

**A WOVEN WEB OF GUESSES, CANTO TWO:  
Network Centric Warfare and the Myth of Inductivism**

**Track: Information Age Transformation**

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#### **Abstract**

This is the second in a series of three inter-related papers proposed to the 8<sup>th</sup> ICCRTS, which together describe the results of our critical inquiries into the NCW thesis and propose an alternative framework for understanding and accommodating *information age warfare*. The first paper addressed troubling issues related to the NCW business analogy, describing some important practical consequences of a restated analogy. In this second paper we address what we consider to be the more important and pressing challenge for the NCW thesis; namely, the very real possibility of profound epistemological error. We set ourselves three inter-related tasks herein. First, we seek to alert the military profession and the military research community to the importance of epistemology and methodology as disciplines of considerable relevance to military theory and the NCW thesis. Second, we seek to identify the epistemological and methodological basis of the NCW thesis, which we submit to originate in a theory known in contemporary literature as naive inductivism. Finally, we will describe a refutation of naive inductivism originating in the work of a philosopher named Karl Popper, and show its important implications for the NCW thesis. In the final paper we will show how Popper's alternative theory – critical rationalism – can provide a robust and surprising new conception of information age warfare and force transformation.

**...Round the decay  
Of that colossal wreck, boundless and bare,  
The lone and level sands stretch far away.**

**-- Percy Bysshe Shelley  
"Ozymandias"**

## **Introduction**

In Canto One<sup>1</sup> we explored the first of two remarkable features of the NCW thesis; namely, its status as an argument by analogy from *New Economy* theory, which was predominant in western business culture in the 1990s. The business analogy plays an important role in the NCW thesis, for it provides much impetus and substance, particularly in the earlier NCW literature. But the analogy fails. The once fashionable New Economy outlook upon which it was based has lost credibility and has no remaining constituency whatsoever in contemporary economics and business theory. The case against the analogy itself seems clear and compelling, and its more appropriate and modest contemporary restatement broadly contradicts the very enthusiastic findings that permeate the NCW literature. It is difficult to imagine how we might renovate the flawed analogy of the NCW thesis and still call what remains by the same name<sup>2</sup>.

In this paper we turn our attention to the second, more fundamental and even more important feature of the NCW thesis, and will do so from the perspective of a discipline that is seldom overtly considered in military theory: one that forms a bridge to an alternative theory of information age warfare. This perspective is provided by the discipline of *epistemology*, the branch of philosophy having to do with knowledge and the development of knowledge. That such a seemingly esoteric field of inquiry might have anything of significance to offer the hard-nosed and practical business of conducting war and battle may at first seem unlikely. Nonetheless, we submit that the key question of military theory has always been epistemological in nature, that the NCW thesis perpetuates a particular long-standing, dysfunctional philosophy regarding knowledge acquisition, and that real theoretical progress in military thought has thoroughgoing epistemological change as its basis.

We have a hierarchy of three objectives in this paper. First, we seek to alert the military profession and defence research community to the decisive importance of the epistemological aspects of military theory, for this is a fact that may have been largely overlooked or forgotten in contemporary debate to our collective disadvantage. Second, we seek to identify the particular ideological orientation of military epistemology. We will argue that military culture has long subscribed to a particular epistemological theory

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<sup>1</sup> Ralph E Giffin and Darryn J. Reid, A Woven web of Guesses, Canto One: Network Centric Warfare and the Myth of the New Economy, unpublished manuscript.

<sup>2</sup> This is a principle of importance in epistemology, requiring that major changes to the core substance of a theory be reflected by an obvious shift to a new theory. The old terminology should not be conveniently ascribed new meaning to avoid taking the decision to openly refute the old theory. Popper describes this as 'equivocation', while Chalmers calls it 'ad hoc modification'.

often called *naive inductivism*<sup>3</sup>, and that in this respect the NCW thesis is merely an extension of hundreds of years of tradition in contemporary military thought. Our final objective is to alert our readers to the fact that naive inductivism is a failed outlook. This is clearly bad news for conventional military thought. The elaborate edifice of established military wisdom, which has the NCW thesis as its most recent manifestation, stands or falls with naive inductivism, and naive inductivism has most definitely fallen. Our intentions are fundamentally constructive, for in the third and final paper in this series we will extend the epistemological argument and show how an alternative to naive inductivism, known as *critical rationalism*, can lead us out of the rubble that much contemporary military theory has arguably become.

### **The NCW Perfect Information Programme**

One of the surest ways of forming good combinations in war would be to order movements only after obtaining perfect information of the enemy's proceedings.... As it is unquestionably of the highest importance to gain this information, so it is a thing of utmost difficulty, not to say impossibility....

- Antoine Henri de Jomini  
The Art of War

For those who are at all familiar with the history of military thought, it will come as no surprise that the profession would view the advent of revolutionary progress in information and communication technology with great enthusiasm. Information, and especially its paucity and unreliability, has always been a central theme in military theory. Likewise communications, as the primary means of positive control, has traditionally been a significant limiting factor on the battlefield and a source of great frustration to field commanders. Indeed, the two together form the basis for the well-known Clausewitzian conception of fog and friction, and may even be said to have played the most influential role in force development, doctrine development and operational art throughout military history. Uncertainty resulting from the scarcity and unreliability of information combined with inflexibility resulting from limitations on the ability to exert positive control in real time has always been an inescapable reality that compelled military forces to favor mass and momentum. Large formations, robust equipment, automatic drills and relatively simple plans were the only realistic hedges against these two severe and insurmountable obstacles. Military force was a blunt axe: we picked our point of aim and swung with all our might. With luck and good judgment we hoped to hit the log, and not a boulder.

For the military profession, the information age appears to represent a change in this historical reality of the most fundamental kind. Advances in our ability to acquire,

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<sup>3</sup> Epistemological outlooks come in various broad schools, and these are subsequently subdivided according to their level of complexity and refinement. For example, naive inductivism is the simplest and most literal form of the school of inductivist thinking. The most straightforward version of knowledge development by conjecture and attempted refutation is sometimes called naive refutationism, and the outlook called critical rationalism that we will espouse is a particularly sophisticated form of refutationism.

digitize, transmit, store and manipulate information have been breathtaking. Compared to military forces of only a decade ago, the quantity of information theoretically available to all participants on the battlefield is orders of magnitude greater and growing, as is our technical ability to share that information. Information technology is a stiff wind that clears away the Clausewitzian fog, and grease to sooth Clausewitzian friction. Given revolutionary progress in both domains, the military consequences must be likewise revolutionary. Perhaps at long last we can transform the blunt axe of military force into a scalpel, and the brute force of military operations into delicate surgery.

This, more or less, is the basic claim of the NCW thesis. Throughout the literature, again and again, we encounter a consistent view of the nature and importance of information and communications in battle. Consider two passages from the early NCW publications. First, the following passage, by Dr David S Alberts *et al* in the landmark *Network Centric Warfare: Developing and Leveraging Information Superiority*, is typical of the attitudes at issue here and well worth citing at length:

Data are individual facts, measurements, or observations which may or may not be sufficient to make a particular decision. Information is obtained when elements of data are assembled, reconciled, fused, and placed in an operational context. Knowledge is derived from being able to use information to construct and use an explanatory model based upon an understanding of the situation or phenomenon. Such a model allows us to forecast future states, predict outcomes, and also contributes to our ability to control the situation – or to be proactive rather than reactive.<sup>4</sup>

Now consider a related passage, by Vice Admiral (ret'd) Arthur Cebrowski and John Gartska, in an early and widely read article on the NCW thesis:

Whether these [information-intensive] interactions are focused on commerce, education, or military operations, there is "value" that is derived from the content, quality, and timeliness of information moving between nodes on the network. This value increases as information moves toward 100% relevant content, 100% accuracy, and zero time delay--toward information superiority.<sup>5</sup>

Given the asserted nature of and relationship between data, information and knowledge throughout the NCW literature it is, once again, little wonder that the military profession would be excited by the prospects for military art in the information age. Ongoing advances in information and communication technology have resulted in a huge increase in the access to data of battlefield actors. We would thus expect a corresponding increase in the quantity and quality of their knowledge and, thus, in their ability to “forecast future states...” – the holy grail of military planning and an undoubtedly decisive advantage to the side with the most data.

But note that the NCW thesis posits more than just a revolutionary change in extent: it also posits a revolutionary change in nature. Networking enables information, the

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<sup>4</sup> David S. Alberts, John J. Gartska and Fredrick P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 2<sup>nd</sup> ed. revised. pp127-128

<sup>5</sup> Vice Admiral Arthur K Cebrowski and John J. Gartska, “Network-Centric Warfare: Its Origins and Future”, Naval Institute Proceedings, January 1998, p. 31.

progenitor of knowledge according to this view, to become ubiquitous. It no longer flows exclusively from top to bottom and from bottom to top, in sealed envelopes along the traditional lines of command. It may now, assuming a robustly networked force, flow sideways and in the open. If data is the fountain of knowledge, then *shared* data is the fountain of *shared* knowledge. For the proponents of the NCW thesis this suggests an attractive new possibility. It is called shared situational awareness and self-synchronization; namely, the capacity of otherwise disparate elements of a force to decide and act independently in an evolving environment, guided only by an understanding of the commander's intent and the processed facts of the Common Operating Picture (COP)<sup>6</sup>. Forces no longer need to suffer the delay of centralized positive control. Speed of command is a decisive advantage that hits its theoretical peak when a force commands itself.

With these assertions in the background, Alberts *et al* provide a succinct explanation of the NCW thesis in a series of four inter-related tenets of NCW<sup>7</sup>. These tenets are shown at figure 1. We should be clear to acknowledge that Alberts and his associates in no way claim that the NCW thesis is a completed work, and freely acknowledge that theirs is a research programme with much more distance to go; nonetheless, a picture of the implications of the thesis for force and doctrine development and for military art has coalesced in popular opinion. There is, it appears, precious little that is not set to change to some degree in the information age military force. The NCW thesis has led its proponents to favor a programme of significant information-enabled force transformation. The old preference for mass and momentum is no longer necessary. Hand in hand with the parallel development of the concept of effects-based operations (EBO), NCW proponents envision lighter, nimbler forces, exploiting the cognitive and operational benefits of a robust digital network, accelerating computational capability and pervasive information sharing to simultaneously mass the effects of dispersed platforms and thus to secure favorable outcomes with new-found prescience, precision and economy. And at the root of it all rests the purported inter-relationship between data, information and knowledge, and the capacity for reliable historical prophecy that they presumably deliver.

**Figure 1: The Tenets of NCW**

- 1. A robustly networked force improves information sharing.**
- 2. Information sharing and collaboration enhance the quality of information and shared situational awareness.**
- 3. Shared situational awareness enables self-synchronization.**
- 4. These, in turn, dramatically increase mission effectiveness.**

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<sup>6</sup> We include here more recent versions of the basic Common Operating Picture model, such as the Commonly Informed Operating Picture, which imposes dissimilar filters to provide information tailored to different needs. All of these models share the ideal of an underlying logical pool of totally consistent information.

<sup>7</sup> David S. Alberts, *Information Age Transformation: Getting to a 21<sup>st</sup> Century Military* (Washington, D.C., CCRP Publications, 2002), pp. 7-8.

We call the treatment of information in the NCW literature *the NCW perfect information programme*. Clearly the NCW thesis does not assert that perfect information is possible. Instead, perfect information is treated as a theoretical and pragmatically unattainable upper limit on a sliding scale: one that, thanks to information and communications technology, we may now approach by far more closely than has ever been even remotely possible in the history of warfare, with revolutionary implications for information age forces. It is the asserted positive correlation between the quality and quantity of data, information and knowledge on one hand, and success in battle on the other hand, that we seek to label as the perfect information programme. This is the essence of the NCW thesis: the phenomenon that allows its proponents to make their bold claim that the network is the axis and core of the information age force and to assert that its prospects are revolutionary in nature. As far as we are aware the perfect information programme, and its underlying view of knowledge, has never been challenged in military theory in a concerted and meaningful way. In addition, while the NCW community has acknowledged limitations in achieving shared awareness and a COP, and the concept has evolved, it is still held up as a preferred goal and its purported benefits have likewise never been subjected to sustained and successful criticism. It seems that the possibility that these two bold conceptions are in any way problematic is too unlikely to be conceivable for contemporary military culture. What a pity, for the defense community's nonchalance on these two key points is arguably a crisis in contemporary military thought that cries out to be addressed as a matter of utmost priority.

### **A Most Relevant Discipline**

Of course these truths must be rooted in experience. No theorist, and no commander, should bother himself with psychological and philosophical sophistries.

- Carl von Clausewitz  
*On War*

Insofar as its attitudes toward information and knowledge are concerned, there is nothing at all that is new in the NCW thesis. As we will discuss later in this paper, they are consistent with traditional attitudes that began to manifest themselves in military theory over two centuries ago, and that have exerted a largely uninterrupted and pervasive sway over military thought and doctrine ever since. Indeed, these attitudes as a whole even have a name, and originate in an identifiable ideological movement that dates back much farther still. They are, we submit, at once and together the great affliction of military theory and a robust start point for its recovery. But how is this so?

In our introduction we stated that our first and most important objective was to alert the military profession and the defence research community to the vital importance of the epistemological aspects of military theory. This point has already been made in large part, but given the stakes we will make it clearer. The word epistemology comes from the Greek words *episteme*, or 'knowledge' and *logos*, or 'explanation', and these together mean roughly "the explanation of knowledge". As one standard reference puts it, in other words, epistemology is "the study of the nature of knowledge and justification;

specifically, the study of (a) the defining features, (b) the substantive conditions, and (c) the limits of knowledge and justification.”<sup>8</sup> Along with the likes of logic, metaphysics and ethics, it is one of the core disciplines of western philosophy and interest in it traces its origins back to the earliest fragments of recorded abstract thought. The title of this series of papers, for example – *A Woven Web of Guesses* –, is a phrase from a passage by the pre-Socratic Greek philosopher named Xenophanes, and is epistemological commentary. Given the central role played by assertions concerning the inter-relationship between data, information and knowledge in the NCW thesis, any attempt to deny the relevance of epistemology would surely defy credulity<sup>9</sup>.

And note that it is not just the NCW thesis that possesses a heavy epistemological component: the entire body of military thought is imbued with it. This is so first and foremost as a matter of principle. Military thought as a whole is, after all, a quest for knowledge: precisely the focus of epistemology. Moreover, the substance of military thought is full to overflowing with claims concerning the nature of knowledge, methods for achieving knowledge as well as particular knowledge of various sorts. Our theory of principles of war is knowledge derived from historical experience. Our theory of the estimate of the situation and the operational planning process attempt to describe rational thought processes, making use of and resulting in knowledge. The concept of Intelligence Preparation of the Battlefield (IPB) asserts some relationship between observation and knowledge. The NCW thesis itself is just a recent nugget of *knowledge about knowledge* resident in military thought. The very aim of all of our theoretical and doctrinal efforts is *knowledge* about war and battle. We seek to generate and justify hypotheses. We use evidence, make arguments and seek proof or relative certainty. In the process we must adopt some vision of what constitutes effective hypotheses, relevant evidence, valid arguments and convincing or at least sufficient justification. Military thought by its very nature is an epistemological exercise, just as much as is any other intellectual undertaking. Given this, a blasé attitude toward the epistemological component of military theory would seem to constitute undeniable imprudence.

But epistemology is not relevant only as a matter of principle: it is relevant because its centrality in military theory was a deliberate and important, if albeit seemingly forgotten ideological choice by the pioneers of contemporary military thought themselves. As we are about to see, roughly 250 years ago military theory tied its cart to Prince Eugene’s mule, by choosing to accept as its fundamental basis the tenets of a particular epistemological theory ***that was already refuted when the choice was made***. This whole

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<sup>8</sup> Robert Audi, ed., *The Cambridge Dictionary of Philosophy*, (New York, Cambridge University Press, 1995), p. 233.

<sup>9</sup> While we will not address the matter here in any detail, one caution is in order. Alberts *et al* acknowledge what they call a cognitive domain of warfare. Unfortunately, insofar as theoretical work in this domain is concerned, cognitive psychology, and especially the naturalist movement of Gary Klein and others, rules the field as if it were sufficient. We contend that it is in no way sufficient. In short, cognitive psychology, like military theory, has a heavy and presently problematic epistemological component. Indeed, the naturalist school that seems to so impress many military theorists was at the outset a philosophical movement that arose in the context of an epistemological debate. Naturalism, and the exclusive focus on cognitive psychology for insights into the so-called “cognitive domain” of warfare are both issues that the authors intend to address in a subsequent paper.



process and its implications are the key to understanding the origins and problematic nature of military theory and its contemporary progeny. It is also the key to a revolution in military thought and is thus well worth contemplation.

### **Prince Eugene's Mule**

If a few prejudiced military men, after reading this book and carefully studying the detailed and correct history of the campaigns of the great masters of the art of war, still contend that it has neither principles nor rules, I can only pity them, and reply, in the famous words of Frederick, that "a mule which had made twenty campaigns under Prince Eugene would not be a better tactician than at the beginning."

- Antoine Henri de Jomini  
The Art of War

Roughly 250 years ago, in the middle of the 18<sup>th</sup> century, the military profession began to undergo a profound change in outlook that is widely recognized and acknowledged by military historians. This period, which culminated with the enduring works of Jomini and Clausewitz roughly 80 years later, is sometimes called the Military Enlightenment, and it was marked by a significant increase in interest in military theory as a worthwhile discipline, as measured in part by a dramatic increase in scholarly publication by military officers. While the theoreticians of this age and the implications of their work for subsequent military thought have been debated extensively by commentators ever since, we submit that its central nature has not been always fully appreciated. In our view the Military Enlightenment was first and foremost an epistemological revolution, and in this sense the NCW thesis is merely its echo. For all the seeming differences between the leading theoreticians of this period, it was epistemology in general that illuminated their work, and it was a particular epistemological theory that unified them. Over the ensuing years these two features remained pervasive and constant: epistemology remains the central question of military theory and the specific epistemological outlook adopted by the theoreticians of that age continues to dominate contemporary military thought even today. In other words, we submit that in the mid 1700s military theory took the first step down the path that leads us to the NCW thesis. Ultimately, we intend to argue that this first step was a misstep, for it engaged an epistemology that was discredited even then.

In order support this contention, though, we first need to explore a seemingly unrelated development that occurred a full century earlier<sup>10</sup>. The 1600s were an extraordinary period in human intellectual history, and we only suppose to provide the briefest account here. In short, our forebears entered the century under the diminishing influence of the Holy Roman Church, which had greatly constrained intellectual activity for a thousand years. Our view of the world, and man's place in it – at least in a Euro-centric sense –

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<sup>10</sup> We could trace the origins of the debate that we are about to describe much further back if we chose, to ancient Greek philosophy and in particular to Aristotle. But for purposes and in the interest of brevity, the 1600s will be a sufficient start point for this recounting.

was derived from the word of God, as revealed in the bible and interpreted by papal authority. But by the time the century was done, all of this had changed. We gained an unprecedented degree of intellectual freedom and experienced an impressive period of invention and discovery. In the process we created or recreated the major disciplines of the physical sciences and made tremendous progress in each, almost out of nothing. Under the influence of the crowning glory of this impressive age – Newton’s Laws – our very conception of the universe itself changed in a fundamental way. In place of our millennia-old superstitious, earth-centered cosmology, in which events unfolded in accordance with the mysterious will of an unseen God, we embraced the conception of a self-regulating universe, acting in accordance with autonomous physical laws that were discernable through the fruitful method of the resurgent sciences. And Newton’s Laws led the pack, seldom has an intellectual construct been so successful as this. It explained the universe so simply and so convincingly. It predicted its behavior so thoroughly and accurately. We found its confirmation everywhere we looked. It was a startling new and impressive kind of knowledge, given the long dark legacy of preceding European history: it was manmade and empirically true.

The impressive scientific progress that marked the 17<sup>th</sup> Century suggested an important new question to the philosophers of the age. That question was this: what precisely *was* the method by which science had been able to discover so much unprecedented, useful and certain knowledge, and how did it achieve this remarkable feat so quickly? Out of the ensuing debate, a philosopher named Sir Francis Bacon and a theory of scientific method that would eventually be called naive inductivism emerged apparently victorious. Inductivism starts with the assumption that the truth is manifest in nature, or in other words, that the truth is in the facts and will reveal itself under careful inspection by a sufficiently astute and bias-free observer. Accordingly, scientific knowledge grows by way of an objective, logical process of generalization from the individual facts of observation and experience. As one commentator put it, in words that should ring familiar to students of contemporary military theory:

According to the naive inductivist, then, the body of scientific knowledge is built by induction from the secure basis provided by observation. As the number of facts established by observation and experimentation grows, and as the facts become more refined and esoteric due to improvements in our observational and experimental skills, so more and more laws and theories of ever more generality and scope are constructed by careful inductive reasoning. The growth of science is continuous, ever onward and upward, as the fund of observational data is increased.<sup>11</sup>

And as he goes on to say, this process of generalization is only the first part of the quest of science, for the purpose of the proven laws is to provide a secure basis for explaining phenomena or predicting the future through a process of deduction from the laws and particular initial conditions in combination. In his own words, “It is scientific knowledge that enables an astronomer to predict when the next eclipse will occur or a physicist to explain why the boiling-point of water is lower than normal at high altitudes.”<sup>12</sup> We ask

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<sup>11</sup> A.F. Chalmers, *What Is This Thing Called Science: An Assessment of the Nature and Status of Science and its Methods*, (St Lucia, University of Queensland Press, 1978), p. 5.

<sup>12</sup> *Ibid*, p. 5.

the reader to bear in mind this alleged pattern of knowledge development as we proceed: ***objective observation, inductive generalization, empirical justification and deductive prediction.***

So, learned men emerged from the 17<sup>th</sup> century convinced that Newton's Laws and the conception of the universe that they invoked were true beyond serious question. And they emerged, with some seemingly minor exceptions, convinced that inductivism described the process by which these insights had been derived and proven. What happened next should come as no surprise. As one historian put it, speaking of broad intellectual attitudes in the 18<sup>th</sup> and 19<sup>th</sup> centuries, "The word 'law' came down trailing clouds of glory from Galileo and Newton.... Students of society, consciously or unconsciously desiring to assert the scientific status of their studies adopted the same language and believed themselves to be following the same procedure."<sup>13</sup> To be crass, in other words, pretty soon everybody was 'doing

**Figure 2: The Tenets of Naïve Inductivism**

- 1. Objective observation of the facts regarding a phenomenon under investigation.**
- 2. Inductive generalization to produce a universal theory of the phenomenon.**
- 3. Continued empirical justification of the theory, whereby it eventually attains the status of a law.**
- 4. Deductive prediction of future events.**

inductivism', not just in the so-called physical sciences, but increasingly in non-physical domains as the new social sciences emerged and thrived. And it is little to be wondered that inductivism would come to exert such sway, for not only did it gain considerable legitimacy from its loose association with Newton's successful cosmology, but it also reduced scientific practice to a neat and tidy package of orderly procedures. As another commentator put it:

This is a very seductive theory of science. It seems to be a hardheaded, straightforward and empirically based view. Scientists are seen as steadily piling up facts, generalizing them into laws, and piling up more facts, step by step in the laboratory. If you can infer the laws from the accumulated facts, you can deduce the facts again from the laws, and the content of the laws is nothing but the facts.<sup>14</sup>

This is invention by numbers: everything arranged in good order, lined up in rank and file, secure and reliable.

We intend, as a separate project, to undertake a more comprehensive exploration of the Military Enlightenment and its aftermath from the perspective outlined here, but in the interests of brevity in this paper we must cut the present discussion short. The hallmarks of military inductivism rest perhaps most self-evidently in the incessant debate, especially in early military theory, concerning whether and to what extent war is art or science. They are likewise obvious in the earliest discussions of planning and decision-making,

<sup>13</sup> Edward Hallet Carr, *What is History?* (London: MacMillan and Company, 1962), pp 51-52

<sup>14</sup> R. Harré, *The Philosophies of Science: An Introductory Survey*, (New York, Oxford University Press, 1986), pp. 42-43.

from at least the time of Jomini and Clausewitz onward. According to the consensus that emerged from this early debate, as those familiar with the literature will grant, war is treated as a mixture of art and science. According to this view that remains dominant still, the methods of science – that is, the inductivist methods of science – were indispensable to an understanding of warfare and to the functions of planning and decision-making in war and battle, with the facts of history and the facts of the situation at hand, respectively, providing the start-point for our deliberations and with empirical justification and prediction as their ultimate goal. But warfare, in the eyes of early theorists, could never attain the precision of Newtonian physics because there was always too much uncertainty and imprecision adversely affecting the facts. Moral factors interposed themselves. Unlike the stuff of nature that was the focus of the physical sciences, the enemy possessed free will and the capacity to diverge from his anticipated course. Thus, warfare was also art. Intangibles muddied the water. Military science and its inductivist methods, if effectively mastered, could allow a normal man to become a passing good General of average worth, but to cut through the fog of war with consistent success required the *coup-d'oeil* of a genius: precisely inductivism's special state of mind and the genesis of the military cult of the commander that we will address briefly in our next paper.

We find the paw prints of inductivism throughout the body of abstract and practical military thought and doctrine from the Military Enlightenment on. To begin, the moral of Prince Eugene's mule, cited at the outset of this section, is but one example of Jomini's commentary on this important question, and was intended as a sharp rebuke to those who denied the value of inductivist science in the domain of war and battle. And he follows it up with the eventual consensus:

Correct theories, founded upon right principles, sustained by actual events of wars, and added to accurate military history, will form a true school of instruction for generals. If these do not produce great men, they will at least produce generals of sufficient skill to take rank next after the natural masters of the art of war.<sup>15</sup>

And we see the same essential outlook in Clausewitz, notwithstanding a well-documented tension between conflicting ideas in his work, and the hint of an appreciation for the same critical methodology that we will later espouse in opposition to inductivism. He places a high importance on good military history, precisely because, in his own words "Historical examples clarify everything and also provide the best kind of proof in the empirical sciences"<sup>16</sup>. And in an early preface to his then unpublished manuscript he says of his own work that:

Its scientific character consists in an attempt to investigate the essence of the phenomena of war and to indicate the links between these phenomena and the nature of their component parts. No logical conclusion has been avoided; but whenever the thread became too thin I have preferred to break it off and go back to the relevant phenomena of experience.... Analysis and observation, theory and experience must never disdain or exclude each other; on the contrary, they support each other. The propositions of this

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<sup>15</sup> Baron Antoine Henri de Jomini, *The Art of War*, (Guildford, Surrey, Greenhill Books, 1992), p. 325.

<sup>16</sup> Michael Howard and Peter Paret, ed. Carl von Clausewitz, *On War* (Princeton, Princeton University Press, 1989), p. 170.

book therefore, like short spans of an arch, base their axioms on the secure foundation either of experience or the nature of war as such, and are thus adequately buttressed.<sup>17</sup>

But the very best and most obvious illustration of the inductivist bias in early military theory is found in the influential work of J.F.C. Fuller. Fuller is not perhaps as well known as Jomini and Clausewitz, but his influence over contemporary military theory is arguably even more direct and demonstrable. Writing early in the 20<sup>th</sup> century it was he, for example, who produced the list of nine Principles of War that are verbatim those in the current doctrine of most modern English-speaking armies. Moreover, he provided a description of practical problem solving and decision-making that appears to be the genesis of our current conception of the Estimate of the Situation and the operational planning process. It also bears mentioning that his early work on the implications and effective employment of the then newly invented tank, are considered by many to have been visionary. In his *The Foundations of the Science of War* Fuller opens with a primer on scientific method that might have been written by Bacon himself: indeed, he refers specifically to Bacon as one of the authorities on the subject. Recalling Figure 2 our earlier summary of inductivist method – objective observation, inductive generalization, empirical justification and deductive prediction – Fuller quotes a maxim by Comte, claiming in the process that it “compressed the essentials of all logic”:

*“Induire pour deduire afin de construire.”*

In other words, in order to construct rationally we must first work inductively and then deductively.<sup>18</sup>

And consider two more passages from the text, which we submit to summarize nicely the state of epistemological and methodological attitudes in contemporary military culture:

In brief, by means of the inductive method we attain to science by collecting facts, by sorting these into categories, by extracting their values, and on these values erecting theories. By putting these theories to universal tests, by degrees we extract laws which form our working principles, our weights and measures of war.<sup>19</sup>

It seems that to the list of Fuller’s accolades, we may add credit for inventing the modern *fusion center*.

And consider this passage:

In brief, the method of science is based on analysis, synthesis, and hypothesis, the one necessarily involving the other. We first observe; next we build up a hypothesis on the facts of our observation; then we deduce the consequences of our hypothesis and test these consequences by an analysis of phenomena; lastly we verify our results, and if no exception can be found to them we call them a law.<sup>20</sup>

We submit that these passages speak volumes alone, and require no further elaboration.

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<sup>17</sup> Ibid, p. 61.

<sup>18</sup> J.F.C. Fuller, *The Foundations of the Science of War*, (London, Hutchinson & Co., 1926), p. 43.

<sup>19</sup> Ibid, p. 43.

<sup>20</sup> Ibid, p. 47.

We have taken this circuitous route to place the NCW thesis in what we maintain to be its most important context. There is a *reason* why the military profession sees the advent of the information age and revolutionary progress in information technology as a thing of great import and promise. There is likewise a *reason* for the particular substance of emerging information age military thought and doctrine. That reason finds its origins in attitudes and outlooks that are as old as military thought itself, resident in the earliest glimmering of the Military Enlightenment, and dating to a philosophical tradition that is much older still. When the profession trumpets the revolutionary consequences of a technology enabled approach to 100% relevant and accurate real time information, and when it describes a *cognitive hierarchy* in which data is the fount of knowledge and the key to accurate battlefield prediction, it is merely being consistent with its own conventional wisdom. The NCW thesis and its four tenets only make sense if we grant inductivist methodology and the view of science as a process of objective observation, inductive generalization, empirical justification and deductive prediction. The two stand or fall together. And they have definitely fallen.

### **A Poverty of Method**

This may be considered to be harsh criticism, but it is not intended to be solely destructive, for I have attempted to replace the system of 1914 by what I believe to be a better system, and I hope that twelve years hence my system will be as heavily attacked as I have attacked the one I suffered under; because it will show that progress has been made and the faults in my system have been discovered.

- J.F.C. Fuller  
*The Foundations of the Science of War*

The tragedy for military epistemology is that inductivism was effectively refuted even before, or perhaps just as the pioneers of military theory embraced it in the early days of the Military Enlightenment. But we suggest that these early theorists should be forgiven their choice, for inductivism was the fashion of their day. Moreover, while it had been refuted no better explanation of scientific methodology had yet been articulated. Finally, the legitimizing influence of Newton's Laws was still very much in play. Whatever may have been the esoteric objections of a few argumentative philosophers, inductivism was still the purported basis for this enormously successful construct, and this must have seemed a great vote of confidence to everyone involved.

Perhaps we ought to be less inclined to charity insofar as contemporary theorists are concerned. The 20th century saw enormously important developments in the disciplines of epistemology and scientific methodology. Indeed, it is not an exaggeration to call it the central debate of the age, as close to front-page news as philosophy can become. It arguably began early in the century, when the legitimizing force of Newton's physics dissipated under the influence of the Theory of Relativity and Quantum Mechanics. The poster child of inductivism turned out to be considerably less than indubitable truth and found itself relegated to the considerably diminished status of mere useful approximation. Moreover, cosmology and particle physics found themselves in a quandary: Relativity

and Quantum Mechanics were better than Newtonian physics by all appearances, and yet they were either wrong or incomplete<sup>21</sup>. The whole development simply did not square with the orderly fact-based theory of inductivist science, and philosophy embraced this new problem with vigor. That contemporary military culture and its allies in military research science failed to notice this loud debate and its vital significance to the discipline of military art and science is an extraordinary indictment.

So what happened to naive inductivism? In this closing section we will briefly describe the refutation of inductivism attributable to a 20<sup>th</sup> century philosopher of considerable influence named Sir Karl Popper<sup>22</sup>. We choose Popper's perspective for a purpose. In addition to compiling a thorough refutation of inductivism, Popper provided an alternative theory of scientific method called critical rationalism that we consider to be the best of all available choices as a replacement for naive inductivism. In the final paper of this series we will explore the substantial implications of critical rationalism for military theory in the information age, and a few of its many counter-intuitive findings.

Popper leveled a compelling criticism at each of the four tenets of naive inductivism. Insofar as the first step in this orderly procedure is concerned – objective observation – his case had two main components. First, he argued that objective observation is neither possible nor, for that matter, even advisable. It was impossible because the quantity of facts that presented themselves for inspection in any realistic situation simply defied being addressed without some basis for selection. It was inadvisable because all that we get in exchange is a vast and incoherent jumble of unconnected facts. One of the authors has illustrated this point in an earlier paper with reference to chaos theory, and its concept of super sensitivity to initial conditions. We know, to paraphrase a common illustration in the literature, that a butterfly flapping its wings over Melbourne may affect the weather as we cross the line of departure in Kuwait. Should our objective observation of the relevant facts include rapt attention to the goings on of all of the world's insects? Clearly some selective basis for observation is required before the fact of observing: a requirement that contradicts the inductivist method by definition.

His second response to the concept of objective observation is one that is extremely relevant to the NCW thesis, and even, albeit improperly, creates a controversy for his own theory that we will address in our later paper. When we think about it carefully, we realize that bald facts *per se* are extremely elusive. More typically, it is not the facts that present themselves to us, but reports of facts, through intermediating parties and vehicles. Military commanders are well familiar with this phenomenon. These facts have been selected, interpreted, placed in order and embellished by others. They are not the truth-bearing stuff of direct reality. Far from being *theory inert*, as asserted in naive inductivism and implied in the inductivist assumption that the truth is manifest in nature, they are *theory impregnated* when they come to us, and this is likewise so, as it turns out,

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<sup>21</sup> The word 'incomplete' has a particular mathematical meaning, which we will explore more fully in Canto Three. Professor Stephen Hawking has recently ascribed exactly this precise meaning to these particular physical theories, among others, in recent lectures examining modern physics in light of the lessons of Gödel's incompleteness theorems.

<sup>22</sup> In lieu of a bibliography, cite three key references by Popper.

for at least many of the facts that we observe for ourselves<sup>23</sup>. If facts are theory-laden, how can we say that they give access to the truth, and how can we say that the process in which we are engaged is *objective* observation?

The second tenet of inductivism – the concept of inductive generalization – is probably its most decisive failure. Indeed, it is this aspect of inductivism that was refuted even before the method was fully embraced in military theory. Insofar as this assertion is concerned, Popper accepted as definitive the critique provided by a philosopher named David Hume, in the middle of the 18<sup>th</sup> century. The whole essence of inductivism is a purportedly rational process whereby we may generalize from individual facts to larger hypotheses, theories and laws. In other words, inductivism asserts that there is a logical process for making more out of the facts than just the facts. Consider a simple example. According to inductivism there is a point at which, having observed a large number of swans all of which were white, we can legitimately conclude that *all* swans are white. Note that this inference – that all swans are white – goes beyond the set of swans that we observed, to assert something about swans that we have not yet observed. It is in this sense that inductive generalization makes more out of the facts than just the facts. But Hume showed that we are never rationally justified in making more out of the facts than just the facts. All such inferences necessarily entail that we assume the continuity of nature: that in all the relevant respects affecting the color of swans, the future will be like the past. But this assumption can have no other justification than experience and thus leads to an infinite regress. The continuity assumption is not deductively valid, a fact that logically speaking imperils all generalizations and lends a depressing degree of risk to its use on the battlefield, as military professionals should well know. In the language of the discipline, in order for inductivism to be taken seriously as a logical method, there must be some synthetic principle of induction. Millennia after Aristotle first broached the subject, and centuries after Bacon rekindled our interest in it, the inductivists have still been unable to provide any such principle.

It should now be clear that the final two tenets of inductivism – the quest for empirical justification and the quest to use laws as a basis for reliable prediction – are both in deep jeopardy. We have no access to truth bearing facts, and no mechanism for making any more out of them than what they are. Inductivism cannot deliver the hypotheses, theories and laws – the so-called universal statements – that these two quests demand in the first place. But even if it could, there are compelling grounds to reject these tenets. For example, it might be tempting to assert, insofar as empirical justification is concerned, that while we cannot achieve empirical proof of our theories, we can still achieve a degree of objective probability: some partial measure of their certainty. But leaving aside Hume's critique of the continuity assumption that this approach invokes, we still have a mathematical inconvenience to deal with. Insofar as a universal statement is concerned, it is by definition held to apply forever: the number of future applications is theoretically infinite. Under these conditions, no quantity of observations will budge the value of its probability off of zero. And as to prediction, once again we must make the unjustifiable assumption of a continuity of nature each and every time we attempt it. It is ironic that

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<sup>23</sup> Alan Chalmers provides a particularly readable account of this difficulty in collecting facts in his book *What is this thing called science?* .



inductivist futurology, which seems to so impress many in the military profession, must begin with the curious assumption that the future will be like the past.

We have not done Popper's contribution to epistemology and the philosophy of science credit. He produced a rich and influential body of literature that is immensely accessible and deeply relevant to military art and science. We likewise regret that the limitations on this paper preclude a general investigation of the implications of his critique of inductivism for military theory as a whole, although the consequences for military conceptions of historical analysis, decision-making doctrine, intelligence preparation and strategic planning strike us as largely self-evident. We intend to address these issues at a later date and in a less restrictive forum. For now let us turn our attention to the NCW thesis, and ask what consequences ensue.

As to the four tenets of the NCW thesis, articulated by the NCW proponents and described earlier in this paper, we offer the following:

- ***“A robustly networked force improves information sharing.”*** We criticized this assertion in our first paper, on the grounds that sophisticated economics relating to network effects indicates the existence of a theoretical upper limit beyond which participation and traffic on a network may actually reduce a network's utility as a means of information sharing. It can similarly be criticized on epistemological grounds. Implicit in the inductivist view of science is a picture of the growth of human knowledge as a passive exercise in information processing. What else could be inferred from a theory of knowledge that asserts its origins to be in objective observation and automatic generalization? If this were indeed the process by which human knowledge grew, then perhaps access to a robust network would improve information sharing. But alas this is not the case. It is not the network, or its robustness, that determines the quality of information sharing. What matters is the nature of our thought processes, our attitudes toward the information we may theoretically have access to, the situation we are in and our requirements for information. Let us cite a counter example: where one specific data element is sufficient for our purposes, access to a terabyte of data that we do not need constitutes no meaningful *improvement*.
- ***“Information sharing and collaboration enhance the quality of information and shared situational awareness.”*** By “quality of information”, this tenet must mean to imply something like, “truthful and complete information”. By “quality... of shared situational awareness”, it must mean to imply something like, “a true, complete and accurate understanding of the situation held in common by more than one observer.” If inductivism is the methodological means by which these states are supposed to be achieved, then this tenet is insupportable, for inductivism fails to provide such a means. In addition to arguments already presented, it is worth noting that inductive inferences are not *necessary* inferences in the logical sense; in other words, it is logically possible to draw differing conclusions from the same body of observed facts. Thus it is perfectly reasonable for different observers to draw different conclusions from observation of the same body of facts, and nothing in inductive logic can prevent this outcome or justify this tenet. At best, then, this tenet is problematic. It must be incumbent upon its

- supporters to describe the precise method by which the implied certainty, completeness and commonality is achieved. Until they do so, the assertion surely cannot be granted. Note that this point is not mere sophistry. We submit that this tenet is dangerous in a common sense way. We may share information and collaborate all we like. We may come to a perfectly harmonious agreement in all respects. And we can still be dead wrong. History is full of examples of this phenomenon: and the set of failed military plans includes more than a few instances. Consensus and truth are not synonymous.
- ***“Shared situational awareness enables self-synchronization.”*** We submit that shared situational awareness is neither a sufficient nor necessary condition for the behaviour described as self-synchronization, and will explore the epistemological and methodological basis for this position in more detail in our third paper. We contend to the contrary that two actors with a perfectly harmonious understanding of the situation could still conceivably act at cross-purposes due, for example, to different personal interests and intentions. Conversely, two actors may disagree dramatically concerning the nature of a situation, but still work together without being compelled to do so by higher authority due to open-mindedness or shared intent. Once again this objection is not merely esoteric philosophizing on our part. We will argue in Canto Three that shared situational awareness is neither achievable nor advisable on the battlefield, and that the insistence on shared situational awareness and even on common intent is a symptom of the NCW thesis that is actually dysfunctional. It is not compelling homogeneity, but managing the inevitable and actually beneficial diversity intrinsic to the battlefield, that constitutes the more fundamental and important challenge of command.
  - ***“These, in turn, dramatically increase mission effectiveness.”*** We are in complete agreement with proponents of the NCW thesis that recent progress in the domains of information and communication technology has dramatically improved and will continue to improve military capability. We also agree that this progress creates a compelling case for organizational, materiel, doctrinal and behavioural change. But for the reasons presented, we cannot accept that the three preceding tenets justify this final assertion.

We submit that the NCW thesis is unsatisfactory at an epistemological and methodological level, and we repeat a concern that we admitted in our introduction, in the context of our reference to the failed business analogy: it is difficult to imagine how we might extract the flawed epistemology from the NCW thesis and still call what remains by the same name. We acknowledge our own limitations, and the possibility that our analysis is itself deeply flawed, and we invite the same kind of rigorous criticism that we have tried to offer. But we will not retreat from our basic position that a thoroughgoing epistemological debate is long overdue in military theory.

## **Conclusion**

Over the course of two papers we have attempted to show that the NCW thesis may be susceptible to robust criticism on two particular grounds: its status as a problematic

business analogy and its status as the manifestation of a problematic theory of knowledge. In our first paper we showed that the business analogy was potentially flawed in two broad ways. First, the particular business and economic outlook from which it chose to draw its inferences – New Economy theory – had fallen into discredit in highly relevant ways. Second, even to the extent that these underlying concepts were credible, there were grounds to conclude that NCW proponents had made errors of omission and commission in the execution of the analogy. In our second paper, we have sought to show that there is a seemingly unacknowledged and equally problematic epistemological component to the NCW thesis: the unfortunate influence of a discredited and isolated theory known as naive inductivism. It must be left to others to judge whether our arguments have succeeded in either case, and we welcome rebuttal.

But if the NCW thesis cannot serve the purposes of military theory in the information age, then how are we to proceed? We submit that once again it is the field of epistemology and methodology that holds the solution. This at any rate is the conjecture that we will now set out to explore.