

Unreliability of Community Memories and Its Relativity To Blockading of U.S. Scientific Progress

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This body of work exists as a direct result of my professional exchanges with Prof. Robert Mathews (mathews@hawaii.edu). He is a Principal Scientist, and the Director of the Office of Scientific Inquiry and Applications, at the Center for Strategic Advancement of Telematics & Informatics. This article is drawn from Dr. Mathews' experiences, his research, and analyses in U.S. national security subjects; and wholly, this writing is an excerpt from his works. It would be effortless to class the message contained within, and its meaning as doctrinaire; however, such an action would be a grave mistake. Owing to the length of this article, the following note is offered. This message is presented from a mutual belief (his, and mine) that we in the scientific community are, from time to time, in need of the proper retrospective, if only to have a message such as this function as quality victual for the mind, to enhance and advance quests toward scientific excellence. Most of all, these thoughts are placed before you as homage to the giants in engineering/science, upon whose shoulders we continue to stand. Dr. Mathews wishes to keenly acknowledge the kind assistance of Dr. Gary Fishman, Director - National Material Advisory Board (NMAB) of the National Academy of Sciences (NAS); Dr. Rebecca Alvania of the NAS; Ms. Teri Thorowgood, Research & Administrative Coordinator at the NMAB of the NAS; Mr. Daniel Barbiero, Manager of NAS Archive & Records; and Ms. Kemberly A.M. Lang and her staff at the Battelle Memorial Institute, for their immense support in the collecting of archived information.

ON DISTORTED MEMORIES ¹ AND OTHER THINGS....

Dateline 26 January 1968, 10 Am GMT (Local), Frank Murray is at the controls of an object that can only be described modestly as a *stratospheric bullet*, heading toward the center of the western coast of North Korea. Piloting this craft, designated only as the 'A-12,' and flying at an altitude greater than

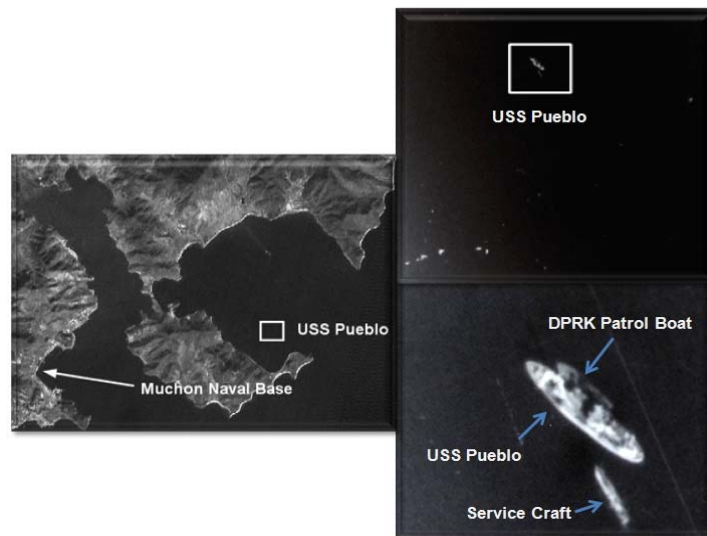


Fig. 1. Relief of North Korean Operational Area
Photo & Information, Courtesy: NARA & Global Security

80,000 feet, at an approach speed 3 times the speed of sound (Mach 3.1 / 2359.1 Mph), Murray's orders are to surveil the North Korean peninsula, easterly to Muchon Naval Base. In the vicinity, and only three

¹ Reference to memories herein generally infer to the ability of the scientific community to recall accurate impressions of circumstances, and outcomes (temporal, and spatial in character) as they relate to historical scientific events.

days earlier, the U.S.S Pueblo [AGER-2],² while on a signals intelligence mission in international waters, was boarded, seized, and its crew imprisoned by North Korea. Code-named *Black Shield 6847* (BX6847), Murray is flying a mission with memories still fresh of Francis Gary Powers, in his U-2 reconnaissance aircraft, shot-down over the USSR³ Somewhere below him are 82 American souls being held prisoner, and presumably being tortured.

Director of Central Intelligence' Richard Helms's mission orders, at the behest of the United States Intelligence Board, are to locate the U.S.S Pueblo, and to determine North Korean military posture in the vicinity. Murray is confident, for he is hurling through space, cocooned in a creation fashioned out of high imagination and innovative American engineering; a product shaped from the fires of many unsurprisingly self-possessed spirits, by and large defiant against any prospect of capitulation in the face of scientific adversity. He is flying the perfect machine for a mission such as this. Capable of assuring *surprise, stealth, speed, and reach* beyond known threats, the A-12 is a high-flying reconnaissance platform, equipped with a Perkin-Elmer Type 1 camera, capable of capturing an incredible amount of detail in a seventy-two mile wide swath of terrain, with each pass.

At approximately 10:10 AM local time (GMT), traveling at 2,143.90 mph, Murray points the A-12's Type 1 camera towards the coastline, and snaps a photograph, which would later confirm the presence of the Pueblo, in North Korean waters. During BX6847, Murray will have photographed 12 out of the 14 North Korean Surface-To-Air Missile (SAM) sites, in detail. In all, the imagery collected by BX6847 spanned two-thirds of North Korea, and Frank Murray will have spent just under 17 minutes over denied areas in total!



Fig. 2. A-12 About To Be Refueled
Courtesy: Lockheed Photo Archives

Except, that is not exactly as events had come to pass. Black Shield 6847 (BX6847) was in reality piloted by the Late Jack Weeks. Long publicized is the information that the planned over-flight of North Korea by Weeks was aborted because of engine problems. In fact, a recent CIA declassification notes that Jack Weeks completed his assignment on 26 January 1968, not only locating the U.S.S Pueblo, but also acquiring an opulence of intelligence information. The *Weeks* mission lacked sufficient coverage of Intel targets over North Korea. Therefore, the National Reconnaissance Office,^[1] per recommendations of Commander-In-Chief, Pacific (CINCPAC), and the Defense Intelligence Agency (DIA), petitioned for a second round of North Korean fly-overs to satisfy the Intel gap. Frank Murray flew that Black Shield 6853 mission (BX6853) on February 19, 1968.

² Auxiliary General Environmental Research Ship

³ Francis Gary Powers was shot down near Sverdlovsk, on 1 May 1960

It is not clear *why* many authors, ^{[2]-[8]} who managed to research this event intimately, proceeded to *collate and publish incorrect memories* of that important event. In the immensely popular "*Body of Secrets*," author James Bamford takes literary license the extra mile, wrongly noting that Frank Murray was "ordered to make the *first* A-12 over-flight of North Korea," ^[6] adding that Murray originally attempted to launch on the 25th, however, a "malfunction on the aircraft had forced him to abort shortly after takeoff," ^[6] and he consequently launched on the 26th. At least two sets of authors, Remak & Ventolo, and Crickmore [9], correct previous errors in later revised versions of their respective works. However, they offer no explanation regarding the changes they present in later versions. One author, a retired U.S. Air Force officer (Irwin/2000) [10] offers an incogitable proposition ⁴ that 14 hours after the U.S.S *Pueblo* was hijacked, reconnaissance photos were presented before the President of the United States for decisioning. This could not have been possible, for the *Pueblo* was boarded by North Koreans on 23 January, at 1432 Hrs local time, or 0032 Hrs on 23 January, Washington time; and according to official records, the first over-flight over the region did not occur until 26 January. Finally, it needs to be said that the one person who was perhaps most intimate with the lifecycle of this aircraft, team leader Clarence L. Johnson of Lockheed Aircraft has declared in his report "History of The OXCART Program," [11] that "a successful mission over North Korea, after the seizure of the *Pueblo*" was flown on 14 February 1968. Nonetheless, official records do not indicate any A-12 over-flight of North Korea on 14 February 1968.

There is opportunity for error to be introduced at any stage in a process, and by anyone involved. At the core, this paper endeavors to lay bare how error /propagating distorted memories ably produce a retarding of, and distortion in scientific progress, and also in formulating national science policies.

Funded by the CIA, and built by the Lockheed company, history continues to celebrate the genesis of the élan A-12 (later known as the SR-71 Blackbird) as an enduring symbol of American ingenuity, daring, technical brilliance, and institutional farsightedness. For all the praises that are sung in its name, this engineering marvel almost failed to materialize. To use a common metaphor, the A-12 was born out of wedlock, and of high dysfunctionality, which is often the case when new paradigms are proposed against the longstanding traditions, where institutions predictably cling to moribund ideals. Washington Turf wars, bureaucratic dysfunctionality, institutional power grabs, and significantly more than the usual share of technical challenges bloomed to a full; all this during the A-12's gestation, and much before it could exit the womb. Among the many struggles, orchestrating the availability of sustained research and development funding in a highly politicized world of intelligence program funds allocation, was, among other things, a principal necessity.



Fig. 3. First A-12 Delivery to Groom Lake
Courtesy: Lockheed Photo Archive

From an engineering point of view, however, one of the leading technical challenges associated with the A-12's manufacture involved the use of Titanium as the chief metal with which the airframe was to be constructed. Even though Titanium was being used in small quantities, and in localized areas of

⁴ By facts available, and known today

commercial aircraft manufacturing starting in the early 1950s, the A-12 design was the first to require Titanium for the construction of the whole aircraft. However, reliable processes for Titanium alloy sheet manufacturing that ensured “*increased uniformity, reliability, strength, weldability, and fabricability characteristics*” [12] to the scale required, did not exist.

Not only was there a significant Titanium shortage at the time when the A-12 was needing to be built, but to immensely complicate matters, the United States lacked the vital scientific knowledge to fabricate this aircraft.

In essence then, *a strategic national defense component was being planned* in the absence of 1) Titanium in sufficient quantities, and 2) the scientific knowledge needed to turn a characteristically brittle metal [11] into the desired usable state. In retrospect, materially, the genesis of A-12 was only possible due to the work of key parties at the Battelle Memorial Institute, National Academy of Sciences (in particular the Materials Advisory Board), and Anderson Aircraft, among others. Lockheed’s aerospace designer and engineer Clarence ‘Kelly’ Johnson is credited most, and often, for the creation of the A-12. However, from a scientific point of view, Johnson had no known role in the evolution of Titanium as a nationally strategic metal. To tidy-up misperceptions merely, Johnson rightly deserves many praises. The names of those significant contributors to the evolution of Titanium as a nationally strategic metal, and hence to the development of the A-12, have remained largely muted by the amplitude, and tune of praises for Kelly Johnson. Today, many important parts of the A-12’s evolution receive little attention, if any; and the footprints of great contributors to the effort have been significantly obscured. Consequently, at present, while the evolutionary detail of the A-12 is ably preserved within certain key institutions, personal and community memories regarding key contributors and events remain less durable.

If one were not careful in reviewing the history of A-12’s evolution, one is likely to unwittingly be left with an impression that the A-12 emerged from an ‘instant universe.’ⁱ Such an impression spares the inquisitive mind from the details of the hefty institutional and intellectual acrimonies that surrounded the parturition of the A12. If it were not for the brilliant minds of scientists like Dr. William J. Harris, Jr.,ⁱⁱ Nathan E. Promisel, Dr. Robert I. Jaffee, and others, and their intimate involvements in evolving Titanium’s usability for national strategic purposes, the A-12 would have merely remained a sketch on the drawing boards at Lockheed’s *Skunk-Works* in Burbank, California. It has been quietly recognized that, if the demand to fabricate Titanium in a certain manner to build the A-12 had not existed, the Titanium industry as a whole would not have come into being at all, as it did, because military applications represented the most promising areas of continued use initially [13]. It is essential to note that the collaborative work between the pre-eminent naval and civilian materials scientist Dr. William J. Harris, Jr.,ⁱⁱⁱ and the Titanium Metallurgical Laboratory (TML) at Battelle Memorial Institute, were crucial to the formation of the DoD’ Titanium-Sheet-Rolling program.^{iv} That work also substantially shortened the time, which would have been consumed otherwise to ready Titanium as a *reliable material* for construction, in both a qualitative, and a quantitative sense [14]. Fact remains that, outside of efforts to grow the technical knowledge to use Titanium as a strategic metal, and the *Manhattan Project* where the development of enriched Uranium also required a constitution of resources involving high concentration of scientific and technical talent plus financial support, there has never been another assemblage of resources in a similar manner to advance the use of a single metal for national strategic purposes [13].

The much-abridged description of the A-12 development, as surveyed here, is meant to demonstrate that there just may be quite significant aspects of a certain subject, such as the development of the A-12, of which we know little, none at all, or worse - are in possession of distorted knowledge, which somehow becomes the driving force for forward thought. With respect to the A-12’s evolution, the advancements related to Titanium, or the design and construction of the aircraft can never be considered uniquely, or compartmentally from each other; for one could not have materialized without the other. As will be discussed, knowledge always represents an amalgamation of information. Therefore, dealing with the interpreted product of illusionary signals as in the case of Titanium development, result in a type of

cognitive parallax,^v which must be corrected to enable progress, and to make our contributions to science effective and meaningful.

The principle to be carried forward from this chronicle, in relationship to facilitating the progress of science, is simple. To be blunt, if parties in the scientific enterprise, or decision-makers that support the scientific enterprise, suffer from niggling effects of aforementioned *cognitive parallax*,⁵ the prospect to properly instrument strategic and/or tactical decisions in the national interest will likely be very slim. The complexities associated with attempts to replicate such efforts now in the national interests are exceedingly complicated all by themselves, and must not be obscured further by such errors.

In such a context, the United States' scientific community is likely to face three major inhibitory factors when wanting to stimulate, or accelerate the progress of science and scientific policy in the national interest, in the 21st Century. They are: 1) lack of comprehensive scientific knowledge vital to national leadership roles, 2) ever increasing complexities associated with the uninhibited growth of information in the digital universe, and 3) the absence of rightly optimized operational enterprises, which can adequately leverage informational synergy and advantage. The lack of comprehensive scientific knowledge at the leadership level will only continue to result in a national inability to strategically plan, and/or support critical strategic, and tactical scientific activities. The uninhibited growth of information in the digital universe will undoubtedly present a significantly augmented, engorged proverbial '*needle in a haystack*' problem. Whereas, the absence of accountable, properly optimized, engineered, forward-thinking enterprises will permanently impede the materialization of goal oriented actions to bring about material and policy effectiveness and efficiency. America must urgently seek to instate a national science policy leadership that possesses deep humility, and the capability to recognize the amount of variance in the scientific environment, which now exists in large part directly due to errant, factious, contumacious, and perverse policy measures and mechanisms that were thought up, and have been put into place over the years. Decision makers must be open to contrarian ideas, and hear them out in full, as it is now an indispensable ingredient to reversing our national scientific plight. The three major factors stated above are expanded here briefly, to acquaint the reader ever so lightly to the great nub behind these significant issues.

With respect to 1) directly above, Dr. Edward Wenk, Jr. [15]⁶ once observed that a national capability necessary to enable the proper decisioning for scientific progress is impinged when the role of government as either the means for change, and/or as the 'steering system' to achieve change, is essentially disabled by 'incompetence, error, exhaustion, self-delusion, bias, venality, or hubris.' Additionally, Wenk acknowledges that decisional error, for example, has the potential to be 'lethal to society.' With respect to 2), special interest groups, by adding more noise through sensationalism, and the introduction of bias in their reportage, now constantly vie for public attention. To the lay person, including policy makers and their staff, such actions by special interests groups often cause issue particulars to become blurred, which then introduces further complexity into the processes that otherwise ensure traceability and accountability for basis in policy decisions. Lastly, with respect to 3), the consistent and almost predictable employment of reductionistic logic by leaders in enterprises, exempting full picture thinking, jeopardizing *interoperability*,⁷ [16]-[21] and promoting *unintended consequences*, will produce in all likelihood, lethal societal effects.

⁵ Thinking that one adequately comprehends a subject matter, when in fact, one does not.

⁶ Dr. Edward Wenk, Jr. served as the very first advisor to U.S. Congress. Afterward, he served in a scientific advisory capacity to Presidents Kennedy, Johnson, and Nixon.

⁷ Dr. Robert Mathews has defined interoperability as the capability by which all operating elements of interdependent and interconnected systems are able to operate synchronously to achieve mission success, or pre-determined goals and objectives continually. Synchronous operations here infers to an operational requirement for all components / sub-systems of interdependent and interconnected systems to be properly oriented, skillfully aligned, and readied across geographic and organizational boundaries, and professional disciplines to achieve mission objectives.

Whether the three factors aforementioned stand-alone, or will combine, means little in terms of total outcome, as each is capable on its own to severely obstruct us from timely engaging nationally significant opportunities in science. Further, in terms of assuring U.S. competitiveness on a global scale, and possessing a sizeable national security edge in view of rising threats, the costs associated with the loss related to any nationally strategic scientific opportunity are presently immeasurable. Therefore, in this paper, three banded ideas that are substantively important to the orchestration of meaningful solutions are brought together. A) We^{vi} identify that memories relating to scientific achievements need to be holistic, and complete such that any scientist can comprehend the nature of the road that was travelled to attain progress.⁸ B) Skewing in memories relating to past scientific achievements can substantially alter our perspectives regarding the type, and scale of effort among other things that had to be mounted to achieve progress. C) Lastly, we present a brief discussion on critical missing pieces that need to be included into a solution orientation as part of any reformative process. Remember that this discourse is not intended to be a segment-by-segment analysis of the many aspects or parties involved in U.S. science policy failures. However, we hope that this writing will stimulate further thought and conversation regarding much needed leadership, and rightly piloted direction in U.S. science policy development and research activities.

OF FALSE KNOWLEDGE⁹ AND OTHER THINGS....

The introduction of *false knowledge* into the scientific community is continually corrupting the way we need to advance scientific knowledge, institutions, capacities, and capabilities. However, the scope of this writing cannot address the breadth of this subject as necessary. Nevertheless, we shall attempt to demonstrate, in a small way, the error of our ways with regard to the advancement of science, and more specifically, how ill-thinking U.S. science policy instruments are now laying to waste many opportunities to seed innovation, and opportunities to materialize a spirited scientifically competitive economic edge for America's future.

On the impact of *false knowledge*, the administrator of the US Space agency was the invited speaker before the American Astronautical Society in October of 2008. In his presentation titled "NASA and Engineering Integrity," Griffin attempted to disqualify incompetence at the agency, saying "[w]e at NASA cannot possibly make everyone happy with our decisions. Most decisions will produce an unhappy outcome for someone. However, that unhappiness is not by itself a symptom of incompetence, bad intentions, or a lack of integrity on our part," and that "the taxpaying public and its elected representatives, our overseers, can and do expect from NASA be summarized in two words: *objective expertise*." [22]

Perhaps, Griffin is unaware that his agency was indicted for carrying on, keeping alive, a "*cycle of smugness substituting for knowledge*," [23] and for maintaining a kind of "'arrogance" within NASA that led leaders and managers to be dismissive of the views of others, both within the organization, and especially from outside the Agency." [23] Maybe he is indeed *arrogant and ignorant*, [24] as one of the space agency's foremost scientists has described Griffin. One thing is perfectly clear, given all that is publicly known, Griffin appears to have been "making a runtish proposition that the level of engineering insight and management vigor that **could have**, and **should have** been demonstrated by NASA, before Challenger and Columbia space shuttle missions, were indeed optimal!" [25] Logic would have it then that 'taxpayers' did not expect NASA's "*objective expertise*," which Administrator Griffin was peddling that day, to have been responsible for the destruction of two spacecrafts, the loss of 14 American lives, and very nearly shut-down the entire American space program. By Griffin's own admission, the Challenger and Columbia disasters caused "extensive redirection, massive delays, and huge cost

⁸ See reference to the discovery of DNA structure in the section "On Acquiring Knowledge and Employing Wisdom..."

⁹ For the purposes of this writing, the significant distinctions between data, information, knowledge, and wisdom are not detailed herein; as such, an exploration is largely out of the narrow scope of this writing. Nevertheless, being familiar with the distinctions between them is expected of the reader. To refresh, reference to memories herein generally infer to the ability of the scientific community (or more the 'inability' in this case) to recall accurate impressions of circumstances, and outcomes (temporal and spatial in character) as they relate to historical scientific events.

overruns” [22] at NASA. These redirections, delays, and cost overruns were also not endured with the consent of the American taxpayer. However, NASA administration evidently believes that *false knowledge*, and the organizational apparatus that used *false knowledge* to render the wretched decisions that almost tore-down America’s space agency, is in fact the “*objective expertise*” that the agency materially needs to tackle future scientific challenges! Fact remains that the opportunity costs and programmatic setbacks suffered by NASA, because of the Challenger and Columbia accidents, have yet to be tabulated accurately.

How does *false knowledge* hold back the progress of science? Francis Bacon in his treatise on ‘Advancement of Learning’ wrote, “...as navigation was imperfect before the use of the compass, so will many secrets of nature and art remain undiscovered, without a more perfect knowledge of the understanding, its uses and ways of working.” [26] Scientific progress depends primarily on our ability to navigate properly through the subject/field that is under observation. While mankind’s accumulated knowledge has provided a jumping-off point for arbitration, negotiation, and/or intercession, in the pursuit of new knowledge, the scientist must constantly be on alert for new clues that yield new information regarding our place in the universe [27]. In the here and now, when information is distributed at the speed of light across the world, how do we organize ourselves to shed internal *false knowledge*, to collect, analyze, and use information comprehensively, to positively affect the state of scientific progress?

On acquiring knowledge, and Employing Wisdom...

Through the millennia, inscriptions that have conveyed the collective memories of humanity and knowledge were held in venerated places, such as the Royal Library of Alexandria, and The Pergamum library of antiquity. Only sands of time now exist as unchangeable testimonies to their greatness, and their once grand archives on human progress. Is destruction of the type that consumed the Royal Library of Alexandria possible in our time, and likely to annihilate consequentially, in near totality, all prior memories, knowledge, and detail of human progress? Given our state of existence, and our connections to, and employment of, processes and technologies, to distribute and share knowledge presently, we can combat a catastrophic loss such as that. Today however, in its place, the one very likely threat that is of an equal or greater magnitude to the inexpressible loss of the Royal Library of Alexandria is the approaching high hazard of expediting a widespread permeation of *false knowledge*. We must keep in mind that distorted memories, are in essence, *false knowledge*. Any permeation of *false knowledge*, to borrow from *Erasmus*, can compactly be stated only as “plagues of the mind [that] spare neither rank nor sex nor age, and are restrained by no boundaries, but sweep the earth with unimaginable speed.” [28]

What follows is an example of how one entity has managed to distinguish *between useful and useless information*, and to utilize the ‘useful,’ to fuel operations and performance globally. Wal-Mart, the world’s largest retailer, is said to be storing and managing over 460 Terabytes of business information [29] to improve business practices. Wal-Mart routinely utilizes commodity, customer, business transactions, and business environment information to generate actionable wisdom, enterprise-wide, from the breadth of data it possesses and processes, which in turn allows them to have ‘the edge’ over their competition. By all measures, they seem to accomplish this goal exceptionally well. These days, organizations and businesses are not the only ones routinely straddled with the responsibility to distinguish *between useful and useless information*. At an individual level, our thirst for information and knowledge is equally great; we seem to be ever industrious, creating familial, personal, professional, and social libraries. Curious and full of brio, Americans appear to be in constant need to ferret-out some form of information from some part of the *Digiverse*.¹⁰ In October of 2008, Americans performed 12.6 billion searches at the core search engines. [30] Of this, Google alone handled 8 billion searches. 12.6 billion searches roughly translate to 4791 searches/sec. According to the ‘Diverse and Exploding Digital Universe’ report, [31] this *Digiverse*, was roughly 281 ExaBytes, or 281 billion GigaBytes in 2007, 10%

¹⁰ The Digital Universe

bigger than what was originally expected to be. Individuals create 70% of all information in the *Digiverse*. [31] The important question before us is, are people finding that for which they are searching?

Not all information is either knowledge, or wisdom. How are we to separate the wheat from the chaff? During Medieval times, kingly courts had food tasters who were present to ensure that a *bon vivant* monarch did not succumb to any venom of wickedness. While not suggesting that we employ food or information tasters to daunt what wickedness comes, is there a modern day equivalent of this practice to be emplaced in each of our lives? Surely, considering the volume of information that is now available, when confronting it, mere mortal sensibilities could quite easily suffer vast strain! How are we able to ensure that which we read and take to heart is valid, and is indeed knowledge? Science is not immune from the challenge imposed by the aforementioned question.

Dr. Mathews reminds that science cannot progress at the expense of wisdom-in-debit; that true wisdom empowers us with the ability to observe ‘a matter,’ to be reasoned to it, and from it, in all manner, to be prudent, discerning, relational, expressionally lucid, and analytically incisive of the whole, and not just any single part, or a collection of select parts. He points out that, while James Watson, Francis Crick, and Maurice Wilkins have been credited with the discovery of the molecular structure of DNA, he emphasizes that DNA advancement would not have been possible if it were not for the simple fact that other scientists had unraveled key aspects of the puzzle before Watson, Crick, and Wilkins. The work of Erwin Chargaff, Linus Pauling, and indeed Friedrich Miescher are representative of *foundational work that preceded* Watson, Crick, and Wilkins’s endeavor. More in keeping with struggles we face today, F. W. Bain has expressed adds to this sentiment quite well in his elaborations of *Plato’s* teachings, urging that a reformed understanding of the *organic* whole, as Bain says, “... can do for modern science, something of which it stands in sore need.” [32]¹¹ In terms of *false knowledge*, according to Nicholas Maxwell,¹² responsibly for progressing science in our time, however, requires being attentive, for instance, to Bain’s proposition of the *organic whole*. According to Maxwell, this would require a communal correction in the manner we formulate and express our scientific/academic inquiries, one where the basic aim of all academic processes must be reorganized, “to promote wisdom, and not just acquire knowledge.” [33]

Maxwell explicates that “[e]very branch and aspect of academic inquiry needs to change if we are to have the kind of inquiry, both more rational and of greater human value, [which] we really need.” He emphasizes that overall aims and methods of academic activity have the “responsibility to make clear what is wrong, and what needs to be done to put things right... shout out, loud and clear, that we urgently need to bring about an intellectual and institutional revolution in the aims and methods, the whole structure and character, of academic inquiry, so that it takes up its proper task of helping humanity learn how to create a wiser world.” [33] In instructing us to *Plato*, Bain poses an intellectually complimentary message, which connects Plato and Science, signifying that *Plato* cannot be discretely analyzed, or understood, without a comprehension of his works in terms of the style, the vehicle, the atmosphere, and the by-play involved. [32] So too in science, progress is tightly coupled to our intimate understanding of certain key fundamentals, such as the ways and means, which has facilitated humanity’s scientific progress through time. In this, and other vital concerns, we continually and detrimentally fail to recognize that our perspectives are not often whole. It is not the intent of this writing to provide a most comprehensive gap analysis on shortfalls in necessary actions. Inquisitive parties involved in the pursuit of science are well positioned to acquire that information on their own; to signify and correct errors in our perceptions. Some of our largest challenges achieve little resolve today, as we remain unable to realize and pinpoint the boundaries of our personal knowledge, which if we did, could permit us to cogitate problems more effectively, collaborate more efficiently, and to conceive solutions more expediently. Yet, in this realm, we lack many things. To break the deadlock, we must understand how *false knowledge* inhibits us from achieving the necessary breakthroughs.

¹¹ Speaks specifically to the need for highly integrated critical thinking

¹² Nicholas Maxwell is Emeritus Reader in Philosophy, at University College London

ON PERMEATION OF FALSE KNOWLEDGE...

Maxwell's proposition toward "helping humanity learn, how to create a wiser world" [33] presents a beguiling challenge indeed. Genuinely, the 'helping humanity learn' part intrinsically commands that mankind shed its *false knowledge*, and be prepared to progress forward with a clarified mind. [32] However, that is easier said than done. George Bernard Shaw has characterized the difficult situation, where humanity appears to consistently desire to be nourished with *poison from the fountain of false knowledge*. Shaw presses, "[e]very fool believes what his teachers tell him, and calls his credulity science or morality, as confidently as his father called it divine revelation." [35] Clearly, he is pondering a most contemptuous likely state of the human-mind, where more than a freshman philosophy student may be let impoverished by *false knowledge*. Shaw strongly demonstrates that dedicating oneself to very hard work to correct one's accumulated mis-perceptions is the only path to ushering in progress. However, for a lack of toil, we have been free to tender *false knowledge* as a substitute. The impact of permeated *false knowledge*, in the sphere of scientific advancement, is immense. From scientists, who purport themselves to be subject matter experts, to policy makers and their staff, government department and agency heads and their scientific staff, and all parties in between are potentially subject to influence from the permeation of *false knowledge*.

In the 'helping humanity learn' with a clarified mind department, [34] perhaps *Socrates* provides us with the best practical details from the ancient world - on how to root out error. To that purpose, *Socrates* chose to cross-examine his counterparts to root out 'pretenders of wisdom,' [36] or purveyors of *false knowledge*. Classical philosophy texturally details an instance when *Euthyphro* is sardonically complemented by *Socrates* (a tactic/exploit now often referred to as *Socratic Irony*) upon the discovery that *Euthyphro* intended to prosecute his own father, for murder, by that which *Socrates* considered *false knowledge*. [37] It has been said that "[t]he irony of *Socrates* was the art by which he drew a pert and shallow sophist or pretender to wisdom out of his state of half-knowledge. It showed how men rested on words and passed mere tallies or counters about as if they were current coin," and "[u]nder an air of levity the *Socratic irony* was in reality, a call to seriousness a protest against those idols of the market place, the commonplaces and saws which passed for wisdom." [38]

Regarding the progress of science, *false knowledge* is the subject to which we must attend in our current time, to supervise and to clarify for ourselves as men and women of reason, of science, that the knowledge we foundationally hold dear as a basis for our beliefs, our understanding, and our reality is sound. Beyond any personal struggle, there are organizational struggles as well. Bain is eloquent in articulating the nature of organizational struggles, to be precise, how educational systems indoctrinate persons into the realm of *false knowledge*. Bain says "when sophistry has become a classic; when it is taught in colleges and bound in vellum; when its commentators have become a fraternity, its elucidation, a trade; when critical reputations have been staked on its truth, and professorial expositions of its principles stand or fall with it; *it dies hard*. To convict it of error is, as it were, to take down great 'critical' philosophers from their pinnacles..." [32] "like little statues on great pedestals, only seem the smaller by their very elevation." [39] ^{vii} The world dislikes nothing so much as to see its idols broken, and have to confess that its gods were after all not porcelain, but common clay. Rather than admit this, it will obstinately refuse to see." [32] In the case of *Socrates*, his cross-examining of pretenders of wisdom, his challenge against false information, and the spread of it so infuriated Athenians, they handed him a death sentence. [40]

Democritus, *Socrates*, *Plato*, *Aristotle*, and others sought to understand the nature and constitution of knowledge at a personal level. Through the times, from *Kepler* to *Galileo*, and from *Newton* to *Einstein*, the amassing of cosmological knowledge has not been painless. We now know that Newtonian Physics fails, against Quantum Mechanics, General Relativity, and Special Relativity, while continuing to serve purpose in Classical Mechanics, which then points to the need for knowing the place, the purpose, and usage for each. Extending this thought to the prospect of advancing science in the national interest, at the

very least implies then that those involved in policy processes *must have* an unmatched insight into human evolution in terms of the growth of knowledge, and its relativity to present circumstances, in order to be effective, efficient, and foresightful. In *Perspectives on Science*, Henry Bauer contends that guided evolution of science, or accelerating that evolution through sound “science policy,” has the prospect to transpire only if we have the sufficient understanding of *how science works*, and how, and why, it has progressed in the past. [41]

ON SOWING TAINTED POLICIES

William D. Carey ¹³ has held the following thought on making scientific progress. He said, “the nature of progress through science is a meandering and uncertain struggle toward discovery and verification, a search carried out in an environment of intellectual joy and disappointment. Such a perception, however, says nothing of the presence of competitiveness, of reward and punishment systems, of queuing phenomena, of sharp practices, of ethical and moral dilemmas, or of the arrogation of science or much of it into instrumental service to the State, and to the Corporation.” [42] Carey has, gently and artfully exposed us to one of the many poisons swirling in the *fountain of false information*. He notes that, beyond the many ideational, paradigmatic, institutional, financial, and personal struggles, which those that pursue science are often forced to endure, there are even greater external forces, or aspects, that attempt to exert a corrupting influence over the direction of science. As an example, reflect on the fact that Young, et. al., have presented on one such aspect, and have presaged that commoditization of scientific knowledge is likely to distort Science itself. [43]

At the risk of assuming that readers will be in possession of requisite knowledge, we intrinsically present that scientific research supporting institutions at the governmental level, their tenets and mechanisms to evaluate and to fund, are in fact broken. How are they to be righted? A very brief view of the state-of-affairs is put forward for considerations here, with due reference to the presence and permeation of *false knowledge* in establishments and persons.

In post WW-II America, McGeorge Bundy candidly expressed that government should not impede scientific progress, with paper-pushing bureaucracies, and organizational restrictions, saying “...there is a wide, deep, and important coincidence between the temper and purpose of American national policy and the temper and purpose of American science. Our science and our society are deeply alike in the pragmatic, optimistic, energetic, and essentially cooperative view of the way in which useful things get done.” [44] Of course, this cooperative view of science’s place in society was presented by Bundy at a time when the political ideology, as explained by Proctor [45], celebrated scientific research as neutral, and requiring protection from barbed forces for the benefit of the nation. Proctor made clear a discernment of roles, which related to basic research as a whole on one side; and on the other, the application of research outcomes toward any specific purpose.

It was also before ramshackled ideals began to infiltrate Capitol Hill, and members of U.S. Congress began to view science and scientists, in Don Price’s words, as “just another selfish pressure group, not as the wizards of perpetual progress.” [46] To make clear Price’s expression, Congress has for whatever ham-fisted and capricious reason, begun to think of ‘science’ simply as another government program needing funding. Because Congress is not mindful of the need to finance basic science as the primary strategic constituent to nourishing the fountain of innovation and knowledge, strengthening and enhancing our national security capabilities, our quality of life, and domestic and global economic vitality, the road to improvement is that much harder. Then again, Congress has probably never heard of Jürgen Habermas, or of the Habermasian extensions of Aristotelian principles, which suggest that our

¹³ Formerly, director of American Association for the Advancement of Science (AAAS), and served under five presidents in the Bureau of the Budget, last as Asst. Dir. of the Executive Office of the President-Bureau of the Budget. He was formerly Chairman of the United States side of the bilateral working group with the USSR on science policy; and Chairman of the Visiting Committee of the National Bureau of Standards (NIST, today).

pursuit of knowledge is largely motivated by our need to enhance human life, along a technical, practical, and emancipatory line. [47] In the absence of one's awareness of the building-block, Habermasian principles in the policy realm is likely to leave one informationally handicapped, and less capable to act in the best interest of all Citizens. An extremely compact examination of the extensions of Aristotelian principles by Habermas is therefore a reasonable exercise here.

Shirly Grundy interprets Habermas's particularization of 'technical knowledge' as 'a' domain interest in the 'control and technical exploitability of knowledge,' where civilization is innately "governed by a fundamental human interest in explaining, explanations providing the basis for prediction and predictions providing the basis for the control of the environment." [48] Grundy establishes a line from humankind's thirst for knowledge, to the need to free him/her from bondage of ignorance. At least an affirmation related to Grundy's proposition is discernible in the U.S. Government's interest in 'regenerative medicine.' Expectations are that 'regenerative medicine,' which include advancements in Genetic therapies, will be revealing ways by which previously unthinkable medical treatment approaches can now be employed. A U.S. Dept. of Health and Human Services report projects that the cost of American healthcare is expected to rise from 13% to 25% of US GDP by the year 2040. The same report states that integrated treatment approaches such as regenerative medicine will provide the technology edge to bring about not only cost containment, but previously unforeseen means to improve the quality of healthcare and healthcare practices as well. [49] The report, however, admits that the U.S. is behind the curve in terms of investment and support for such programs in comparison with other countries. As U.S. healthcare costs continue to soar, necessary are innovative approaches to dispense a superior level of patient care that makes it possible to contain costs without sacrificing quality. Policymakers must be well equipped to meet and exceed such national challenges.

Congressional functioning under auspices of *false knowledge* is, among other things, a prime obstruction to the formation, and the sustenance of health policy regimes, among other policy areas, which are able to benefit the scientific community, and equally and complementarily in the service of the nation.¹⁴ Consider the genesis of NSF as the premier governmental research support vehicle for U.S. colleges and universities. President Franklin D. Roosevelt's science advisor Vannevar Bush is often credited with launching and shepherding the key ideas and efforts, responsible for the founding of the National Science Foundation. In familiar tales, U.S. Senator Harley Kilgore is often characterized as Bush's nemesis, holding up NSF related legislation in the Senate. While it is true that Bush and Kilgore were not on the same page with respect to the proposals to create the NSF, Kilgore had some very legitimate concerns regarding the creation of the NSF, as Bush had proposed it, and vice-a-versa. It must be noted that Kilgore, independent of Bush, had been thinking about the need for a government mechanism, similar to an NSF, that would not only advantage the nation from WW-II production efforts, but would see to it that technological innovations that resulted from production efforts could be quickly brought to the benefit of the nation. [50] Principally, Bush agreed with Kilgore on matters regarding national needs, acknowledging, "Without scientific progress no amount of achievement in other directions can insure our health, prosperity, and security as a nation in the modern world." In addition, Bush professed that it was incumbent upon "a stream of new scientific knowledge to turn the wheels of private and public enterprise" for the United States. [51]

The point of interest here is that various details regarding the founding of the NSF may be mired in *false information*. The very reasons behind NSF's founding, and the form of its present-day existence, cannot be suitably understood if one is not habituated to the thoughts and actions of both Kilgore and Bush, among others. It would also be quite inappropriate to consider Vannevar Bush as the sole originator of vital ideas, in terms of the NSF's inception.

¹⁴ This article is not intended to be an expose' of Congressional disconnects with national priorities. A literature search will undoubtedly reveal numerous examples of the history of serious policy disconnects in multiple areas.

ON DRINKING FROM POISONED CHALICES...

“It is from investment in basic science . . . that the most valuable long-run dividends are realized. The government has a critical role to play in this regard,” [52] so stated the Hart-Rudman Commission. Yet, fundamentally, there is little understanding among involved parties at U.S. government institutions supporting the furtherance of science, on the definition and the nature of *basic science* research; and that is severely impeding the future prospects for U.S. Science innovation and leadership. The relationship between *basic research*, national strategic investment as a whole, and aspects which are impeding United States progress in science, the capability to innovate, and to broaden the sphere of human knowledge, is **very highly nuanced; so much so that nearly all today have missed it.**

The Hart-Rudman Commission has also acknowledged, “Americans are living off the economic and security benefits of the last three generations’ investment in science and education, but we are now consuming capital. Our systems of basic scientific research and education are in serious crisis.” [52] However, contradictorily, a report prepared for the Office of the Secretary of Defense [53] by RAND suggests that the challenge that America is facing is perhaps not as grave as many believe. The RAND report further poses that the U.S. is not under-investing in ‘basic research.’ The most disconcerting element in the RAND report, as it relates to their assessment of U.S. *basic research* investment, is that it remains unclear to the reader just how RAND defined *basic research*, and how ‘that’ definition relates to their overall assessment of U.S. *basic research* investment value, and ultimate determinations. [54]^{viii} We believe that the RAND report is not on target, especially with regard to the view, and representation of basic research.

We present, and emphasize that the meaning of *basic research* today is vastly misunderstood. Institutional and individual memories of what *basic research* actually means is the key issue here, where the lack of an aggregated understanding of its meaning within the science community, and an integration of that meaning into a nationally strategic planning framework, is unquestionably crucial. With respect to the evolution of an organization such as NSF, and its present day existence, none can prospectively distinguish how well such governmental instruments, once created to further the scientific capacities and capabilities of a nation, are now functioning and serving as it was meant to be, unless certain background on their emergence were available. United States’ capability to materialize innovation, and to enable scientific and technological progress, is now fast diminishing. [55] In terms of crafting helpful strategic science policies, and deciding upon where to make appropriate investment for America’s future, we must never just assess if we are investing enough. Instead, we must also ask if we are investing properly. **At the very foundation of whether we are investing properly lies the question: do we understand what *basic research support* is to be?**

During the summer of 1959, the National Academy of Sciences, the American Association for the Advancement of Science, and the Alfred P. Sloan Foundation sponsored a meeting titled, ‘*Symposium on Basic Research*’ in New York to detail the nature, and the various aspects of ‘*basic research*.’ [56] The men who attended the symposium were the Roman equivalent of the *Decemviri*,^{ix} although they numbered more than 10, and were not given any powers to enact laws. While these men were not aristocrats themselves, they were patricians, and represented the *cream-of-crop* in American science, scientific philanthropy, and astute métiers of national scientific policy. At that meeting, many valuable and indelible points became known, which were to have served as guideposts to formulating U.S. national strategic policy directions, and scientific investments for the future. Yet, even after those worthy debates and their documentation, since 1959 the need to understand and to fervently support ‘*basic research*’ for the long-term success of U.S. scientific foundations is vastly mis-understood by organizations such as the NSF, DARPA, DHS, IARPA, and others. Some of this deficiency is evident in the manner U.S. research and development directions are considered, structured, funded, manned, and operated. [57]

Undeniably, the first order of business here is to distinct *basic research* from *applied research*. In his work, Dr. Mathews has described ‘basic science research’ fundamentally as the funding and the initiation

of scientific inquiries to “Understand and lay elaborate, the many aspects of man’s existence and the environment, his surroundings and the things within it; how things come to be, why they are in the manner they are, and what function they serve.” [58]

To aid the reader’s understanding of basic research, some of the key points raised at the 1959 ‘Symposium on Basic Research’ are presented here, in the hopes that it will remind, and cajole the scientific enterprise and those within it to right itself. After all, as Carey was so mindful to be interrogative once, “[i]n an age of directed, mission-oriented research, an age of high stakes and space stations.... who speaks now for... the nature of scientific progress?” [42]

On the subject of *basic research*, and on making scientific progress, Dr. Warren Weaver¹⁵ opened the symposium, asking among other questions, the following. 1) “Are not universities so deeply invaded by the demands for solving immediate problems, and by the temptation of income for so doing, that there are all too few cases of competent scholars pondering about problems simply because it interests them to do so? Is there not a real danger that the scholars in our universities will lose—and indeed have already partly lost—the “maneuvering room for their continuing reanalysis of the universe?” 2) “Has it been effectively accepted in our country that the spirit of basic research is an essential ingredient of the educational process—and that this fact should affect educational procedures at all levels?” And, 3) “Has either industry or government learned how to protect basic research from the insistent demands of applied research and development?” [56] Weaver’s prescient questions have held like a yoke around the American Scientific enterprise’s (public and private) neck for half a century, painfully ‘dragging out’ the struggle by committed members of the scientific community to enlist national leadership’s interest in pursuing, and advancing the envelope of scientific knowledge in the strategic interest of the United States.

Also at the symposium, Dr. J. Robert Oppenheimer urged all to recognize that “great intellectual developments [by way of *basis research*], whether they will in time lead to practical application or not, are continuous with, and contiguous to, parts of science which have played an enormous part in practice.” [56] Perhaps more than anyone else at that symposium, Dr. Merle Tuve of the Carnegie Institution summed up the fundamentals of how we ought to view, and approach, *basic research*, which is to be supported by public investment. He identified *basic research support* as the financing of the ideas of the one “individual man, who has ideas.” Crediting Andrew Carnegie, Tuve emphasized that “buying a man’s time and giving it back to him, as a support for his ideas and his thinking... the support of thinking, in the search of new knowledge... which can enlarge our understanding, knowledge, which is not isolated facts but related to guiding hypotheses or principles” [60] *was not any national option, but an absolute necessity.*

Also in his talk, Tuve became indictive of the quagmire that politicians, scientists, and scientific establishments were complicit in creating, twisting the original intent and meaning behind the public support principle for *basic research*. Tuve agitatedly said further, “I wish it could be possible to make really honest men out of us in these discussions, so honest that we would all quit stretching the meaning of the words “basic research” to cover huge areas of essentially technological activity for which huge amounts of taxpayers’ money can be obtained.’ ‘...So I’d like to point out, at least for today, that we have all contributed to a more or less purposeful confusion in our uses of the words “basic research.” A great deal of the money listed as spent for basic research is spent for highly peripheral activities and operations, and too small a fraction actually goes for the subsidy of thinking, to give selected competent individuals both the freedom and the time to think... the subsidy of ideas, not the operations aspect of technological performances, however spectacular...” [42]

¹⁵ Then Vice President of the Alfred P. Sloan Foundation

On Antidotes....

Equally of weight is how policy-makers themselves purvey false information. The public wrecking of Dr. John Marburger, III, is a fine example of how, a reputed scientist's spirit can be re-worked by the political instruments of the day in Washington, to spew *false information*, and to use the *kind of science that gives one the policy they want*, [61] in lieu of exercising one's *free will* to halt the White House's science policy madness. Marburger, the past president of State University of New York at Stony Brook, was appointed as science advisor to the 43rd President of the United States. To this, the American science community applauded. Nevertheless, that applause quickly transitioned to a pin-drop silence, followed by the sprouting of vehemence, and its escalation to vitriol. At the time of Marburger's appointment, the White House had in advance diminished the position to which he was being appointed. Among other things, the President's point man on science was instructed to not report to the President as his predecessors, but instead, to the White House Chief-of-Staff. Marburger has often energetically denied this diminution, in despite of its authenticity. [62] At the very least, the circumstances relating to Marburger's appointment as science advisor should have been seen as an urgent telegram from the White House to the science community, saying that the welcome-mat was being pulled in, and that science policy would be crafted without the participation of, or input from science. Public civility was sacrificed as never before, when the voice of Dr. Howard Gardner of Harvard, if for a moment, seemed to express the sentiments of an exceedingly disgusted scientific community, when it reverberated through the nation airwaves via the syndicated Diane Rehm radio program. There, Gardner exclaimed, "I actually feel very sorry for Marburger, because I think he probably is enough of a scientist to realize that he basically has become a prostitute." [63] In the mind of much of science, Marburger had become an able-bodied tool for crackpot political plotters. In retrospect, the Union of Concerned Scientists (UCS), whose public statement sums up the situation, best offers a glimpse of the political climate overflying the potential to organize highly beneficial science policy in Washington, D.C. UCS has said, "[p]olitical interference in federal government science is weakening our nation's ability to respond to the complex challenges we face" and that "[t]he scope and scale of the manipulation, suppression and misrepresentation of science by the Bush administration [has been] unprecedented." [65] For nearly a decade, highly corrosive U.S. national policy mechanisms had a cornucopia full of opportunities at their disposal to retard thoughtful propagation of reason, and to surcease national progress, in favor of advancing a few national administration themes. Such is the type of poison for which the scientific community must now quickly deploy an antidote.

Possessing unobstructed issue perspectives, and the inimitable understanding of our achievements, are clearly important pre-requisites in national science policy, and resource planning. Len Peters, former Director of Pacific Northwest National Laboratory, and Senior-Vice President of Battelle, have been quoted saying "If we want to steer the Titanic of American competitiveness out of danger, we also need to address the deeper, less-obvious issues underneath, and we all have a part to play." [66] Dr. Peters' statement on U.S. competitiveness is relevant here for two reasons, 1) in so far as U.S. science and technology is foundationally the enabling competition engine, *basic research* represents the essential seed to fruits, and 2) because Dr. Peter's quote is problematic, and it is illustrative of the type of problem disconnects showcased throughout this article. With many apologies to Dr. Peters in advance, we note that, while it might not have been Dr. Peter's intention to equate American competitiveness to the Titanic, establish any direct connection, or even any distant relationship between the two matters, we believe the proximal placement of the two - more than murk issues. One fact is amply clear: the Titanic is forever lost; prospect for U.S. competitiveness however, is not lost, which may very well have been the point Dr. Peters was intending to make. However, that which we know today tells us that the fate of the Titanic was perhaps etched in stone. From the loss of sensibilities in leadership at the helm, and in rank duty, to the usage of sub-standard materials and engineering of the vessel, cumulatively lead to more than a human tragedy during the early morning hours of 15 April 1912. [67] To make a point explicit regarding Dr. Peters' suggestion that the Titanic could have possibly been steered away from harm, and similarly, U.S. competitiveness too can possibly be steered away from irreversible decline, is a meaningless and untenable statement, according to Dr. Mathews. To clarify, Mathews recalls David Brown's recently unearthed evidence, which strongly suggests Titanic ran aground on a submerged iceberg; one which

none apparently even saw. [67] Likewise, Mathews says, “the way in which science can be made to contribute evocatively to long-term U.S. economic security may not be steerable at all, chiefly because those who formulate funding policy in support of vital science programs are by and large, not properly clued-up. However, this is a correctable situation, and for the good of the nation, it must be rectified.” He adds, “Now, we say we are funding ‘basic research,’ when in fact we are not, and much worse, many have miscomprehended the meaning of ‘*basic research*’ more deeply. “

With the beginning of a new national administration, who not unlike others, have promised our deliverance from intellectual inequity and mediocrity in nationally relevant leadership areas, the President, and his cabinet must ensure progress of science by improving the fidelity in the objectivity and validation data, to limit proliferation of false information, and refine our current knowledge base. To that extent, the following intelligence, a series of ineffaceable observations from Carey, will be worthwhile remembering. He has said, “[m]y view is that the public business today is in a state of exceptional fluidity, and because of this the public manager’s first responsibility is to have *an open mind*, and his second is to *want passionately to understand the meanings—not the forms*—of his changing world. The hard and terrible truth is that we age and cling to axioms and Bible texts while the ground under us shakes and trembles.” [68] With respect to the role of science in the assurance of our national security, Carey says, “if national security and strong national economy presume a first-class technology base, and if the conduct of foreign policy presumes that the United States will be a reliable partner in cooperative undertakings, the management of the science component of the policy system takes on a centrality that oncoming Presidencies cannot ignore.” He forewarns though, “[i]n science policy, as elsewhere, homework counts” [69] signifying essentially that what we know, how we know it, and when we know it, are all important questions to answer while doing the necessary homework. Finally, Carey most importantly reminds, “we need to take our courage into our hands and make choices about major scientific or technological investments on the basis of their social contribution.” [70]

We would be wise to take this advice to heart, and urgently act upon it.

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Endnotes

ⁱ Prof. Mathews attributes the term “instant universe” to the legendary R. Buckminster Fuller. Fuller has used the specific term to demonstrate to his audiences around the world that before the 20th Century, the ‘speed of light’ had never been a matter of scientific consideration, that in fact those involved in the pursuit of science had always considered the presence of heavenly stars in earthly skies to have been constant.

ⁱⁱ Dr. William J. Harris, Jr., the ‘quiet giant,’ as Dr. Mathews has often referred to him, served as the Chairman of Materials Advisory Board - Main Panel of the DoD Titanium Alloy Sheet Rolling Program from 1955 to 1962. He also served as the Executive Director of the Materials Advisory Board between 1957 and 1960, and as Chairman (from 1969 - 1971) of the renamed National Materials Advisory Board (NMAB). Dr. Harris was a prime member of the Material Advisory Board Sub-Panel to Formulate a General Program on Titanium Fabrication of the DoD Titanium Alloy Sheet Rolling Program from 1957 to 1959, and the Material Advisory Board’s Sub-Panel on Alloy Selection of the DoD Titanium Alloy Sheet Rolling Program from 1957 to 1960.

ⁱⁱⁱ Following the Battle of Britain, between 1941 and 1945, Dr. William J. Harris, Jr., was recruited to be the lead scientist at the (then) Navy Department, and charged with the responsibility to armoring US Naval Aircraft, which as a result, saved countless American lives. Dr. Harris and his team at the Naval Research Laboratory were the key parties responsible for defining the problem associated with the “Liberty Ship Steel” failures. In fact, he is the author of the definitive report on Liberty Ship failures. Knowledge gained in both areas, consequently went on to improve commercial ship and aircraft manufacturing, and improving both quality and safety of operations. In addition, from an engineering history point of view, his cutting-edge technical investigations at American Association of Railroads (which he had more than a hand in founding), and elsewhere, enabled the rise of world’s railways and remains an impressive testament to one man’s influential contribution to science.

^{iv} Titanium Steering Group of the Office of Assistant Secretary of Defense for Research and Development, directed TML (August 1955) to assist and guide the Navy Bureau of Aeronautics (on behalf of the Department of Defense) to develop a recommended course of action for Titanium development. Upon approval, the Navy was to then assume responsibility for coordinating the implementation of the Titanium-Sheet-Rolling program, and implementation of the various phases to be accomplished through various Department of Defense Agencies that were to be involved.

^v Merriam-Webster defines a ‘parallax’ as “the apparent displacement or the difference in apparent direction of an object as seen from two different points not on a straight line with the object.” Extending the physical principles behind ‘Parallax Error,’ to processes relating to cognition, Prof. Mathews chooses to use the term ‘cognitive parallax’ to describe the incongruity between informational and cognitive constructs that presents gaps in the logicity composite, having the potential to then go on to create/form the basis for incorrect historical memories and informational matrix unless corrected. For a holistic elaboration on the properties of a ‘Parallax,’ we refer you to “The Parallax View” [Slavoj Žižek], MIT Press, Cambridge, MA, 2006. Supplemental reading: Bradshaw, Mark F., et. al., “Surface orientation, modulation frequency and the detection and perception of depth defined by binocular disparity and motion parallax,” *Vision Research*, Vol. 46, Issue 17, September 2006

^{vi} When not referenced otherwise, use of the tense “we” in this article reflects the joint opinions of Dr. Robert Mathews of CSATI and this author, as it is sufficiently detailed within the Prologue to this article.

^{vii} Attributed to Plutarch, by Sir. Francis Bacon “men of weak abilities set in great place, that they were like little statues set on great bases, made to appear the less by their advancement.”

^{viii} It will be of interest to note the following comment by the late Dr. Merle Tuve regarding this also. He said, “[r]egardless of the doubling and redoubling year by year of the announced annual expenditures by government and industry for basic research in science, we all feel a bit helpless and disappointed because these large sums seem to contribute so little to the really basic core of scholarly accomplishment which is central to all the varied degrees and qualities of activity we now seem to include under the term basic research.” In addition, Tuve said the following of the scope of apparent ‘busyness,’ which is often displayed. Tuve said, “[h]uge new synchrotrons and cosmotrons and electronic computers, and polar expeditions and balloon and rocket flights and great government laboratories costing more each year than the total academic costs of many of our greatest universities—all these conspicuous aspects of our new national devotion to science are subsidiary and peripheral. They do not serve appreciably

to produce or develop creative thinkers and productive investigators. At best they serve them, often in a brief or a rather incidental way, and at worst they devour them.”

^{ix} *Decemviri consulari imperio legibus scribundis* was a Roman board of sorts, composed of former Consuls (wise men), generally seated by election after a prolonged expression of societal disenchantment with existing rules/laws in order to deliberate, reconcile, represent foundational changes in aspect of law, and to thereafter codify and publish the revisions, or newer laws entirely.