SUPERSTITIOUS RITUALS

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Naive Inductivism in Command and Control Doctrine:
Its Causes, Consequences and Cures

Track:
C2 Decision Making and Cognitive Analysis

Author:
Lieutenant Colonel R.E. Giffin
Director Information Management Strategic Planning 5
Information Management Concepts and Doctrine Development
Canadian Armed Forces

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Lieutenant Colonel R.E. Giffin

Director Information Management Strategic Planning 5
National Defence Headquarters
101 Colonel By Avenue
Ottawa, ON
K1A 0K2
giffin.re@forces.ca

Abstract

Contemporary military thought and the loose body of ideas associated with the Revolution in Military Affairs (RMA) operate under the influence of a discredited theory of scientific method called inductivism. Its largely unconscious inductivist predisposition has led the military profession to misunderstand rationality and thus to err substantially in such areas as the design and execution of planning processes and the exploitation of information technology. The Estimate and the Operational Planning Process, and such concepts as the Cognitive Hierarchy, Knowledge Management and the Common Operating Picture, to name a few, are thus susceptible to a refutation of inductivism. This paper describes inductivism and shows how it manifests itself in command and control doctrine and the RMA thesis. With heavy reliance on the work of the late Sir Karl Popper, it then describes a refutation of inductivism that applies equally to this body of ideas. Finally, this paper describes Popper's alternative model, critical rationalism, and some of its implications for doctrine and practice. In particular, it describes an experiment currently in definition that will investigate the consequences of adopting an Operational Planning Process designed in accordance with Popper's insights. As it turns out, the prerequisite to a revolution in military affairs is a revolution in military thought.

A METAPHOR….

It is like a superstitious ritual carried out by a primitive tribe deep in an isolated jungle at the foot of a dormant volcano.

The conference room dims like a setting sun; the slideshow comes on like a bonfire. The adult males assemble, arriving according to rank and sitting according to status. The soothsayer enters last, delayed by a secret consultation with entrails in some hidden smoke-filled pavilion. He takes his seat at the head of the circle. The nervous chatter subsides out of deference. Eyes turn to the fire. There is silence.

Then the chanting begins, in the form of a round. It is a quiet staccato monotone at first, with eyes dulled and heads bowed, but it grows into a frenzy as the night goes on, "observe, orient, decide, act... observe, orient, decide, act... observe, orient, decide, act" over and over and over again. To this chorus the soothsayer adds a personal incantation, chanted in a louder, shriller counterpoint, "data, information, knowledge, wisdom... data, information, knowledge, wisdom... data, information, knowledge, wisdom...." on and on and on. And as the night passes, and the chanting builds to a climax, here and there one of the assembled lapses into reverie, eyes wild, mouth frothing, arms flailing, body shaking "data fusion, knowledge workers, cognitive systems..." until he falls, exhausted, back into his seat.

As the dawn approaches and the stars grow dim the chanting subsides. The bonfire burns low and the sun rises. The tribe emerges from its trance. Drained but confidant that its obligations have been fulfilled, it dissolves in its family groups back into the jungle.

The gods are placated for another day.

The volcano will be silent.

There will be good hunting....

INTRODUCTION

Thanks in no small measure to the efforts of research scientists working in the domain of military command and control we have been making breathtaking progress in the field of information technology. The military community has greeted this rush of technological innovation with much enthusiasm. The consensus is that our rapidly evolving technology is driving a Revolution in Military Affairs (RMA): not merely improving our ability to wage war but fundamentally changing the nature of the art. Accordingly, we are witnessing a flurry of academic and doctrinal writing and the emergence of a new lexicon as my profession struggles with the implications. Phrases like data fusion, the Cognitive Hierarchy and Knowledge-based Forces have taken over the literature. But I submit that the military profession is failing at its task. It is badly misstating its case and thus failing to exploit the full potential of the powerful tools that research science is delivering.

My position is bound to be controversial with a military audience. I will present a case against the RMA thesis and such related tenets of existing and emerging command and control doctrine as the Operational Planning Process, the Cognitive Hierarchy, the OODA Loop, Knowledge Management, the Common Operating Picture, Effects-based Operations and the like. Given the enormous popularity of the RMA thesis and its trappings, I risk an incredulous reception. Moreover, the means that I will use to make this case may prove just as controversial. The military profession appears not to have recognized that the RMA thesis operates first and foremost in the domain of critical philosophy: a field of inquiry that many of them dislike and distrust. We thus have no alternative but to consider the matter at hand from a perspective that most military professionals would prefer to avoid. Ironically, though, this is so at their unconscious bidding. As I hinted with my opening metaphor, the RMA thesis is the deeply flawed manifestation of their primitive faith in the superstitious rituals of a discredited philosophic theory. Likewise, the only way out of the difficulty that their philosophy

leads them into rests with an alternative philosophic theory of decidedly superior grounding. As it turns out, the prerequisite to a revolution in military affairs is a revolution in military thought.

I will begin this paper by describing the philosophic theory at issue and by showing how it worked its way into military thought in general and the RMA thesis in particular. This theory is called inductivism, a model of scientific methodology that has long formed the lens through which my profession views rationality and, hence, the world around it. Next, with a profound debt to the work of the late Sir Karl Popper, I will describe a refutation of inductivism that likewise applies to its sundry specialized military manifestations. Finally, I will describe an alternative methodological basis for exploring and conducting information age warfare. This alternative is critical rationalism and is due once again to Popper. Critical rationalism clarifies and demystifies the phenomena that the inductivist RMA thesis has so deeply muddled. In the process it will improve the quality and speed of decisions and action, sharpen our capacity to learn, save commanders and staffs from drowning in data and reduce our demand for bandwidth.

These are goals worth seeking, whatever it takes to get there.

THE INTELLECTUAL ORIGINS OF A BAD IDEA

What is inductivism, where did it come from and how did it work its way into military command and control doctrine? Inductivism traces its origins to the dawn of the 17th century and an important turning point for western civilization. Oversimplifying greatly, we approached that century without science in its contemporary form and with critical philosophy under the control of a domineering Holy Roman Church. But in short order, thanks largely to the likes of Galileo, Kepler, Boyle and Newton, all of that changed. We regained the freedom to think for ourselves and we invented or re-invented most of the disciplines of modern science. In the process we abandoned our superstitious earth-centred worldview, in favour of a view of the universe as the consequence of autonomous and discernible physical laws.

All of this impressive scientific progress begged an important question for the philosophers of the age: what was the process by which science had figured out so much seeming *truth*, so fast? It was Sir Francis Bacon and inductivism that won the ensuing debate. Let's take a look at Bacon's contribution to western intellectual development.

The hallmarks of inductivism are three closely related tenets. The first of these is its contention that "the truth is manifest in nature" or, in other words, that the truth is in the facts and that it will reveal itself to those who view the facts objectively. The second tenet is the contention that there is a logical process of probable inference and in particular that we can infer causes from effects. In other words, inductivists believe that there is a principle of reasoning called *induction* that allows us to make more out of the facts than just the facts. The third tenet is the characterization of science as an achievable quest for true and certain knowledge, with "knowledge" defined as "justified true belief". The vehicle for the justification of our beliefs is the theory of probability, with the claim

being that at some point near the upper limits of probability we can establish truth. Putting this all together then, an inductivist would claim that Newton's Laws were logically inferred from the objective observation of physical phenomena: the behaviour of the planets in the night sky or of steel balls rolling down an incline, for instance. Moreover, he would claim that the repeated success of Newton's Laws at predicting physical phenomena constituted evidence of its truthfulness, as expressed by the theory of probability.

Viewed as a process, then, inductivism depicts science as a four-part method, to be applied in strict order: objective observation, synthesis, justification and proof. The growth of scientific knowledge starts, so the theory goes, with a mental state commonly known as objectivity. Only in such a state can we see the facts before us as they truly are. Next, we observe the facts of nature, seeking inter-relationships and dependencies. Our analysis enables synthesis: the articulation of hypotheses. These hypotheses are then subjected to further observation and experimentation, wherein both refutation and confirmation are possible. Where we encounter only confirmation we are entitled to elevate our hypotheses progressively to the status of theories and ultimately of laws, in accordance with the objective mathematics of probability. So that, in brief, is inductivism, but how did it work its way into military thought?

Notwithstanding some important philosophic reservations to which we will return in the next section, inductivism emerged from the 17th Century as the popular depiction of scientific method. Accordingly, it wasn't long before it began to exert a profound influence over western intellectual development. As the historian Edward Carr put it:

> Throughout the eighteenth and nineteenth centuries, scientists assumed that laws of nature – Newton's laws of motion, the law of gravitation, Boyle's law, the law of evolution, and so forth – had been discovered and definitely established, and that the business of the scientist was to discover and establish more such laws by process of induction from observed facts. 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.[1]

In other words, before long everybody was 'doing induction': objectively gathering and analysing facts and synthesising them into irrefutable laws. In the gardens of the burgeoning Arts and Science faculties inductivism soon proved to be a powerful fertilizer. The emergence of the so-called social sciences that hit full stride in the 19th century was due in large measure simply to the extension of inductivist methodology into non-traditional domains, with Hegel, Marx, Comte and Freud in the vanguard. A flood of diverse and often mutually exclusive new theories and laws soon overwhelmed us. We discovered laws of political development, laws of economic development, laws of class development, laws of social development and laws of psychological development. And for the longest while no one seemed to notice or care how a single purportedly logical method added to a single body of purportedly objective historical fact could add up to such a discordant din of incompatible and irreconcilable "justified true belief".

[1] Edward Hallet Carr, *What is History?* (London: MacMillan and Company, 1962), pp 51-52.

It is vital to recognize that contemporary military thought originates at precisely this same time and in precisely this same tradition. Its founders, beginning at the time of Napoleon and including the likes of Jomini and Clausewitz, had as their explicit goal improving our knowledge of war and battle by bringing to bear the method of science. Moreover, the method of science they took for granted to be true was that of inductivism, just as so many others were doing in the other social disciplines. Nor has our chosen method changed to this day.

To make the linkage between inductivism and contemporary military thought clear, let's take a quick tour through some of the key elements of command and control doctrine. First, consider some of the longer standing elements of that doctrine:

- We should start with the Theory of Principles of War, the elder statesman of contemporary military thought. The likes of Jomini, Clausewitz and Fuller may have had different lists of principles, but they were in perfect agreement insofar as method was concerned. The Principles of War are held up as "justified true belief" concerning the timeless secrets to success in war and battle. The purported code breaker, moreover, is probable inference from the objective facts of military experience. This is inductivist history at every step of the way.
- Our theory of the Estimate of the Situation is perhaps the most expressly inductivist element of military doctrine. The estimate is the problem-solving process that we teach our tactical leaders. It begins with an objective analysis of the facts relevant to the attainment of the aim. During this analysis, we are called upon to make "deductions" from the facts[2] and promised that in the process of making these deductions courses of action will emerge: probable inference by definition. Once the analysis is complete and a number of courses have been inferred, they are compared and their respective advantages and disadvantages are considered. On the basis of this comparison, the best course is identified and selected; in other words, we develop an empirically justified true belief. This procedure is quite literally inductivist.
- The basic pattern of problem solving embodied in the Estimate also animates our Operational Planning Process: the problem solving method that is used for collective work. The inductivist nature of the process is revealed in its call for courses of action to be inferred through a distributed process of analysis conducted by the various staff branches. The method that the staff specialists are to use is again that of the inductivist estimate.

And what of the RMA thesis? To begin, the very notion that information technology would create a revolution in military affairs suggests an inductivist perspective. Why is this? The inductivist implication is that since the facts are the font of knowledge and since information technology is delivering a billion-fold improvement in the quantity,

[2] For the record, the notion that we can make "deductions" from facts is a common mistake that is often addressed early in introductory logic texts. A deduction is a necessary inference of a lower order of universality than its premises, but our doctrine means by its use of the word precisely the opposite outcome; namely an inference that is broader than the particular facts that it is drawn from. At least our doctrine should get its basic vocabulary right: the intended operation is actually "probable inference". In my experience this straightforward misuse of a basic concept in logic leads the casual military officer to think that the estimate is a deductive process. It is no such thing.

quality and timeliness of the facts, then we should expect a corresponding increase in the quantity, quality and timeliness of our knowledge. How revolutionary that would be!

To make the association between the RMA thesis and inductivism clearer consider the now fashionable construct known as the Cognitive Hierarchy and the concept of Knowledge Management that often appears in conjunction with it. This construct has been cropping up in a number of command and control-related contexts in military organizations in recent years. The depiction of the hierarchy at Figure 1, for instance, appears in the Canadian Forces' (CF) Information Management Strategy document[3]. The depiction at Figure 2 appears in a recently circulated and well-received draft paper that is set to form a chapter of the CF White Paper on Knowledge Management and was also circulated in support of its Joint Information and Intelligence Fusion Capability project[4]. These graphics send a clear inductivist message: understanding and knowledge grow out of information and data. If more evidence is needed that inductivism is the implicit method of the Cognitive Hierarchy and Knowledge Management, then consider the words of the author of the draft document in which Figure 2 appears: "The transformation and aggregation of data into information, knowledge, and understanding is the essence of knowledge management."[5] With these words he is expressing an inductivist sentiment that resonates well with his sympathetic audience.

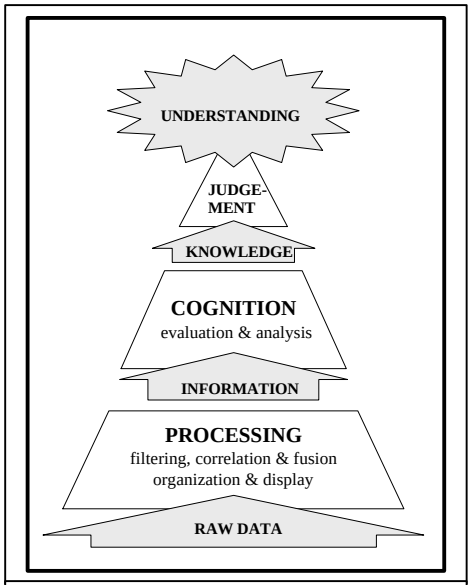

Figure 1: The Cognitive Hierarchy: From the CF IM Strategy

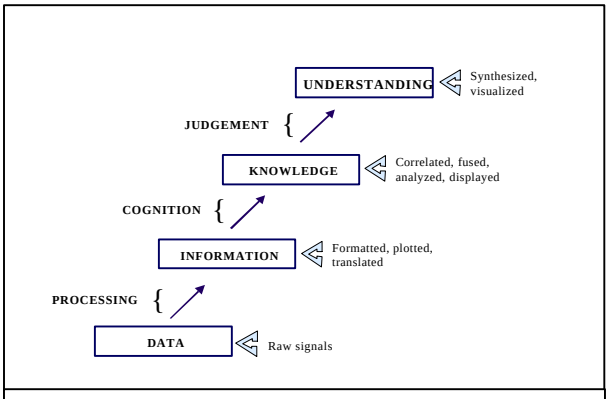

Figure 2: The Cognitive Hierarchy from "Picturing the Puzzle"

We can find the influence of inductivism throughout the body of concepts associated with the RMA thesis. Enthusiasm for the COP is due to the belief that it is a rich new source of facts for our inductivist planning processes. Our decision cycle – the OODA Loop – begins with observation and implies confirmation and empirical justification as a prelude to decision. The concept of Effects-based Operations, with its assertion that we may establish the mathematical probability of the second and third order consequences of our

[3] See *Defence Information Management Strategy*, (Ottawa, 23 March 2000) pp 3.
[4] See the unpublished manuscript "Picturing the Puzzle: A Knowledge Management Model for Military Operations" pp 3/14. I have chosen to withhold the author's name as a courtesy.
[5] ibid, pp 3.

actions on the battlefield is clearly beholden to inductivism. There is no way to escape the conclusion that inductivism exerts the force of a premise over military thought, command and control doctrine and the RMA thesis. It has thus become a matter of some significance that, in the succinct appraisal of one commentator, "inductivism will hardly stand a moment's serious criticism."[6]

THE FALL OF INDUCTIVISM

Whereas it is a straightforward matter to show that contemporary military thought is inductivist, matters become less straightforward when we move to assess inductivism. As I mentioned above, notwithstanding the enormous popularity of inductivist method coming out of the 17th century it always had a controversial status in subsequent philosophy. There have been and are a host of different attitudes toward inductivism, although I cannot find contemporary support for the particularly naive interpretation resident in military thought. Moreover, there are several conflicting alternatives in the literature. We thus cannot rely on an imagined philosophic consensus to help us out in this debate. We need to choose sides on the basis of argument.

I have chosen sides. The position to which I subscribe and which I will present here is due to the work of the late Sir Karl Popper and of his associate, David Miller. I have made this choice because I have not encountered a defence of inductivism that defeats Popper's refutation. Perhaps more important, though, is the appeal of his alternative model of scientific method. In addition to its intellectual strength, Popper's is a hard-nosed, practical, action-oriented view of science that is immediately transportable to the domain of military command and control with so many constructive implications. But I am getting ahead of myself. First we need to dispense with inductivism.

Popper's view was that each of the three related tenets of inductivism – the notion that the truth was manifest in the facts, the concept of probable inference and the characterization of knowledge as empirically justified true belief – were all indefensible and unnecessary and that its four part procedure – observation, synthesis, justification, proof – could thus not be the method of science.

As context to the following description of Popper's refutation of inductivism we should consider the insight of an earlier philosopher named David Hume. Working early in the 18th century, Hume identified what would later be called "Hume's Problem of Induction". Recall that one of the hallmarks of inductivism is the contention that there is a principle of reasoning that allows us to make probable inferences from the unblemished facts of observation. With a finding that has never been answered by the inductivists, Hume showed that there was no such principle of induction and that we were never logically justified in generalizing beyond the facts of observation. Unfortunately for subsequent western philosophy, though, Hume nonetheless considered that inductivism *was* the basic pattern of human cognition: knowledge *does* grow out of observation and experience, we *do* make probable inferences and we *do* treat our successful inferences as true. But rather

[6] R. Harre, The Philosophies of Science: An Introductory Survey (Oxford: Oxford University Press, 1985), p 43.

than being based on a demonstrable principle of reason and logic, Hume accepted the inductivist pattern of human reason as an inescapable habit of the mind. Note the implication here: if Hume is correct, then human reason has been reduced to an arbitrary non-rational psychologism. With this as context, then, how did Popper proceed?

Insofar as the start point for inductive method is concerned, Popper argues that objective observation is neither achievable nor desirable and that we must have in mind some basis for selecting the facts we observe before we begin to observe. I will let Popper speak for himself on the matter:

> The reason why all description is selective is, roughly speaking, the infinite wealth and variety of the possible aspects of the facts of our world. In order to describe this infinite wealth, we have at our disposal only a finite number of finite series of words. Thus we may describe as long as we like: our description will always be incomplete, a mere selection, and a small one at that, of the facts which present themselves for description. This shows that it is not only impossible to avoid a selective point of view, but also wholly undesirable to attempt to do so; for if we could do so, we should get not a more 'objective' description, but only a mere heap of entirely unconnected statements. But, of course, a point of view is inevitable; and the naive attempt to avoid it can only lead to self-deception, and to the uncritical application of an unconscious point of view.[7]

So the first step in inductive procedure is unachievable and potentially destructive.

Insofar as the second step in the inductivist procedure is concerned – synthesis through probable inference – Popper takes Hume's Problem of Induction as decisive. Inductivism is intended to describe a rational process for the growth of human knowledge, leading ultimately to justified truth. But if we cannot describe a rational principle upon which probable inference is based, then we cannot treat probable inference as a rational procedure: a situation Popper found unacceptable and unnecessary. Hume's problem leaves inductivists with a simple challenge: to describe their own principle. Until they do so they can't claim to be describing a rational procedure.

Insofar as the third step in inductive procedure is concerned – justification – Popper's complex critique can be characterized as follows. First he rejected probability on the basis of an infinite regress argument, for the theory is itself merely a purported probable inference learned from experience. Consequently, Hume's Problem of Induction applies and the theory of probability cannot provide empirical justification[8]. A second insight should also be considered here. According to inductivism, science is a quest to find the *most probable* theories; that is, those theories that in our experience enjoy the most

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[7] Karl R. Popper, *The Open Society and its Enemies*, Vol 2: *The High Tide of Prophesy: Hegel, Marx and the Aftermath* (5th ed; London: Routledge and Keegan Paul, 1966), p 261.

[8] Incidentally, during the pursuit of my MBA I asked one of our statistics professors to describe Popper's infinite regress argument of probability in the language of statistics. I think that the request tickled his fancy and he provided me with the following equation, which I include for the benefit of the "quantitatively inclined": .

$$probability = \prod^{n} p^{i} \rightarrow 0 \quad as \; n \rightarrow \infty$$

For the record, my subsequent attempt to argue that since the theory of probability had been refuted there was no need to study statistics, while popular with many of my fellow students, ultimately failed to impress those in charge of the curriculum.

success. But Popper argued to the contrary. The growth of scientific knowledge involves the pursuit of ever better theories or, in other words, theories of increasing information content. We see this process in cosmology, for example, as we moved from the Aristotelian model to Kepler's, to Newton's and then to Einstein's. Popper pointed out that in the process of increasing their information content, our theories become less and less probable, for this growing information content results in a corresponding increase in the number of bases upon which the theory could, in principle, be refuted. In this sense, then (and ironically for the inductivists), science is a quest for the *least* probable theory. In the end, the view of knowledge as empirically justified true belief is untenable: there is no empirical procedure for justification nor should we hold this up as our goal.

Having refuted the first three steps in its orderly method, we can ignore inductivism insofar as the truth is concerned. Thus the final step in inductivist method would not seem to require comment. But note that Popper introduced an important new insight here. He believed passionately in truth, which may explain why he so strenuously objected to a theory of scientific method that inadvertently reduced the quest for it to an irrational *habit of mind*. His insight was to recognize that science got closer and closer to the truth *not by confirmation, **but by refutation***. Popper turned this revelation into an elegant, constructive and even exciting theory of scientific method that is, among other things, the basis for a long overdue revolution in military thought.

Before we move on to investigate Popper's alternative to inductivism and its military implications let us close the book on contemporary military thought and the RMA thesis. We have seen that the key elements of the military profession's worldview are inductivist and we have seen that inductivism cannot be taken seriously. The implications are significant. There does not appear to be much room left for the belief in the existence of discernable, timeless principles of war, for the necessary procedure – probable inference from the objective facts of military experience – has been refuted. It does not give us much hope for the Theory of the Estimate or the Operational Planning Process, for in demanding probable inference and offering empirical justification, it combines unworkable means with unattainable ends. We can see that our enthusiasm for an approaching revolution in military affairs driven by unprecedented progress in information technology appears unwarranted: for the underlying assumption that observation drives invention and provides proof, can't be borne out. As to the popular Cognitive Hierarchy, we now have grounds for scepticism, for it can be at best only a partial depiction of the process it seeks to describe and the devil is in the missing details. As to the COP, we have been alerted to ask what purpose is to be served by the terabytes of information that we are programming into this overstuffed database. And we are alerted to ask of the proponents of Effects-Based Operations how they intend to undertake their ambitious programme with their underlying methodology in tatters. We built the house of modern military command and control doctrine on the sands of inductivism and the tide of critical rationalism has swept the sands away....

TOWARD A REVOLUTION IN MILITARY THOUGHT

In a letter to Popper, Albert Einstein expressed the following sentiment:

> Altogether I really do not like the now fashionable 'positivistic' tendency of clinging to what is observable... and I think (like you, by the way) that theory cannot be fabricated out of the results of observation, but that it can only be invented."[9]

Personal testimony, even from the most eminent of practitioners, does not add weight to Popper's argument; nonetheless Einstein's words are worth considering. They express, in a matter of fact way, precisely the attitude toward its craft that the military profession should adopt. But what does Einstein mean when he writes that theory "can only be invented"?

As I mentioned earlier, Popper believed passionately in the truth and sought a description of the method of science that rescued it from irrationality. He found this method not in inductive logic and confirmation, as philosophy had long assumed, but in deductive logic and refutation. Or, in a clarification due to his associate David Miller, Popper recognized that it was not the theory itself, but the process through which it was arrived that made it rational[10]. Popper saw scientific method as a process that closely corresponded to that of deductive logic and had no need at all for inductive logic. He characterized science as an unending quest carried out through a process of ***conjecture and refutation*** or of ***trial and the elimination of error***. In Miller's words, then, his view was that:

> ... science grows, and may even approach the truth, not by amassing supporting evidence, but through an unending cycle of problems, tentative solutions – unjustifiable *conjectures* – and error elimination; i.e., the vigorous testing of deductive consequences and the refutation of conjectures that fail....[11]

For Popper, then, the growth of knowledge began with problems, which are in turn the result of failed theories and their unsatisfied expectations. When confronted with a problem, the task of the scientist is to propose a bold new solution, from which necessary consequences could be inferred. Next it is the task of the scientist to test this bold conjecture as vigorously as possible, with its deducible consequences providing the focus of these crucial tests. To the extent that this new conjecture survived its crucial tests the scientist is justified only in continuing to hold it as tentatively true, recognizing that no imagined weight of empirical justification has been added. But when this conjecture fails its tests, the scientist is compelled to acknowledge the event and seek a bolder and better conjecture to put in its place. Thus knowledge grows through an unending process of conjecture and refutation, as better and better theories approach closer and closer to the truth. For illustration note how we see Popper's method embodied in a plausible description of Albert Einstein's behaviour. Einstein saw the few failures of Newtonian physics as decisive, notwithstanding the overwhelming weight of its empirical successes. He proposed an alternative, a bold conjecture for its time, in a form that allowed us to

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[9] Karl R. Popper, The Logic of Scientific Discovery (New York: Routledge, 1992), p 458.

[10] See, David W. Miller, "Induction: A Problem Solved", p 1. "… neither beliefs nor acts of belief, nor decisions, nor even preferences are reasonable or rational except in the sense that they are reached by procedures or methods that are reasonable or rational." The paper will not be published until summer 2002, but is available at http://www.warwick.ac.uk/philosophy/dm_Induction.pdf

[11] Robert Audi ed., *The Cambridge Dictionary of Philosophy* (Cambridge: Cambridge University Press, 1996) p 631. David Miller wrote the passage in question.

determine its deducible consequences. He acknowledged that these often surprising consequences – that the apparent orbit of Mercury would deviate from its Newtonian path by a calculable extent or that two timepieces travelling at different velocities would measure time differently – represented crucial tests and that his theory would be refuted if they were not borne out. Finally, Einstein retained a critical attitude toward his own theory, notwithstanding its enormous success, recognizing that it had been refuted at the sub-atomic level. He devoted the rest of his life, just as subsequent physics has done, to the search for a better Unified Theory.

What are the implications of Popper's theory for military thought and the RMA thesis? This is a huge question. If we take inductivism out of military thought and the RMA thesis there is precious little left. We face the requirement to rebuild the whole discipline, from the ground up. For those who prefer a neat and tidy world, full of familiar questions and answers and with everything in its accustomed place, this will be an uncomfortable state of affairs. But for those who enjoy exploring, creating, thinking and building, there could be no more exciting challenge. There is plenty of work in here for everyone. Let us consider some of the possibilities and along the way I hope that my readers will find some ideas that stimulate their own interests.

We should begin by clarifying the features of Popper's philosophy that we are seeking to bring to bear on military thought and culture. We must start by exorcising the profession's faith in the trappings of inductivism, the belief in objective observation, probable inference and empirically justified true belief. These we must replace with a new set of perspectives. We must recognize and accept that what makes our efforts rational is not their results, but the process through which they are achieved. Moreover, we must acknowledge that the defining characteristic of any rational process is criticism – vigorous tests, sophisticated debate, acknowledged refutation – and not confirmation and consensus as we so long vainly assumed. Thus we are seeking to impose on military thought a critical but creative and constructive rhythm, one that works unceasingly from problems, to tentative solutions, to harsh tests and then to new, intriguing problems. Finally we must impose this pattern not just on every relevant aspect of military doctrine, but embed it in our values, norms and outlooks.

Perhaps the most obvious implication of this programme is in the domain of problem solving and planning, for our current approach has always been a literal application of what we took to be scientific method. In fact, as I write an experiment motivated in part by this very thesis is being considered for sponsorship by the Canadian Forces Experimentation Centre (CFEC) with the involvement of our research and development establishment at Toronto (DRDC Toronto)[12]. As discussed earlier the basic pattern of

[12] I must stress that these discussions should not be taken to imply that either CFEC or DRDC Toronto share the views that I have expressed in this paper. Moreover, these discussions are preliminary. There are obvious programmatic, conceptual and resource issues to be addressed. However, CFEC is demonstrating a commendable open-mindedness toward this thesis. Moreover, there is enough correspondence between modern cognitive psychology and critical rationalism to allow for cooperative work on the Operational Planning Process. Note, for instance, that the theory of Bounded Rationality and so-called naturalistic decision-making that have emerged in recent cognitive psychology are at least more closely aligned than their behaviourist predecessor with the tenets of critical rationalism.

inductivist military problem solving is clarification of the aim[13], followed by fact gathering and analysis, followed by option development, followed by option comparison and then decision and execution. A critical rationalist would approach the process in an entirely different way. After clarifying the aim he or she would propose tentative solutions to the problem at hand[14], skipping the unfruitful attempt at objective analysis of the facts. Each tentative solution would then be applied to the reality of the situation at hand and the consequences would be deduced: exposure to enemy forces, ammunition requirements, fuel requirements and the like. These inferred consequences would in turn point the way to crucial tests: for example, do we have the ammunition to suppress the enemy while we are exposed to him, or do we have enough fuel given the length of the approach? Moreover, this process of testing would have one of two possible implications for our tentative courses. First, it may reveal sufficient empirical refutation (i.e., we do not have enough fuel to perform the right flanking attack). More likely, though, it will cause us to modify and elaborate our tentative solutions (i.e., if we take a shorter route on the right flanking attack, fuel does not refute the option, or if we chose the right flanking attack we must suppress the enemy depth position during the assault). Note how, in this process of testing consequences, a simple tentative solution – "We will conduct a right flanking attack" – becomes a detailed plan – "We will conduct a right flanking attack along the shorter route with artillery suppressing the enemy depth position from H+20 to H+30".

The final unique feature of this method occurs at the decision point. In an inductivist procedure we seek to create a "justified true belief" in the best course of action; however, the faith in empirical justification is merely a mistaken illusion, and a potentially dangerous one, at that. All that the commander really knows is that he has before him a number of vigorously tested alternatives that may or may not succeed in implementation. There is no procedure that can replace courage and judgement.

My hope for the CFEC-sponsored experiment mentioned earlier is that it will test the approach to operational planning described above. First, it will demand that the commander articulate tentative courses of action in the initiating planning guidance document. Second, it will ask the commander and his staff to conduct the subsequent analysis and decision processes in accordance with the pattern of critical rationalism: deduce the consequences of the tentative options, test those consequences through observation and experimentation, refute or elaborate the courses accordingly and then

[13] By this is meant identifying the conditions that the plan must satisfy in order to be deemed a success.

[14] My military brethren often greet the notion that we can propose solutions before analysing the facts with incredulity. I believe the force of their resistance, apart from being a natural reaction against a contradiction of their uncritical faith, originates in the way we practice the estimate. These exercises usually present us with an artificial problem occurring on a map sheet we have never seen and in a reality described in a short pamphlet we have never seen. They are thus confusing "reading in" with analysis. But in reality we are usually *in* the problem we have to solve and have a working familiarity before we start. Moreover, our doctrine provides all we need by way of outline tentative solutions to tactical problems in its prescribed forms of manoeuvre and the like. Finally, against the often-heard claim that analysis must precede option development in novel situations, I argue that novel situations are evidence in my favour. First Hume's Problem still applies. Second, if the situation is so novel that we haven't the faintest inkling of a tentative solution then we would be no more able to select the facts worth relevant to it.

choose on the basis of professional judgment. In addition to providing military professionals with a method that, unlike its inductivist predecessor, actually ***can*** be performed as described, here is what I believe that we will gain from these changes:

- **The process will be faster**. First, this process eliminates delays in articulating the fundamental prerequisite to staff analysis: tentative solutions. Simplistically speaking, the staff won't have to sit around idle, waiting for someone to articulate options that it can bite into. Second, to be discussed more fully below, it will eliminate time wasted in gathering and considering irrelevant information.
- **Its results will be better**. At present the staff distributes its time and effort over two activities; namely, inventing and then comparing courses of action. But in this new procedure, their time and effort is focused on one activity; namely, the vigorous testing and elaboration of alternatives. If all of the survivors of this process have received more attention, they will be better off and so too will be the one we choose.
- **Bandwidth requirements will be reduced dramatically**. This is one of the most vexing technological problems currently confronting military command and control. It is also little wonder that it should vex us. For an inductivist procedure, data and bandwidth requirements are theoretically infinite, for we have no basis to exclude data and we believe that all data has potential value as a source of empirical justification. Thus, as Chaos Theory conjectures, because a butterfly flapping its wings over Peking may affect the weather as we cross the start line near Kabul, the inductivist user of a Common Operating Picture would want it to provide up-to-date, fully-fused information on the 'goings on' of all the world's insects. Critical rationalists can elect to ignore bugs. Note that if we begin planning with a finite series of tentative options, we have eliminated the need to collect and consider huge volumes of suddenly irrelevant data. In the process we not only reduce bandwidth requirements, but also save data fusion resources and time.
- **Data processing requirements are honed**. I am not an expert in this field, but I believe that would be easier to design data processors that tell us what we *can't do*, than it would be to design computer programmes to tell us what we *should do*. And besides, all that data processors performing the latter function really accomplish is to add just another opinion to the din of competing opinions that human beings can already provide. We know well in advance of most military problems most of the things that would refute a plan. The Operational Order format, for example, already embodies many of these potential kinds of refutations in its generic headings and sub-headings. These provide us with a simple place to start in the design of *refuting algorithms* for our decision support programmes.
- **Execution will improve**. With an inductivist procedure we direct our mental efforts at creating a "justified true belief" in our eventual decision. In other words, the whole process is geared to convincing us of the wisdom of our choice and creating an unjustified empirical confidence in our decision. I submit that this is a bad way to start the execution phase of an operation, for it risks distracting our attention from the most important information of all: evidence that our plan is beginning to fail and that a bold new conjecture is needed "on the fly". A critical rationalist enters the execution phase, to the contrary, only tentatively committed to his plan, and the only information that truly interests him is that which is indicative of refutation or of a new problem. In fact, he eagerly awaits this eventuality, for it is his opportunity to lead by

> quickly inventing a new tentative solution to the new problems that his now failed solution has presented. His soldiers will thank him for his scepticism every time it saves them from repeating one of our profession's most common and unfortunate traditions: dieing in the service of a plan that the general staff deems to be brilliant long after it has failed. I believe that the critical rationalist is innately more agile than the inductivist, and that this agility will make us better at conducting operations.

This experiment relates to but one of many practical implications of critical rationalism, and yet even it implies a wealth of new research programmes of a doctrinal, technological, psychological or sociological nature. Moreover, I believe that if we can be successful in changing this one pervasive process, then we will have created a strong impetus for other related changes in military thought and behaviour. Its practitioners will take it with them into the wider military domain, and its basic pattern and values will light their way.

I will close this discussion of implications with a brief address of the RMA thesis and two of its closely related associates: the Cognitive Hierarchy and Knowledge Management or the quest for Knowledge-based Forces. To begin, from the point of view of critical rationalism, there is very little use for the notion of revolutionary change. For reasons we won't discuss here, theories of revolutionary change ironically imply a world dominated by a state of non-change and are thus highly conservative. But for critical rationalism, there is no constancy: change is a defining characteristic of the human condition. While perhaps unlikely to deem it a revolution, though, the critical rationalist would indeed recognize the significance of the tremendous progress being made in the area of information technology. But the particular spin that would be placed on this technological innovation would be distinctive. The critical rationalist would see in this technology the exciting prospect of using it to find new problems more quickly, to conduct more crucial tests of our conjectures more rapidly and effectively and to transmit our tentative new solutions more broadly and more completely.

It might even be that the critical rationalist would choose to articulate the implications of information technology with the help of a few simplistic graphics, perhaps even calling them the Cognitive Hierarchy and the Decision Cycle. But once again these would differ substantially from their inductivist predecessors. The critical rationalist would flip the Cognitive Hierarchy on its head. Knowledge and understanding **do not** derive from information and data. To the contrary, we need first to establish shared tentative understanding and knowledge in order to identify the information and data that would be useful to us. Next, the military profession might still have an OODA Loop under a regime of critical rationalism, but rather than proceeding from Observation to Orientation, the loop would proceed from Orientation to Observation. Still, the purist might insist on a change of name for this construct, both to better distinguish it from its predecessor and to more accurately describe the new decision cycle it depicts. It might thus be called a "C&R Loop": meaning "Conjecture and Refutation Loop", of course.

Finally, a critical rationalist would doubtless be favourably disposed to Knowledge Management and the concept of Knowledge-based Forces. But here, too, the critical

rationalist would mean something entirely different than those phrases imply in an inductivist world. There are two decisive problems for the concept of Knowledge Management as it is currently being pursued, both of which are due to the inductivist assumption that knowledge is empirically justified true belief. First, because of this mistaken definition, proponents of Knowledge Management cannot articulate a vision that differs substantially from that of Information Management. This is so because one person's "justified true belief" is simply information to others. Thus, Knowledge Management efforts start to resemble Information Management and are technology-centric. We are led to develop fuller databases (wherein the "justified true beliefs" and their possessors are listed) and better search engines (by which we may find these "justified true beliefs" and the people who hold them) and sexier chat rooms (wherein "thought leaders" may herd their presumable "thought followers"). Better databases, better search engines and better chat rooms would all be welcomed by all of us, but how are they not Information Management? The second problem for Knowledge Management that arises when we assume that knowledge is empirically justified true belief is that it encourages us to think of knowledge as a thing or an output; indeed it is often referred to in this sense as a "corporate asset". As a consequence of viewing knowledge as a thing, the traditional approach to Knowledge Management focuses on "capturing knowledge" and "sharing knowledge". The most important question about knowledge thus goes begging: How did we get it in the first place?

The critical rationalist would not make these two mistakes. He or she would treat knowledge as a process and perhaps define it in the context of Knowledge Management as "the capacity to make and manipulate conjectures". This in turn would lead the critical rationalist to focus on key institutional processes related to invention, problem-finding and problem solving; namely, its planning and decision-making processes, doctrine management, training practices, lessons' learning processes and the like. In short, the critical rationalist would see in the organization's inevitably problematic but crucially important theoretical content a highly unstable commodity, one that if not tended with great care will change quickly into dogma.

Finally, note that the critical rationalist's definition of knowledge as "the capacity to make and manipulate conjectures" would point the way to a useful characterization of the Knowledge-based Force. Such a force recognizes that its theoretical content – the doctrine, plans, procedures and practices that it has tentatively accepted as true at any point in time – are its own centre of gravity. This theoretical content drives the way our forces view the world, determines how they will react to their challenges and opportunities and dictates their success or failure in battle. Accordingly, the Knowledge-based Force would seek to be the master of its theoretical content. It would recognize that its success was beholden largely to the quality and speed with which it created, tested, refuted and recreated that content. ***It would know that a cycle of conjecture and refutation would determine its fate***.

These are all of the implications of Popper's fertile insights that we have space to address here, and even these we have addressed only in part. But I hope that this has been sufficient to stimulate interest and that others will find in Popper's work a rich new

source of intriguing problems with which to we may refuel the engine of our profession's intellectual progress.

CONCLUSION

O Queen of air and darkness,
I think 'tis truth you say,
And I shall die tomorrow;
But you will die today.

-- A.E. Housman
"Her Strong Enchantments Failing"

I close with Housman's words because they describe for me the simple rhythm of Popper's method and remind me that I must also subject myself to its logic. But inductivism must go first. We have seen how a theory of scientific method that most military professionals would not recognize by name dominates their view of human reason and their understanding of some of their most important challenges. We have seen what a poor incumbent inductivism is. And finally, we have explored an alternative that offers great promise. It would seem a reasonable expectation that the military profession would at least begin to consider the benefits of Popper's insights, however strong the enchantments of its primitive faith in inductivism's superstitious rituals.

My long experience with this thesis has taught me the wisdom of seeking incremental victory. Thus I will close this paper with a modest proposal that I would hope to be universally acceptable and more readily achievable. Whatever we may make of Popper's views on inductivism and of his alternative model of scientific method, certainly we must agree with its underlying sentiment. At root Popper is making a simple request: that we acknowledge and embrace the indispensable requirement to adopt a critical attitude. There can be no objection to this. Who would say that we should ignore the results of reasonable criticism? Who would say that we should put into action doctrine, plans and procedures that have not survived critical inspection? Who would say that we should keep research and development inside the locked box of dogmatism? I believe that if we can make this one small step, to embrace a critical attitude from time to time and to follow it where it leads us, the rest will eventually take care of itself.

This is a moral matter after all. The prospects do not look good that the institutions of democracy and freedom that we are sworn to protect will ever be safe unless we remain perpetually at our very best. And the young men and women who carry the burden of our security in an immediate and personal way deserve at least that much from us.

Giffin, June 2002