# Scientific Progress During Peacetime: Current Epistemological Trends

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**Abstract**

This analytical study explores the nature of scientific progress connected to current philosophical definitions and the role of institutional governance in promoting this progress. This paper examines how public and private initiatives intersect to create a wartime level of scientific progress during peacetime, as promoted in detail by Vannevar Bush, Director of the Office of Scientific Research and Development (OSRD) from 1941-47. This study suggests that the public benefit from the *war footing* approach to scientific progress should outweigh the losses to the public good that accumulate due to *wartime* restrictions on scientific discourse during times of peace. The interaction and dependence of scientific progress on military development, public health and public needs in general, the tax code and the patent system form the foundation of Bush's program for sustaining wartime levels of scientific progress during peacetime. This study references the COVID-19 period and the solutions that were applied to emergent public needs through scientific programs. Justice of the United States (U.S.) Supreme Court Neil Gorsuch noted in May 2023 that "…we may have experienced the greatest intrusions on civil liberties in the peacetime history of this country." This study proposes that the dilution of scientific truth in public policy is the result of a collective institutional mindset among scientists. This mindset endorses public programs that provide society with a wartime risk response in peacetime. In this study, from an epistemological standpoint and considering the work of other researchers in this field, these developments in scientific progress will be analyzed.

## 1. Evolving Science

Bush (1943, 1945) suggested that World War II was won by the powerful effect of scientific progress in the war effort. Bush noted that this effort had to be scaled up during the war, which took time, and determined that the time was largely spent educating and training scientists in the great number needed for war. Bush outlined to President Roosevelt that America's military advantage should not be lost through attrition of demand for scientific progress, which the war had established. Bush proposed that the wartime level of scientific progress be maintained in peacetime through the federal promotion and funding of science in all sectors of American society, industry, public

and private spheres, and military. For Bush, scientific progress would be the instrument by which public needs would be met. In this manner, the war advantage brought by scientific progress would be in a state of continuous upgrade and readiness, as scientific progress was to play a central role in the provision of all public needs from the post-World War II period until today. As a result, scientific progress has been further incorporated (through law and statute) as a primary mission in the national security of America. Bush argued that it was necessary to continue scientific progress at wartime levels in peacetime to maintain the United States' global standing and national security. This plan went on to change all aspects of American life from the economy to education, health care, national security, and the environment. Industries that could benefit most from this model of scientific progress – medicine, finance, environmental science, health care, and education – have expanded exponentially. In contrast, industries that seemed to have had the least ability to exploit this mission – arts, culture, housing, public works, and social justice – might not have had the same public and civil development. (The author suggests this is an area of future real-world research.)

It is hypothesized that in times of war, the notion of what is scientific progress moves toward the collective mindset where truth alone or in significance will not determine that which is considered scientific progress. On the other hand, one can suggest that in times of peace, the semantic and epistemic notion of scientific progress will be more persuasive to government and policy-makers. This study also considers Vannevar Bush's contribution regarding scientists and their peacetime intellectual freedom and what happens if the collective controls of the wartime effort continuously govern scientific output. The author suggests that the greater benefit to the public will come if the peacetime efforts of scientific progress require an epistemic/semantic definition of scientific progress.

Nagel (2012) argues that the human mind is evolving just like the human body but that the study of the evolution of the mind seems to be neglected. Nagel concludes that the theory of evolution is a product of the currently evolved human mind and that theories of evolution are themselves a part of human evolution. If the mind/brain evolves, then so to do our mind/brain-held theories of evolution and cosmology. Nagel considers this an evidentiary flaw in the theory of evolution, which explains his suggestion that evolutionary theory is almost certainly false. For example, the anthropic principle, evolutionary theory and the 'big bang' are supported by empirical evidence and the prevailing collective scientific mindset. These three theories also serve each other in a broad fashion; they at least do not flatly contradict each other. They might propel mutual acceptance among these three theories. A collective mindset might develop in this scientific community even though factual knowledge is

not universally understood or shared, as Ross (2021) notes '*factive epistemic states*' of collective and accumulated knowledge.

For some researchers, what constitutes scientific progress is the result of a series of knowledge universes placing Socratic reasoning at the outer earliest boundary of this knowledge universe. Then, morality, alchemy and inductive methodologies were the primary or complimentary foundation of knowledge. Most recently, the empirical universe of real-world observations and deductive truth are the raw material of knowledge. It seems that scientific progress is currently defined in part by the gravitas and enormity of institutional knowledge. The research programs of institutions are represented and communicate through a variety of stakeholders, including councils, plenaries, scientists, and administrative actors, who have formed a scientific multiverse utilizing a platform of multiscience wherein a variety of scientific networks, instruments and theories exist in an organizational balance.

What one might consider to be scientific progress can change, but it is generally assumed that the real-world upon which it is founded stays the same. One of the arguments against the inductive method is the declining relevance, meaning and usefulness of inductive output.

For example, viruses have, in terms of classification, obfuscated the demarcation between what is considered living and nonliving. Viruses have some of the conditions needed to meet the definition of being a living thing. Termed by Salk (1962) the infectious molecule, a virus can regenerate a molecular manufacturing code (its natural patent) in its host. The virus does not replicate in a manner considered to be living reproduction. Conjecture on the living or nonliving status of viruses is settled by scientific consensus and the refinement of zoological definitions of what is a living thing. A virus is nonliving, as in Salk's original 1962 terminology, an 'infectious molecule'. One might consider a virus something like a replicating nonliving molecular patenting apparatus.

## 2. Method Change

Rather than evidentiary changes in the real-world I suggest it is conflict between methods (including those considered incommensurate) which defines sectorial knowledge and this includes theistic, epistemic, and collective notions of scientific progress. For example, Catholic Priest and scientist Father Georges Lemaître proposed the instantaneous formation of the universe based on Einstein's quantum theory, and Lemaître termed it the 'big bang'. Lemaître's postulation came to satisfy two contradictory worldview paradigms: creationist and materialist. The 'big bang' created a bridge between material evolution and creation. An instantaneous 'big bang' sympathizes with a

theistic mystery, and the scientist who first stated the 'big bang' was a Catholic Priest. However, this worldview alignment was not accepted immediately.[1]

A scientific mindset, according to Mizrahi (2013), can accept a range of outcomes as defining scientific progress. For example, the 2019 Nobel Prize in Medicine was awarded to three scientists for their study of oxygen in cells. This discovery explains a process by which an empirical and measured observation is universally accurate. Another example of scientific progress might be a pharmaceutical drug that, according to the recommendations of its manufacturers and government, has the chance of improving one's health through a mechanism that is not fully understood but for which testing and trials has revealed a statistical significance that is understood to be positive for health. This is also considered scientific progress. The existence of complimentary but contradictory scientific

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[1] A few hundred years earlier, the notion that the earth was not the center of the universe, or our solar system, did not align spatially with the theistic notion of the individual's relationship to their soul, the material world, and the heavens. Some theists consider the existence of a spiritual soul residing centrally in our material bodies until death, at which point it returns to God in the sky above, through the earth (the center of the universe being beneath our feet in the earth), and finally resides in Heaven far, far above us. Materially the 'center' of the solar system (and universe) could not be in two places at once, those being beneath us in the earth and far from us being the sun. In addition, where did this place the heavens? In part, the theistic resolution to these world-view conflicts may have come from the natural sciences. The natural sciences proved the significance of the sun being the source of energy on earth. The theistic vision of the human spirit reaching toward the light of the sun is often represented theistically as 'the light'. Since Biblical times, representation of *the light* has been a vehicle of religious experience. The sun is 'the light', and the sun shines seemingly infinite power toward the earth and the entire solar system. The sun and the light are a metaphor of God's universal presence and infinite power. With this framing, the soul upon death can join with the light of God in the physical universe and the metaphysical universe as God consciousness. Popular, intellectual and scholarly writers such as Aldous Huxley promoted these views as a perennial philosophy. One might consider that Albert Einstein's theories were, by theistic accounts, even-handed in their presentation of the prospect of 'light' as the fabric of all things and therefore all knowledge.

definitions residing inside of a broadly singular institutionalized scientific mindset that collectively produces scientific progress looks like a multiscience environment.

This study suggests that there are multiple definitions of scientific progress and that the institutional and private sectors that operate within the mission of scientific progress do not demarcate definitions of scientific progress but instead exist mostly harmoniously for mutual benefit. Scientific progress can refer to both a partially good result in a skin care product and the discovery of how human cells use oxygen.

Researchers have a range of methodologies and idealizations as research options, idealizations being models with 'falsity' Lawler (2022), for progressing science. Nickles (2017) suggests that innovation will be followed by a change in methodology and that knowledge and methods are mutually dependent.

Basic science explains nature and will require certainty in scientific outcomes termed 'truth-likeness.' In basic science, findings are almost certain, perhaps only in a different part of the universe operating under a yet unencountered cosmology is the result generally refuted; 'almost certainty' in basic science is considered scientific progress and requires consistently repeatable truths.

Applied science can produce results that can be very close to 'almost certain'. Applied science creates a 'truth window' for itself by using a subset of data and variables to envisage plausible outcomes that do not hold true all the time but hold true under the conditions specified by the methodology. Among civilians and nonscientists, the term 'science' has wide acceptance, and generally, no distinction is made between basic and applied science. To some, science is primarily an action of observation and methodology that creates truths rather than finds them. It is equally possible that the application of a scientific method creates findings that are representative of the truth or predictive of a truth but not especially accurate.

In the current discourse on scientific progress, one can speak of the scientific collective mindset (Harris, 2021; Ross, 2021) that characterizes the interaction between real-world scientists and society. Theorists might fall into two categories regarding the scientific mindset. Some suggest that a scientific mindset can only be attained by a qualified scientist; this would denote scientific progress as being a product of organization. For example, Copernicus and Galileo were each opposed by the institutional worldviews of their times, which were dominated by religiosity; in those days, a theistic organization of society was the prevailing method of governance. One might consider that the scientific progress of Copernicus and Galileo was not opposed by theism; it was opposed by governance, and at the time, governance was theistic.

### 3. Theory Choice and Causation

Nickles (2017) considers that if 'rationality and objectivity' can be preserved during a period of 'transformations', they speak to transformation as part of the process of generating scientific progress and that not all methods, logics and object definitions will remain static during a transformation process.

Rowbottom (2014) describes a scenario whereby a 'thought experiment' might offer a patch over some existing knowledge lacuna, though at the risk of failing to clarify, or account for, an argument pump, a logical miscalculation based on a semantically false equation. For example, the dog is larger than the cat is larger than the mouse is larger than the dog, being A > B > C > A, is a common example of the argument pump falsity. If these were theories T1 is better than T2 is better than T3 is better than T1. What constitutes 'better' is the essential topic of theory choice, the accumulation of knowledge and scientific progress. In addition, the similar question of whether knowledge is preserved in theory choice can also be asked. The argument, if satisfied by two competing theories, is incommensurate if it satisfies T1 > T2 > T3 > T1', where T1 = T1'. It is reasonable to consider, as Agazzi (1985) theorizes, that in this transformation at some point, the meaning of an object has changed within the 'global' context. With regard to theory choice, it is argued that the theory chosen might be the one in which the theory that unsettles the least preexisting knowledge is the best choice. In contrast, the theory that best serves practical real-world variables like efficiency or even some preexisting idealizations, models, like climate change, might be selected. Agazzi suggests that the incommensurate situation is the result of meaning change; essentially, the objects have been defined differently, and the dilemma is how to compare theories that seem to contain different objects. Agazzi suggests that to pass through this transformation, a new 'domain' of objects could be the focus of our attention. A theory is true when it satisfies semantic analysis when objects are considered in their 'domain of reference.'

Notably, if the transformation of T to T' takes place, if a theory is chosen to replace previously held theory, this suggests that in hindsight, the meaning of the objects has changed to accommodate the new theory T'. Predictably, this will affect our historic perception of superseded scientific theories. The effect on past held theories can be a complete demolition of historical methods, beliefs and truths. This author argues that methods are significantly more vulnerable to expungement from the prevailing scientific epoch than knowledge and truly held beliefs. It is suggested that the reason why some archaic theories of science seem so dysfunctional is that the change in meaning of objects has rendered the previously held cause and effect relationship between historic logical objects

broken. For example, where A > B > C, A is greater than C is no longer true if C in the new global context is considered C'. Thus, A > B > C', leading to a realization of C' > A. Scientific progress therefore relegates some previously held knowledge to a state much less than bettered, but demolished, fantasied, mythologized, and infantilized, all due to a change in the meaning of objects as instructed by the new dominant theory, which formally eliminates and makes illogical the previously held causal relationship.

Theory choice requires comparison, and Baker (2001) uses the example of quantum mechanics and presents three prevailing methods of explaining quantum theory. Baker notes the use of quaternions as explanatory, but the quaternion explanation is not the method or theory chosen, as it is deemed not the most 'suitable' for the real world. According to Agazzi's analysis, what makes a theory eligible for real-world truth status might depend on accepting the 'complementarity' of empirical properties, in which case two different properties cannot be simultaneously known. This promotes a verisimilitudinous outcome, and the consideration of global context might steer the epistemologist away from truth-likeness and toward verisimilitude. Will a community of scientists choose theory by resolve, that is, is scientific agreement due to a united approach toward truth-likeness? Or is consensus found through complementarity and the encouraging appearance, or at least the appearance of a mindset that agglutinates around an impression of truth-likeness? Cevolani and Tambolo (2013) analyze this and reveal that it might be the role of scientists to somehow 'persuade' other scientists to use a different or at least changed methodology. When Popper uses the term truth-likeness in reference to falsity, the meaning of the semantic object 'truth-likeness' is associated with falsity, specifically the role of falsification in scientific progress. Cevolani and Tambolo present an argument that suggests that the starting point of the verisimilitudinous method of determining scientific progress originates at the point at which Popper's falsity argument is halted by the realization that truthful knowledge, which is falsifiable, can be accumulated but will always approximate truth and thus could never formulate an absolutely true belief. Cevolani and Tambolo suggest believable truths, that truth-likeness is now reframed as an accumulation of believable truths, verisimilitudes, and it is this redefinition of truth-likeness that abjugated Popper yet keeps the likeness of Popper's foundation. Thus, verisimilitude might be a theory of the science of science.

### 4. Scientific Progress is Institutionalized

Hall (1921) suggests that science is institutionalized in part due to power being institutionalized. Contributing to their ability to influence decision-making, political stakeholders promote their own scientific progress in connection to problem solving. Individual actors aligned in 'group' epistemic states, as defined by Ross (2021), produce 'group' knowledge. Scientific progress is for some almost entirely an action of problem solving, as discussed in Lawler (2022). In addition, there is the question of how to use scientific progress for the distribution of public benefit, as explained by Bush (1943, 1945) One might consider the collective scientific mindset to be institutionalized and to be a catalyst for a consensual and collective approach to progress in science. As aforementioned, the scientific approaches used to propel stakeholder positions should not, and intentionally do not, contradict the methods of other stakeholders. Examples include the use of qualitative sociological narratives by justice stakeholders, natural science environmental models by climate stakeholders, data analysis by economic stakeholders and public opinion surveys by political stakeholders. Mizrahi (2013) explores the multiscience environment in terms of 'varieties' of scientific knowledge and accepts a broad range of outcomes to be considered scientific progress. Much of this compatibility depends on whether the stakeholder applies epistemic or collective reasoning. It is possible to find a 'truth window' on the epistemological spectrum that will create scientific outcomes that will further the stakeholder mission without creating conflict with other institutional stakeholders. Ross (2021) details these accounts of actor conflict avoidance as 'controversy.'

It is proposed that the institutionalization of scientific progress solidified during the end of World War II with the discussion of the Kilgore Bill first proposed in 1942 by Vannevar Bush, the then Director of the Office of Scientific Research and Development (OSRD) from 1941-47. The OSRD was established by President Roosevelt in 1941. Attempts to pass the Kilgore legislation (Douglas, 2014; Miri, 2021) failed, although congressional activity regarding the administration of science continued with Vannevar Bush writing "Science – The Endless Frontier" in 1945. In this document, Bush notes the essentiality of scientific progress to national security and ex post to health, employment, living standards and culture. Bush makes the important point that scientific progress propelled victory in war, but to maintain this advantage, scientific progress must be maintained at wartime levels. Bush notes that without wartime-level scientific progress in times of military peace, the proven wartime advantage of scientific progress is lessened, and the nation will face greater threats. Bush notes that in times of peace, scientific progress can only progress at the wartime level needed with the idealization of war onto other things of public need. One might consider that Bush makes national defense the first argument for federally administered scientific progress.

During times of military peace, Bush's program requires a war footing on societal issues such as disease, space exploration and unemployment. Bush notes two ways in which the government can directly promote scientific progress in the public and private sector during times of peace: clarification of the *tax code* to promote privately funded research and changes to the *patent system* to better the position of industry.

Bush notes the importance of scientific freedom in peacetime even though the war effort enforced restrictions and consensus on scientists and scientific progress. Bush phrases peacetime scientific progress as requiring 'vigorous' and 'healthy' 'wellsprings' where the scientist is free to 'pursue the truth wherever it may lead' to maintain a 'flow' of scientific progress. Bush suggests the use of 'caution' to note the very different conditions of wartime to peacetime, and the wartime 'rigid controls' imposed must be removed to 'recover freedom' where a 'scientific spirit' built on competition of 'free intellects' will continue to maintain safety and prosperity in the United States. Bush's meaning is clear; scientific progress must be returned to conditions that scientists require for the public good in peacetime. Bush does not make any material suggestions to promote this. The tax and patent code advantages do not inherently promote scientific freedom in peacetime. One might ask what effect this has on the nature of scientific progress in peacetime. It does seem that industry has maintained scientific progress at wartime levels of employment, but are the methods (tax code and patents) promoted by Bush still the best path to peacetime health and prosperity for society and security for the nation? Is the scientific progress that has been created the most ideal for the public good?

### 5. Post-World War II Scientific Progress

The interaction of scientific method, military development, public health, education, and the patent system form the foundation of the modern pathway toward sustaining wartime levels of scientific progress. The work of Vannevar Bush provided the platform for federal government funding for the continuation of wartime response toward scientific research in peacetime. This period of state mission formation can be considered the blueprint that survived into the 1990s and still propels scientific progress. For example, James D. Watson, Director, Cold Spring Harbor Laboratory, and Director, National Center for Human Genome Research, National Institutes of Health, in 1992 forward to the publication "Discovering the Brain" Ackerman (1992), uses a vocabulary of military language to note the importance of medical research of the brain. Watson notes that disease 'invades' and is the 'enemy', that 'weapons are new ideas', and that they form a 'formidable armamentarium'.

Scientific progress is an instrument of government, institutions and corporations engaged in a peacetime war against public enemies such as disease, malnutrition, disinformation, inequitable education, and public works. These initiatives sit alongside the direct support of military research. This plan suggests that our military enemies will be pushed to the exterior of our nation's borders and national interests, corporate enemies defeated by the patent system, medical enemies defeated in our bodies, and public health enemies attacked with our public health programs; this happens during times of peace to maintain wartime levels scientific progress. A peacetime war utilizes a collective mindset of human intelligence to maintain scientific progress. Interestingly, scientists, logicians, leaders, and philosophers agree that the output of this consensus of collective scientific progress is not known nor can it be fully comprehended by a singular individual. Reducing, or deducing, truths from a collective consensus is not necessary if the operational method is collectively understood. Collective understanding replaces truth.

Can scientific progress most effectively meet our peacetime public needs with a wartime collective mindset? If the answer is yes, then one might ask which peacetime efforts have accomplished this most efficiently with the least collateral cost. For example, the Manhattan Project was a military project that has had public benefit in terms of nuclear energy. At the time, the United States and Japan were at war, and the loss of Japanese lives might not have been considered a determent to scientific progress. The Apollo Program to put a human on the moon engaged enormous scientific resources and promoted broad scientific progress and social wellbeing. The Apollo Program enhanced the understanding of military intercontinental ballistic missiles and employed German scientists and technicians after the war.

## 6. Scientific Progress Outcomes Measured

The US COVID-19 response can be considered a measure of US readiness for peacetime war; it should, according to Bush, also reveal US readiness for wartime war. The possible lack of epistemic truth in public health policy created a closed institutional mindset among some scientists. This mindset launched a public health program that provided society with a wartime public health response in peacetime. After initial positive outcomes, this program relied on an evolving science that attempted to scientifically explain the generally declining outcomes and declining public adherence to societal lockdowns, masking, school closings, quarantine, and vaccination mandates and guidance. Each public health response to the period seemed to provide an immediate temporary solution, but without an abundance of factual knowledge, knowledge as a requirement of progress (Harris, 2021; Lawler, 2022; Mizrahi,

2013) and the institutionalized collective mindset's alienation of contrary scientific research, the COVID-19 program needed greater civil and administrative power to implement and police social behavior and adherence to behavioral mandates. This outcome was expressed in hindsight by Justice of the U.S. The Supreme Court noted in May 2023 that "…we may have experienced the greatest intrusions on civil liberties in the peacetime history of this country."

This author suggests that the peacetime war footing of scientific progress (Bush, 1943, 1945; Douglas, 2014; Miri, 2021) limited the ability of scientists to objectively analyze the emerging data, hospitalization rates, mortality rates and vaccine breakout infection rates. The war footing hindered and eventually oppressed the possibility of scientists debating the material evidence and emerging findings. For example, persons who died with the coronavirus but not from coronavirus were included in mortality rates to support war footing health policy but one could suggest that this approach did not support the role of material facts in the creation of knowledge from scientific progress. The theoretical framework sometimes used to discredit contrary clinical studies were large population-based studies, which on scale did not reveal the statistically significant variation detailed in smaller clinical, district and hospital-based studies. Medical studies considering blood type, history of smoking, gender, age-related risk, natural immunity and other empirical considerations were deplatformed, and their authors were subject to institutional and peer governance.

## 7. Conclusion

The public benefit from the peacetime war footing of scientific progress should outweigh the losses to the public benefit, which include accumulated restrictions on scientific truthfulness (considered acceptable) during actual war. Does the peacetime initiative that maintains the wartime output of scientific progress operate with efficiency in regard to the greater public benefit? One might analyze the significant nonmilitary domestic wars that the United States fights continuously, such as the obvious continuing wars on poverty, drugs, terror, climate change, crime, cancer, heart disease and illiteracy. It can be observed that to have a nuclear weapons program, a nation might consider a nuclear energy program as a peacetime effort of maintaining nuclear scientific progress at wartime levels; to have a ballistic weapons program, a nation needs a space and rocketry program; and to have bioweapons program, a nation needs a public health program. To maintain demand for scientists and scientific progress, the nation catalyzes nearly all public programs through a lens-gate of scientific progress. The goal has been to bring necessary

public service benefits during peacetime by addressing public needs from the continued operationalization of a paradigm (scientific progress), which is of the highest importance to national security from a military point of view.

Risk analysis might be considered when weighing public benefit; one of the differences between war and peacetime scientific effort is risk. War, with its impending danger, brings a greater acceptance of risk. If peacetime scientific progress addressing public needs functions at wartime levels of risk, society might be carrying a greater risk burden than it should for the provision of these public needs and might be engaging in more actual military war than is needed to justify the apparent threat and maintain demand for scientific progress. The verisimilitudinous collective mindset of public health administrators and scientists during the COVID-19 period approached problem solving with the notion that truth-likeness is actionable and that public health is successful even if it only involves the avoidance of mortality, which would seem to be a materially war-like footing for a peacetime civilian population. Cevolani and Tambolo (2013) reveal that a scientific community might have reached strong consensus regarding a new scientific theory, but the new theory itself has only a moderate chance of repeatable accuracy and cannot be falsified. At another time, the same scientific community has moderate consensus but is ignorant to a certainty before them. This last case would suggest that there is some real-world justification or complimentary mission for adhering to a conceivably wrong path.

**Competing Interests**

The author discloses that there are no financial or nonfinancial interests or competing interests that are directly or indirectly related to this work.

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