

## One Culture: Two Methods

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### Abstract

Opposition between the culture of the ancients and the culture of the moderns is as necessary for the pursuit of truth as the opposition between the fingers and the thumb is necessary for the working of the human hand. In the nineteenth century, Matthew Arnold and T. H. Huxley vigorously advocated for the importance of the humanities (ancients) and sciences (moderns), respectively in the education of a cultured person. However, by the first half of the twentieth century, as reported by *The New York Times*, the cutting edge of science outpaced the understanding of nonspecialists, and by the second half of the twentieth century, C. P. Snow realized that those educated in either the culture of science or the culture of the humanities were incapable of understanding the other culture. Snow suggested that since science was the dominant job-producing culture that leads to the improvement of civilization, those in the humanities, whose method encourages them to look to the past, should learn more of the sciences that look toward the future. Here I suggest that the search for truth in science can be enriched and deepened if we, as scientists, incorporate the backward-looking method of the humanities as a complement to the progressive scientific method. We can do this by critically reading and questioning the original and foundational works of past scientists from their perspective as well as from our current perspective. In so doing, we will either gain confidence in current scientific dogmas or support the quest for alternative theories.

**Keywords:** Matthew Arnold, Frank Capra, Albert Einstein, T. H. Huxley, C. P. Snow

*“Although the bodies of our ancestors are incorporated into ours without any effort by us, we can share their mental images, their world views, only by trying to rethink their thoughts. We must read what they wrote, look at and listen to what they produced, try to imagine ourselves living their lives. Only by attempting to recapture their sensibilities can we affirm the humanity which we share with our ancestors and participate in the continuity of human history. Unless each one of us attempts this imaginative reconstruction of the thoughts of his ancestors, he is condemned to live in an existential present, cut off from human history. A man who learns nothing of the past abandons his cultural inheritance.”*

Harold L. Burstyn (1970)

## Introduction

As agricultural practices are necessary for the cultivation of crops and farm animals for food, clothing and shelter, philosophy or the love of knowledge is necessary for the cultivation of the mind. For Cicero (708), philosophy plucks up vices by the roots; prepares the mind for the receiving of seeds; and sows them in the hope that when they mature they will produce a plentiful harvest. But how do we cultivate the mind to search for an objective and unique scientific reality that is shared by everyone? Is knowledge of the sciences and the humanities equally valuable in forming the prepared mind of a scientist that is able to take advantage of chance? Is the pursuit of the knowledge of the past, which is encouraged in the humanities, helpful in transcending a potentially narrow scientific viewpoint of the present, known as the cutting edge? Is it worthwhile to stop on occasion at the precipice of the cutting edge and ask, is the direction that culture and each of its subcultures going praiseworthy or blameworthy? That is, is the progressive scientific direction *ipso facto* always positive, enlightened, advanced and better than the regressive humanistic direction? Is the regressive direction always negative, less advanced, degenerating, deteriorating, and backsliding? Can the regressive direction also be seen as enlightened? In becoming cultured, is it worthwhile to learn both the method of the humanities and look backward and inward and the method of the sciences and look forward and outward? Yes, according to Einstein (1954), who wrote, “*somebody who reads only newspapers and at best books of contemporary authors looks to me like an extremely near-sighted person who scorns eyeglasses.*”

In his book *Culture and Anarchy*, Matthew Arnold (1869), recommended “*culture as the great help out of our present difficulties; culture being a pursuit of our total perfection by means of getting to know, on all the matters which most concern us, **the best which has been thought and said in the world**, and, through this knowledge, turning a stream of fresh and free thought upon our stock notions and habits, which we now follow staunchly but mechanically....This inward operation is the very life and essence of culture, as we conceive it.*” Arnold also wrote that “*establishments tend to give us a sense of a historical life of the human spirit, outside and beyond our own fancies and feelings; how they thus tend to suggest new sides and sympathies in us to cultivate.*”

Thomas Henry Huxley (1881), a close friend of Matthew Arnold, wrote that “*Perfect culture should apply a complete theory of life.....*” and “*After having learnt all that Greek, Roman, and Eastern antiquity have thought and said, and all that modern literatures have to tell us, it is not self evident that we have laid a sufficiently broad and deep foundation for the criticism of life which constitutes culture.... I find myself wholly unable to admit that either nations or individuals will really advance, if their common outfit draws nothing from the stores of physical science....We cannot know all the best thoughts and sayings of the Greeks unless we know what they thought about natural phenomena. We cannot fully apprehend their criticism of life unless we understand the extent to which that criticism was affected by scientific conceptions.*” Perhaps Huxley pushed the view of the moderns too far, when he said, “*We falsely pretend to be the inheritors of their culture, unless we are penetrated, as the best minds among*

*them were, with an unhesitating faith that the free employment of reason, in accordance with scientific method, is the sole method of reaching truth."*

Arnold's philosophy of education, which emphasized literature, was not restricted to the *belles lettres* as was inferred by Huxley, but included Euclid's *Elements* and Newton's *Principia*, and what had been written by other luminaries, including Copernicus, Galileo, and Darwin. In his Rede Lecture, Arnold (1882) said that "*in natural science the habit gained of dealing with facts is a most valuable discipline, and that everyone should have some experience of it;*" but that natural science should not "*be made the staple of education for the bulk of mankind.*" In his search for balance, he thought that it was enough for a cultured person to know "*the great results of the scientific investigation of nature...but how much of our study were we bound to give to the processes by which those results are reached?*" Arnold (1882) believed that "*those who are for giving to natural knowledge, as they call it, the chief place in the education of mankind, leave one important thing out of their account—the constitution of human nature.*" Human nature, according to Arnold (1882) assures that "*the vast majority of mankind feel the need of relating what we have learnt and known to the sense which we have in us for conduct, to the sense which we have in us for beauty.*" Consequently, "*the importance of humane letters in man's training becomes not less, but greater, in proportion to the success of science in extirpating what it calls 'mediaeval thinking.'*"

Assuming that culture exists in "*an objective and unique reality which is shared by everyone*" (Townes, 1995), each person is entitled to find his or her own balance between Matthew Arnold's humanistic culture and T. H. Huxley's scientific culture. Indeed, Aldous Huxley (1963), at once the grandson of T. H. Huxley and the great-nephew of Matthew Arnold found his balance. However, the cultural fulfillment of humankind requires that we not marginalize the scientific or the nonscientific view. In the words of William Bragg (1933), "*It is the fact that in our lives, in all that we work at and strive for, it is of first importance to know as much as we can about what we are doing, to learn from the experience of others, and, not stopping at that, to find out more for ourselves, so that our work may be the best of which we are capable. That is what science stands for. It is only half the battle, I know. There is also the great driving force which we know under the name of religion. From religion comes man's purpose; from science, his power to achieve it. Sometimes people ask if religion and science are not opposed to one another. They are: in the sense that the thumb and fingers or my hand are opposed to one another. It is an opposition by means of which anything can be grasped. It is right, therefore, with all our heart to learn what will help us in the work we want to do, and that when the call comes we can say, 'I am here and ready; I want to play my part, and I have tried to for myself to play it well.'*"

As a chemical engineering major who graduated from the California Institute of Technology in 1918, Frank Capra "*changed his whole viewpoint on life, from the viewpoint of an alley rat to the viewpoint of a cultured person* (McBride, 2011)." Capra (1971; Gilbert 1997), a true multidisciplinary, later went on to write, direct and produce educational movies for the Bell System Science Series that are excellent examples of the multidisciplinary search for truth along three avenues: the avenue of the humanities, the avenue of religions, and the avenue of sciences.

The movies made by Capra include *Our Mr. Sun*<sup>1</sup>(1956), *Hemo the Magnificent* (1957), *The Strange Case of the Cosmic Rays* (1957) and *The Unchained Goddess* (1958).

*“The spirit of man seeks truth through many avenues,”* according to Doctor Baxter, the scientist in *Hemo the Magnificent*. Through Doctor Baxter, Capra (1957) went on to say, *“The artist seeks it through creative expression, through beauty, music, form, the laws of harmony; the religious through spiritual revelation, through the power of prayer, love, mercy, moral laws; and in science we seek it through the study of nature and its physical laws, and for us it is as fascinating as any poetry.”* The search for truth is a personal journey and each step along an avenue to truth is often illuminated by one or two individuals, who become known as luminaries. No single avenue or discipline has a monopoly on the truth, but has both value and limitations in the search for truth. It follows that no single avenue or discipline should have veto power over any other in the search for truth, and the search for truth should be multidisciplinary (Wayne, 2016). Moreover parallel avenues to truth are valuable when the cutting edge of a given avenue to truth turns out to be a dead end. Science is not always as self-correcting as we think (Holcombe, 2015). Consequently, it may be productive not only to look forward along with the moderns and scientists but also, in the company of the ancients and humanists, to look back.

### Materials

The Cornell University Library and the Amherst College Library provided the original texts cited in this paper, and the translations of Cicero and Henrik Ibsen. Links to Frank Capra’s movies on YouTube are available on my website:

<http://labs.plantbio.cornell.edu/wayne/Bell%20Telephone%20Science%20Movies.html>.

### Results and Discussion

In this day and age, when we cannot go through a single day without encountering the acronym, STEM (science, technology, engineering and math), the epigones that represent the literary culture of Matthew Arnold and the scientific culture of T. H. Huxley are far more polarized and polarizing than Huxley and Arnold ever were. In part this polarization was captured by C. P. Snow (1961), himself a physicist and novelist, in his Rede Lecture entitled, *The Two Cultures*. According to Snow (1961, 1964), culture is defined not only by *“intellectual development”* and *“the development of the mind,”* but also *“without knowing it, we are more than we think children of our time, place and training.”* A cultural group responds *“without thinking about it.”* Snow defined instinctual reactions of the two cultures in terms of their views of the future: *“If the scientists have the future in their bones, then the traditional culture responds by wishing the future did not exist.”*

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<sup>1</sup> Aldous Huxley contributed to the original script of the movie (Smith, 1969).

Educational specialization, according to Snow, raised the barrier that separated the two cultures. Such specialization led to the scientist's inability to comprehend the literary works of writers such as Dickens, and the literary intellectuals' "*total incomprehension*" of the sciences that would provide well-paying jobs and the technology necessary for civilization. This was not such a problem for the scientists themselves, since according to Snow, "*their culture contains a great deal of argument, usually much more rigorous, and always at a higher conceptual level, than literary persons' arguments.*" Snow clearly had one foot and four toes firmly entrenched in the culture of the moderns.

Taking this fractional approach himself, Snow realized that "*the number 2 is a very dangerous number.... Attempts to divide anything into two ought to be regarded with much suspicion.*" Thus he contemplated a third culture. Today there is a *third culture* (Brockman, 1995, 2008), which is defined by John Brockman as a group of intellectuals who have skill and knowledge in both science and literature. However, the *third culture*, like C. P. Snow himself, lives at the cutting edge and does not seem to use the historical skills which are learned in the humanities to question the veracity of the science. According to Brockman (2008), "*A fundamental distinction exists between the literature of science and that of disciplines whose subjects are self-referential and most often concerned with the exegesis of earlier thinkers. Unlike those disciplines in which there is no expectation of systematic progress and in which one reflects on and recycles the ideas of others, science, on its frontiers, poses more and better questions, better put. They are questions phrased to elicit answers; science finds the answers and moves on. Meanwhile, the traditional humanities establishment continues its exhaustive insular hermeneutics....*"

Today, as in Arnold's and Huxley's time, "*the importance of humane letters in man's training becomes not less, but greater, in proportion to the success of science in extirpating what it calls 'mediaeval thinking'*"—not as a handmaiden to science, as practiced by the *third culture*, but as an equal partner.

What can be learned by treating the two methods of the humanities and science as equal partners in the search for truth? Through critical exegesis and hermeneutics of the foundational texts of science, a second method in addition to the scientific method, is put forth so that the scientific establishment is able to question the assumptions and determine the strength of the foundations upon which the cutting edge balances. Harold Burstyn (1969) wrote, "*Ask a practicing physicist whether he ever has read a word of one of his heroic predecessors; the answer most likely will be no. The sense of belonging to a tradition of affirming one's links with the whole of mankind through time, is the scientist's right by virtue of his having mastered the methods of his profession. Every physicist alive and contributing to physics today stands in a line stretching back through Einstein, Maxwell, and Faraday to Newton, Galileo, and beyond, whether or not he ever has studied their actual contributions.*" The second method complements the scientific method when the goal of science is the search for truth.

I recently read Einstein's (1997) paper on the precession of the perihelion of Mercury and found that logically, I could not get from his assumptions to his conclusion (Wayne, 2015a).



Then I realized that there was either a typo or a mistake in equation 7c. I wrote to a famous astrophysicist, who replied on May 23, 2015:

*Hi Randy,*

*It certainly looks like a typo in the paper by Einstein. The Newtonian potential has to be  $GM/r$ , as you noted.*

*By the way, I have personally never referred to Einstein's original papers for equations like this - I always go to one of the textbooks. Not sure whether I should feel ashamed or vindicated ...*

Perhaps the foundations of the general theory of relativity have not been scrutinized as much as the textbook versions imply (Wayne, 2012, 2015a).

With great rights come great responsibilities. In the search for truth, one of the scientist's responsibilities is to make sure that the foundation upon which the edifice of science is built is secure. In the spirit of Roger Bacon (1985), Francis Bacon (1676) and the natural philosophers who founded the Royal Society, "*Nullius in verba*," that is, one must not accept anyone's word for the truth but be prepared to understand science from observation and/or first principles. As science has grown, however, it has also strayed from this foundational principle. It is important to take stock of where we are in history "*Since science has become our paradigm for demonstrative knowledge, we have accepted the argument based on its progress as the foundation of our educational endeavors* (Burstyn, 1970)." It is clear that science has lost sight of its foundational principles given that it is currently sufficient to make a truth claim by referring to the authority of the mob by saying that 97% of scientists believe a given theory or by referring to the authority of an individual by parroting the conclusions of that particular individual without having read the original works.

The scientific method, which has strayed from its roots, can learn from the method of the humanities. Burstyn (1969) reminds us that "*The scientific contributions of Newton never are presented in their original form to be compared with those of Einstein. What we compare, rather, is our latest interpretation of each. Yet, we always go back to the original in our examination of a work of art or literature, and we judge contemporary works with reference to the models provided by the past....One can not teach literature honestly with exclusive reliance on contemporary novels—though they may raise all the fundamental questions of human existence—nor can he teach history by showing students how to make use of evidence to understand contemporary events. The humanist tradition never can be method alone; it must be content as well.*" Indeed, a critical reading and analysis of Book Two of Newton's *Principia* (Cajori, 1946), which discusses the reality of friction, would have gone a long way to bring modern physics in line with an objective and unique scientific reality that is shared by the layperson (Wayne, 2010).

In order to help bring the scientific culture back to its foundational philosophy of "*Nullius in verba*," I want to point to a particular paper that defined the science of today. Science, as defined by C. P. Snow (1970), who was particularly interested in the application of technology to

solve the world's problems, does not require even a glance at the content of the past. In fact, Snow states that the distinguishing characteristic of science is that "*No scientist, or student of science, need ever read an original work of the past.*" To put his quote in context, I give a lengthy quotation from Snow:

*"Two kinds of understanding. Two ways of dealing with experience. Judged by a single powerful discriminant there really are two and only two. The phrase 'two cultures' means more than was originally intended. One of these cultures is a search and a successful search for agreement. That is, by limiting the content of experience which minds had to cope with, and abstracting certain parts, it was found possible to reach a level of agreement: and to build upon this, by the same process, brick by brick, incorporating what had been previously done into the growing structure. This is the culture or tradition which we call science. It only became organized and accepted as a form of mental consensus about 400 years ago (possibly the real start of science had to wait until the invention of printing): but now, so far as we can foresee, it is irreversible.*

*By the year 2070 there will be within limits in which science works, enormously more and deeper agreement about the natural world than there is now. This is the culture which cannot help showing the direction of time's arrow.<sup>2</sup> It has an organic and indissoluble relation with its own past. To use a sentence of Burstyn's: 'In science, the insights of the past are digested and incorporated into the present in the same way that the genetic material of our ancestors is incorporated into the fabric of our bodies.'*

***This is the characteristic of science which distinguishes it in kind from the other way of knowing. No scientist, or student of science, need ever read an original work of the past.*** As a general rule, he does not think of doing so. Rutherford was one of the greatest of experimental physicists but no nuclear scientists today would study his researches of fifty years ago. The substance has all been infused through the common agreement, the textbooks, the contemporary papers, the living present.

*This ability to incorporate the past gives the sharpest diagnostic tool, if one asks whether a body of knowledge is a science or not. Do present practitioners have to go back to an original work of the past? Or has it been incorporated? The English definition of science has always been stricter than that of Wissenschaft or nauk[нау́к], and has in effect employed precisely that diagnostic tool.*

*Science is cumulative, and embodies its past. The other culture, or tradition, has and must have a different relation with its own longer and more variegated past. Take Shakespeare and Tolstoy. Anyone partaking of the 'humanist' culture (there should be a more acceptable term, but it has not yet emerged) has to read their works as they were written. They have not passed, and cannot pass, into a more general agreement or a collective mind. They cannot, nor can any works of art, be incorporated into the present as scientific work is bound to be.*

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<sup>2</sup> Ironically, while Snow acknowledges that the scientific culture shows the direction of time's arrow, the mathematical physicists consider the arrow of time to be an illusion (Greene, 2004).

*Shakespeare and Tolstoy have to be read as the words stand on the page. And that will be true so long as man reads English or Russian.*

*The works endure as independent entities. Partly outside of time. Partly but not entirely: for we have to see them with a kind of double exposure, perceiving as well as we can what they meant in their own time, and (what is much easier) what they mean in ours. But, though the relation to time of humanist art is not simple, there is no direction of time's arrow<sup>3</sup> By the year 2070 we cannot say, or it would be imbecile to do so, that any man alive could understand Shakespearian experience better than Shakespeare. Whereas any decent eighteen-year old student of that year will know more physics than Newton.*

*There is no built-in progress in the humanist culture. There are changes, but not progress, no increase of agreement. Ask yourself, was van Eyck a worse painter than Cézanne? The answer is, he was different. Sometimes in the history of art, particularly in the visual arts, one can identify periods of what can, without absurdity, be called technical progress. But there is nothing ultimately cumulative about this passage through time: and there cannot be in a culture which is in essence concerned with content and not with process. That is its nature. That is why it is in many ways closer to our human selves—so long as we don't forget that the abstracting, consensus-seeking mind is one of the most human things about us. In fact, the only one which, so far as we know, we don't to some extent share with the animal creation from which we sprang. It is tempting to borrow two fashionable terms and say that one of these cultures is synchronic and the other diachronic [Ferdinand de Saussure used the analogy of cutting a tree: a vertical cut is diachronic and a horizontal cut is synchronic]. Synchronic is partly right for the other but not quite, because of its subtle relation with its own past.*

*So we seem to have reached a clear divide between two cultures or traditions. One is cumulative, incorporative, collective, consensual, so designed that it must progress through time. The other is non-cumulative, non-incorporative, unable to abandon its past but also unable to embody it. The second culture has to be represented by negatives, because it is not a collectivity but is inherent in individual human beings. This means it possesses qualities which the scientific culture does not and never can: and, on the other hand, since there is a principle of mutual exclusion, it loses by its nature the diachronic progress which is science's greatest gift to the mind of man."*

Science now has *its own longer and more variegated past* than when Snow wrote these lines. While it is acknowledged that the truth as ascertained by social science is highly contextual, it is stereotypically thought that the truth ascertained by natural sciences that deal with numbers and facts tends to be absolute. But what if the truth as ascertained by the natural sciences is faulty? Despite the consensus, Max Planck, Albert Einstein, Louis de Broglie and Erwin Schrödinger never accepted the indeterminism of quantum mechanics (Born, 1954). Schrödinger (1952) wrote: "*PHYSICAL science, which aims not only at devising fascinating new experiments, but at obtaining a rational understanding of the results of observations, incurs at*

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<sup>3</sup> Again, note the irony that the culture of the humanities, according to Snow, shows no direction of time's arrow and according to the mathematical physicists, time's arrow, in reality, has no set direction (Greene, 2004).



*present, so I believe, the grave danger of getting severed from its historical background. The innovations of thought in the last 50 years, great and momentous and unavoidable as they were, are usually overrated compared with those of the preceding century; and the disproportionate foreshortening by time-perspective, of previous achievements on which all our enlightenment in modern times depends, reaches a disconcerting degree according as earlier and earlier centuries are considered. Along with this disregard for historical linkage there is a tendency to forget that all science is bound up with human culture in general, and that scientific findings, even those which at the moment appear the most advanced and esoteric and difficult to grasp, are meaningless outside their cultural context. A theoretical science, unaware that those of its constructs considered relevant and momentous are destined eventually to be framed in concepts and words that have a grip on the educated community and become part and parcel of the general world picture—a theoretical science, I say, where this is forgotten, and where the initiated continue musing to each other in terms that are, at best, understood by a small group of close fellow travellers, will necessarily be cut off from the rest of cultural mankind; in the long run it is bound to atrophy and ossify, however virulently esoteric chat may continue within its joyfully isolated groups of experts.”*

I claim that the level of agreement that comes in science “*by limiting the content of experience which minds had to cope with, and abstracting certain parts*” is not worth the loss of the deeper understanding that an individual gets from reaching deeper into the history of the subject and by reading the original utterances of scientists (Schrödinger, 1952; Wayne, 2015b). Albert Einstein and Erwin Schrödinger were marginalized by the moderns for wanting to go back to the principle of causality espoused by the ancients (Schlipp, 1949; Wheeler, 1980; Stone, 2013; Sofronieva, 2014). Such individualism in the search for truth should be encouraged rather than met by the tyranny of the mob similar to that experienced by Doctor Thomas Stockmann in Henrik Ibsen’s (1911) *An Enemy of the People*. The sense of truth rests in the individual, not in the consensus. D. H. Lawrence (1994) described the sense of truth in two poems:

### ***The Deepest Sensuality:***

*The profoundest of all sensualities  
is the sense of truth  
and the next deepest sensual experience  
is the sense of justice.*

### ***Sense of Truth***

*You must fuse mind and wit with all the senses  
Before you can feel truth.  
And if you can’t feel truth you can’t have any other*

*Satisfactory sensual experience.*

According to the historian Paul Johnson (1983), “*The modern world began on 29 May 1919 when photographs of a solar eclipse, taken on the island of Principe off West Africa and at Sobral in Brazil, confirmed the truth of a new theory of the universe.*” On November 11, 1919, *The New York Times* reported, “*As all common folk are suavely informed by the President of the Royal Society that Dr. Einstein’s deductions from the behavior of light as observed during an eclipse cannot be put in language comprehensible to them, they are under no obligations to worry their heads, already tired by contemplation of so many other hard problems, about this addition to the number.*” Science is willing to question everything but its own foundations, particularly when the questioners are outsiders and/or “*common folk.*” The progressive movement of science does not necessarily do a good job in communicating the relationship between its conclusions and the first principles upon which they rest. Is it possible that physical science is currently taking a wrong turn off the avenue towards truth much like biological science did in the age of eugenics in the last century (Popenoe, 1934), when William Jennings Bryan (1925), the “*uncommon commoner*” questioned the moral foundations of science: “*Science is a magnificent material force, but it is not a teacher of morals. It can perfect machinery, but it adds no moral restraints to protect society from the misuse of the machine. It can also build gigantic intellectual ships, but it constructs no moral rudders for the control of storm-tossed human vessels. It not only fails to supply the spiritual element needed but some of its unproven hypotheses rob the ship of its compass and endanger its cargo.*” A single avenue of truth, when unquestioned and unopposed, may not lead to truth at all.

Is it possible that nonscientists who understand the language of science cannot understand much of scientific truth because there is nothing to understand? Indeed nowadays scientists pride themselves in not understanding, saying things like “*I think I can safely say that nobody understands quantum mechanics*” (Feynman, 1965). Scientists not only conceal themselves under the cloak of authority (Galileo, 1967) as they did in Galileo’s time, but also conceal themselves under the cloak of the majority by saying anthropogenic climate change is correct because 97% of climate scientists agree (<http://climate.nasa.gov/scientific-consensus/>). Since when was the truth in science determined by compliance or by a plebiscite (Frost, 1931; Coletta and Tamres, 1992)? Boris Ephrussi (1953) rightly claimed, “*we cannot determine the truth of a hypothesis by counting the number of people who believe it.*” How many books on quantum mechanics and relativity theory have educated laypeople read without understanding either of these two theories? Even though quantum mechanics and the theories of relativity are the foundations of modern physics, their foundations remain unquestioned. Could it be that quantum mechanics is not a fundamental theory but a very limited and unnecessary theory of reality that does no more than describe some simple aspects of the world that allowed the invention of transistors? And could it be that the theories of relativity are also limited and unnecessary theories of reality that only explain simple aspects of the world such as the global positioning system (Wayne, 2012, 2015b)? People want a multidisciplinary and intelligible description of the world, no matter what the majority of scientists say. Matthew Arnold (1869) wrote “*it is not at*

*this moment true, what the majority of people tell us, that the world wants fire and strength more than sweetness and light, and that things are for the most part to be settled first and understood afterwards.”*

## Conclusion and Recommendations

I believe that we are currently not in a golden age of science and that science is in a period called *normal science* by T. S. Kuhn (1970). This is captured in a conversation between Penny and Leonard in an episode of *The Big Bang Theory* (Lorre et al., 2007):

**Penny:** *So, what's new in the world of physics?*

**Leonard:** *Nothing.*

**Penny:** *Really, nothing?*

**Leonard:** *Well, with the exception of string theory, not much has happened since the 1930's, and you can't prove string theory, at best you can say "hey, look, my idea has an internal logical consistency."*

**Penny:** *Ah. Well I'm sure things will pick up.*

How can the current state of science be improved? We, in the sciences, can learn from those in the humanities, and see our cultural inheritance as a product of our time. Notwithstanding C. P. Snow's recommendation, we should remember that the original utterances of the giants, upon whose shoulders we stand, might still have something to teach us. We can become one culture by including the method of the humanities into the method of the sciences. We can do this by reading the original papers of the founders of science (Wayne & Staves, 2008). In this way, a healthy skeptical science can be both synchronous with the linear flow of time and diachronous—not being held hostage to the flow of time<sup>4</sup> (Harrison, 1987). “*The clashing point of two subjects, two disciplines, two cultures—of two galaxies*” according to Snow (1961) “*ought to produce creative chances. In the history of mental activity that has been where some of the breakthroughs came.*” A cultural example that reaps the benefits of the two methods—one of synchrony and one of diachrony will be a pedagogical example for the cultivation of the mind that is worth following.

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<sup>4</sup> Interestingly, the moderns have two views of time. The mathematical physicists believe that time is relative and reversible while the biologists and geologists believe that time is absolute and irreversible (Wayne, 2015c).

I believe that today, as in Matthew Arnold's (1869) time, we should "*know, whether through reading, observing, or thinking, the best that can at present be known in the world, to come as near as we can to the firm intelligible law of things, and thus to get a basis for a less confused action and a more complete perfection than we have at present.*" I also believe today, as in T. H. Huxley's time (1881), that "*Perfect culture should apply a complete theory of life*" that includes "*the stores of physical science.*" I believe that we can do this by knowing "*the best which has been thought and said in the world.*" There is no need to replay *The Battle of the Books* (Swift, 1704), where the Ancients and Moderns are continually at war with each other, but to engage in the constructive engagement of two temporally opposing methods.

Today, as in Arnold's and Huxley's time, we do not have to be held hostage to C. P. Snow's (1970) claim that science is defined by a negative answer to the following question: *Do present practitioners have to go back to an original work of the past?* There is no need to take my word on this formulation that strives for one culture and two methods. Read Einstein's (1932) own words, which can be found in the introduction to his book, *Builders of the Universe: From the Bible to the Theory of Relativity*: "*Everybody knows approximately how our ideas about the construction of the astronomical world and the position of the earth within it have been determined. Everybody knows the names of the men who have in the first place contributed to the creation of those ideas, opinions, and theories. Few people, however, have the opportunity to become closer acquainted with those men. This is best done, not by reading their biographies, but by getting acquainted with utterances of those great personalities in the original wording that characterizes their ways of thinking.*"

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### Literature Cited

Arnold, M. (1869). *Culture and anarchy: An essay in political and social criticism*. London: Smith, Elder & Co.

Arnold, M. (1882). Literature and science. *The Nineteenth Century*, 12 (August), 216-230.

Bacon, F. (1676). *Novumorganon*. London: Printed for Thomas Lee.

Bacon, R. (1985). *Four stumbling blocks to truth*. Dallas, TX: Somesuch Press.

Born, M. (1954). The statistical interpretation of quantum mechanics. Nobel Lecture, December 11, 1954.

- Bragg, W. (1933). *The world of sound*. London: G. Bell & Sons, Ltd.
- Brockman, J. (1995). *The Third Culture*. New York: Simon & Schuster.
- Brockman, J. (2008). The New Humanists. In: J. Brockman (Ed.), *Science at the edge. Conversations with the leading scientific thinkers of today* (pp. 11-18). New York: Union Square Press.
- Bryan, W. J. (1925). Last message. In: Last message of William Jennings Bryan. *A reprint commemorating the fiftieth anniversary of the Scopes evolution trial. July 10-21, 1925*. Dayton, TN: Bryan University.
- Burstyn, H. L. (1969). Tradition and understanding: The sciences and the humanities. *School & Society* 97(2320), 419-424.
- Cajori, F. (1946). *Sir Isaac Newton's mathematical principles of natural philosophy and his system of the world*. Berkeley: University of California Press.
- Capra, F. (1957). *Hemo the magnificent*. Sponsored by the Bell Telephone System. <http://labs.plantbio.cornell.edu/wayne/Bell%20Telephone%20Science%20Movies.html>
- Capra, F. (1971). *The name above the title. An autobiography*. Toronto: Bantam Books.
- Cicero. (708). *Tusculan disputations*. <http://www.gutenberg.org/files/14988/14988-h/14988-h.htm#page-7>
- Coletta, W. J. & Tamres, D. H. (1992) Robert Frost and the poetry of physics. *The Physics Teacher*, 30, 360-365.
- Einstein, A. (1954). On classic literature. In: C. Seelig (Ed.), *Ideas and opinions* (pp. 64-65). New York: Wings Books.
- Einstein, A. (1997). Explanation of the perihelion motion of Mercury from the General Theory of Relativity. In: *The collected papers of Albert Einstein*. Vol.6, Doc.24, pp.112-116. Princeton: Princeton University Press.
- Einstein, A. (1932). *Builders of the universe: From the Bible to the Theory of Relativity*. Los Angeles: The U. S. Library Association, Inc.
- Ephrussi, B. (1953). *Nucleo-cytoplasmic relations in microorganisms*. Oxford: Clarendon Press.
- Feynman, R. (1965). *The character of physial law*. Cambridge MA: The MIT Press.
- Frost, R. (1931). Education by poetry. A meditative monologue. *Amherst Graduates' Quarterly*, 20(2), 76-85. <http://www.en.utexas.edu/amlit/amlitprivate/scans/edbypo.html>
- Galilei, G. (1967). *Dialogue concerning two chief world systems—Ptolemaic & Copernican*. Translated by Stilman Drake, foreword by Albert Einstein. Second Revised Edition. Berkeley: University of California Press.



- Gilbert, J. (1997). *Redeeming culture. American religion in an age of science*. Chicago: University of Chicago Press.
- Greene, B. (2004). *The fabric of the cosmos: Space, time, and the texture of reality*. New York: Vintage Books.
- Harrison, E. (1987). Whigs, prigs and historians. *Nature*, 329, 213-214.
- Holcombe, A. (2015). Science is self-correcting. In: J. Brockman (Ed.), *This idea must die. Scientific theories that are blocking progress* (pp. 369-372). New York: Harper Perennial.
- Huxley, A. (1963). *Literature and science*. New York: Harper & Row.
- Huxley, T. H. (1881). Science and Culture. In: *Science and culture and other essays*. London: Macmillan and Co.
- Ibsen, H. (1911). *An enemy of the people*. London: Dent. [https://librivox.org/search?title=An+Enemy+of+the+People&author=Ibsen&reader=&key words=&genre\\_id=0&status=all&project\\_type=either&recorded\\_language=&sort\\_order=catalog\\_date&search\\_page=1&search\\_form=advanced](https://librivox.org/search?title=An+Enemy+of+the+People&author=Ibsen&reader=&key words=&genre_id=0&status=all&project_type=either&recorded_language=&sort_order=catalog_date&search_page=1&search_form=advanced)
- Johnson, P. (1983). *Modern times. The world from the twenties to the eighties*. New York: Harper & Row.
- Kuhn, T. S. (1970). *The structure of scientific revolutions*. 2nd ed. Chicago: University of Chicago Press.
- Lawrence, D. H. (1994). *The complete poems of D. H. Lawrence*. UK: Wordsworth Editions, Ltd.
- Lorre, C., Prady, B., & Molaro, S. (2007). The Fuzzy Boots Corollary. *Big Bang Theory Series 1, Episode 3*. <https://bigbangtrans.wordpress.com/series-1-episode-3-the-fuzzy-boots-corollary/>
- McBride, J. (2011). *Frank Capra: The catastrophe of success*. New York: Simon & Schuster.
- Popenoe, P. (1934). The German sterilization law. *Journal of Heredity*, 25(7), 257-260.
- Schlipp, P. A. (Ed.). (1949). *Albert Einstein: Philosopher-scientist*. New York: Tudor Publishing Co.
- Schrödinger, E. (1952). Are there quantum jumps? *The British Journal for the Philosophy of Science*, 3, 109-123, 233-242.
- Smith, G. (Ed.). (1969). Letter from Aldous Huxley to Julian Huxley, 25 January 1953 In: *Letters of Aldous Huxley*. New York: Harper & Row.
- Snow, C. P. (1961). *The two cultures and the scientific revolution*. New York: Cambridge University Press.
- Snow, C. P. (1964). *The two cultures; and a second look*. 2nd ed. Cambridge: Cambridge University Press.

Snow, C. P. (1970). The case of Leavis and the serious case. *The Times Literary Supplement*, Thursday, July 9, 1970, London, England, Issue 3567, p. 737.

Sofronieva, T. (2014). Erwin Schrödinger's poetry. *Science & Education*, 23, 655-672.

Stone, A. D. (2013). *Einstein and the quantum: The quest of the valiant Swabian*. Princeton: Princeton University Press.

Swift, J. (1704). *A Tale of a tub. Written for the universal improvement of mankind...to which is added, an account of a battel between the antient and modern books in St. James's library*. London: Printed for John Nutt.

*The New York Times*. (1919). Amateurs will be resentful. November 11, 1919.

Townes, C. H. (1995). *Making waves*. Woodbury, NY: American Institute of Physics Press.

Wayne, R. (2010). Charged particles are prevented from going faster than the speed of light by light itself: A biophysical cell biologist's contribution to physics. *ActaPhysicaPolonica B*, 41, 2297-2323.

Wayne, R. (2012). Rethinking the Concept of Space-Time in the General Theory of Relativity: The Deflection of Starlight and the Gravitational Red Shift. *African Review of Physics*, 7, 183-201.

Wayne, R. (2015a). Explanation of the perihelion motion of Mercury in terms of a velocity-dependent correction to Newton's Law of Gravitation. *African Review of Physics*, 10, 185-194.

Wayne, R. (2015b). Nature of light from the perspective of a biologist: What is a photon? In: M. Pessaraki, (Ed.), *Handbook of photosynthesis*, 3rd ed. US: CRC Press. In Press.

Wayne, R. (2015c). As time goes by and Albert Einstein. Do the fundamental things still apply? *The Lansing Star* November 20, 2015. <http://www.lansingstar.com/around-town/12214-as-time-goes-by-and-albert-einstein>

Wayne, R. (2016). Evolution in real time. *South-Asian Journal of Multidisciplinary Studies*, 3, 1-47.

Wayne, R. & Staves, M. (2008). Model scientists. *Communicative & Integrative Biology*, 1, 97-103.

Wheeler, J. A. (1980). Albert Einstein. March 14, 1879—April 18, 1955. *Biographical Memoir*. Washington, D. C.: National Academy of Sciences.