idea about an object in the sub-microscopic world that had never been considered previously in physics. Having found this, how does he or she communicate it to others? The viewer will have to struggle with the use of simile and metaphor (ruling out science fiction–type telepathy) to communicate the genuinely new idea.

One of the properties of the mathematical language is if an object or idea has a mathematical description, there is automatically a way to communicate it in a precise and detailed way to others' minds. This is true even though those other minds have no previous experience with the new discovery. The mathematically precise understanding of the discovery is accessible to anyone with a sufficiency of mathematical "numeracy" (the analog of literacy). Mathematics has this peculiar telepathic nature to it because of the precision it enforces in its users. In a very real way we can know with much more precision, than with other forms of human communication, what another person is thinking. This precision does not exist in the media of aural or written, nor in graphical representations (outside of mathematics), nor visual representations. We share a common platform for the exchange of concepts.

The physicist Eugene Wigner (1902-1995) once wrote an essay entitled, "The Unreasonable Effectiveness of Mathematics in the Natural Sciences." In this he noted the puzzling scope of success the physical sciences have achieved in the last few centuries based on the use of the language of mathematics. I'd like here to give one such example.

In the late 1920s, the physicist P.A.M. Dirac (1902-1984) found equations that provide a description of the electron and are consistent with both the Theory of Relativity and Quantum Theory (the laws of the very tiniest structures in our universe). When he investigated the equations completely, he found indeed one solution that accomplished the goal of describing the electron. Unexpectedly, a second consistent solution was also found. This second solution had not played any part in his thinking about the properties a mathematical description of electrons ought to possess. Yet it was there, and by studying its properties, one learns that this second mathematical solution describes an object with the same mass as an electron but also the opposite electric charge. Even more startling, if this second solution is superimposed at the same location as the electron, it causes both to disappear and be replaced by an amount of equivalent energy given by Einstein's famous equation, "$E = mc^2$."

A few years later in a laboratory experiment, C.D. Anderson (1905-1991) discovered a particle possessing these properties. It is the anti-particle to the electron (called the "positron") and was the first known form of what we now call anti-matter. Dirac did not set out to discover anti-matter. Nonetheless, the mathematics he used forced this. The point of this story is to ask the question: Why?

The history of physics is filled with such stories. "Why does the mathematical understanding of how gravity works at the surface of the earth explain how it works for planets?" "Why does the mathematical understanding of how electricity and magnetic work in the laboratory explain how fast a light beam travels?" In all of science this same phenomenon occurs.

With the emergence of physics from the classical liberal arts conversation, using a highly specialized language, this "queen of the sciences" pulls all of the sciences in this direction. It pulls the language of all of the other sciences in a direction that is mathematically based and represents a particular kind of human reasoning and perception. In *A Treatise on Painting,* Leonardo da Vinci (1452-1519) phrased this concept as follows: "No human investigation can be called real science if it cannot be demonstrated mathematically."

To this day physics continues to "pull" other physical (and even non-physical) science disciplines toward using a mathematically-based paradigmatic philosophy. Within the last decade, there has been a noticeable divergence in some fields of biology, so they increasingly are coming to more resemble physics.

Indeed, the physics community itself is responsible for some of this. Numbers of its members have turned their approaches, techniques, and philosophies of physics toward issues of biological systems.

However, due to the field's use of this language, physicists often find enormous difficulty communicating with others outside of their field and language. When speaking among ourselves, we presume there exists this common language, and thus when, for example, confronted with speaking to the public or to funding agencies or entities, we are thrown back into the issue of communicating the goals and achievements of the field. We are forced to use other forms of communication, and our effectiveness is important to gain support for the continuation of research activities.

Before we leave the consideration of the power of mathematics as it shapes the culture science, there is one other development that is now apparent and could have likely more important implications for the future culture of science. It need hardly be remarked upon how enormous is the impact of computers and computer technology on society today.

Throughout most of the history of the development of science, there has essentially been a single medium through which mathematics has been accessible. Practitioners had to master symbolic systems of representations in order to master mathematical concepts. This point is easy to overlook, and it might be thought the two are inseparable. However, with the creation of the modern computer, a potentially new medium with which humans might research mathematics has appeared.

In order to explore this more fully, let us focus upon another area where human creativity and a powerful symbolic representation technology co-exist. There is one obvious such example: music. A score to an intricate piece of music is at least as complicated as pages of mathematical calculations.

While pieces of music exist as scores, they can also be played on musical instruments. Any person possessing the ability to hear has a direct access to the concepts in music that have their symbolic representation in the scores being performed. Until the advent of the computer, there were no analogous instruments or medium for mathematics. It is possible to use a fantasy to better stress this point.

Imagine a planet on which there existed no sound at all but with beings who were our equal in intelligence. Could music exist on such a world? I would argue the answer to this question is "Yes." If by some means one of these beings happened upon the idea of a musical score, then he or she would have access to music. Of course, only those who mastered the technique of scoring would have such access, but they might be inspired to marvel at the beauty, elegance, and power in this world of symbolic representation. They would also encounter enormous difficulties communicating with their fellow beings.

The introduction of sound and musical instruments changes this immediately. One goes from a world in which only those who master the symbolic representation of musical concepts can develop an appreciation of music to a world where there can be almost universal appreciation. In our world, we know of musical geniuses who never learned to read scores! Musically, creativity is not limited solely to those who master the symbols. I have a suspicion that with a sufficiently long interaction between humans and their computers, something like this might happen with mathematics. This would herald an enormous cultural shift. We can see some of this starting to happen in computational science, cellular automata, algorithm, and computer science. Science serves as a foundation of technology. Although it is true physicists "find the codes of reality," this is only done in the context of several centuries of experience, which have shown that by allowing some members of society to engage in this activity (of low immediate value), the knowledge uncovered has demonstrated lasting (high) value over the long term. This is very apparent when we note whereas physics finds the rules for what can be, it is the effort of talented engineers and technologists who use these rules to create what has never existed previously…advanced technology. So physics and all of the science are serving the purpose of creating a storehouse of knowledge. The role of the sciences is to uncover the codes.

When speaking to young people, I often like to use a scene from the popular movie "The Matrix" to drive home this point. There is a scene when the lead character, Neo, first realizes who he is, and when this occurs, the scene around him fades to be replaced by strings of green characters running across a screen. These characters represent the underlying computer codes running the matrix. Likewise, science is the activity that uncovers the codes that run physical reality. In speaking to students, I have found many believe that science is a collection of facts found in books and that being a good science student consists of regurgitation of these facts. My response is it is necessary to change this definition of science. If that is the view one has of science, it is like walking into the studio of a great sculptor, looking down at the rubble on the floor, and concluding that sculptors are people who make little piles of pebbles from large rocks. This misses the main point of the activity. The facts that end up in books are the results of science.

Science is the human process by which our species gains its most precise understanding of the place in which we live, the universe (or physical reality—the part of reality not dependent on our emotional state as far as we can measure). It is a process, a conversation among a group of humans, and in a sense, a conversation between a group of humans and the universe. This conversation has taught us to be cautious in our attitude toward what it is that we believe.

Often non-scientists appear subject to an illusion that science uncovers "scientific truths" for our species. This is not the work of science. Science reveals "theories" about the structure of the universe. In *Ideas and Opinions,* Albert Einstein said,

> It is difficult to attach a precise meaning to the term "scientific truth." Thus the meaning of the word "truth" varies according to whether we deal with a fact of experience, a mathematical proposition, or a scientific theory.

The use of the word theory recognizes any paradigmatic explanation of facts (i.e., scientific observation) is a proposition that can be proven false. Any claim made to being a part of science must surrender ab initio to this property, and it must in principle allow (by the action and reasoning of scientists) for the claim to be proven false.

Scientists are aware ours is a clever species, having inhabited earth for at least hundreds of millennia before obtaining our present status as the planet's dominant life form. Our mental processes have allowed us first to survive and later thrive and thereby reach this point. Due to our cleverness, science must take into account we are also clever enough to fool ourselves. Accordingly, built into the structure of science there must be mechanisms for error correction. This is the role of what has been called the scientific method and the means by which we discern arguments, observations, and experiments that provide a basis for our system of beliefs. A corollary to such a system is scientists must be willing, when presented with a preponderance of evidence, to abandon beliefs held as correct. In science, there can be no final certainty about one's scientific beliefs. Part of the charge to each new generation of scientists is to check and re-check the "canon" that is its inheritance from previous generations.

Among systems of belief, science is almost unique in this embrace of fallibility and limitations on human ability and perception. Instead of a weakness, this is the source of the strength of science. It can be argued that this unremitting dedication to the refinement of our understanding of the universe gives science, through its application in technology, more power to alter the quality of human life than perhaps any other system of belief. Certainly human history over the course of the last several centuries supports this.

Science lies at the intersection of several different and not completely overlapping regions. One of these is the human imagination, and mathematics is part of it. A second consists of physical reality, and the final is a subset of this corresponding to the technical competence of our species. Science, as we know it, can only exist in the region where these three completely overlap. Not all are static. It is clear that what we call technological progress means that the technical competence of our species is expanding. The part of the circle of physical reality that lies outside of our technical competence and mathematical imaginations constitutes the realm of profoundly unknown parts of physical reality.

It is possible to observe phenomena without possessing the requisite mathematical ideas to explain and give complete context to the observations. A present day example is the phenomenon of "high temperature" superconductivity where there exits no accepted scientific theory. Perhaps the opposite example to this is the part of physics known as "superstring/M-theory." Here we have lots of mathematical imagination, but no observational basis of this set of ideas. It remains a piece of "pre-physics," "proto-physics," or "putative physics." (Some of its detractors even say that it is "meta-physics," i.e., not physics.)

This is not the first time a situation of this character has arisen in physics. The understanding of motion in the realm of atoms was developed in two major conceptual steps by three physicists, Niels Bohr (1885-1962), Erwin Schröedinger (1887-1961), and Werner Heisenberg (1901-1976). The basic reason why they were driven in this direction was the need to explain the unique pattern of colors (i.e., a spectrum) that each element emits when, for example, it is burned.

Brilliant propositions were required to explain this observation about nature. The first occurred in 1905 when Bohr suggested the orbit of the electron was quantized; in other words, it could only orbit at a number of fixed distances from the proton. This became formalized in an ad hoc rule (Bohr-Sommerfeld rule) to be added to the already existing understanding of physics.

This was an unsatisfactory situation. It is not a desirable result that willy-nilly new rules are added to the existing theoretical framework. The world's physicists were simply taking all the theory that had been proposed by Isaac Newton and then adding one more such rule…one that only applied to tiny objects.

Imagine it was possible to build a time machine, travel back to the year 1920 and ask the world's leading physicists, "What is the deep conceptual basis for quantum behavior?" The answers given would have been confused and chaotic and most likely incorrect. This was best possibility in the time between 1905 and 1925/1926. A true paradigm shift (including Bohr's suggestion) occurred in 1925/1926 when Schröedinger and Heisenberg introduced Quantum Theory.

This conceptual framework is a genuine paradigm shift that totally changed how physics envisions the universe at the level of the very tiniest scales. Although in some ways today's situation in String Theory is distinctive (laboratory-based observational input drove the development of Quantum Theory), at best it presently exists in the state of an incomplete paradigm.

Quantum Theory demanded a new view of objective reality. The Classical Newtonian Theory described a reality cast in the form of points, which for simplicity we can envision as tiny billiard balls. The Quantum Theory description requires these to be replaced by mathematical ("wave functions") entities that can exhibit the behavior of points under some circumstances but behave as waves under others.

This paradigm shift illustrates a number of features about the two cultures we are discussing. Scientific culture is extremely conservative with regard to its basic beliefs or paradigms. Observational facts have the power to cause a true shift. However, once the shift occurs, the culture accommodates it. These shifts are dramatic. For Newton, a "mechanical universe view" based on generalizing the laws of motion from a game of billiards was sufficient. He invented his calculus to be able to describe such motion. For Bohr, Schröedinger, and Heisenberg, a "mathematically-based universe view" was necessary.

The shift from one to the other is dramatic and illustrates vividly Einstein's dictum: "Imagination is more important than knowledge" (*Ideas and Opinions)*. For many years this comment puzzled me. I could not see how imagination (which is often associated with creativity and even play) could be more important than knowledge, the basis of technology. The Newtonian/Bohr-Schröedinger-Heisenberg shift illustrates the correctness of Einstein's comment. Quantum Theory is not derivable from Classical Newtonian Theory, it is a daring leap of the imagination in its final form.

In other words, in science the creation of a genuinely new rational paradigm is itself an irrational process.

This perhaps is the most profound distinction between the two cultures. In science, the creation of paradigms is not determined solely from the internal discourse within the culture. I believe that as scientists view the other culture collectively, we are left in a state of confusion as to how this irrational process is governed or if it is at all.

Knowledge (mathematical, scientific, and technological) is finite. It definitely possesses a boundary beyond which we are blind. The only human facility by which it is increased is imagination. We imagine new answers and solutions. We make them up! However, as scientists we are charged with taking this marvelous facility and seeking Nature's confirmation that we are less incorrect than with our previous theories. Einstein's comment was that it was the sad fate of most theories to be shown incorrect shortly after their conception. For those not so roughly treated, at most Nature says "Maybe." Again and again we go to the laboratory to see if the new paradigm gains support. Science is thus always in a state of "tentativity" (if I may introduce such a term), a state mostly static but with punctuating dynamic periods of changes in beliefs about the universe. This culture must accept that its most cherished theories at some point in the future will likely be changed.

I believe living with uncertainty is a very unnatural way for humans to exist. As I think about fellow members of humanity, beliefs, behavior, cultural patterns, and structures that exist, it seems to me a great deal can be understood as an attempt to remove uncertainty from existence. Many would prefer to have certainty about a false belief than to admit uncertainty and strive thereafter for enlightenment. In science it is impossible to maintain the illusion of certainty. This makes doing science difficult. We are enormously happy when we have wrestled a single fact from, in Einstein's words, the library of the Ancient One. It takes an enormous investment in human creativity and effort to cause this new understanding to come into being. For me, creativity is the ability to form universally recognizable patterns of harmony, symmetry, and order synthesized from ignorance and/or chaos. I do not know how creativity can come to exist in a person without discipline. So in this sense it is fitting that we scientists all work in "disciplines."

The culture of science, as I have known it, is a reflection of all I have tried to illuminate above, and I hope I've not neglected some important point. Most, if not all, of this likely has been said before in other ways, places, and times. Creating new science is a human effort, and it exists at the edges of what we know by harnessing an irrational quality of the mind—human creativity.

What does this have to do with the liberal arts? I believe we can discern the answer from several points I have attempted to make in the previous discussion.

The strongest of these is based on common assumptions about how human minds operate in formulating systems of belief about existence. Both cultures must begin with the assumption that we are smart enough to figure it out. That is, we are capable of bringing patterns of understanding to the totality of human experience. If we throw up our hands as step one and despair that existence is too complicated to yield to rationalist views, then we never get to step two. Both are forced to rely on deliberative and rational processes to carry the conversation forward.

I would posit that the liberal arts are posing questions and exploring concepts about how the human mind works internally and collectively. From my perspective, we physical scientists, roughly speaking, view our existence as being such that it can be split into two parts, objective reality and human consciousness. We in the sciences are asking the question, "How does our house (the universe) operate when we are not there?"

The liberal arts, I believe, are asking the question "How do we and the house operate when we are home?" To explore their respective questions, both cultures use discourse and collective deliberation as the basic tools for seeking answers. Minus our use of mathematics, these techniques are remarkably similar. We are both "discoursive" (again I hope I'm introducing a useful phraseology). In a sense, the scientists have likely picked the easier question to answer. The spectacularly technological progress since the time of Galileo can be interpreted as evidence for this. From my perspective, whereas there is in general, and especially in the U.S., no great interest in doing science, there is an enormous appetite for the increase in the technical competence that results.

Society permits science to exist for this reason. There still generally seems to be a healthy regard for science due to the benefits derived from the activity.

In the process of achievement, there are certainly "spiritual" reasons to support scientific research. The work of Einstein informs us we live in a universe about 14 billion years old that has undergone almost unimaginable transformations through a cosmic evolution of space, time, matter, and energy. This permits the existence of every individual human consciousness. During this enormous gulf of time and effort, the universe produces apparently exactly one copy of a creature called "you." The 1933 work of W. Baade (1893-1960) and F. Zwicky (1898-1974) gave us the power to comprehend supernovae, nature's forges for creating heavy elements (the "star stuff" spoken about by Carl Sagan [1934-1996]) required for planets and life. The work of Darwin informs us how our planet and universe are capable of creating first life and then consciousness. The discovery by F. Crick (1916-2004), J. Watson (1928-), and M. Wilkins (1916-2004) (with an often unacknowledged assist from female crystallographer, R. Franklin) of the DNA molecule is leading to scientific indications of just how closely related are all members of the human family and our relation to all life forms on our planet. In all these instances, the scientific culture produces answers that curiously echo ideas, comments, and propositions that have long occurred in the liberal arts. Should not these be mutually reinforcing for the two cultures?

Above I commented that the nature of scientific systems of belief is they almost invariably are tentative, and this is likely an "unnatural" state of mind for most people. This is one of the types of questions the liberal arts can explore. There are so many other such questions where it seems to me the liberal arts have and will continue to lead us in exploration of the human condition. Why is it we relate to one another as we do? What is it that art, music, and poetry tell us about the human mind?

After the creation of nuclear weapons, Einstein observed that unless we have advances in the understanding of the essential nature of humanity, we are in a position to be overwhelmed by our increasing control over objective reality to the extent that self-extinction is a possibility. At that time, the threat was from the use of nuclear weapons of mass destruction. Although we seem to have avoided that dire fate, this new millennium clearly brings us new challenges.

With new advances in understanding the human genome, shall we embark upon "improving" our species? I have on occasion posed questions to general audiences asking, "If you could choose to have a daughter who could hit a tennis ball like Serena Williams, possess the leadership qualities of Margaret Thatcher, and look like a *Sports Illustrated* swimwear model, how many of you would choose otherwise?" "If it becomes possible through the use of nano-technology to insert microscopic machines into your body to enhance its function and performance, improve vision, assist weight loss, maintain a youthful appearance, and provide a wireless connection within your mind, would you not so decide?"

To survive essentially as humans, we must diligently maintain the discussion that occurs in the liberal arts and broaden it to cover our entire society, including the other culture. We must endeavor to harness the universal source of human creativity to this end.

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